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IMPLICATIONS OF RECRUITMENT, DISTRIBUTION AND AVAILABILITY OF STOCKS FOR MANAGEMENT OF SOUTH AFRICA'S WESTERN CAPE PURSE-SEINE FISHERY.

by

ROBERT JAMES MINCHIN CRAWFORD

Supervisors : PROFESSOR J.G. FIELD
DR. G.G. NEWMAN

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STATEMENT CONCERNING CO-AUTHORSHIP

Chapters 2 and 3 are co-authored papers. Mr. P.A. Shelton contributed the section entitled "Feeding" in the report "Pelagic fish and seabird interrelationships off the coasts of South West and South Africa" and commented critically on the remainder of the manuscript. Though both the flow-charting for and text of "Revision of species and age composition of landings in the South African purse-seine fishery, 1950 to 1976" were prepared by the candidate, Messrs O.M. Centurier-Harris and G.H.L. Wingate were frequently consulted and provided much of the data. The computer programs were compiled by Mr. B.D. Kriedemann. I acknowledge my indebtedness to these colleagues.

To

Phyl and Peter,

who provided such a happy home during the
compilation of this thesis,

My father and mother,

for their constant encouragement and unfailing love,

Clive and John,

Felicia, Craig, Clare and Brenda.

The wind goeth toward the south, and turneth about unto the north; it whirleth about continually, and the wind returneth again according to his circuits.

Ecclesiastes 1:6.

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excluding those appearing in chapters 2 (Crawford and Shelton 1978) and 3 (Crawford *et al.* 1978).

CHAPTER 1. INTRODUCTION.

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CHAPTER 1. INTRODUCTION

South Africa's Western Cape purse-seine fishery is situated off the country's western seaboard in the highly productive waters of the southern Benguela Current system (Cushing 1969). Management of the multi-species resource is the responsibility of the government's Department of Industries and since 1950 a large volume of data relating to performances of contributing species has been collected. Recent analyses have indicated an oversubscription of effort, a sequential depletion of the more valuable stocks and, consequently, a present reliance upon less favourable species (Newman and Crawford 1979, Crawford et al. in press). These adverse trends have been precipitated, in part at least, by ineffective legislation, which has resulted from a past failure to appreciate that exceptionally good year classes occur infrequently (Newman and Crawford in press). Optimal ways of harvesting strong cohorts, or of avoiding over-exploitation in the event of recruitment failure, remain to be explored.

The current situation is also one in which long-term yields are unlikely to increase or even be maintained (Newman and Crawford 1979) and in which the fuel crisis has caused operating costs to rise sharply. It is therefore important that the remaining populations are rationally exploited and that the best use is made of raw materials. Though the former aim may be achieved through conventional effort and quota limitations, these are not sufficient to ensure optimal utilisation. In 1978 only 0,13 per cent of the combined landings was processed for direct human consumption (canned products, fish paste and frozen fish). The bulk of the catch was reduced to less profitable oil and meal, emphasising the need for improvement.

Not all processing factories possess facilities enabling them to produce canned fish, fish paste or frozen fish. However, equally significant factors precluding the manufacture of these commodities are the small average size of fish caught and the poor condition of larger fish after they have been transported considerable distances from the fishing grounds. Seasonal patterns of distribution and availability characterise the component species. These are generally age specific and it may therefore be possible to improve utilisation of raw materials through regulating the open season or closing areas in relation to migration patterns.

The complexity of the fishery necessitates the use of computer techniques to evaluate various strategies that might lead to the attainment of these objectives and this thesis aims to develop suitable simulation models. Many of the parameters required for use in the models were not available and had to be derived. This is the function of the initial chapters.

Chapter 2 attempts to research the frequency and amplitude of recruitment fluctuatuions historically, through analysis of changes in the population sizes of seabird predators as reflected by guano production. The impact of fishing on both South West African and South African fish stocks is also investigated.

Chapter 3 through 11 deal with quantification of the seasonal patterns of fish distribution and availability. Chapters 3 and 4 examine the adequacy of catch, sample and effort statistics and describe preliminary manipulations of these data which were necessary to calculate catch rates for individual species in different regions. Trends in the deployment of fishing effort are documented and a new time series of effort information is presented. Then, in chapters 5 - 9, catch-per-unit-effort levels are used to investigate the distribution, availability and movements of the different age components of the pilchard <u>Sardinops ocellata</u>, anchovy <u>Engraulis capensis</u>, horse mackerel <u>Trachurus trachurus</u>, mackerel <u>Scomber japonicus</u> and round herring <u>Etrumeus teres</u> populations. The somewhat sporadic catches of lantern-fish <u>Lampanyctodes hectoris</u> are discussed in chapter 10. For all these species locations of commercial catches recorded during the period 1964 - 1976 are comprehensively illustrated. Chapter 11 describes seasonality in the fishery as a whole and considers the influence of some environmental factors.

Chapter 12 summarises certain of the more important biological parameters and two simulation models are described in chapters 13 and 14. In computing fish catch the first makes provision for the deployment of catcher vessels, each associated with a base factory, throughout the fishing grounds and also the seasonal patterns of distribution and availability exhibited by the fish stocks. The second model simulates processing of the raw material to various commodities. Finally, implications for future management of the mixed-species resource and research priorities are discussed in chapter 15.

It is intended to publish the majority of chapters in scientific journals and they have been drafted with this intent. However, in the construction of the thesis tables and figures have been numbered consecutively to avoid repetition. Details of literature cited have been combined into a single list.

Previous publications (Davies 1956b, Baird 1970, 1971, 1974, 1975, 1978a, Baird and Geldenhuys 1973, Geldenhuys 1973, Centurier-Harris and Crawford 1974, Centurier-Harris 1977, Heydorn et al. 1978) have discussed inter alia the distribution, availability or movements of certain of the fish stocks. However, consideration of these aspects has been of a limited nature and, with the exception of those dealing with mackerel (Baird 1974, 1975, 1978a), none identify the various age components of the populations. Furthermore no previous attempt has been made to quantify observed patterns. The present treatment, therefore, may be regarded as original. This is also the first simulation study of South Africa's Western Cape purse-seine fishery. Its multi-species basis and unique characteristics have necessitated the development of entirely new models.

CHAPTER 2. PELAGIC FISH AND SEABIRD INTERRELATIONSHIPS OFF THE COASTS OF SOUTH WEST AND SOUTH AFRICA.

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PELAGIC FISH AND SEABIRD INTERRELATIONSHIPS OFF THE COASTS OF SOUTH WEST AND SOUTH AFRICA

ROBERT J. M. CRAWFORD & PETER A. SHELTON

Department of Industries, Sea Fisheries Branch, Beach Road, Sea Point, 8001, *South Africa*

ABSTRACT

Breeding of the Cape cormorant on the South West African platforms and of the jackass penguin on islands off South Africa is coincidental with the seasonal availability of pelagic fish shoals. The largest numbers of Cape gannets and Cape cormorants occur off South West Africa where the biomass of fish is highest, though dominated by one species, the pilchard. By contrast, jackass penguins, limited in their range through flightlessness, are concentrated at the centre of the smaller but more stable South African multispecies fishery. In both South West and South Africa, densities of Cape cormorants are heaviest near the recruitment grounds for juvenile pilchard and anchovy. Island yields of guano are shown to provide reliable estimates of bird population sizes and fluctuations in these are closely related to temporal changes in fish abundance. They consequently have value in providing an understanding of fish stocks prior to exploitation and as indicators of the current state of the resources. Since the turn of the century large oscillations in the South West and South African pilchard populations were apparent but overfishing in the 1960*s depressed both below their normal levels and reduced the numbers of birds.*

INTRODUCTION

The Benguela current system, an area of intense upwelling and correspondingly high phytoplankton crops (Cushing, 1969), supports the important South West and South African purse-seine fisheries. Large numbers of coastal seabirds utilise these fish stocks and the deposits collected from offshore islands and platforms (Fig. 1, Table 1) have for many years formed the basis of the guano industry. The three major contributors are the Cape gannet *Sula capensis*, the jackass penguin *Spheniscus demersus* and the Cape cormorant *Phalacrocorax capensis*. Davies

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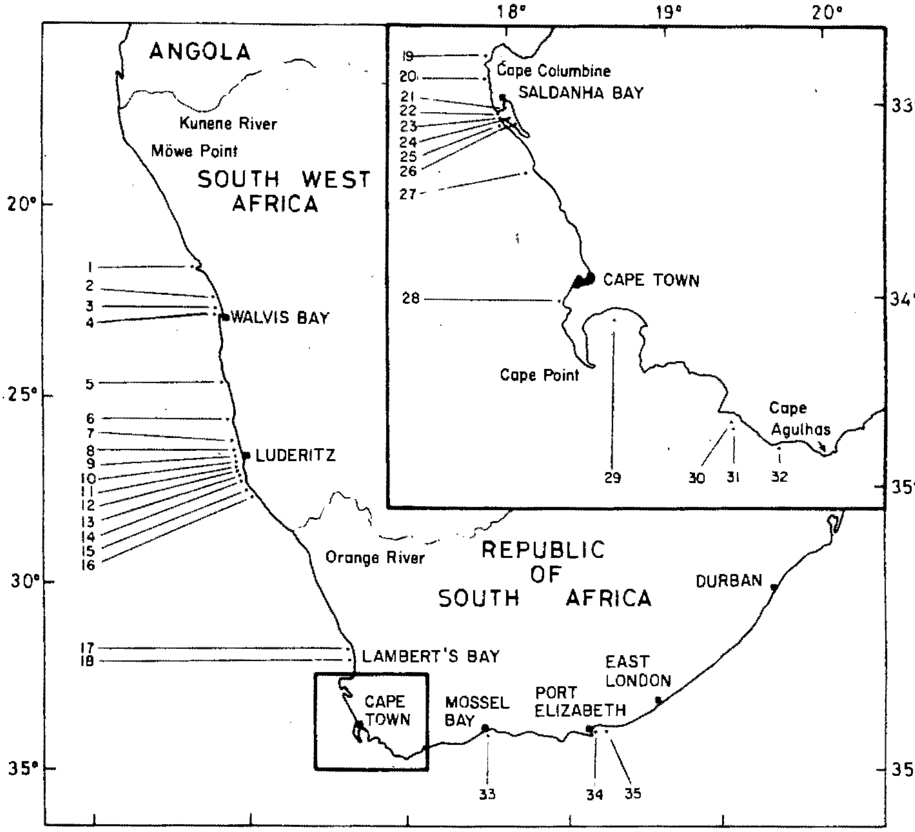

Fig. 1. Distribution of the important breeding colonies of the guano-producing seabirds (see Table 1 for numerical order).

(1955, 1956), Rand (1959, 1960*a*, 1960*b*) and Matthews (1961) investigated the feeding habits of these three species between 1953 and 1958. The findings, summarised in Table 2, show that all are to a large extent predatory on shoaling pelagic fish. In constructing Table 2 food recorded as fish remains was allocated *pro rata* to identifiable fish food sources. Other bird species of lesser importance include the bank cormorant *Phalacrocorax neglecta*, the white-breasted cormorant *P. carbo*, the crowned cormorant *P. africanus* and the white pelican *Pelecanus onocrotalus*.

Interactions between pelagic fish and seabird populations have been discussed by a number of authors. Berry (1975) asserts that low guano production on Bird Rock platform (Fig. 1) may be attributed to a fall in the number of roosting cormorants and that this in turn is caused by reduced availability of fish. Frost *et al.* (1976) suggest that a decline in the pelagic fish stocks may have been partially responsible

TABLE 1

POPULATION ESTIMATES FOR SOME SEABIRD BREEDING COLONIES OFF SOUTH WEST AND SOUTH AFRICA. THE GEOGRAPHICAL POSITIONS OF THE ISLANDS AND PLATFORMS ARE SHOWN IN FIG. 1

Species	*Cape gannet*	*Jackass penguin*	*Cape cormorant*	*Bank cormorant*	*White-breasted cormorant*	*Crowned cormorant*
Year	1956	early 1970s	1956	1956	1956	1956
Source	Rand 1963*a,b*	Frost et al. 1976	Rand 1960*b*, 1963*a,b*	Rand 1960*b*, 1963*a,b*	Rand 1960*b*, 1963*a,b*	Rand 1960*b*, 1963*a,b*
1. Cape Cross platforms			675000[d]		350	
2. Swakopmund platform			unknown			
3. Bird Rock platform			240000[d]	present[a]	450[a]	74[b]
4. Pelican Point platform	[f]		unknown			
5. Hollamsbird Island		10	386			
6. Mercury Island	9300	3000	5500	100		
7. Ichaboe Island	230000	2000	706	2604		few
8. Seal Island, Lüderitz			2056			
9. Penguin Island				253	63	few
10. Halifax Island		5400				
11. Long Islands				Known to nest		
12. Possession Island	31000	25000		58		few
13. Albatross Rock						
14. Pomona Island		7000		106		
15. Plumpudding Island		3000	few		80	few
16. Sinclair Island		200				52
17. Elephant Rock						
18. Bird Island, Lambert's Bay	10000	150	61954	138	60[c]	148
19. Paternoster Rocks			few	few		
20. Jacobs Reef			few	6		
21. Marcus Island		9000		86	8	16
22. Malagas Island	39000	1000	29094	204		80
23. Jutten Island		7000	56270	80	570	
24. Meeuw Island			few			few
25. Vondeling Island		400	1596	58		few
26. Schaapen Island			few			fair sized colonies
27. Dassen Island		70000	23520	70	few	few
28. Duikerklip				124		
29. Seal Island, False Bay		50		88	few	
30. Dyer Island		15000	6400	60	44[e]	400[e]
31. Geyser Rock				72		
32. Quoin Rock				44		
33. Seal Island, Mossel Bay						
34. St Croix Island		23000			172[e]	
35. Bird Is. group, Algoa Bay	33000	500			44[e]	
Total	352300	171710	1102482	4151	1841	770

[a] Estimate from Berry (1975).
[b] 1973 estimate from Berry (1974) (37 occupied nests).
[c] Estimate from Jarvis & Cram (1971).
[d] Upper limit.
[e] 1958 estimate from Rand (1963*a*).
[f] Constructed in the 1950s but collapsed soon after.

TABLE 2
DIETS OF THE CAPE GANNET, JACKASS PENGUIN AND CAPE CORMORANT, 1953–1958

Food item	*Cape gannet*				*Jackass penguin*				*Cape cormorant*			
Period	53/54	54/55	54/56	57/58	53/54	54/55	54/56	57/58	53/54	54/55	54/56	57/58
Source of data	*Davies* 1955	*Davies* 1956	*Rand* 1959	*Matthews* 1961	*Davies* 1955	*Davies* 1956	*Rand* 1960*a*	*Matthews* 1961	*Davies* 1955	*Davies* 1956	*Rand* 1960*b*	*Matthews* 1961
% by weight												
Pilchard	58	60	51	93	45	64	30	99	67	71	13	89
Anchovy	11	9	20	—	20	31	19	—	21	18	15	—
Horse mackerel	19	24	12	3	4	3	16	0	10	5	22	9
Mackerel	3	—	4	—	3	0	3	—	—	—	1	—
Red-eye round herring	—	—	1	—	—	—	6	—	—	—	4	—
Harder	9	6	1	4	26	—	0	—	—	—	—	1
Other fish	—	—	8	0	—	—	10	—	1	5	40	—
Crustaceans and polychaetes	—	—	0	—	2	0	11	—	1	1	6	1
Cephalopods	—	—	2	—	—	2	4	1	—	—	—	0

Table 2—*contd.*

Food item	*Cape gannet*				*Jackass penguin*				*Cape cormorant*			
Period	53/54	54/55	54/56	57/58	53/54	54/55	54/56	57/58	53/54	54/55	54/56	57/58
Source of data	*Davies* 1955	*Davies* 1956	*Rand* 1959	*Matthews* 1961	*Davies* 1955	*Davies* 1956	*Rand* 1960*a*	*Matthews* 1961	*Davies* 1955	*Davies* 1956	*Rand* 1960*b*	*Matthews* 1961
% by frequency												
Pilchard	44	62	19	85	37	49	N	83	36	44	15	76
Anchovy	30	26	25	—	2	44	O	—	32	19	12	—
Horse mackerel	18	11	30	10	23	2		6	21	14	16	18
Mackerel	6	—	4	—	20	2		—	—	—	1	—
Red-eye round herring	—	—	1	—	—	—	D	—	—	—	3	—
Harder	1	1	1	4	10	1	A	—	—	—	0	1
Other fish	—	—	8	1	—	—	T	—	7	18	45	—
Crustaceans and polychaetes	—	—	0	—	8	1	A	—	5	5	9	3
Cephalopods	—	—	12	—	—	2		11	—	—	—	1
Mean total length of prey (cm)	10·98	16·22	—	28·25	7·94	6·66	—	8·47	10·49	9·85	—	19·74
No. of birds examined	98	191	257	155	16	112	247	19	37	77	204	210
Study area	Cape Town to St Helena Bay	St Helena Bay	Walker Bay to St Helena Bay	Walvis Bay	Cape Town to St Helena Bay	St Helena Bay	Walker Bay to St Helena Bay	Walvis Bay	Cape Town to St Helena Bay	St Helena Bay	Walker Bay to St Helena Bay	Walvis Bay

for a drop in the jackass penguin population. Elsewhere, Jordan (1967) and Idyll (1973) record that during periods of low availability of the Peruvian anchovy *Engraulis ringens*, the guano-producing birds suffer from malnutrition which eventually leads to cachexia, desertion of nestlings and death, while Ainley & Lewis (1974) ascribe the continuing low population levels of the double-crested cormorant *Phalacrocorax auritus* and the tufted puffin *Lunda cirrhata* on the Farallon Islands to the decline in the stock size of the Pacific sardine *Sardinops caerulea*. This report relates seabird population estimates with the changing availability and abundance of the commercially exploited pelagic fish stocks off Southern Africa.

THE FISHERIES

South West African purse-seine fishery

The pilchard *Sardinops ocellata* dominates the purse-seine fishery of South West Africa. Catches of this species rose to 1·4 million metric tons in 1968 (Table 3) but

TABLE 3

COMPOSITION OF THE SOUTH WEST AFRICAN PURSE-SEINE CATCH, 1947–1976 (THOUSANDS OF METRIC TONS)

Year	*Pilchard*	*Anchovy*	*Horse mackerel*	*Others*	*Total*
1947	0·9				0·9
1948	2·7				2·7
1949	8·0				8·0
1950	46·7				46·7
1951	127·2				127·2
1952	225·8				225·8
1953	262·2				262·2
1954	250·6				250·6
1955	227·1				227·1
1956	227·9				227·9
1957	227·5				227·5
1958	229·1				229·1
1959	273·5				273·5
1960	283·3				283·3
1961	343·5				343·5
1962	438·2				438·2
1963	555·2	0·1			555·3
1964	635·9	0·6			636·5
1965	666·1	1·0			667·1
1966	718·5	3·3			721·8
1967	926·0	24·3			950·3
1968	1386·6	161·2			1547·8
1969	1111·0	226·1			1337·1
1970	513·7	188·9			702·6
1971	325·1	184·7	140·2	5·2	655·2
1972	373·5	136·6	21·7	2·4	534·2
1973	408·1	296·1	12·4	4·2	720·8
1974	561·6	249·1	30·1	2·1	842·9
1975	561·4	186·4	14·1	7·7	769·6
1976	451·8	87·8	23·2	7·6	570·4

then fell considerably. This caused a proportion of the fishing effort to be directed at the anchovy *Engraulis capensis*, of which significant catches were subsequently recorded. Horse mackerel *Trachurus trachurus*, mackerel *Scomber japonicus*, round herring *Etrumeus teres*, and the bearded goby *Sufflogobius bibarbatus* are of lesser importance to the industry, though larvae of the last were the most common element in the ichthyoplankton during the summers of 1972 to 1974 (O'Toole, 1977).

The fishing boats are equipped with echosounders and sonars to assist them in locating fish. However, fishermen frequently follow the direction taken by flocks of seabirds and consider feeding parties of seabirds to be good indicators of worthwhile fish shoals. These must be closely packed and near to the surface for rewarding fishing, requirements which are common to the avian predators as well.

The hydrology of the inshore region is dominated by the Benguela current (Currie, 1953; Hart & Currie, 1960) which results from cold upwelled water and is driven north by the southerly trades. Off Walvis Bay these winds are generally strongest in late winter and spring. Late summer and autumn, on the other hand, are often characterised by an invasion of the coastal area by waters of a more oceanic nature (Stander, 1964).

Research by King (1977) and O'Toole (1977) has indicated that there are two major spawning areas for the pilchard in South West Africa, off Walvis Bay in spring and further to the north, off Möwe Point, in summer (Fig. 1). Larval dispersal from the southern spawning area is in a northerly direction. Schülein (1973) has shown that the appearance of juvenile pilchard in the catches is associated with southerly currents and postulated that the nursery grounds are situated to the north of the fishing area. He further suggested that the mature pilchard stock undertakes a southern migration between August and October to spawn off Walvis Bay. Upwelling reaches a peak during these months so that a ready supply of food particles is available for the larvae (O'Toole, 1977).

Virtual population analysis (VPA) indicates that the total biomass of the pilchard stock reached a peak of some six million metric tons in 1967, but thereafter decreased to approximately half of this value by 1970. According to assessments based on data from the years prior to the decline, an annual catch of 800,000 metric tons would not have depleted the stocks (Newman, 1970). However, during the period 1967 to 1969, catches were considerably in excess of this figure, a possible reason for the severity of the decline.

South African purse-seine fishery

Six species comprise the South African purse-seine fishery which is situated in the Western Cape, between the Orange River and Cape Agulhas: pilchard, anchovy, horse mackerel, mackerel, round herring and a lantern-fish *Lampanyctodes hectoris*. The historical catches of each are listed in Table 4. Pilchard and horse mackerel were initially the most important, but, following a decline in the landings of both and the introduction of a smaller-meshed net over the period 1963 to 1965, anchovy became

TABLE 4

COMPOSITION OF THE SOUTH AFRICAN PURSE-SEINE CATCH, 1950–1976 (THOUSANDS OF METRIC TONS)

Year	*Pilchard*	*Anchovy*	*Horse mackerel*	*Mackerel*	*Round herring*	*Lantern-fish*	*Total*
1950	85·3	—	49·9	—	—	—	135·2
1951	101·9	—	98·5	—	—	—	200·4
1952	170·0	—	102·6	—	—	—	272·6
1953	132·5	—	85·2	—	—	—	217·7
1954	88·3	—	118·1	4·0	—	—	210·5
1955	121·9	—	78·8	20·2	—	—	221·0
1956	76·6	—	45·8	32·6	—	—	154·9
1957	109·5	—	84·6	7·4	—	—	201·5
1958	194·4	0·2	56·4	21·6	0·8	—	273·4
1959	260·2	1·4	17·7	33·1	2·6	—	314·9
1960	318·0	—	62·9	31·0	0·1	—	412·0
1961	402·2	—	38·9	49·7	0·1	—	490·9
1962	410·2	—	66·7	20·4	0·1	—	497·3
1963	390·1	0·3	23·2	13·2	0·2	—	427·0
1964	256·1	92·4	24·3	50·0	2·7	—	425·6
1965	204·5	171·0	55·0	41·4	8·2	—	480·1
1966	118·0	143·9	26·3	53·4	15·4	—	357·1
1967	69·7	270·6	8·8	128·2	32·0	—	509·3
1968	107·8	138·1	1·4	91·0	30·3	0·1	368·6
1969	56·1	149·2	26·8	91·7	23·3	4·9	352·0
1970	61·8	169·3	7·9	77·9	23·7	18·2	358·9
1971	87·6	157·3	2·2	54·2	21·6	2·0	324·5
1972	104·2	235·6	1·3	56·7	20·6	15·2	433·6
1973	69·0	250·9	1·6	58·8	28·7	42·4	451·4
1974	16·0	349·8	2·5	30·7	1·3	0·3	400·5
1975	89·2	223·6	1·6	69·3	23·6	0·1	407·4
1976	176·4	218·3	0·4	0·5	11·7	0·1	407·5

the main contributor. Considerable quantities of mackerel have also been caught, though round herring and lantern-fish are of lesser importance.

In contrast to South West Africa, the hydrology of the South African fishing region is more complex in that it is influenced by both the cold, north-flowing Benguela current and the warm, south-flowing Agulhas current. There is, as a result, an area of mixing in the southwest. In addition, under the action of the south-east winds that predominate in summer, areas of localised upwelling occur off the west coast. Both these systems give rise to high primary productivity.

Since the decline in the pilchard resource, adult fish have been caught mainly east of Cape Point (Fig. 1). Spawning takes place from September to January, after which there is a progressive eastward movement of these shoals of adults. They are preyed on extensively by hake in the Port Elizabeth vicinity between April and June (Hecht, 1976). Juvenile recruits first appear on the west coast north of Bird Island, Lambert's Bay in late autumn or early winter.

Catch-per-unit-effort studies by Stander & Le Roux (1968) showed that the size of the recruited pilchard stock increased rapidly to reach a peak in 1961 but thereafter declined. Only fish four years and older were fully recruited, the minimum mesh size in force at the time being 32 mm. By means of VPA biomass estimates, Centurier-Harris (1977) demonstrated that the increase in the population size was caused by a succession of good year-classes commencing in 1955.

Adult anchovy stocks are generally located between Cape Columbine and Cape Agulhas (Fig. 1). Spawning takes place in late spring and early summer and the recruitment pattern is similar to that of the pilchard, though nought-year-old fish move south as the season progresses. Over the period of commercial exploitation fluctuations in year-class strength have not been so marked as those of the pilchard (Centurier-Harris, 1977).

Discrepancies in catch-per-unit-effort trends presented by de Villiers (1977) suggest that at least two separate stocks of horse mackerel exist in the waters off South Africa. The one, situated along the Western Cape, has been severely reduced by commercial exploitation. Exceptionally strong 1947 and 1948 year-classes (Geldenhuys, 1973) resulted in the peak catches between 1951 and 1954 (Table 4). Further good year-classes in 1956 and 1957 bolstered the landings of the early sixties (Centurier-Harris *et al.*, 1977) but, since the full-scale introduction of the small-meshed (12·7 mm) anchovy net in 1965 and the passing of legislation in 1966 enabling all species to be pursed with this net, the purse-seine catches of horse mackerel in the Western Cape have been minimal. The second stock, located on the south coast between Mossel Bay and East London, as yet shows no signs of overfishing (de Villiers, 1977).

Baird (1975) records that the spawning grounds of mackerel in Western Cape waters are off Saldanha Bay (Fig. 1). The main spawning period is from June to mid-August and during this time the mature adults move in towards Cape Columbine and Saldanha Bay from offshore waters. Juveniles are caught inshore. VPA estimates for this species indicate that there are large variations in year-class strength (Centurier-Harris *et al.*, 1977).

The distributions of round herring and lantern-fish have been discussed by Centurier-Harris & Crawford (1974). The best catches of both these species are recorded between Cape Columbine and Dassen Island. Their contributions to the total landings are relatively small (Table 4).

SEABIRD POPULATIONS

Cape gannet

The Cape gannet nests on Mercury, Ichaboe, Possession, Bird (Lambert's Bay), Malagas and Bird (Algoa Bay) Islands. The 1956 population estimates for these islands (Rand, 1963*a*,*b*) are listed in Table 1; 65 % of the total of 352,300 birds was concentrated on Ichaboe Island. The breeding cycle, which commences in August or September, has been discussed by Jarvis (1970). Egg laying occurs between mid-October and mid-December and incubation takes 43 or 44 days. Since the chick remains in its nest for a further 90 to 105 days, it is late April before the majority of fledglings have left the breeding islands. Broekhuysen *et al.* (1961) have shown that they migrate up the western and eastern coasts of Africa to tropical waters where mortality is high. The survivors generally return to the breeding colonies in which they were reared one to three years later. Most adults also leave the islands at the end of the breeding season but generally remain in the vicinity. A limited number move in an easterly direction along the south coast and Davies (1956) related this to the migration of the pilchard.

Jackass penguin

Frost *et al.* (1976) state that the jackass penguin breeds at a total of 18 localities, extending from Hollamsbird Island on the west coast to Bird Island (Algoa Bay) in the south. Their population estimates (Table 1) total 171,710. The highest numbers were recorded on Dassen (70,000), Possession (25,000), St Croix (23,000), the Saldanha Bay group of islands (17,000) and Dyer (15,000). Peaks of egg-laying occur on most west coast islands in September and February, and the hatching out of chicks 38 to 41 days later (Rand, 1960*a*) coincides respectively with the concentration in the region of spawning pilchard and anchovy and the first appearance of juvenile recruits of these species. At St Croix the main breeding season is in February (G. B. Ross, pers. comm.) and incubation terminates shortly after the adult pilchard shoals have arrived in the vicinity. As mentioned earlier, this food source remains until the end of June. Horse mackerel are present throughout the year.

Cape cormorant

The Cape cormorant has been recorded by Rand (1963*a*,*b*) as breeding on 16 islands or platforms around the Southern African coastline. His 1956 population figures (Table 1) show that the most important localities were Cape Cross lagoon (upper limit of 675,000), Bird Rock platform off Walvis Bay (upper limit of 240,000) and Bird Island at Lambert's Bay (56,270). The upper limit values for the two South West African platforms were based on an assumption that one square yard could accommodate 30 roosting birds ($36/m^2$). Berry (1976) considered $25/m^2$ to be a more realistic value and from an aerial survey in June 1974 estimated a minimum population of 1,053,000 Cape cormorants on the Cape Cross, Swakopmund and Bird Rock platforms.

Breeding at these nesting sites is a predictable occurrence, initiated by an increase in photoperiod during August, but only commencing when the availability of pelagic fish in the area becomes greater (Berry, 1976). In South Africa the Cape cormorant starts nesting in August and may continue until February (Rand, 1960*b*). There is a high mortality of nestlings, which persists after fledging, mainly due to starvation when parents leave the inexperienced juveniles to catch their own fish in February and March, but successful juveniles migrate extensively along the coast in either direction, reaching Mocamedes (Angola) on the west and Durban on the east (Rand, 1960*b*, Berry, 1976).

Other species

The known distributions of the breeding colonies of bank, white-breasted and crowned cormorants are indicated in Table 1. Only insignificant numbers of each of these three species were noted by Rand (1960*b*, 1963*a*,*b*), a minimum of 4151, 1841 and 770 bank, white-breasted and crowned cormorants respectively being counted.

Between 500 and 600 white pelicans occur on Bird Rock platform, Walvis Bay, during the peak of their breeding season. In addition they are known to breed on Dassen Island and to have bred on Seal Island, False Bay (Rand, 1963*a*) and on Quoin Rock.

FEEDING

Any local shortage in fish could to some extent be countered by an increase in the distance travelled from the roosting or nesting area to the food source. The Cape gannet is well adapted in this respect. Jarvis (1970), assuming an average speed of 34 mph (54·4 kph), estimated that this species could cover up to 510 miles (816 km) in a 15-h day, and noted that it usually remained within 10 miles (16 km) of the coast. It is noteworthy that about 75% of the gannet population breeds on the South West African islands (Table 1). Here the commercial fishery is much larger than its South African counterpart (Tables 3 and 4), but is to a large extent dependent on one species, the pilchard. This is reflected in the diet of the birds at Walvis Bay (Table 2) (Matthews, 1961). Jarvis (1970), after comparison with the commercial purse seine catch, suggested that the food of gannets at Lambert's Bay was a reflection of the relative abundance in mass of the various pelagic fish species in the Western Cape.

Frost *et al.* (1976), by contrast, noted that flightlessness limits the feeding range of penguins and estimated that the foraging area of breeding jackass penguins does not exceed 1500 sq km. Due to this fact, they suggested that penguins must be able to rely on a highly predictable temporal and spatial distribution pattern of their prey. About 50% of the total penguin population is concentrated on Dassen Island and the Saldanha Bay group of islands, inside a radius of 25 km. The South African purse-seine fishery, being characteristically multispecies, especially in the vicinity of these islands, indicates a temporally stable food resource.

Peruvian members of the Phalacrocoracidae have an operative range of 30 to 40 nautical miles (56 to 74 km) but have a preference for the nearshore zone (Jordan, 1967). Similarly 91% of Cape cormorant sightings at sea were within 20 km of the nearest land and none were observed more than 70 km offshore (Siegfried *et al.*, 1975). The majority of these birds occur on the bird platforms of South West Africa where the biomass of fish is highest. Their distribution prior to the erection of these structures is uncertain.

The maximum total lengths of fish recorded from the stomachs of the Cape gannet, jackass penguin and Cape cormorant are 35·0 cm (Rand, 1959), 27·0 cm (Matthews, 1961), and 25·8 cm (Davies, 1956), respectively. Calculated values of total length-at-age for the six commercial pelagic species are presented in Table 5. It is apparent that, with the exception of older maasbanker and mackerel, which move to the mesopelagic environment where they are caught by deepsea trawlers, the majority of the pelagic fish stocks are available to the guano-producing birds. However, the mean lengths of fish consumed (Table 2) indicate that the Cape cormorant selects a smaller prey than the Cape gannet. This could explain the large concentrations of Cape cormorants at the northern extremities of both the South West and South African fishing grounds where recruitment of pilchard and of pilchard and anchovy, respectively, occurs.

TABLE 5
TOTAL LENGTH AT AGE OF SIX COMMERCIALLY EXPLOITED SOUTH AFRICAN FISH SPECIES (cm)

Age	*Pilchard*	*Anchovy*	*Horse mackerel*	*Mackerel*	*Round herring*	*Lantern-fish*
Source	*Baird* 1970	*Pollock* 1970	*Geldenhuys* 1973	*Baird* 1974	*Geldenhuys* 1978	*Centurier-Harris pers. comm.*
1	13·2	9·5	8·3	28·2	10·2	5·4
2	16·7	12·2	13·8	38·3	16·3	6·6
3	19·5	14·0	18·6	46·4	20·4	7·5
4	21·7	15·1	22·9	53·1	23·7	8·1
5	23·5	15·8	26·6	58·5	25·9	8·6
6	24·9	16·3	29·7	62·9	27·4	9·0
7	26·1	16·6	32·8	66·5	28·6	9·2
8	27·0	16·8	35·3	69·4	29·4	9·4
9	27·7	16·9	37·6	71·7	30·0	9·6
10	28·3	17·0	39·6	73·6	30·4	9·7
L_α[a]	30·6	17·1	54·3	82·0	31·5	10·0

[a] Maximum theoretical length.

POPULATION TRENDS

Censuses of seabirds on the islands off Southern Africa have been infrequent. On account of this, population trends have here been estimated from guano production figures. Jarvis (1970) suggested that a decline in the guano crop from Malagas and Ichaboe Islands since the mid-1940s indicated a downward trend in the gannet populations, while Jordan (1967) found it possible roughly to estimate fluctuations in the Peruvian seabird numbers from the annual guano harvest. On certain islands where bird counts have been made the reliability of this method was tested. The results, illustrated in Fig. 2, show a close relationship between guano production and bird numbers. Since many of the censuses were conducted during the nesting season,

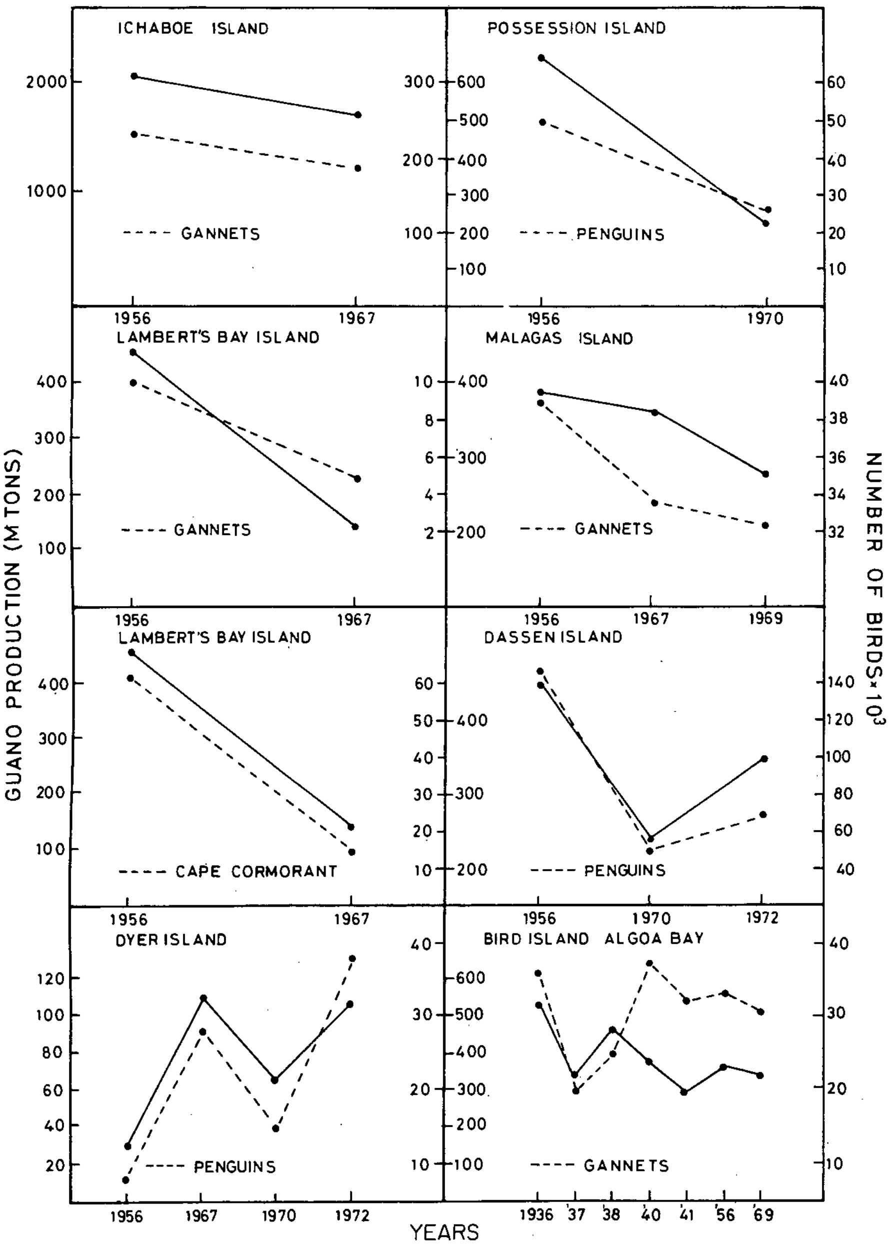

Fig. 2. Relationship between dominant seabird populations and guano production on certain South West and South African islands. Data on population sizes from Anon. (1973), Courtenay-Latimer (1954), Frost *et al.* (1976), Rand (1963*a*,*b*) and this paper for all 1967 and 1969 estimates, which were determined from aerial photographs. The guano yields are offset by one year to allow for the fact that scraping of the islands takes place during the year following breeding.

the resulting population estimates are likely to have been largely determined by the number of breeding pairs, although roosting individuals were also included in the counts. On-island guano production is, therefore, probably more dependent on the breeding than the absolute population size.

Early exploitation of the guano accumulations off Southern Africa was so intensive that, by the end of 1845, practically no deposits were left (Jarvis, 1970). Production figures since the turn of the century have therefore been accepted as representative of the bird populations involved. Prior to 1976, when the islands were leased to private contractors, all collection of guano was undertaken by the South African government. Difficulties in obtaining sufficient labour were frequently experienced, with the result that it was not always possible to harvest the guano from all islands. The deposits on those islands which could not be reached were accordingly left until the following year. In addition, rainfall was often responsible for the loss of varying amounts of guano to the sea. For these reasons, the figures for guano production from all islands were smoothed by threes when comparing the trends in bird populations with estimates of fish abundance. Conversely, the South West African platforms have been managed by private enterprise and scraped annually since their construction. Moreover, rainfall in the region is minimal (Berry, 1975) and smoothing of the data therefore unnecessary.

PELAGIC FISH AND SEABIRD INTERACTIONS

Interactions between seabird and fish populations were examined by comparing the guano production on certain islands with catches in the vicinity or other estimates of fish stock abundance.

Guano collection at Bird Rock platform, Walvis Bay, where Cape cormorants are the dominant species (Table 1), takes place during the late summer months (February/March), when mass breeding has ended (Berry, 1975), whereas purse-seine fishing in the area generally occurs between March and August each year. The season is closed during spring and summer to allow for uninterrupted spawning among the pilchard shoals. The annual guano harvest (since the completion of the platform in 1939), the total pilchard catch at Walvis Bay (including that of factory ships) and the pilchard catch per unit effort are compared in Fig. 3. The pilchard catch rose rapidly to a peak of 1·3 million metric tons in 1968, well in excess of the value of 0·8 calculated by Newman (1970) as the potential yield of the resource, before falling sharply. This overharvesting resulted in a decrease in abundance after 1966, as depicted by the trend in catch per unit effort. Over the period 1941 to 1967, guano production fluctuated between 500 and 1000 metric tons, but it subsequently dropped steadily to under 300 metric tons in 1970, indicating a reduction in the number of birds.

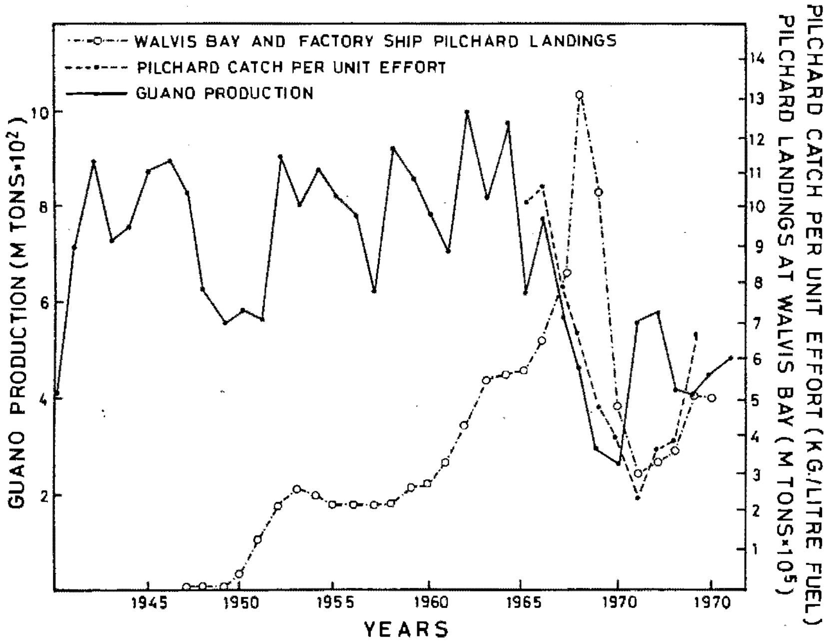

Fig. 3. Guano production on Bird Rock platform, total pilchard catch off Walvis Bay and catch of South West African pilchard per unit effort, 1940–1975.

It is possible that large numbers of Cape cormorants moved out of the area while the catch was still high but catch-per-unit-effort was fast declining, and probable that breeding success at the platform was greatly reduced. Certainly the dependence of the seabird predators on the fish stocks is emphasised by a simultaneous decline in the populations of both. After 1970, trends in guano production and pilchard catch per unit effort do not correspond. In these years a split-quota system directed some fishing effort away from the pilchard stock and towards the anchovy. This may in part account for the discrepancy. Alternatively increased availability of horse mackerel in 1971 (Table 3) may have enabled the bird population to recover ahead of the pilchard stock.

At the southern extremity of their South West African range (between Walvis Bay and Hollamsbird Island) the pilchard are mainly adult. These fish comprise the bulk of the pilchard catches offloaded at Lüderitz and are also the nearest food source for the large colonies of gannets on Ichaboe Island. The guano production on this island has been plotted in Fig. 4 together with the Lüderitz pilchard catch ($r = 0{\cdot}917$; $p < 0{\cdot}005$; $n = 12$) and the biomass of the adult stock (three years and older) ($r = 0{\cdot}614$; $p < 0{\cdot}025$; $n = 12$). The trends are similar, again emphasising the dependence of seabird populations on their food resource.

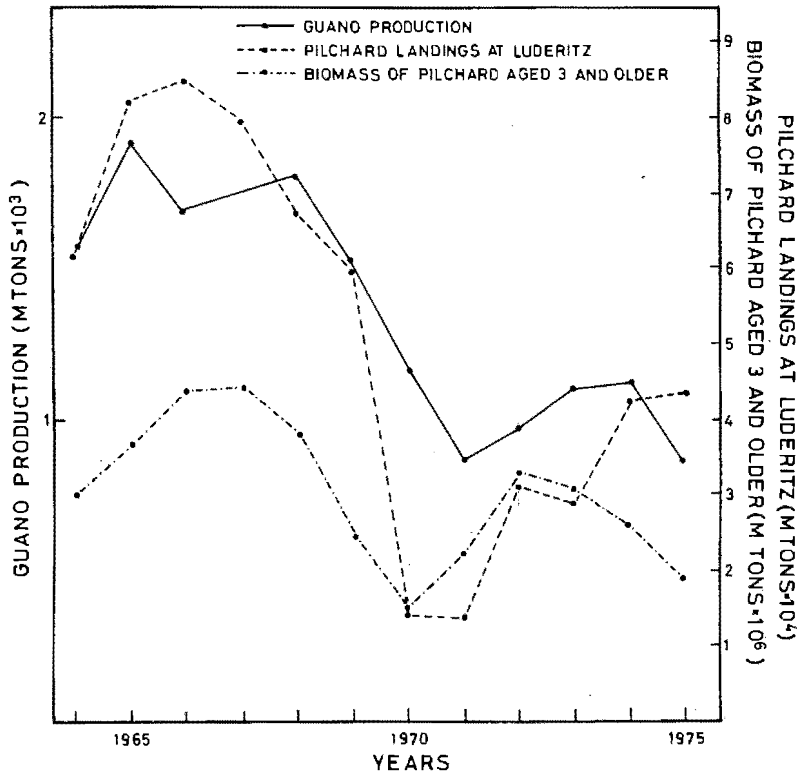

Fig. 4. Guano production on Ichaboe Island (smoothed by threes), landings of pilchard at Lüderitz and biomass of South West African pilchard aged three and older, 1964–1975.

No obvious patterns were obtained for islands further south, suggesting that these islands are not influenced to any great extent by fluctuations of the South West African pilchard population.

In South Africa, annual guano collection takes place in April or May when the breeding season has nearly ended (Jarvis, 1970). As discussed above, juvenile pilchard recruit to the fishery in the vicinity of Lambert's Bay, whereas the adults are generally located east of Cape Point. Biomass estimates of the nought-year-old age-group and guano production at Lambert's Bay are plotted in Fig. 5. The similarity of the trends is evident. The largest catches of juveniles are made just prior to the commencement of breeding in spring, though the guano is only scraped in the following year. When this is taken into account, the correlation between the two is significant ($r = 0{\cdot}783$; $p < 0{\cdot}005$; $n = 20$). Nought-year-old anchovy also recruit to the fishery in the same area but observed variations in year-class strength have not

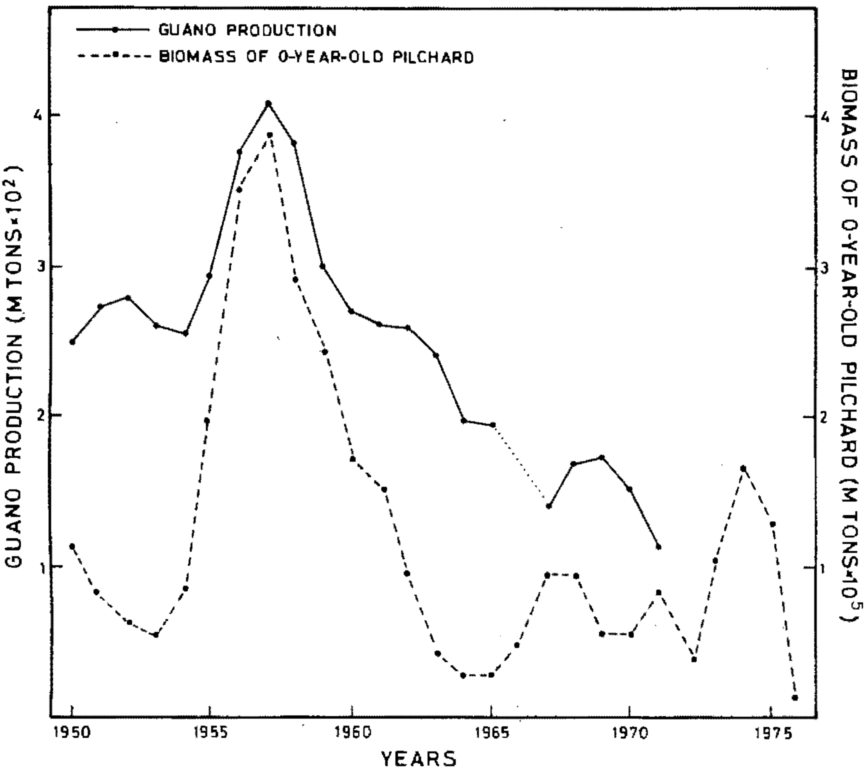

Fig. 5. Guano production on Bird Island, Lambert's Bay (smoothed by threes) and biomass of nought-year-old South African pilchard, 1950–1976.

been so marked as those for pilchard. Furthermore they exhibit a distinct tendency to move south and at the commencement of breeding are most abundant off Cape Point.

Should a local scarcity of fish occur it is possible that the gannets' long range would enable them to exploit the concentrations of adult pilchard and anchovy which are located between Cape Point and Cape Agulhas from September to January or later. The return distance would be 640 km or more and a considerable proportion of the guano could be deposited at sea. At Lambert's Bay, in 1956, Cape cormorants were six times as abundant as gannets (Rand, 1963*a*). These birds do not have the same range and it is likely that they are affected to a greater degree by a scarcity of fish in the vicinity. They have been noted to desert their nests at all stages of the breeding cycle (Rand, 1960*b*), an event attributed by Siegfried *et al.* (1975) to a failure in their food supply.

Catch-per-unit-effort of snoek *Thyrsites atun* for the area west of Cape Point is available for the period 1898 to 1905 and is plotted on Fig. 6 together with guano production at Lambert's Bay. The similarity between the two ($r = 0{\cdot}804$; $p < 0{\cdot}025$; $n = 7$) suggests that both snoek and bird predators are influenced by prey availability.

Jarvis & Cram (1971) related an increase in guano on this island to a stricter control of tourists. However, it appears that the main factor affecting the yield is the abundance of juvenile pilchard.

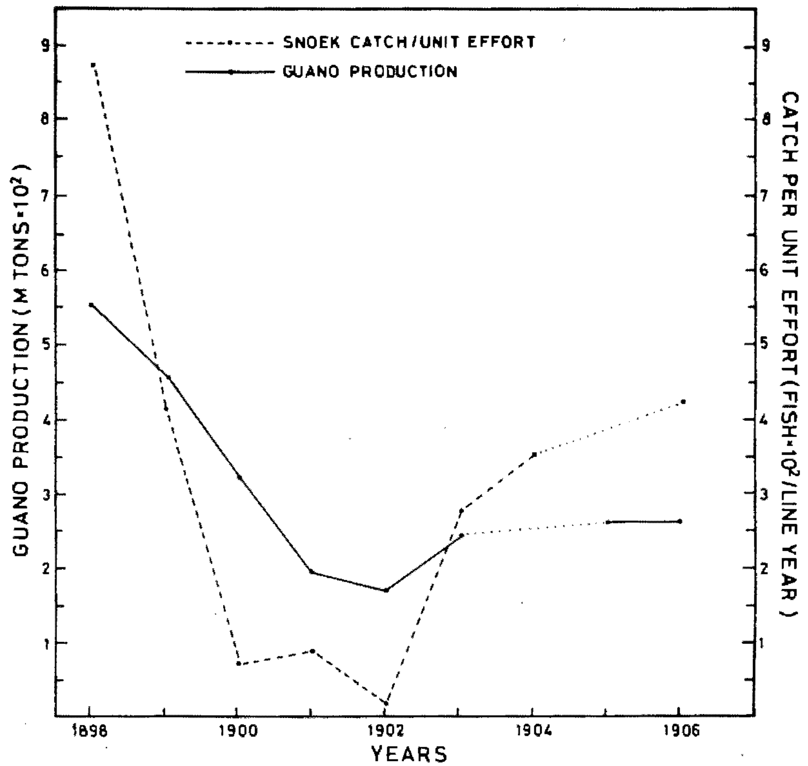

Fig. 6. Guano production on Bird Island, Lambert's Bay (smoothed by threes) and catch of snoek per unit effort, 1898–1906.

The other main guano-producing areas in the Western Cape are located at the centre of the multispecies purse-seine fishery and their production could not be linked to the trends of any one fish species.

The guano harvest of Bird Island, Algoa Bay, situated at the eastern extremity of the South African seabird colonies, is plotted on Fig. 7 with VPA estimates of the biomass of pilchard aged three and older and the catch-per-unit-effort values of

Stander & le Roux (1968). The distribution of juvenile pilchard is largely restricted to the waters west of Cape Agulhas but, as mentioned earlier in this report, shoals of adults migrate in an easterly direction each spring and some are located near Algoa Bay in winter. The rapid increase in adult biomass after 1957 is reflected by an increase in guano one year later. This again results from the guano being scraped in the following year. The correlation between the two is significant ($r = 0{\cdot}672$; $p < 0{\cdot}005$; $n = 24$). Catch-per-unit-effort values also correspond well ($r = 0{\cdot}827$; $p < 0{\cdot}005$; $n = 16$) and are in phase, as only fish aged four and older were fully recruited to the fishery at the time.

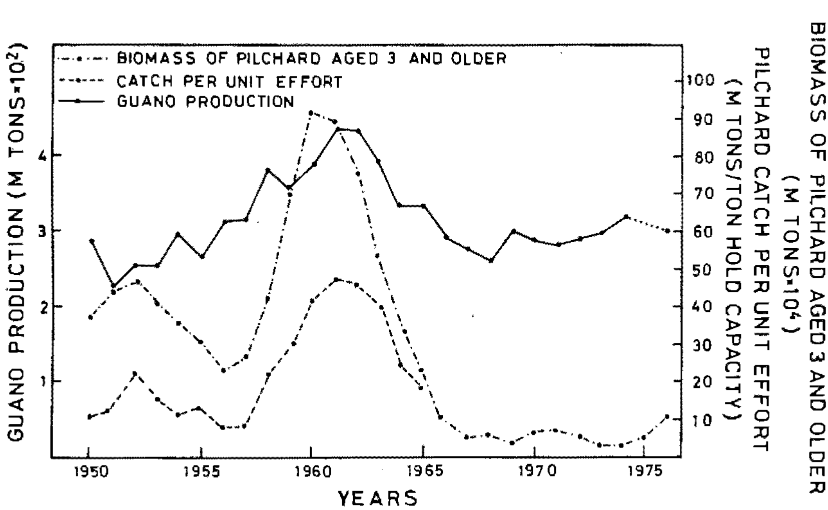

Fig. 7. Guano production on Bird Island, Algoa Bay (smoothed by threes), catch of South African pilchard per unit effort and biomass of South African pilchard aged three and older, 1950–1976.

When the combined guano yield of all islands off the South African coast is considered (Fig. 8), it becomes apparent that, prior to the commencement of commercial purse-seine fishing in 1943, large-scale fluctuations were characteristic. Subsequently, the guano yield stabilised at around 1800 metric tons per annum, but after 1961 there was a rapid fall. At this time, scraping on Marcus and Vondeling Islands became sporadic but, as their combined annual production seldom exceeded 250 metric tons, this could not have accounted for the overall decrease of about 900 metric tons. The deterioration coincided with a decline in the catch-per-unit-effort of pilchard. The earlier stability of the guano yield may be attributed to the multispecies nature of the fishery. VPA biomass estimates (Centurier-Harris *et al.*, 1977) indicate that fluctuations in pilchard and horse mackerel populations were to some extent out of phase and hence the *status quo* was partly maintained. From 1953 to 1956, the dominant fish species in the diets of the Cape gannet, the jackass

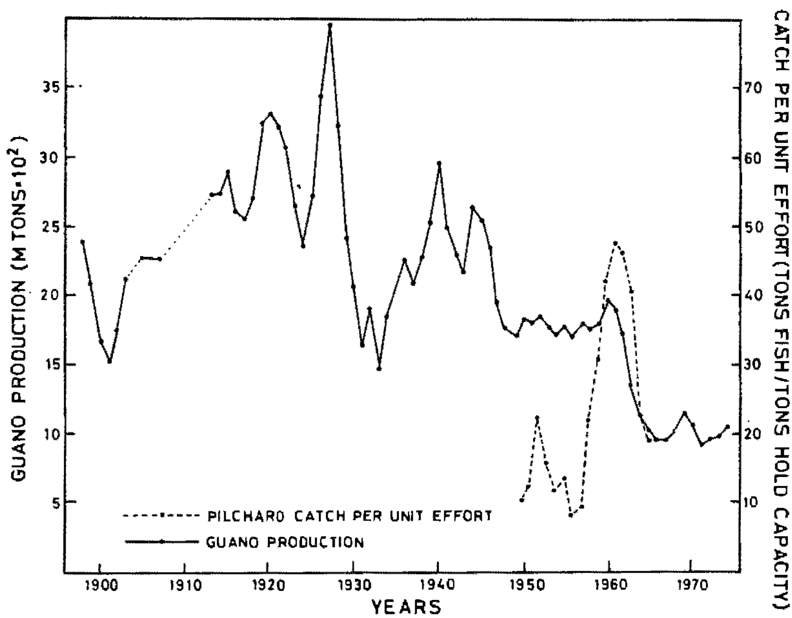

Fig. 8. Guano production on all islands situated off South Africa (smoothed by threes) and catch of South African pilchard per unit effort, 1898–1974.

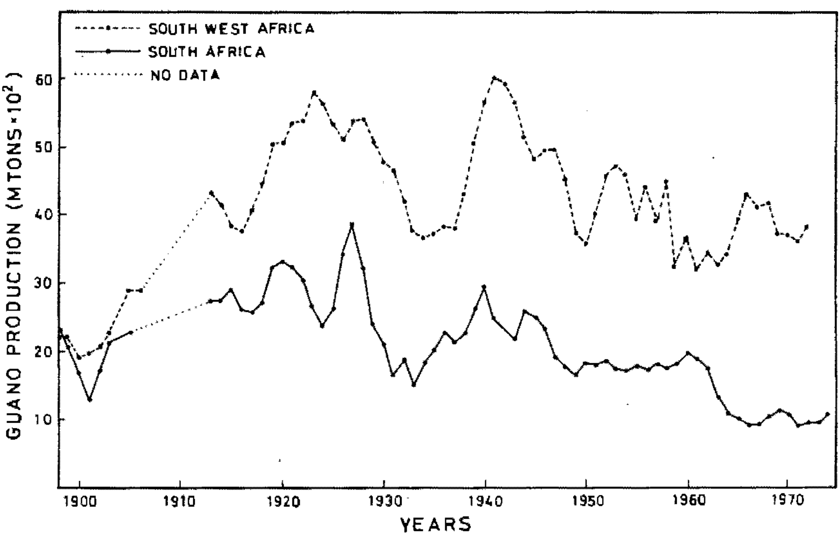

Fig. 9. Guano production on all islands situated off South West Africa and off South Africa (smoothed by threes) compared, 1898–1974.

penguin and the Cape cormorant were pilchard, anchovy and horse mackerel (Table 2). It appears that the bird populations were not able to adapt to deteriorations in both the horse mackerel and pilchard stocks, and the subsequent failure of the guano crop to recover suggests that the anchovy did not expand to fill the niche vacated by these two species. Centurier-Harris (1977) was unable to demonstrate any significant interaction between the pilchard and anchovy populations.

Overall guano productions on the islands off South West and South Africa are compared in Fig. 9. The collection from the South West African bird platforms, which only started in 1931, has not been considered. There is a similarity in the fluctuations of both prior to those years when the purse-seine fisheries were subject to heavy exploitation. The correlation over the entire period was significant ($r = 0{\cdot}798$; $p < 0{\cdot}005$; $n = 70$). This may suggest that an overall climatic or other factor governs both ecosystems.

DISCUSSION

The above consideration of guano production and fish stock trends indicates that fluctuations in the Cape gannet, jackass penguin and Cape cormorant populations are largely dependent upon the abundance and availability of their food sources. Figures 3 and 8 show that there is an immediate response by these bird populations to declining fish stocks. This can probably be accounted for by the fact that much of the guano deposited in any year results from the breeding season. Thus reduced food supplies appear to have had an instantaneous effect on reproductive behaviour, though the full influence of this on the strength of the adult populations may have been deferred. Conversely, in both instances, fishing effort expanded on a diminishing resource. Although catches were initially maintained, or even increased, the subsequent collapses were inevitable and depressed the bird populations beyond their normal range of fluctuation.

Estimates of fish stock abundance prior to the initiation of commercial exploitation are not commonly available. Records of guano production in South West and South Africa, which have been shown to be closely linked to fish stock sizes, date back to the turn of the century. As a result they have the potential of providing insight into the dynamics of these populations in their unfished state.

If guano production at Bird Island, Lambert's Bay, is considered as indicative of variation in the year-class strength of the South African pilchard stock, it is possible to conjecture on both the periodicity and order of magnitude of large scale fluctuations. Major peaks, approximately doubling the guano production, occurred at intervals of about 30 years (1898 or earlier, 1927 and 1957) (Fig. 10). In this respect it is interesting to note that the catch of the Japanese sardine *Sardinops melanosticta* is currently approaching its former high levels after a lapse of some 40 years (FAO, 1975). In South Africa the buffering effect of anchovy and other populations makes it difficult to speculate on the extent of the fluctuations. Year-class strength would have doubled at least, though the difference was probably greater. VPA estimates (Centurier-Harris, 1977) suggest that a factor of 10 is more likely to describe the situation adequately. Guano records are not complete for the early 1900s but the 1927 and 1957 recruitment peaks at Lambert's Bay are followed by crests in production at Bird Island, Algoa Bay, in 1930 and 1961 respectively (Fig. 10), reflecting the subsequent rise in the adult pilchard population biomass. Moderately good year-class successions in 1921–1922, 1932–1934 and 1939–1941 gave rise to equally large parent stocks in 1927, 1936 and 1945. As a result the periodicity in the fluctuations of the adult population is less regular, though again the difference between good and poor years is about twofold.

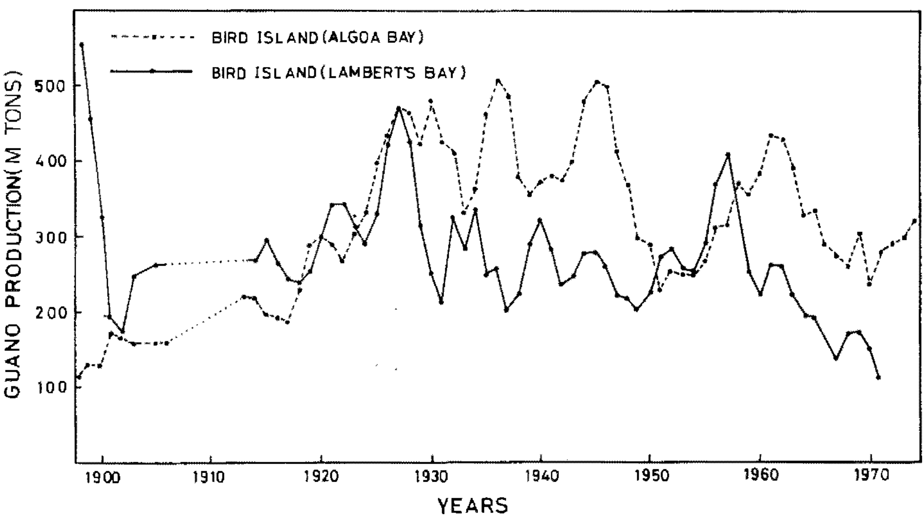

Fig. 10. Guano production on Bird Island, Lambert's Bay, and on Bird Island, Algoa Bay (smoothed by threes) compared, 1898–1974.

Although guano records on Bird Rock platform, Walvis Bay, only date back to 1940 and fishing on a small scale commenced shortly afterwards, the South West African pilchard population does not appear to have been adversely affected until the late 1960s (Fig. 3). Oscillations in guano production were frequent with good years producing a crop roughly twice that of the poor ones.

A further invaluable consequence of the close connection between guano harvest and fish abundance is that it may be possible to use the former as an indicator of the current state of the pelagic resources. Since the amount of guano deposited reflects bird numbers it is probable that an advance assessment could be obtained by selecting such strategic points as Bird Rock platform (Walvis Bay), Ichaboe Island, Bird Island (Lambert's Bay) or Bird Island (Algoa Bay), and conducting aerial surveys to determine the number of birds present during the breeding season. Bird counts on other islands are also likely to be indicative of the availability of fish in the immediate vicinity, and would have additional value in monitoring the state of these populations. Now that guano scraping on a number of islands has been terminated, no indirect estimates will be available.

The interrelationships of pelagic fish and seabird populations signify the overriding importance of sound fisheries management for the conservation of other ecosystem components. Any sharp declines in fish abundance, such as those experienced in South and South West Africa in the early and late 1960s respectively, will result in a corresponding reduction in the numbers of Cape gannet, jackass penguin and Cape cormorant. Decreases in the gannet and penguin populations have already been noted by Jarvis (1970) and Frost *et al.* (1976), the state of the latter species being cited as threatened.

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CHAPTER 3. REVISION OF SPECIES AND AGE COMPOSITION OF LANDINGS IN THE SOUTH AFRICAN PURSE-SEINE FISHERY, 1950 TO 1976.

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REVISION OF SPECIES AND AGE COMPOSITION OF LANDINGS IN THE SOUTH AFRICAN PURSE-SEINE FISHERY, 1950 TO 1976

R. J. M. CRAWFORD, O. M. CENTURIER-HARRIS, G. H. L. WINGATE and B. D. KRIEDEMANN

Catch figures previously published for the outh African purse-seine fishery in the Western ape have been based upon factory estimates of he species composition of the catches offoaded by their respective fishing units. Alhough the total mass (weight) of fish landed has lways been recorded accurately, catches, espeially since 1964, often comprised more than one pecies and were generally allocated *in toto* to the pecies most abundant in that landing. Juveniles f pilchard *Sardinops ocellata* and round herring *trumeus teres*, for example, frequently occurred n mixed catches in which anchovy *Engraulis apensis* was dominant and were catalogued as nchovy. It was anticipated that this would signiicantly influence not only the catch figures of hese three species and of two other commerially caught fish, horse mackerel (maasbanker) *rachurus trachurus* and mackerel *Scomber aponicus*, but also the age compositions deternined from them. A second factor expected to ias these estimates was the use of field-laboraory information on the length distribution of the andings without any account being taken of the atch weight represented by each sample. A ixth species, the lantern-fish *Lampanyctodes ectoris*, also contributes to the fishery, but no ge determination technique for this fish has yet een developed.

Sampling has been undertaken, though not alays concurrently, at five separate landing oints: Lambert's Bay, St Helena Bay, Saldanha ay, Hout Bay and Gans Bay. As may be seen om Figure 1, these sites cover the factories parcipating in the fishery in a reasonably represenative manner. Details of species composition nd length distribution of the catches from nown localities were recorded, while otoliths nd scales were removed for subsequent age detrmination.

All skippers were requested to report the posiions of their catches and the tonnages offoaded. Landings form the basis of their reuneration, so that skipper estimates of total atch were reliable, but the position was not alays recorded and had, in some cases, to be inrred from that of sister vessels operating from the same home port.

Factories have been required by law to supply accurate monthly catch totals and have, in addition, kept records of the approximate species composition of the landings.

These three sources of information have now been combined to obtain corrected catch figures and length and age compositions for each species (Fig. 2). The purpose of this report is to document the methods employed for future reference and to present the revised estimates of the annual catch and age compositions.

WEIGHTING PROCEDURES

The Western Cape purse-seine fishery was initiated in 1943, but no accurate records of performance are available before 1950. Since this date, a change in the minimum mesh size, expansion of the fishing grounds and differences in the quality of available data have necessitated a subdivision of the period into three phases: 1950–1963, 1964–1972 and 1973–1976. Each of these was treated in a separate manner.

1950 – 1963

The prescribed minimum mesh size of treated cotton nets in use from 1950 to 1955 was 38 mm, but the gap was rapidly reduced by shrinkage to an average of 32 mm. Because of this, 32 mm was adopted as the new minimum when synthetic nets were introduced in 1956 and can for most purposes be regarded as the effective minimum for the period 1950 – 1963. During these years, the fishery was almost entirely dependent upon three species – pilchard, horse mackerel and mackerel.

Fishing operations were initially confined to the environs of St Helena Bay but later expanded southwards. Davies (1956) recorded that 92 per cent of all catches made from 1950 to 1955 were located between Lambert's Bay and

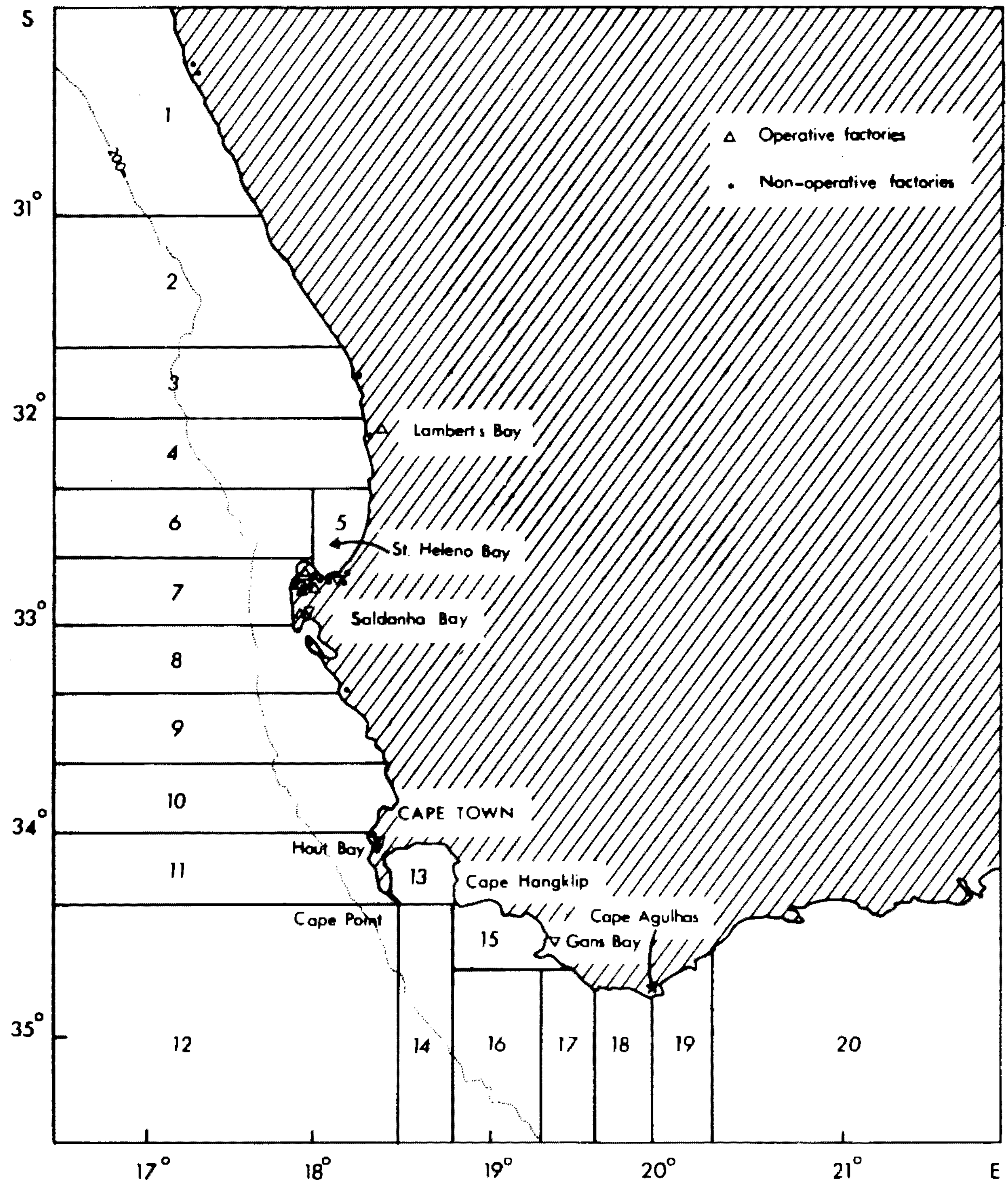


Fig. 1: Factories and fishing grounds of the Western Cape purse-seine fishery showing the 20 areas used in the analysis

St Helena Bay, but by the end of 1958 the area of exploitation extended from Lambert's Bay to Cape Hangklip (Du Plessis 1959). In January 1959, two new reduction plants were opened at Hout Bay in order to make more effective use of the southern concentrations of fish, and were followed in January 1963 by one at Gans Bay.

Skipper reports only commenced in 1956 and until 1963 were irregular and incomplete, so factory estimates of the species composition of the catches were accepted. These are thought to be largely accurate, as field sampling indicated that landings involving more than one species were infrequent. It is possible that catches of round herring were wrongly classified as pilchard on occasion. From 1964 to 1972, 65 per cent of the round herring catch came from waters between Saldanha Bay and Cape Point (Centurier-Harris and Crawford 1974). Any misidentification of the catches is therefore likely to have been severest after fishing had been extended to these waters.

Length-frequency information was collected at Lambert's Bay (1950–1953), St Helena Bay (1950–1963) and Hout Bay (1960–1963). At all localities, samples of 50 fish each were taken from one boat on each day that fish were landed, after tests had indicated that there was little advantage to be had from sampling more vessels. The data intake at Lambert's Bay was terminated after comparison with samples obtained at St Helena Bay had revealed no significant difference (Davies 1957).

The length information was grouped on a monthly basis and combined with factory estimates of species catch to obtain annual age compositions. The age-length keys used in this process are tabulated in the Appendix. In the case of pilchard and mackerel, it was necessary to adopt age data procured at a later date, and estimates may be biased if there were discrepancies in growth rates between the respective periods.

Pilchard scales were collected from 1950 to 1963 and were used by Davies (1958) in a preliminary age study. However, later analysis showed the results obtained from scales to be at variance with those recorded from otoliths in 30 per cent of the comparisons and as, in the cases of pilchard, rings are more clearly defined on otoliths (Baird 1970), scale readings were rejected. Age determination from otoliths has been described by Baird (*op. cit.*) for pilchard, Geldenhuys (1973) for horse mackerel, Baird (1974) for mackerel and Geldenhuys (in press) for round herring, and from scales by Pollock (1970) for anchovy. In contrast to pilchard, anchovy otoliths are extremely difficult to interpret.

1964 – 1972

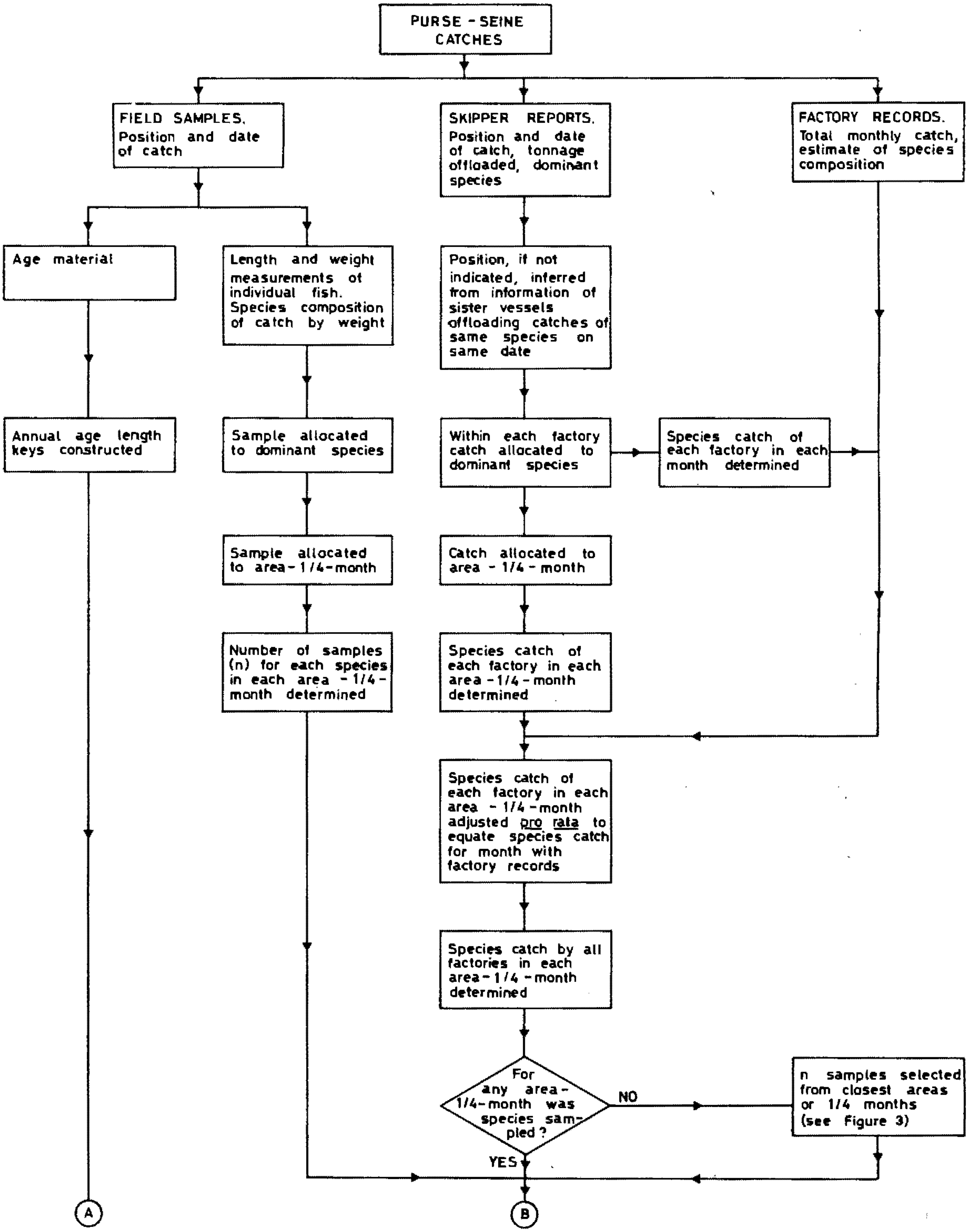
In 1964, certain boats were permitted to fish for anchovy with nets having a minimum mesh size of 12,7 mm. The experiment proved successful and from the beginning of the 1965 season this concession was extended to all vessels. In these two years no other species were allowed to be caught with the small-meshed nets, but difficulties were experienced in identifying shoals before the nets were set, and from 1966 the exploitation of all species with the 12,7 mm net was sanctioned. This lowering of the minimum mesh size had a marked impact on the fishery. Landings of anchovy and round herring increased considerably and the age structures of the pilchard, horse mackerel and mackerel catches were lowered. Lantern-fish made its first documented appearance in 1966, but was only recorded separately from anchovy during 1968 and subsequently.

The abundance of large pilchard on the fishing grounds off the West Coast declined at this time and led to increased fishing east of Cape Point, particularly from January to April. This was facilitated by the introduction of larger fishing vessels with an extended range, allowing many of the boats from Lambert's Bay, Saldanha Bay and St Helena Bay to fish on the southern grounds and also as far north as the Orange River.

In 1964, skipper reports accounted for 55 per cent of the total catch (Table I). The coverage

Table I: Percentage of the total catch reported by the skippers

Year	Reported catch (metric tons)	Actual landings (metric tons)	Percentage reported
1964	233 288	425 622	54,8
1965	288 992	480 129	60,2
1966	300 112	357 134	84,0
1967	491 898	509 313	96,6
1968	368 939	368 593	100,0
1969	349 651	351 951	99,3
1970	356 354	358 886	99,3
1971	326 784	324 531	100,0
1972	433 666	433 597	100,0
1973	408 151	451 393	90,4
1974	383 871	400 499	95,8
1975	351 929	407 415	86,4
1976	358 700	407 545	88,0


PURSE - SEINE CATCHES
FIELD SAMPLES. Position and date of catch
SKIPPER REPORTS. Position and date of catch, tonnage offloaded, dominant species
FACTORY RECORDS. Total monthly catch, estimate of species composition
Age material
Length and weight measurements of individual fish. Species composition of catch by weight
Position, if not indicated, inferred from information of sister vessels offloading catches of same species on same date
Annual age length keys constructed
Sample allocated to dominant species
Within each factory catch allocated to dominant species
Species catch of each factory in each month determined
Sample allocated to area - 1/4 - month
Catch allocated to area - 1/4 - month
Number of samples (n) for each species in each area - 1/4 - month determined
Species catch of each factory in each area - 1/4 - month determined
Species catch of each factory in each area - 1/4 - month adjusted pro rata to equate species catch for month with factory records
Species catch by all factories in each area - 1/4 - month determined
For any area - 1/4 - month was species sampled?
NO
n samples selected from closest areas or 1/4 months (see Figure 3)
YES
A
B

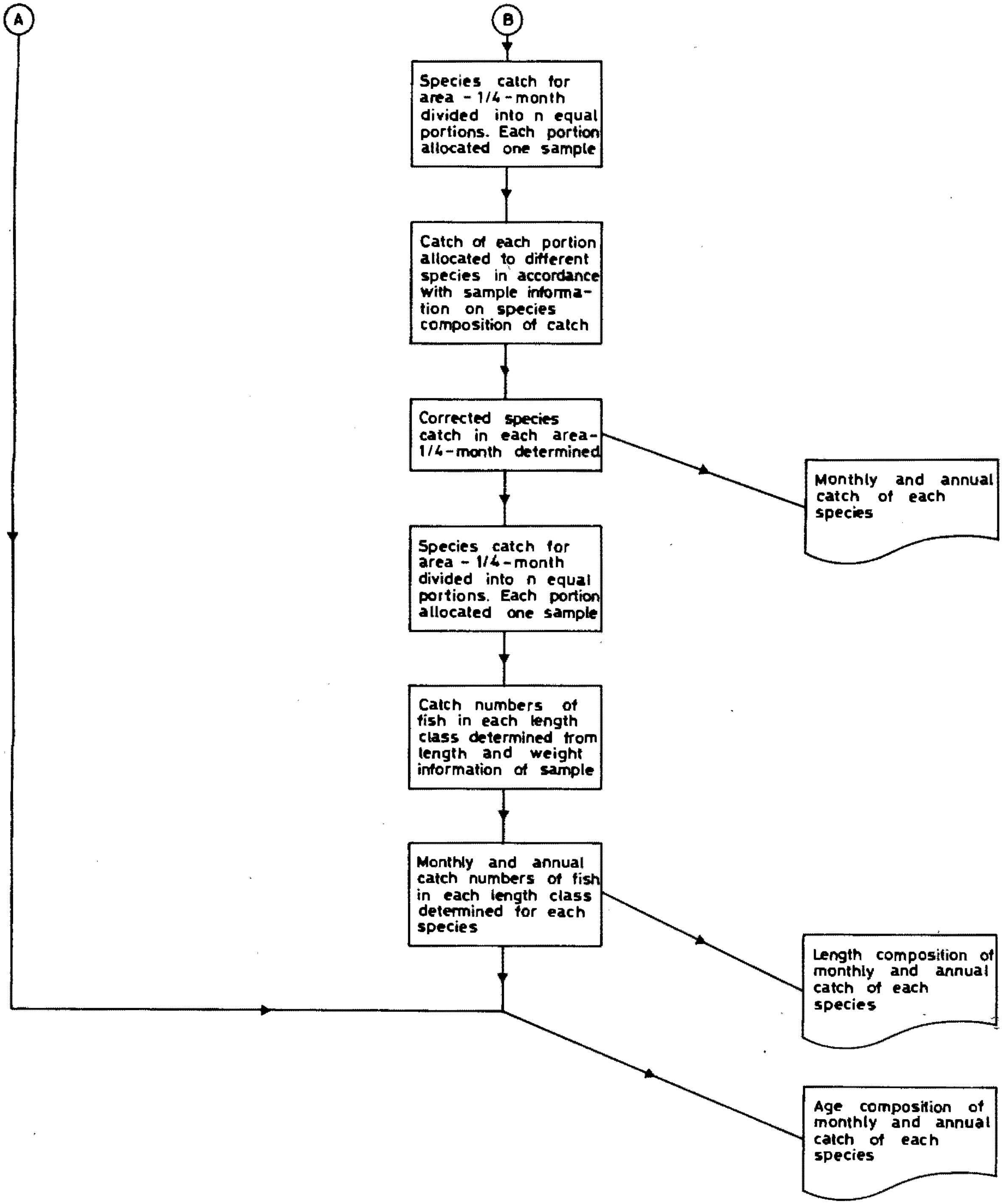


Fig. 2: Diagrammatic representation of the method of treating data for the period 1964 – 1972 to compute the revised monthly and annual catch and age composition of species contributing to the Western Cape purse-seine fishery

continued to improve and was almost complete by 1967. Between 1964 and 1972, the total catch, dominant species and catch position of each trip were recorded, but from 1973 estimates of the species composition of each landing also became available. For this reason the periods 1964–1972 and 1973–1976 have been treated separately, though in both instances the fishing grounds were divided into 20 areas (Fig. 1), following a preliminary division into 28 areas (Centurier-Harris and Crawford 1974).

During the years 1964–1972 the species catch of each factory in each area was determined from skipper returns for each quarter month. These values were then adjusted *pro rata* to ensure that the total catch of each species in every month corresponded to the official factory figures. This process led to a first approximation of the species composition of the catches and also accounted for those catches for which no skipper returns had been received.

The final species breakdown was obtained by adjusting the catch of each species in each area-quarter-month according to field observations for that same locality in time and space. Sampling during the period was conducted at St Helena Bay (1964–1971), Saldanha Bay (1972), Hout Bay (1964–1972) and Gans Bay (1972). The sample size was increased in 1972 to approximately 150 fish. When no field information was available for any particular area-quarter-month, data from the nearest space-time intervals were employed. This involved a search routine in which a computer scanned adjacent and progressively further removed areas and quarter-month intervals (Fig. 3).

Once this process had been completed, length distributions were computed in a similar manner, that is from field data for the area-quarter-month associated with or closest to the catch locality. These length distributions were then used to generate the monthly and annual age structures of the catches. The age-length keys used in this analysis appear in the Appendix. They were all constructed from age material collected during the period, but the data were generally insufficient to provide separate keys for individual years, and any inter-year difference in growth would not have been accounted for.

The entire weighting procedure for the period 1964 to 1972 is illustrated in Figure 2.

1973 – 1976

Skipper estimates of the species composition of catches during this period obviated the necessity of using factory figures to obtain a first approximation of the landings, though adjustments were still made to account for unreported catches. Otherwise the techniques employed were the same as those for 1964 – 1972. Samples of all species were collected from Lambert's Bay (1976), Saldanha Bay (1973–1976), Hout Bay (1973–1976) and Gans Bay (1973–1976), and of mackerel only from St Helena Bay (1973 and 1974). The intake of age material was intensified, with the result that annual keys were available for pilchard and biennial keys for mackerel and round herring. These are listed in the Appendix. Age data from the previous period were employed for anchovy and horse mackerel.

DISCUSSION

An analysis of the searching process, in the event of samples being unavailable for a particular area-quarter-month interval, is presented in Table II. The number of intervals having no samples of their own fell by half, from 89 per cent in 1964 to 44 per cent in 1976, when regular field observations were obtained from four localities for the first time.

The opening of a field station at Gans Bay in 1972 had little impact on the overall picture, probably because this year also witnessed the closure of the St Helena Bay field station in favour of one at Saldanha Bay. As a result, the increased sampling of catches from the eastern fishing grounds was largely offset by a reduced coverage of the northern areas. This deficiency led to the reopening of the Lambert's Bay station in 1976. The relatively high values for negative sampling of 60 and 66 per cent in 1973 and 1974 respectively were probably due to the early end of the fishing season in these two years, the equivalent amount of fish being caught in a shorter period of time and so allowing less opportunity for sampling.

Table II also indicates the extent to which searching took place. When samples were adopted from other areas they almost invariably came from the nearest five areas on either side, that is within a range of about 185 km, and were frequently from the adjacent areas. Similarly it was seldom necessary to employ information from intervals displaced by more than five quarter-months. The 1964 season was an exception, suggesting that sampling during this year

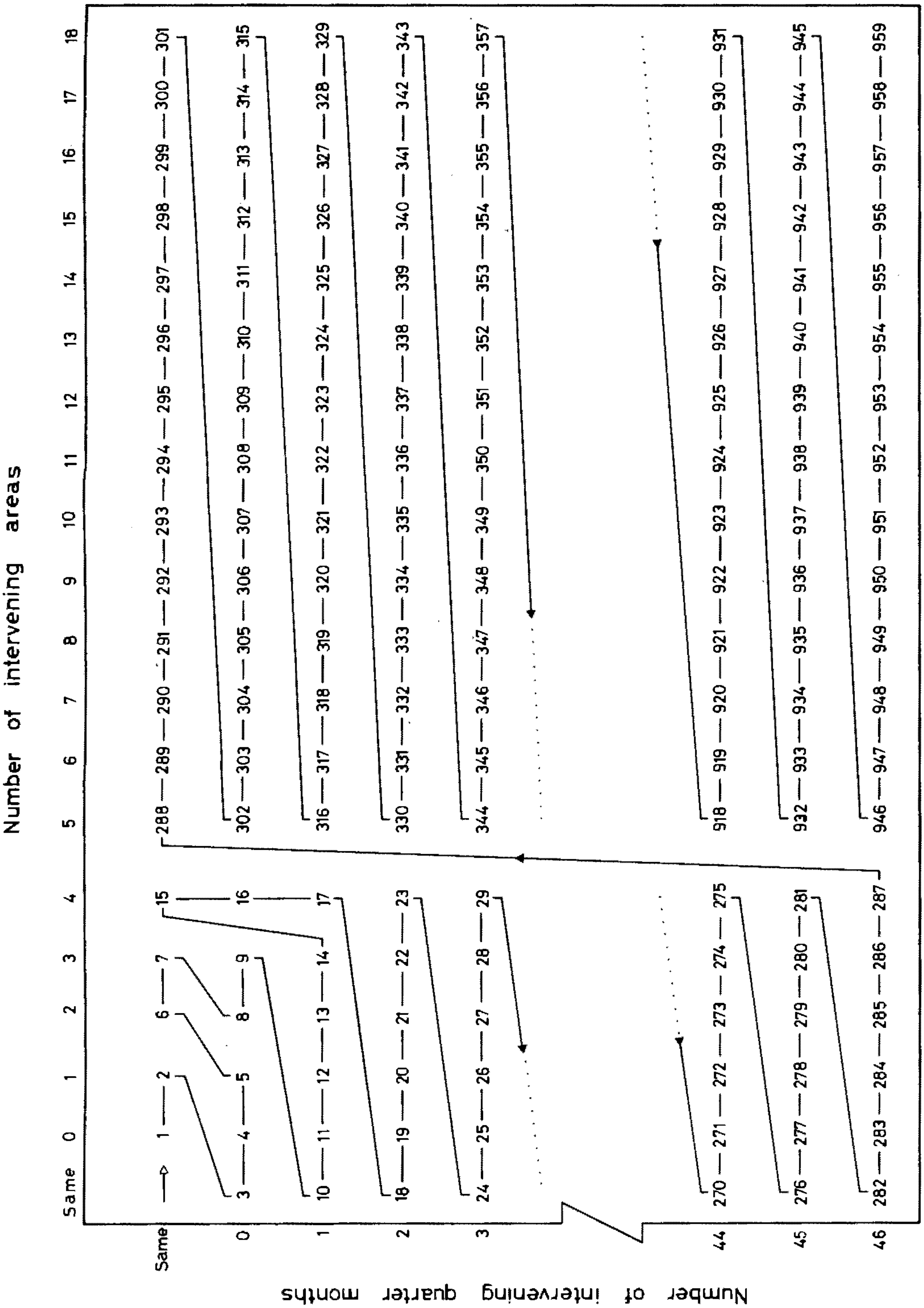


Fig. 3: Computer scanning routine used to find samples when none were available for a particular area-quarter-month. The number of steps required to reach each search level is indicated

Table II: Percentage of all area-quarter-months for which samples were derived from other space-time intervals

Year	Percentage of all area-quarter-months with								
	no sample	sample derived from							
		other areas when number of intervening areas was				other quarter months when number of intervening quarter months was			
		0	1	2–4	>4	0	1	2–4	>4
1964	89,1	21,4	17,8	28,6	1,0	19,7	6,3	8,5	21,3
1965	65,8	24,3	15,4	13,9	1,0	26,0	7,5	3,6	0,5
1966	56,9	23,0	12,9	11,1	0,2	19,0	7,5	3,6	1,4
1967	58,6	18,7	11,0	19,3	1,9	14,7	5,9	9,4	7,8
1968	48,9	15,5	12,5	13,7	0,0	13,9	4,3	6,0	4,0
1969	44,5	14,8	10,3	13,5	1,0	12,6	3,8	6,8	1,7
1970	51,1	16,3	13,0	11,5	4,5	14,3	5,5	4,6	5,3
1971	53,6	15,7	12,0	17,8	0,1	17,2	8,5	7,6	4,0
1972	53,5	16,5	11,6	15,3	3,1	16,0	7,2	4,0	2,5
1973	60,0	19,4	14,0	15,9	2,6	20,1	2,9	7,3	8,8
1974	66,2	23,8	16,8	15,5	4,3	14,8	6,8	7,3	8,8
1975	51,7	18,7	11,7	14,3	0,0	15,0	5,5	7,6	0,8
1976	43,5	22,5	10,1	8,2	0,2	6,5	2,9	2,5	2,4

was relatively inadequate. In extreme instances, data were selected from intervals as far removed as 16 areas or 42 quarter-months and under such circumstances any estimate of the length distribution, or species or age composition of the catch would have been little more than a necessary guess.

In a limited number of cases, additional information on the average weight of anchovy caught in area-time intervals having no sample of their

Table III: Species composition of South African purse-seine fish landings, 1950 – 1976 (thousands of metric tons)

Year	Pilchard	Anchovy	Horse mackerel	Mackerel	Round herring	Lantern-fish	Total
1950	85,3	—	49,9	—	—	—	135,2
1951	101,9	—	98,5	—	—	—	200,4
1952	170,0	—	102,6	—	—	—	272,6
1953	132,5	—	85,2	—	—	—	217,7
1954	88,3	—	118,1	4,0	—	—	210,5
1955	121,9	—	78,8	20,2	—	—	221,0
1956	76,6	—	45,8	32,6	—	—	154,9
1957	109,5	—	84,6	7,4	—	—	201,5
1958	194,4	0,2	56,4	21,6	0,8	—	273,4
1959	260,2	1,4	17,7	33,1	2,6	—	314,9
1960	318,0	—	62,9	31,0	0,1	—	412,0
1961	402,2	—	38,9	49,7	0,1	—	490,9
1962	410,2	—	66,7	20,4	0,1	—	497,3
1963	390,1	0,3	23,2	13,2	0,2	—	427,0
1964	256,1	92,4	24,4	50,0	2,7	—	425,6
1965	204,5	171,0	55,0	41,4	8,2	—	480,1
1966	118,0	143,9	26,3	53,4	15,4	—	357,1
1967	69,7	270,6	8,8	128,2	32,0	—	509,3
1968	107,8	138,1	1,4	91,0	30,3	0,1	368,6
1969	56,1	149,2	26,8	91,7	23,3	4,9	352,0
1970	61,8	169,3	7,9	77,9	23,7	18,2	358,9
1971	87,6	157,3	2,2	54,2	21,6	2,0	324,9
1972	104,2	235,6	1,3	56,7	20,6	15,2	433,6
1973	69,0	250,9	1,6	58,8	28,7	42,4	451,4
1974	16,0	349,8	2,5	30,7	1,3	0,3	400,5
1975	89,2	223,6	1,6	69,3	23,6	0,1	407,4
1976	176,4	218,3	0,4	0,5	11,7	0,1	407,5

Table IV: Age composition of the South African pilchard landings, 1950 – 1976 (thousands of fish caught)

Year	Age class							
	O	I	II	III	IV	V	VI	VII	VIII
1950			4 420	64 240	176 370	221 820	146 290	24 020	870
1951		70	4 650	44 000	209 720	280 240	169 170	27 450	860
1952	670	4 160	19 510	224 330	475 460	436 280	206 240	23 350	530
1953	270	3 790	26 590	87 400	336 620	391 180	175 370	19 080	480
1954			310	24 140	204 450	281 150	131 920	9 230	250
1955			50	22 430	261 140	403 030	187 460	12 120	240
1956	420	4 010	9 000	45 200	139 900	224 630	134 220	11 490	160
1957	50	3 240	62 480	174 350	290 230	271 100	123 060	18 220	150
1958			112 590	1 070 740	650 670	207 930	58 940	5 860	60
1959	1 700	26 890	412 690	1 719 110	927 360	156 130	8 670	250	
1960	1 030	14 900	323 030	1 714 270	1 299 950	291 110	16 530	250	
1961	90	2 400	77 040	827 460	1 902 910	847 160	102 090	1 280	
1962		1 220	163 570	1 304 660	1 651 060	768 130	140 200	350	
1963	16 190	117 640	838 750	1 233 910	1 526 760	681 780	92 980	740	
1964	790	12 540	252 208	1 080 797	918 121	203 871	21 014	414	
1965	234 643	129 479	317 600	1 027 346	599 248	155 792	14 788	125	
1966	370 269	73 554	55 361	404 675	411 697	150 764	17 326		
1967	3 623 027	812 973	108 490	156 079	56 258	6 984	122		
1968	4 306 589	643 292	158 907	354 231	197 605	43 870	3 270		
1969	2 558 093	326 484	203 627	254 937	53 721	7 363	136		
1970	1 631 633	421 336	192 776	356 778	60 138	3 154			
1971	4 489 153	682 438	164 127	296 736	87 793	8 172	211		
1972	1 317 150	686 689	203 829	201 560	216 383	76 619	12 784		
1973	3 010 414	14 215	179 492	187 765	25 895	1 166	50		
1974		48 296	16 991	49 685	52 664	18 207	3 853		
1975	2 688 417	466 480	172 837	186 029	99 663	34 407	1 261		
1976	10 172	429 148	1 232 342	741 651	124 735	12 373	367		

wn was available and, when compared with the dopted samples, indicated that a biased picture as being presented. The majority of such comarisons, however, validated the allocation process, and the scarcity of occasions on which earching extended to distant intervals suggests that the method is superior to the former process of lumping all information on an annual basis.

Revised catch figures for the period 1950–1976 are presented in Table III, whereas annual age compositions for the landings of all species except lantern-fish appear in Tables IV to VIII. Comparison with previously published figures (Baird 1975, Baird and Geldenhuys 1973, Sea Fisheries Branch 1950–1974) shows that since 1966, when legislation first provided for the capture of all species with the small-meshed net, the adjustment of catch figures to take into account the effect of mixed catches has resulted in significant changes. After this date, former figures usually underestimated the catches of pilchard and round herring, while overestimating those of anchovy. This was because anchovy was generally the main contributor in mixed catches involving these three species.

The 1974 season proved to be a notable exception, there being very little change in species catch. In this year, juveniles of both pilchard and round herring were noticeably absent from the catches, with the result that mixed catches were seldom encountered. The close correlation between the former and revised catch totals in this year suggests that figures for the period

ble V: Age composition of the South African anchovy landings, 1964–1976 (thousands of fish caught)

ear	Age class				
	O	I	II	III	IV
64	4 112 558	3 691 963	1 032 013	264 526	25 809
65	6 112 724	5 888 132	2 552 185	846 577	106 995
66	17 472 147	3 755 349	876 426	262 574	24 167
67	31 844 250	8 111 306	1 299 942	518 433	104 438
68	13 352 969	4 810 371	701 545	226 698	41 462
69	18 344 074	4 313 846	612 167	158 040	19 940
70	24 597 890	4 522 904	830 006	208 994	26 982
71	12 822 676	5 463 940	1 192 470	485 286	70 238
72	10 107 668	7 417 308	1 619 056	655 910	121 340
73	28 878 896	3 593 843	139 651	16 107	7
74	19 302 169	12 619 213	1 972 432	312 830	8 299
75	28 793 310	5 229 766	1 355 714	277 282	10 025
76	18 775 756	7 474 908	1 097 631	202 036	18 098

Table VI: Age composition of the South African horse mackerel landings, 1950–1976 (thousands of fish caught)

Year	Age class												
	O	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
1950			50 000	213 000	58 800	19 100	24 200	8 570	8 570	1 950	3 120	2 340	
1951			8 030	164 000	114 000	116 000	68 000	31 600	19 800	2 680	5 350	5 890	
1952	15 100	45 900	3 910	23 000	62 100	173 000	85 500	54 700	12 700	1 950	2 930	7 330	
1953				11 500	19 000	84 600	54 000	65 600	26 600	2 120	3 930	5 140	
1954			3 220	10 400	14 300	53 700	88 500	73 400	78 100	7 520	14 300	14 000	358
1955				922	2 770	45 600	58 500	51 900	34 800	16 600	9 220	9 220	922
1956				344	2 180	10 400	17 800	24 900	23 600	15 500	14 700	3 780	1 600
1957			2 900	17 400	4 840	13 000	16 300	28 500	39 500	26 500	41 000	10 800	8 520
1958			623	2 740	5 360	8 970	7 470	9 970	27 200	16 300	22 800	14 500	5 980
1959			240	2 160	5 660	8 440	6 380	3 020	4 320	4 840	7 620	3 360	1 970
1960		510	16 600	27 300	41 500	74 400	42 300	8 410	9 170	4 330	17 100	8 920	4 330
1961			177	8 300	29 500	76 500	52 300	5 470	1 770			706	1 770
1962			234	1 870	16 600	58 100	101 000	25 100	16 900	1 870	5 160	5 160	2 110
1963	No data available												
1964			16 553	56 720	48 481	45 391	9 306	6 548	809				
1965	29 586	6 760	43 396	58 731	97 417	56 997	8 330	8 937	517	14	14		
1966	166 818	80 608	22 205	19 345	36 549	27 307	4 150	4 805	803	33	58		
1967	16 842	47 336	122 694	7 022	575								
1968	32 954	1 767	4										
1969	125 150	28 205	10 718	18	506	14 558	15 430	11 947	10 699	3 210	2 063		
1970	688 380	124 028	3 556										
1971	57 647	3 835	3 041	62	49	14							
1972			1 205	5 420	4 452	1 118							
1973	38 015		557	1 646	3 075	1 896	290	408					
1974	140 376	26 415	4 149										
1975	No data available												
1976	No data available												

Table VII: Age composition of the South African mackerel landings, 1954–1976 (thousands of fish caught)

Year	Age class								
	O	I	II	III	IV	V	VI	VII	VIII
1954	62	410	1 972	1 290	310	8			
1955		902	8 757	6 383	2 234	46			
1956	2	2 912	18 024	7 033	3 034	663	248	45	6
1957				290	1 107	879	679	182	41
1958	701	26 308	20 120	1 321	3				
1959	6	7 708	30 125	6 211	175				
1960	589	7 340	13 813	10 109	2 627	72			
1961	6	9 095	42 430	9 661	1 194	67			
1962		680	10 664	6 332	1 194	59	11	2	
1963	40 070	7 469	10 845	1 129					
1964	33 001	109 334	12 312	69					
1965	71	2 204	7 753	7 060	4 323	531	58	9	
1966	252 636	1 120	16 179	9 415	1 496	51	6		
1967	312 501	293 427	8 871	2 866	288	20			
1968	3 622	48 632	51 639	13 291	7 787	1 492	373	61	4
1969	21 225	17 974	34 095	14 020	12 014	3 229	1 199	228	39
1970	9 512		789	9 584	16 838	6 012	2 385	442	41
1971	39 694	16 242	15 032	6 344	5 089	1 819	781	152	9
1972	8 135	44 632	32 995	8 764	1 064	292	140	53	17
1973	64	11 687	60 458	8 626	1 099	125			
1974	39 792	1 225	24 130	4 440	138				
1975	366	55 299	32 124	17 614	2 269	298	27		
1976	431	945	155	1					

Table VIII: Age composition of the South African round herring landings, 1964–1976 (thousands of fish caught)

ear	Age class						
	O	I	II	III	IV	V	VI
1964	34	9	18 823	18 222	2 907	243	
1965	6 567	4 512	20 852	38 902	12 465	1 863	
1966	290 346	253 304	46 817	32 620	7 792	732	
1967	1 085 828	441 715	65 807	139 111	61 433	12 493	
1968	4 198 734	635 560	96 674	85 291	23 868	3 173	
1969	2 553 906	422 729	32 889	65 480	32 230	6 713	
1970	2 773 755	844 905	139 338	23 601	3 453	218	
1971	406 855	293 368	92 152	89 191	28 606	3 345	
1972	93 596	13 121	65 125	122 543	52 006	2 419	
1973	226 920	140 102	73 740	192 466	53 423	1 975	
1974	2 289	18 710	7 635	6 614	1 719	76	
1975	982 082	171 246	77 740	178 215	47 776	5 276	316
1976	660 106	403 788	47 763	24 854	8 083	1 458	207

950–1963, when no correction was introduced account for mixed landings, are reasonably ac- rate.

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APPENDIX

Age-length keys used in the weighting procedure

In each case, the length class Lc (cm) given refers to the mean of each 0,5-cm or 1-cm length group (e.g. 12,75 cm refers to fish 12,50 – 12,99 cm in Lc).

Lc is the length from the tip of the snout to the tip of the caudal peduncle.

PILCHARD

Period of use: 1950–1971
Age material collected: 1965–1967

Length class Lc (cm)	Age class										Total
	0	I	II	III	IV	V	VI	VII	VIII	IX	
5,25	3										3
5,75	5										5
6,25	2										2
6,75	11										11
7,25	14										14
7,75	14										14
8,25	15										15
8,75	18	1									19
9,25	33	4									37
9,75	19	3									22
10,25	18	7									25
10,75	20	12									32
11,25	15	13									28
11,75	12	20									32
12,25	3	24	1								28
12,75		17	1								18
13,25	3	13	4								20
13,75	1	9	12								22
14,25		4	14	1							19
14,75		2	18	3							23
15,25		1	13	4							18
15,75			5	8							13
16,25			3	8							11
16,75			4	10							14
17,25			4	11	1						16
17,75			4	11	3						18
18,25			2	17	3						22
18,75			3	23	4	1					31
19,25			2	35	13	1					51
19,75			1	24	17						42
20,25				7	23	2					32
20,75				2	26	9					37
21,25				2	14	8	1				25
21,75				2	12	9					23
22,25					7	18	4				29
22,75					4	8	6				18
23,25					3	8	7				18
23,75					1	8	8	1			18
24,25						4	8	4			16
24,75						1	8	6			15
25,25						1	8	8	1		18
25,75							4	8	4		16
26,25							1	8	6		15
26,75							1	8	8	1	18
Total	206	130	91	168	131	78	56	43	19	1	923

PILCHARD

eriod of use: 1972
ge material collected: 1972

Length class Lc (cm)	Age class 0	I	II	III	IV	V	VI	Total
8,25	13							13
8,75	12							12
9,25	37	4						41
9,75	25	2						27
10,25	43	11						54
10,75	34	8						42
11,25	51	15						66
11,75	53	28	1					82
12,25	50	32	5					87
12,75	30	42	6					78
13,25	17	31	4	1				53
13,75	13	14	3					30
14,25		8	8	1				17
14,75		11	21	7				39
15,25		5	26	9				40
15,75		6	36	21				63
16,25		6	45	18	5	1		75
16,75		8	27	26	8	1		70
17,25		3	27	36	16	4		86
17,75			16	31	36	15		98
18,25			6	40	45	16	4	111
18,75			9	33	50	11	3	106
19,25			1	16	65	29	3	114
19,75			1	7	31	13	3	55
20,25				4	6	7	2	19
20,75					2	3	1	6
21,25				1	15	8	1	25
21,75					12	9	1	22
22,25					5	16	2	23
22,75					4	7	6	17
23,25					2	4		6
23,75						1		1
Total	378	234	242	251	302	145	26	1 578

Period of use: 1973
Age material collected: 1973

Length class Lc (cm)	Age class 0	I	II	III	IV	V	VI	Total
6,25	2							2
6,75	3							3
7,25	5							5
7,75	4							4
8,25	1							1
8,75	2							2
9,25	9							9
9,75	9							9
10,25	3							3
10,75	1							1
11,25	1							1
11,75	2	1						3
12,25		1	3					4
12,75		3	1					4
13,25		3	1					4
13,75		4						4
14,25		4	5	1				10
14,75		2	14	4				20
15,25		1	11	4				16
15,75			15	5				20
16,25		1	7	5				13
16,75			11	9				20
17,25		1	27	30				58
17,75		1	42	35				78
18,25			58	40	1			99
18,75			49	47	3			99
19,25			40	44	3			87
19,75			16	49	17			82
20,25			12	30	21	2		65
20,75			7	25	8	1		41
21,25				1	7	4	1	13
21,75				1	6	5		12
22,25					2	8	1	11
22,75					2	4	3	9
23,25					2	4		6
23,75						2		2
Total	42	22	319	330	72	30	5	820

PILCHARD

Period of use: 1974
Age material collected: 1974

Length class Lc (cm)	Age class 0	I	II	III	IV	V	VI	Total
10,25		1						1
10,75		1						1
11,25		2						2
11,75		1						1
12,25		1						1
12,75		1						1
13,25		1						1
13,75		1						1
14,25		2	2					4
14,75		1	1	1				3
15,25		2	3	2				7
15,75		2	4	1				7
16,25		2	4	3				9
16,75		1	10	23	4			38
17,25			17	25	10			52
17,75			9	38	25	2		74
18,25			14	34	26	8		82
18,75			12	48	35	10	2	107
19,25			15	36	52	18	3	124
19,75			7	42	53	19	4	125
20,25			2	23	40	19	6	90
20,75			2	16	52	24	4	98
21,25				4	27	10	3	44
21,75				3	15	12	2	32
22,25					3	3	6	12
22,75					5	17	2	24
23,25					2	3	3	8
23,75					1	2		3
24,25						2		2
Total		19	100	299	350	149	35	954

Period of use: 1975
Age material collected: 1975

Length class Lc (cm)	Age class 0	I	II	III	IV	V	VI	Total
9,25	4							4
9,75	2							2
10,25	16	4						20
10,75	14	11						25
11,25	17	18						35
11,75	8	18						26
12,25	4	6	2					12
12,75		2	3					5
13,25		6	2					8
13,75		4	2					6
14,25		3	3					6
14,75			4					4
15,25		1	12					13
15,75			20					20
16,25		3	41	11	3			58
16,75		5	56	8	3			72
17,25		2	80	26	6			114
17,75			81	29	6			116
18,25			56	46	18	6		126
18,75			33	71	18	2		124
19,25			6	80	36	13		135
19,75			7	62	46	18		133
20,25			1	45	51	23		120
20,75				24	64	23	2	113
21,25			1	13	32	17	4	67
21,75				2	12	8	4	26
22,25					10	34	4	48
22,75					8	14	12	34
23,25					3	6		9
23,75						1		1
Total	65	83	410	417	316	165	26	1 482

Period of use: 1976
Age material collected: 1976

Length class Lc (cm)	Age class 0	I	II	III	IV	V	VI	Total
9,25		3						3
9,75		3						3
10,25		10						10
10,75		8						8
11,25		8	1					9
11,75		8	3					11
12,25		8	2					10
12,75		9	2					11
13,25		18	4					22
13,75		19	7					26
14,25		25	9	2				36
14,75		20	21	3				44
15,25		23	29	6				58
15,75		7	54	12				73
16,25		3	63	29	2			97
16,75		3	71	28	2			104
17,25		1	47	53	5			106
17,75		1	35	38	7			81
18,25			27	39	18			84
18,75			13	19	3	1		36
19,25			4	17	4	1		26
19,75			3	4	6	4		17
20,25				6	9	2		17
20,75					11	2		13
21,25					2	2	1	5
21,75					3			3
Total		177	395	256	72	12	1	913

ANCHOVY

riod of use: 1964 – 1976
e material collected: 1965 – 1967

ength class Lc (cm)	Age class					Total
	0	I	II	III	IV	
6,75	3					3
7,25	8					8
7,75	17	1				18
8,25	30	2				32
8,75	33	8				41
9,25	35	14				49
9,75	24	25				49
10,25	5	28	5			38
10,75	6	26	7	2		41
11,25	1	22	29	3		55
11,75		10	18	7		35
12,25		1	17	13	2	33
12,75			7	12	5	24
13,25			1	6	2	9
13,75				4	2	6
14,25				2	2	4
Total	162	137	84	49	13	445

HORSE MACKEREL

riod of use: 1950 – 1962
e material collected: 1950 – 1965

ength class Lc (cm)	Age class												Total
	0	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	
4,50	1												1
5,50													
6,50	9												9
7,50	7												7
8,50	18	2											20
9,50	5	6	1										12
10,50		5											5
11,50		3	3										6
12,50		1	4										5
13,50		1	3										4
14,50			5										5
15,50			4	1									5
16,50			4	4									8
17,50			5	5	2								12
18,50			1	6	1								8
19,50			1	9	7	3							20
20,50				4	8	2							14
21,50				7	4	9	3						23
22,50				1	7	11	3						22
23,50				1	16	22	5	3					47
24,50				1	2	13	4	3					23
25,50					1	9	13	1	6				30
26,50					1	8	17	10	5				41
27,50						4	12	11	1				28
28,50						2	11	7	4		1		25
29,50							4	4	2	1	1		12
30,50							1	4	1	1			7
31,50							1	4	4		4		13
32,50								2	2	2	5	1	12
33,50										2	2	1	5
34,50								1	3	1	2		7
35,50									1		4		5
36,50													
37,50											1		1
38,50													
Total	40	18	31	39	49	83	74	50	29	7	20	2	442

HORSE MACKEREL

Period of use: 1964 – 1974
Age material collected: 1965 – 1969

Length class Lc (cm)	Age class											Total
	0	I	II	III	IV	V	VI	VII	VIII	IX	X	
6,50	9											9
7,50	10											10
8,50	6	2										8
9,50	18	9	1									28
10,50		7										7
11,50		4	2									6
12,50		2	6									8
13,50		2	3									5
14,50		1	2									3
15,50			11									11
16,50			3	2								5
17,50			3	3								6
18,50				5	1							6
19,50				1	3	1						5
20,50			1		6	1						8
21,50				3	6	3	1					13
22,50			1	2	1	2		1				7
23,50				1	4	6	1					12
24,50				1	6	6		2				15
25,50					1	5	1	1	1			9
26,50					1	3	3					7
27,50						3	1	1				5
28,50						2	1	2				5
29,50						1	2					3
30,50								1	2			3
31,50								1		1	1	3
32,50							1	1	2	1		5
33,50									1			1
34,50									1	1	1	3
35,50								1			1	2
36,50									1			1
37,50										1		1
Total	43	27	33	18	29	33	11	11	8	5	3	221

MACKEREL

riod of use: 1954 – 1971
e material collected: 1968 – 1972

ngth class Lc (cm)	Age class 0	I	II	III	IV	V	VI	VII	VIII	Total
11,50	5									5
12,50	5									5
13,50	3									3
14,50	1									1
15,50	1									1
16,50	2									2
17,50	10									10
18,50	19									19
19,50	18									18
20,50	22									22
21,50	11									11
22,50	1	1								2
23,50	9	7								16
24,50	21	21								42
25,50	14	23								37
26,50	6	28								34
27,50	8	60	4							72
28,50	8	54	5							67
29,50	1	61	19							81
30,50	1	52	34							87
31,50	1	63	41	1						106
32,50		47	57	5						109
33,50		41	69	10						120
34,50		25	53	6						84
35,50		22	53	7						82
36,50		11	49	7						67
37,50		4	36	7						47
38,50		3	28	4						35
39,50		4	28	9						41
40,50		1	24	7						32
41,50			18	15						33
42,50			11	9	1					21
43,50			9	12	3					24
44,50			7	23	5					35
45,50			1	13	18					32
46,50			2	10	15	1				28
47,50			2	17	23	4				46
48,50				18	34	7				59
49,50				21	29	10	2			62
50,50				11	31	11	5	1		59
51,50				5	23	23	11			62
52,50				4	13	15	7	3		42
53,50					9	7	12	4	1	33
54,50					4	5	7	2	1	19
55,50						1	1			2
56,50							1	2		3
Total	167	528	550	263	208	84	46	12	2	1 818

Period of use: 1972
Age material collected: 1972

Length class Lc (cm)	Age class 0	I	II	III	IV	V	VI	VII	VIII	Total
11,50	5									5
12,50	5									5
13,50	3									3
14,50	1									1
15,50	1									1
16,50	2									2
17,50	10									10
18,50	19									19
19,50	18									18
20,50	22									22
21,50	11									11
22,50	1	1								2
23,50	2	4								6
24,50	11	17								28
25,50	11	19								30
26,50	3	21								24
27,50	2	45								47
28,50	1	37								38
29,50		37	3							40
30,50	1	15	13							29
31,50		12	14							26
32,50		6	15	3						24
33,50		4	17	6						27
34,50		8	18	5						31
35,50			10	3						13
36,50			11	3						14
37,50			11							11
38,50			5							5
39,50			2	1						3
40,50			2							2
41,50			2	1						3
42,50			1							1
43,50				3						3
44,50				4						4
45,50				3	1					4
46,50				1	1					2
47,50				1	1					2
48,50					2					2
49,50					2					2
50,50						1				1
51,50					1					1
52,50					2	1				3
53,50					9	7	12	4	1	33
54,50					4	5	7	2	1	19
55,50						1	1			2
56,50							1	2		3
Total	129	226	124	34	23	15	21	8	2	582

MACKEREL

Period of use: 1973 – 1974
Age material collected: 1973 – 1974

Length class Lc (cm)	Age class						Total
	0	I	II	III	IV	V	
11,50	3						3
12,50	4						4
13,50	3						3
14,50	6						6
15,50	11						11
16,50	4						4
17,50	4						4
18,50	7						7
19,50	8						8
20,50	9						9
21,50	11						11
22,50	4	4					8
23,50	9	7					16
24,50	21	21					42
25,50	14	23					37
26,50		2	6				8
27,50		7	10				17
28,50		2	12				14
29,50		3	10				13
30,50		7	21				28
31,50		5	18	2			25
32,50		6	20	2			28
33,50		6	36	6			48
34,50		4	32	5			41
35,50		3	34	11			48
36,50		1	34	9			44
37,50			21	1			22
38,50			22				22
39,50		1	20	3			24
40,50			18	9	1		28
41,50			18	10			28
42,50			22	14	2		38
43,50			9	7	4		20
44,50			3	7	1	1	12
45,50			2	2	3		7
46,50			2	2	2		6
47,50				2	1		3
48,50				2	3		5
49,50					1		1
50,50				2	1	2	5
51,50				1	6		7
52,50				3	4		7
53,50				1	3	1	5
54,50				1	2	1	4
55,50					2		2
Total	118	102	370	102	36	5	733

Period of use: 1975 – 1976
Age material collected: 1974 – 1975

Length class Lc (cm)	Age class							Total
	0	I	II	III	IV	V	IV	
11,50	3							3
12,50	4							4
13,50	3							3
14,50	6							6
15,50	11							11
16,50	4							4
17,50	4							4
18,50	7							7
19,50	8							8
20,50	9							9
21,50	11							11
22,50		3						3
23,50		10						10
24,50		29	1					30
25,50		31	1					32
26,50		35	5					40
27,50		28	4					32
28,50		36	8					44
29,50		40	6					46
30,50		24	14	1				39
31,50		19	13	2				34
32,50		7	6	5				18
33,50		3	7	3				13
34,50		3	5	6				14
35,50		2	11	3				16
36,50		1	18	8				27
37,50			13	5	1			19
38,50			10	9				19
39,50			4	13				17
40,50			1	9				10
41,50				5	3			8
42,50				1	1			2
43,50					1			1
44,50					2			2
45,50				2	2	3		7
46,50				2	2	2		6
47,50					2	1		3
48,50					2	3		5
49,50						1		1
50,50					2	1	2	5
51,50					1	6		7
52,50					3	4		7
53,50					1	3	1	5
54,50					1	2	1	4
55,50						2		2
Total	70	271	127	74	24	28	4	598

ROUND HERRING

riod of use: 1964 – 1971
e material collected: 1968 – 1972

ength class Lc (cm)	Age class						Total
	0	I	II	III	IV	V	
5,75	14						14
6,25	36	2					38
6,75	57	8					65
7,25	62	14					76
7,75	83	23					106
8,25	48	15					63
8,75	40	23					63
9,25	24	27	1				52
9,75	12	23					35
10,25	11	12	3				26
10,75	3	7					10
11,25	1	12	2				15
11,75		5	6				11
12,25		3	15				18
12,75		3	6				9
13,25		4	8				12
13,75		1	7	1			9
14,25			8				8
14,75			8	2			10
15,25			12	3			15
15,75			19	9			28
16,25			23	15			38
16,75			22	24	2		48
17,25			31	28	3		62
17,75			26	34	7		67
18,25			20	44	10	1	75
18,75			17	41	6		64
19,25			20	42	12	1	75
19,75			9	33	13	1	56
20,25			7	46	20	4	77
20,75			6	29	17	2	54
21,25			1	22	17	5	45
21,75			1	11	9	3	24
22,25				4	7	1	12
22,75				2	4		6
Total	391	182	278	390	127	18	1 386

Period of use: 1972
Age material collected: 1972

Length class Lc (cm)	Age class						Total
	0	I	II	III	IV	V	
6,25	5						5
6,75	5						5
7,25	10						10
7,75	18						18
8,25	9	3					12
8,75	6	1					7
9,25	4	1					5
9,75	5	3					8
10,25	4	1					5
10,75		1					1
11,25	1	12	2				15
11,75		5	6				11
12,25		3	15				18
12,75		3	6				9
13,25		4	8				12
13,75		1	7	1			9
14,25			8				8
14,75			2	1			3
15,25			2	1			3
15,75			5	3			8
16,25			7	3			10
16,75			7	14	1		22
17,25			12	12			24
17,75			5	9	4		18
18,25			4	16	2	1	23
18,75			3	6	3		12
19,25			4	15	2		21
19,75				7	7		14
20,25			1	2			3
20,75			1		1		2
21,25			1	1	1		3
21,75				1	1		2
22,25				2	4	1	7
22,75				1	2		3
Total	67	38	106	95	28	2	336

ROUND HERRING

Period of use: 1973 – 1974
Age material collected: 1973

Length class Lc (cm)	Age class 0	I	II	III	IV	V	Total
5,75	4						4
6,25	10	1					11
6,75	6						6
7,25	8	5					13
7,75	4	5					9
8,25	3	3					6
8,75		6					6
9,25		8					8
9,75		9					9
10,25		1	6				7
10,75		3	1				4
11,25		12	1				13
11,75		5	6				11
12,25		3	15				18
12,75		3	6				9
13,25		4	8				12
13,75		1	7	1			9
14,25			8				8
14,75			8	2			10
15,25		3	17	7			27
15,75		5	27	2			34
16,25		4	38	13			55
16,75		3	35	26			64
17,25			33	49	8		90
17,75			20	65	7		92
18,25			25	52	12	1	90
18,75			12	86	17		115
19,25			10	69	20		99
19,75			8	46	21		75
20,25			2	29	14	2	47
20,75			1	29	18	1	49
21,25				28	12	2	42
21,75			1	11	12		24
22,25				2	4		6
22,75				2	4		6
Total	35	84	295	519	149	6	1 088

Period of use: 1975 – 1976
Age material collected: 1975

Length class Lc (cm)	Age class 0	I	II	III	IV	V	VI	Total
5,75	1							1
6,25	4	1						5
6,75	7	1						8
7,25	9	2						11
7,75	4	1						5
8,25	3	1						4
8,75	7	3						10
9,25	5	6						11
9,75	3	6						9
10,25	4	4	1					9
10,75	6	14						20
11,25		6	1					7
11,75		5	6					11
12,25		1	5					6
12,75		2	4					6
13,25		3	6					9
13,75		1	7	1				9
14,25			6					6
14,75		1	17	2				20
15,25		1	27	19				47
15,75		2	18	31				51
16,25			9	31	2			42
16,75			9	36	1			46
17,25			6	25	8			39
17,75			2	20	4			26
18,25				27	8			35
18,75				17	11			28
19,25				7	18	2		27
19,75				1	19	3		23
20,25				1	15	2		18
20,75					3	8	2	13
21,25						4		4
Total	53	61	124	218	89	19	2	566

CHAPTER 4. CATCH PER STANDARD BOAT DAY AND DEPLOYMENT OF EFFORT IN THE SOUTH AFRICAN PURSE-SEINE FISHERY, 1964 TO 1976.

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CHAPTER 4. CATCH PER STANDARD BOAT DAY AND DEPLOYMENT OF EFFORT IN THE SOUTH AFRICAN PURSE-SEINE FISHERY, 1964 TO 1976.

Six species contribute to the Republic of South Africa's purse-seine landings: pilchard _Sardinops ocellata_, anchovy _Engraulis capensis_, horse mackerel _Trachurus trachurus_, mackerel _Scomber japonicus_, round herring _Etrumeus teres_ and a lantern-fish _Lampanyctodes hectoris_. Catch figures for the period 1950 - 1976 (Crawford _et al_. 1978) reveal several distinct trends. Pilchard, and to a lesser extent horse mackerel, dominated the fishery until 1965. The pilchard catch rose from 85 000 metric tons in 1950 to over 410 000 in 1962 and then declined rapidly, whereas horse mackerel was most productive during the period 1951 - 1954. Although mackerel made its first appearance in the commercial landings in 1954, catches of this species remained at a relatively low level until the mid-1960's, when large concentrations were encountered on the Saldanha Bay ground (Fig. 1). Mesh size regulations prevented the capture of anchovy in significant quantities prior to 1964 but it has been the most important contributor since 1966. Round herring and lantern-fish, also, have started to provide more regular catches in recent years. Large fluctuations in the recruitment of individual species have been responsible for much of this variation in the composition of the annual landings (Newman and Crawford in press).

Two units of effort have previously been employed in attempts to assess the impact of fishing. Stander and Le Roux (1968) used fleet hold capacity to establish trends in the performance of the pilchard stock between 1950 and 1965. Only the months January to July (inclusive) were considered, to exclude the effect of different lengths to the fishing season. More recently Newman _et al_. (1978) estimated the total catch of all species per standard boat season for the period 1964 - 1972. Since the season also varied during these years the analysis was again restricted to the first seven months. The standard boat had a total (deck plus hold) storage capacity of 129 metric tons and a 242kw engine. In addition adjustments were made to allow for the acquisition of small-meshed (12,7 mm) nets, fish pumps and sonars.

A catch limit has been in force at two stages in the history of the fishery: 1953 - 1960 and 1971 - 1976. In the first the combined landings of pilchard and horse mackerel were restricted to 226 900 metric tons, with the proviso that fishing would be allowed to continue until 31st August each year should the quota be exceeded before that date. After 1958 this measure was increasingly unable to restrict the catch (Table I) and it was abolished in 1961. Its ineffectiveness can be largely attributed to two developments: considerable increases both in actual effort and in fish availability.

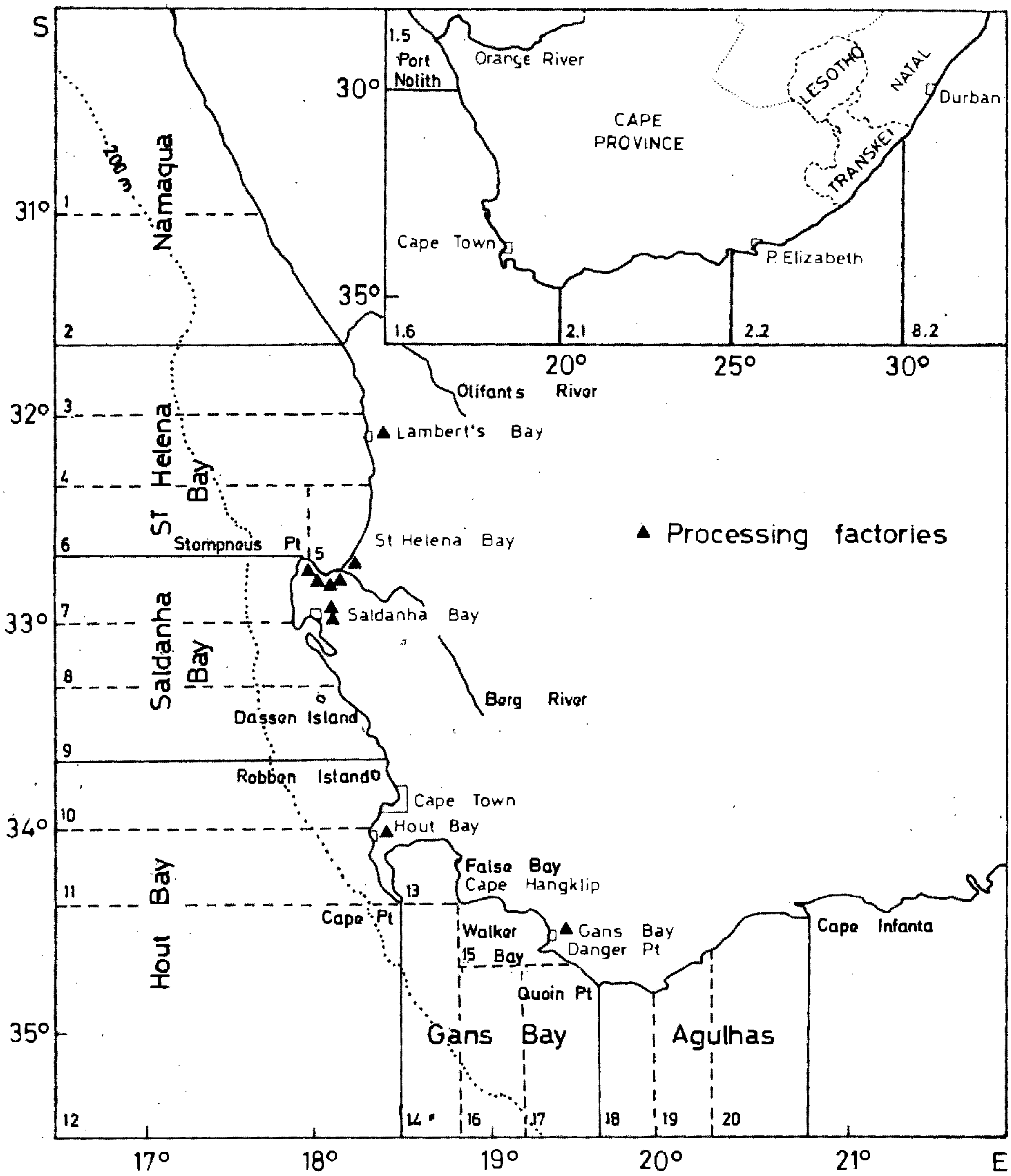

Fig 1 : The main South African purse-seine fishing grounds showing the 20 areas used in the effort analysis, the locations of the processing factories which were operative between 1964 and 1976 and the ICSEAF divisions (inset). The Namaqua ground and area 1 both extend north to the Orange River (inset).

TABLE I : QUOTA RESTRICTIONS IN THE SOUTH AFRICAN PURSE-SEINE FISHERY AND THEIR EFFECTIVENESS, 1943 TO 1976.

Year	Quota at start of season (thousands of metric tons)	Final quota (thousands of metric tons)	Species to which quota applies	Combined catch of quota species (thousands of metric tons)	Amount by which final quota exceeded (thousands of metric tons)
1943-1952	None	None			
1953	226,9	226,9	Pilchard and horse mackerel	217,7	-
1954	226,9	226,9	Pilchard and horse mackerel	206,4	-
1955	226,9	226,9	Pilchard and horse mackerel	200,7	-
1956	226,9	226,9	Pilchard and horse mackerel	122,4	-
1957	226,9	226,9	Pilchard and horse mackerel	194,1	-
1958	226,9	226,9	Pilchard and horse mackerel	250,8	23,9
1959	226,9	226,9	Pilchard and horse mackerel	277,9	51,0
1960	226,9	226,9	Pilchard and horse mackerel	380,9	154,0
1961-1970	None	None			
1971	362,9	362,9	All species	324,9	-
1972	362,9	453,6	All species	433,6	-
1973	362,9	430,0	All species	445,0	15,0
1973	None	None	Mackerel 6/6-30/9	-	-
1974	365,0	400,0*	All species	400,5	0,5
1974	50,0+	50,0+	Mackerel 26/6-30/9	6,4	-
1975**	406,0	406,0	All species	406,0	-
1975**	30,0++	30,0++	Mackerel 16/6-31/8	1,4	-
1976**	407,4	407,4	All species	407,5	0,1

*The additional quota of 35 000 metric tons, granted during the season, was allocated to individual processors.

**The entire quota was allocated to individual processors.

+Additional requirements were that mackerel should be adult and caught more than 12 nautical miles (22 km) from mainland coastline.

++Additional requirement was that mean candal length (distance from tip of snout to tip of candal peduncle) of every mackerel catch should exceed 40,0 cm.

Between 1955 and 1960 the entire fleet was equipped with echo sounders (Table II) and boats were thereby enabled to detect fish not visible at the surface. Although no quantitative estimate of the effect of this fishing aid on the performance of a boat is available, the later introduction of fish pumps and sonars raised the fishing power of an average vessel by 36 and 18 per cent respectively (Newman et al. 1978) and it seems reasonable to assume that echo sounders also had a considerable impact. In the Peruvian fishery, which was based on the anchovy Engraulis ringens, the installation of power blocks improved fleet efficiency by 8 per cent (Boerema et al. 1965). The mean hold capacity of South African boats rose from 33,06 metric tons in 1953 to 52,88 in 1960 (Table II). Not only would this move towards larger vessels have increased fishing range, but Newman et al. (1978) have demonstrated that storage capacity is one of the most important factors determining fishing power.

Large 1956, 1957, 1958 and 1959 pilchard year classes passed through the fishery in the late 1950's and early 1960's (Newman and Crawford in press) leading to a considerable increase in the abundance of this species. In addition the area of exploitation, initially confined to the environs of St Helena Bay (Davies 1956b), included the entire region between Lambert's Bay and Cape Hangklip by the end of 1958 (Du Plessis 1959), thus making available to the fleet age groups which had not hitherto been fished to any great extent (Crawford et al. in press).

In the ensuing decade (1961 - 1970) the catch was primarily controlled through restricting the duration of the season (Table III). Effort, however, continued to escalate. Legislation had permitted an increase of 20 per cent in total fleet hold capacity after 1957 (Gertenbach 1973) and although no immediate change resulted, a rise of 61 per cent was experienced between 1960 and 1970. Power blocks, fish pumps and sonars were introduced (Table II) and the minimum mesh size was reduced from 32 to 12,7mm (Table III).

On account of this it became necessary to revert to the quota system in 1971 and until 1976 it remained the most effective means of limiting exploitation. In these years the quota applied to the catches of all species and was reviewed annually. Details are provided in Table I.

A significant step in the development of the fishery was the decision to allocate 35 000 metric tons of the 1974 quota and all subsequent quotas to specific processors. Prior to this an overall catch limit had been imposed and factories competed to secure as large a share as possible. Under these conditions boats were generally fishing to their utmost capacity and standard boat season was an adequate measure of effort.

TABLE II : CHANGES IN SOUTH AFRICAN PURSE-SEINE FLEET AND VESSEL SIZE AND EQUIPMENT, 1950 TO 1976.

Year	Total fleet hold capacity (metric tons)	Average hold capacity (metric tons)	Minimum mesh size* (mm)	Percentage of boats equipped with:			
				echo sounder	power-block	sonar	fish pump
1950	4 399	29,42	38,0+	0	0	0	0
1951	5 806	31,82	38,0+	0	0	0	0
1952	6 586	33,53	38,0+	0	0	0	0
1953	7 547	33,06	38,0+	0	0	0	0
1954	7 683	34,25	38,0+	0	0	0	0
1955	7 529	33,12	38,0+	0>100	0	0	0
1956	7 448	33,65	32,0	0>100	0	0	0
1957	7 448	35,57	32,0	0>100	0	0	0
1958	7 693	38,39	32,0	0>100	0	0	0
1959	7 856	47,75	32,0	0>100	0	0	0
1960	7 538	52,88	32,0	100	0	0	0
1961	8 445	64,67	32,0	100	0	0	0
1962	8 926	73,39	32,0	100	0	0	0
1963**	9 906	78,24	32,0	100	39	0	0
1964	10 296	81,97	32,0++	100	77	0	0
1965	10 641	85,39	12,7++	100	100	6	0
1966	10 656	85,51	12,7	100	100	6	50
1967	11 665	86,67	12,7	100	100	6	75
1968	12 785	98,65	12,7	100	100	25	100
1969	12 609	99,59	12,7	100	100	33	100
1970	12 157	103,34	12,7	100	100	33	100
1971	12 983	107,63	12,7	100	100	45	100
1972	12 250	107,79	12,7	100	100	48	100
1973	13 176	111,07	12,7	100	100	73	100
1974	13 058	111,95	12,7	100	100	81	100
1975	12 271	112,58	12,7	100	100	83	100
1976	11 055	111,67	12,7	100	100	86	100

* Stretched mesh.

\+ Although nets were initially constructed with a 38 mm mesh, shrinkage rapidly reduced the mesh to 32 mm on average. When synthetic nets were introduced in 1956 32 mm was therefore adopted as the minimum mesh size.

** Of a total of 141 boats six were permitted to fish with a 12,7 mm mesh net from January to April. The number was increased to 42 by September. The minimum size for remainder was 32 mm.

++ In 1964 and 1965 only anchovy was allowed to be caught with the 12,7 mm mesh net.

TABLE III : CLOSED FISHING SEASONS AND NET RESTRICTIONS FOR THE SOUTH AFRICAN PURSE-SEINE FISHERY, 1943 TO 1976.

Year	Species	Closed season	Minimum mesh size of net* (mm)
1943-1949	All species	None	No restriction
1950	All species	None	38
1951	Horse mackerel	None	38
	Pilchard	1/9-31/10	38
1952	Horse mackerel and pilchard	1/9-31/10	38
1953	Horse mackerel and pilchard	1/10-31/12	38
1954	Horse mackerel and pilchard	1/9-31/10	38
	Mackerel	None	38
1955	All species	None	38
1956-1957	All species	None	32
1958	Horse mackerel and pilchard	1/9-31/12	32
	Mackerel	None	32
1959	Horse mackerel and pilchard	15/8-31/12	32
	Mackerel	None	32
1960-1962	Pilchard	1/8-31/12	32
	Horse mackerel and mackerel	1/8-31/10	32
1963	Pilchard	1/8-31/12	32
	Horse mackerel and mackerel	1/8-31/10	32
	Anchovy for 6 boats	1/1-31/8	12,7
1964	Pilchard and round herring	1/8-31/12	32
	Horse mackerel and mackerel	1/8-31/10	32
	Anchovy for max. of 48 boats	None	12,7
1965	Pilchard and round herring	1/8-31/12	32
	Horse mackerel and mackerel	1/8-31/10	32
	Anchovy for all boats	None	12,7
1966-1967	All species	1/10-31/12	12,7
1968	All species	16/9-31/12	12,7
1969-1970	All species	1/9-31/12	12,7
1971	Mackerel	1/10-31/12	12,7
	Other species	1/9-31/12	12,7
1972	All species	5/8-31/12	12,7**
1973-1974	Mackerel	1/10-31/12	12,7
	Other species	1/9-31/12	12,7
1975-1976	All species	1/9-31/12	12,7

* Stretched mesh
** 32 mm from 6/6/73 - 30/9/73 and 26/6/74 - 30/9/74

Since 1974, however, knowledge that their own share of the quota was secure has encouraged processors to schedule their fishing activities and they have shown an increasing tendency to wait for fish to become locally available. Not only has this cut back on rising fuel bills but it has also improved the overall condition of fish offloaded at the processing plants and resulted in higher yields of fish meal from equivalent amounts of raw material (Table IV). Vessels are not necessarily always maximally utilised and standard boat season is no longer a true reflection of fishing intensity.

This paper endeavours to account for these changes by introducing a new series of data concerning catch per standard boat day at sea for the period 1964 - 1976. An attempt is also made to estimate levels of catch per unit effort for the important pilchard and anchovy populations. In addition trends in the annual and seasonal deployment of effort on the major fishing grounds are discussed.

ESTIMATION OF EFFORT

Since 1964 catch statistics for the South African purse-seine fishery have been reasonably comprehensive (Crawford _et al_. 1978). These have included data on the mass offloaded at the completion of each trip, date and position of catch and, for a section of the fleet, the number of days spent at sea irrespective of whether or not any catch was made. For unsuccessful journeys the area of search was also recorded.

Fishing power coefficients for individual vessels, relative to a standard, were established by means of the technique of Robson (1966) from a two-dimensional array arranged by boats and by year (for the period 1964 - 1972). The standard vessel had a total (deck plus hold) storage capacity of 129 metric tons and a 242 kw engine. The elements of the array were the catches of each boat in each season, which was taken to extend from January to July (inclusive), as fishing was conducted throughout these months in all nine years. Data were selected so that only vessels that had fished consistently in every month of the season for four or more years during the period were included in the analysis. The fishing powers of those boats that were not included, or that entered the fishery after 1972, were subsequently determined from comparison with vessels having similar characteristics and operating from the same home port. Newman _et al_. (1978) show that storage capacity is generally the most important factor contributing to fishing power in the South African purse-seine fleet so this method of comparison is likely to have produced reliable estimates. All fishing power coefficients were later adjusted, where necessary, to account for the acquisition by any boat of a fish pump or sonar or its lack of a small-meshed (12,7 mm) net. These aids significantly affect the performance of an average vessel (Newman _et al_. 1978).

TABLE IV : PRODUCTION OF CANNED FISH, FISH MEAL AND FISH OIL FROM SOUTH AFRICAN PURSE-SEINE FISH LANDINGS, 1950 TO 1976.

Year	Canned fish (kg)	Fish meal (metric tons)	Fish oil (metric tons)	Ton fish per ton fish meal	Ton fish per ton fish oil
1950	7 676	21 634	8 503	6,25	15,90
1951	9 779	31 325	9 568	6,40	20,95
1952	16 310	38 130	12 166	7,15	22,41
1953	24 360	31 320	11 313	6,95	19,24
1954	28 635	31 422	11 377	6,70	18,50
1955	17 575	37 313	10 879	5,92	20,31
1956	14 140	26 679	6 683	5,81	23,18
1957	12 737	37 155	10 279	5,42	19,58
1958	11 528	48 804	12 347	5,60	22,14
1959	9 357	64 869	15 091	4,85	20,86
1960	16 193	89 270	26 431	4,61	15,59
1961	19 848	108 727	40 913	4,52	12,00
1962	19 051	113 854	35 043	4,37	14,19
1963	11 204	100 846	28 417	4,23	15,03
1964	11 151	98 653	22 121	4,31	19,24
1965	10 431	112 483	20 430	4,27	23,50
1966	5 428	82 041	12 764	4,35	27,98
1967	3 872	115 765	17 537	4,40	28,10
1968	4 552	86 544	15 998	4,26	23,05
1969	5 766	79 994	20 069	4,40	17,54
1970	3 156	80 309	21 887	4,47	16,40
1971	3 323	74 237	16 492	4,39	19,71
1972	2 998	96 909	16 096	4,47	26,94
1973	3 476	98 446	24 411	4,59	18,49
1974	1 942	89 854	22 912	4,46	17,48
1975	4 218	97 794	14 167	4,17	28,76
1976	21	102 105	24 478	4,00	16,65

Monthly patterns of fishing for the period 1964 - 1976 were established by dividing the fishing grounds into 20 areas (Fig. 1). The effort reported for any area in any month was calculated as the sum of the products of vessel fishing power and the number of days spent operating in the area. An estimate of the actual effort expended was then obtained by raising this to account for unreported catches. The technique for determining the total catch and species catch for each area in each month has been described by Crawford et al. (1978).

TIME SERIES FOR EFFORT AND CATCH PER UNIT EFFORT

Estimates of the total effort expended in any year, obtained by summing over all areas and months, and of the catch of all species per standard boat day at sea are presented in Table V. Values derived by Newman et al. (1978) for the years 1964 - 1972 are also listed. There is a close agreement between the two sets of information, suggesting that standard boat day is an adequate measure of effort for the entire period 1964 - 1976. Although the number of days spent at sea was not recorded for all boats, especially during the earlier years, this omission appears to have been largely accounted for by the raising factor.

Effort rose from 5 466 standard boat days in 1964 to a peak of 13 080 in 1972. By 1976 the level had dropped back to 8 597. The initial increase may be attributed to a rise in fleet hold capacity, an increase in average boat size and the introduction of small-meshed (12,7 mm) nets, fish pumps and sonars (Newman et al. 1978), whereas the subsequent decline was mainly due to decreases in fleet hold capacity, the number of boats operating and the duration of the fishing season (Tables II and III).

Catch per unit effort fell by almost 60 per cent from 77,9 metric tons per standard boat day in 1964 to a value of 32,1 in 1971, but by 1976 had risen again to a level of 47,4. These trends, in large measure, reflect the performance of the pilchard population (Crawford et al. 1978) and underline the importance of this species to the fishery as a whole.

SPECIES CATCH PER UNIT EFFORT

Considerable variation exists in the distribution patterns of the various species involved in the fishery (Centurier-Harris and Crawford 1974) and effort expended in certain areas during particular seasons is often specifically directed towards one or more species. For example, summer fishing to the east of Cape Point is generally aimed at shoals of adult pilchard or adult anchovy, which are characteristically present in these waters after their spawning season, whereas winter fishing off Saldanha Bay is frequently directed towards adult mackerel and in St Helena Bay towards mixed shoals of juvenile fish, especially pilchard, anchovy, horse mackerel and round herring.

TABLE V : EFFORT AND CATCH-PER-UNIT-EFFORT INDICES FOR THE SOUTH AFRICAN PURSE-SEINE FISHERY, 1964 TO 1976.

Year	Effort (standard boat days)	Effort* (standard boat season)	C.p.u.e. (metric tons per standard boat day)	C.p.u.e.* (metric tons per standard boat season)
1964	5 466	83	77,9	5 127
1965	9 580	107	50,1	4 487
1966	8 099	117	44,1	3 052
1967	12 059	168	42,2	3 032
1968	11 110	149	33,2	2 474
1969	10 349	157	34,0	2 242
1970	11 052	187	32,5	1 919
1971	10 126	169	32,1	1 922
1972	13 080	207	33,2	2 095
1973	12 249		36,9	
1974	8 720		45,9	
1975	10 329		39,4	
1976	8 597		47,4	

* Data from Newman et al.(1978)

Thus although boats encountering a shoal of fish they have not been searching for will seldom pass it by, it cannot be assumed that all of a year's fishing is aimed at each of the six species involved in the fishery. On account of this the annual levels of effort directed at each species were estimated by allocating the monthly effort expended in each area to the different species pro rata to their contribution to the combined mixed-species catch and summing over months and areas. That this technique takes cognisance of the seasonal aspect of the fishery may be readily recognised by considering the specific case of one ground g in month m. Then should the catch of a certain species s be represented by Y_{sgm}, of all other species by Y_{ogm} and the associated effort by f_{gm}, that portion of the total effort which is assigned to species s can be computed as:

$f_{sgm} = f_{gm} \cdot (Y_{sgm} / (Y_{sgm} + Y_{ogm}))$.

On occasions when species s dominates the catch (i.e. $Y_{sgm} \gg Y_{ogm}$) it will attract virtually all the effort. Conversely when $Y_{ogm} \gg Y_{sgm}$ the effort will approach zero.

The method, however, has certain drawbacks. Should fish be particularly scarce, the catch will be small and the effort allocated to the species concerned will be too low. Conversely, should fish be abundant and catches unusually high, the species would attract a relatively large proportion of effort resulting in unrealistically low catch rates. Thus a dampening influence, tending to stability, would be exerted on real fluctuations in stock abundance and biases may also be expected from fluctuations in the biomass of other species.

These effects should not be too severe for widespread populations contributing in a consistent way to the landings, but would be more marked for stocks having a restricted distribution or encountered only sporadically. Of the six species involved in the fishery only pilchard and anchovy are considered to fall into the first category. They occur on all the major fishing grounds in a regular manner (Crawford et al. in press). Catch rates for these two populations are contrasted with virtual population estimates of stock abundance (Newman and Crawford in press) in Figs. 2 and 3. Bearing in mind the above-mentioned limitations certain interesting trends are revealed.

There is good agreement between catch-per-unit-effort and biomass indices for pilchard between 1964 and 1973. Both indicate a decline in population size followed by relatively low levels of abundance. Good catches of two-year-old pilchard were recorded in 1976 (Crawford et al. 1978) and the catch rates rose accordingly. Although this strong year class did not contribute exceptional numbers to the catches of previous seasons, virtual population analysis rightly assumes an increased stock size in 1974 and 1975.

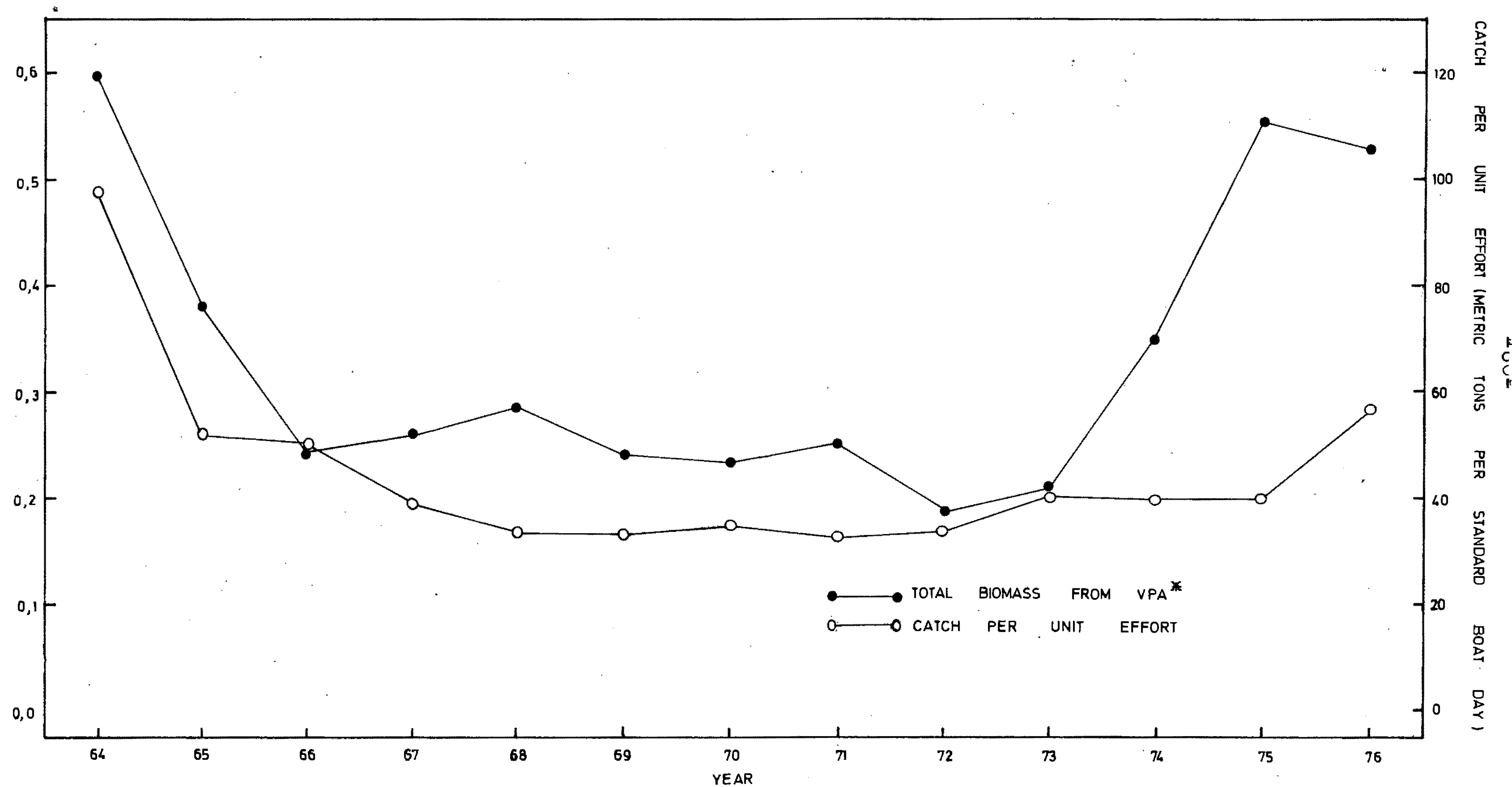

Fig 2 Abundance estimates for the South African pilchard population, 1964-1976.
* Data from Newman and Crawford in press.

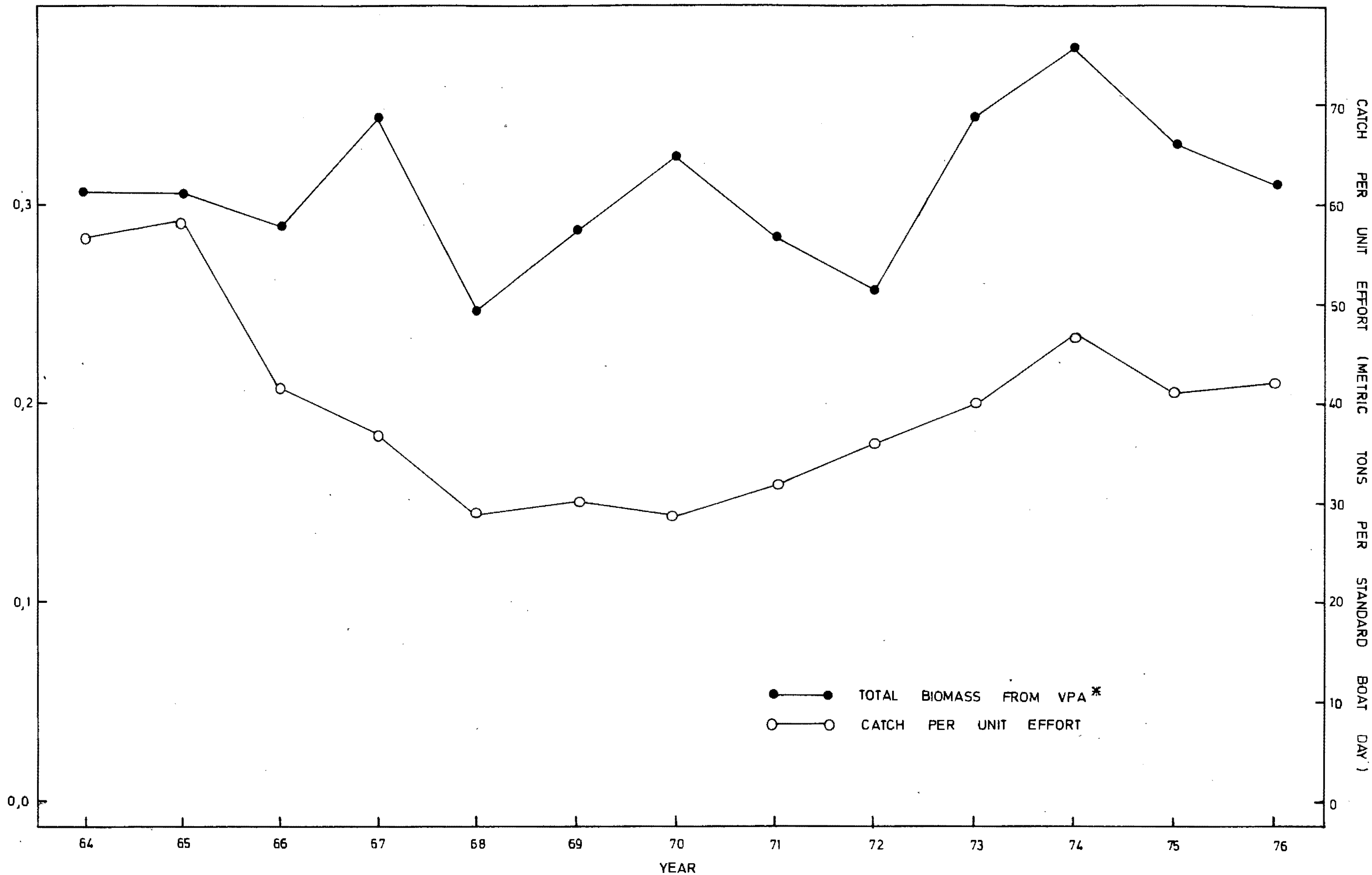

Fig 3 Abundance estimates for the South African anchovy population, 1964-1976.
* Data from Newman and Crawford in press

For anchovy the catch rates provide a somewhat different picture to biomass levels, suggesting that stock abundance was decreased during the initial years of fishing in a manner typical of the early exploitation of a virgin population. After 1970 a slight increase is apparent, with 1974 proving a particularly good year. Large concentrations of anchovy were present on the St Helena Bay and Gans Bay fishing grounds during the season and record catches were experienced (Crawford et al. 1978). Virtual population estimates show no apparent trend but, as expected, fluctuations are more evident. In this analysis a constant natural mortality rate was used. Natural mortality may have been higher in the virgin population than under conditions of exploitation and the biomass level would then also have declined.

DEPLOYMENT OF EFFORT

The fishing pattern was examined by grouping the 20 original areas into six fishing grounds (Fig. 1) of approximately equal size except for the extensive northern region:

1. the Namaqua ground, ranging between the Orange and Olifants Rivers (areas 1 - 2);
2. the St Helena Bay ground, including Lambert's Bay and all offshore waters between the Olifants River and Stompneus Point (areas 3 - 6);
3. the Saldanha Bay ground, extending from Stompneus Point to south of Dassen Island (areas 7 - 9);
4. the Hout Bay ground, running from north of Robben Island to Cape Point (areas 10 - 12);
5. the Gans Bay ground, including False and Walker Bays and the entire offshore region between Cape and Quoin Points (areas 13 - 17); and
6. the Agulhas ground, extending from Quoin Point to Cape Infanta (areas 18 - 20).

Annual catches, levels of effort and catch rates for each of these grounds are listed in Tables Vl - Vlll.

St Helena Bay was consistently fished more intensively than any other region. It absorbed 55 per cent of all effort expended between 1964 and 1976 and contributed 49 per cent of the overall catch. This can be attributed to the fact that 10 of the 15 factories that operated during the period are situated on this portion of the coastline. Catch rates tended to be somewhat lower than in other areas, possibly as a result of continued fishing pressure disrupting shoaling behaviour.

TABLE VI : ANNUAL PURSE-SEINE CATCHES FOR SIX SOUTH AFRICAN FISHING GROUNDS, 1964 TO 1976 (THOUSANDS OF METRIC TONS).

Year	Ground						All grounds combined
	Namaqua	St Helena Bay	Saldanha Bay	Hout Bay	Gans Bay	Agulhas	
1964	21,5	155,0	94,3	43,8	109,6	1,4	425,6
1965	13,1	229,7	161,4	56,4	19,4	0,1	480,1
1966	27,1	211,5	60,8	18,2	39,4	0,1	357,1
1967	5,6	203,9	165,5	93,7	37,7	2,5	509,3
1968	5,1	180,4	87,5	27,4	68,2	0,3	368,6
1969	1,0	190,7	83,7	41,1	35,2	0,2	352,0
1970	4,8	190,7	77,9	21,7	51,1	12,8	358,9
1971	35,3	114,3	85,4	23,2	66,6	0,4	324,9
1972	8,1	276,7	68,8	28,3	50,9	0,8	433,6
1973	1,1	284,9	85,6	23,2	49,1	7,5	451,4
1974	32,1	193,3	12,1	7,9	150,8	4,3	400,5
1975	2,8	224,1	52,6	17,4	109,8	0,7	407,4
1976	13,4	133,3	27,6	27,0	201,0	5,4	407,5
1964-1976	171,0	2 588,2	1 063,1	429,2	988,7	36,6	5 276,8
Percentage 1964-1976	3,24	49,05	20,15	8,13	18,74	0,69	100,0

TABLE VII : ANNUAL LEVELS OF EFFORT FOR SIX SOUTH AFRICAN FISHING GROUNDS, 1964 TO 1976 (STANDARD BOAT DAYS).

Year	Ground						All grounds combined
	Namaqua	St Helena Bay	Saldanha Bay	Hout Bay	Gans Bay	Agulhas	
1964	101	2 547	1 430	535	838	15	5 466
1965	109	5 542	2 899	938	92	1	9 580
1966	373	5 132	1 405	329	858	2	8 099
1967	106	6 131	3 118	1 643	1 007	56	12 059
1968	142	6 409	2 086	749	1 708	16	11 110
1969	33	6 256	1 947	1 097	1 013	3	10 349
1970	117	6 598	2 134	582	1 312	310	11 052
1971	671	4 345	2 601	769	1 723	16	10 126
1972	201	8 233	2 206	820	1 596	25	13 080
1973	52	7 490	2 473	615	1 448	171	12 249
1974	583	4 296	264	193	3 296	89	8 720
1975	75	5 812	1 643	433	2 350	17	10 329
1976	268	3 579	702	505	3 438	105	8 597
1964-1976	2 829	72 369	24 907	9 207	20 680	824	130 817
Percentage 1964-1976	2,2	55,3	19,0	7,0	15,8	0,6	99,9

TABLE VIII : ANNUAL CATCH-PER-UNIT-EFFORT INDICES FOR SIX SOUTH AFRICAN FISHING GROUNDS, 1964 TO 1976 (METRIC TONS PER STANDARD BOAT DAY).

Year	Ground						
	Namaqua	St Helena Bay	Saldanha Bay	Hout Bay	Gans Bay	Agulhas	All grounds combined
1964	213,7	60,9	66,0	81,9	130,8	92,6	77,9
1965	120,5	41,5	55,7	60,1	211,9	160,8	50,1
1966	72,8	41,2	43,3	55,4	45,9	60,6	44,1
1967	53,1	33,2	53,0	57,0	37,5	45,1	42,2
1968	35,9	28,2	40,1	36,6	39,9	17,2	33,2
1969	30,9	30,5	43,0	37,5	34,8	73,5	34,0
1970	41,1	28,9	36,5	37,2	39,0	41,4	32,5
1971	52,6	26,3	32,8	30,2	38,6	50,6	32,1
1972	40,5	33,6	31,2	34,5	31,9	31,7	33,2
1973	21,6	38,0	34,6	37,8	33,9	43,5	36,9
1974	55,1	45,0	46,0	40,8	45,7	49,1	45,9
1975	36,8	38,6	32,0	40,3	46,7	43,1	39,4
1976	49,8	37,2	39,3	53,5	58,5	51,5	47,4
1964-1976	60,4	35,8	42,7	46,6	47,8	44,4	40,3

Saldanha Bay, which included the location of two factories, attracted more effort than any region except St Helena Bay until 1974, when it was displaced by Gans Bay (one factory). It was responsible for 20 per cent of the total catch during the thirteen year period.

The Gans Bay vicinity steadily increased in importance and in 1976 displaced St Helena Bay as the most productive ground, though there was still marginally more fishing, 3 579 as opposed to 3 438 standard boat days, on the latter.

The Hout Bay region, where the remaining two factories are located, was not as important, accounting for only 8 per cent of the catch and 7 per cent of the effort. Even less fishing was directed at the two extremities, in spite of the fact that catch rates for the Namaqua ground proved higher, on average, than for any other. Their greater distance from the processing plants was doubtless responsible for this.

The monthly distribution of effort on each of the six grounds is illustrated in Figs 4a-e and reveals a distinct pattern to the fishing activities for most seasons.

Namaqua and St Helena Bay grounds

North of Stompneus Point effort has generally been at a moderate level early in the season. It has subsequently declined to low levels in late summer or early autumn before rising again later in the year. A peak was recorded between April and July in all years except 1974. This pattern corresponds to the availability of juvenile pilchard, anchovy, horse mackerel and round herring in the region. In certain seasons there were large fluctuations in the expenditure of effort during the winter months, which can probably be attributed to the adverse weather conditions often experienced at this time.

In 1974 most fishing in St Helena Bay was conducted during January and February, when large catches of anchovy were recorded. The anchovy total for the year was easily the highest so far experienced (Crawford _et al_.1978), contributing 87 per cent of the combined landings. It is possible that environmental conditions were responsible for concentrating this species on the St Helena Bay and Gans Bay grounds during the first three months. Little activity took place in the Saldanha Bay and Hout Bay regions. Unfortunately no environmental data are available to examine such hypotheses and they must remain speculation.

In 1964, 1966 and 1971 boats moved as far north as Port Nolloth and the Orange River to record good catches of pilchard and anchovy but it has seldom been necessary to travel such distances.

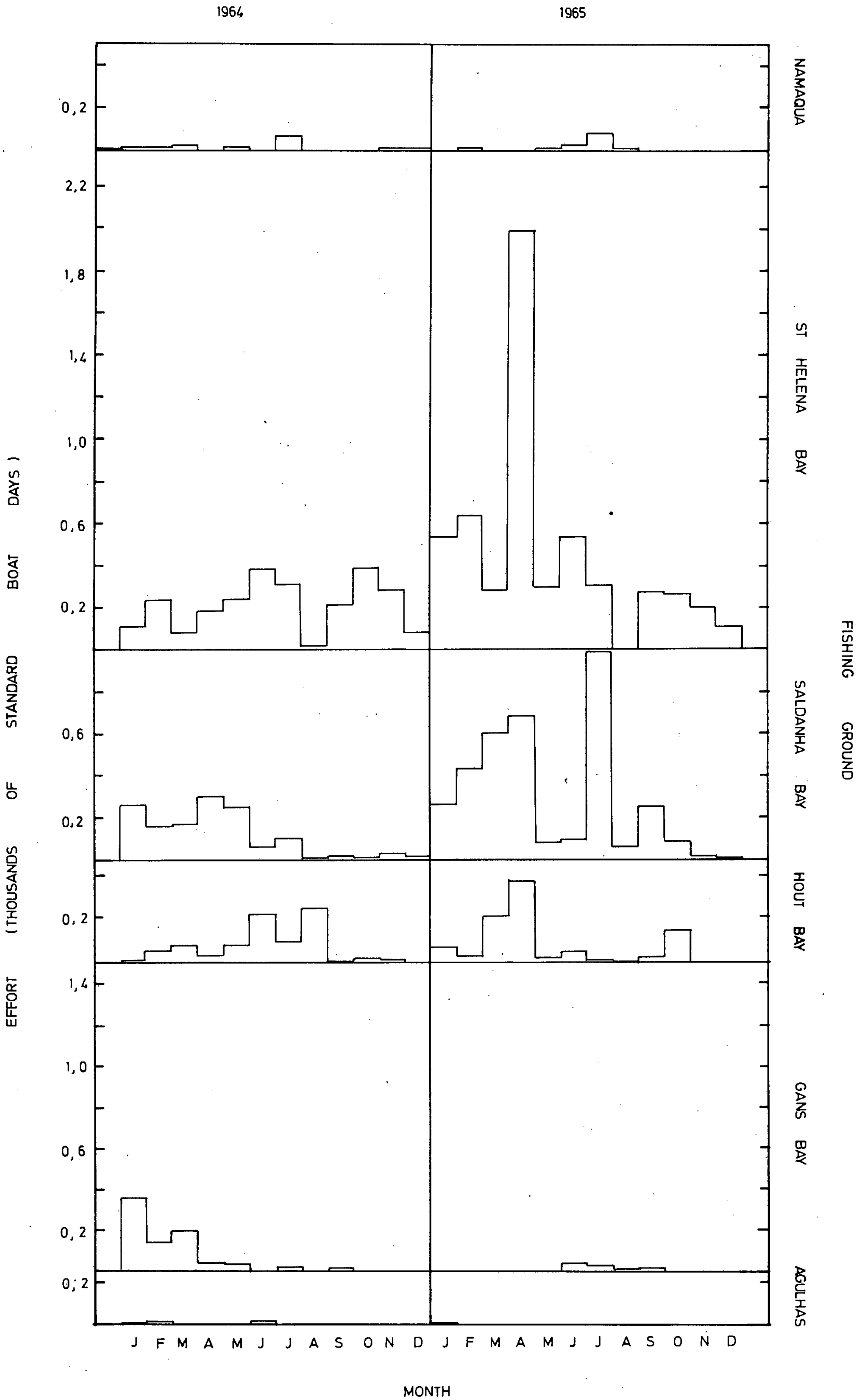

Fig 4a Deployment of fishing effort in the South African purse-seine fishery, 1964-1965.

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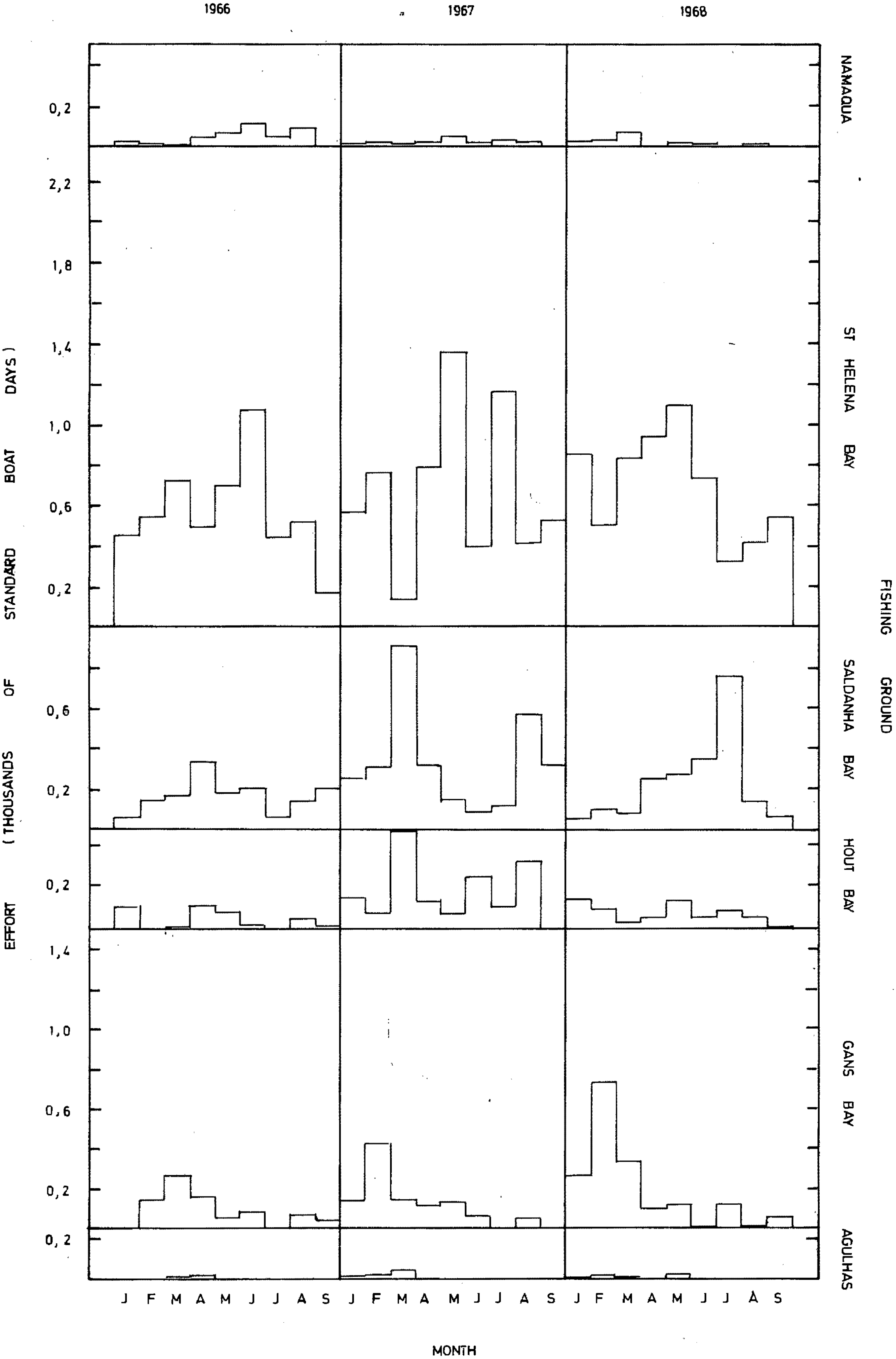

Fig 4b Deployment of fishing effort in the South African purse-seine fishery, 1966-1968

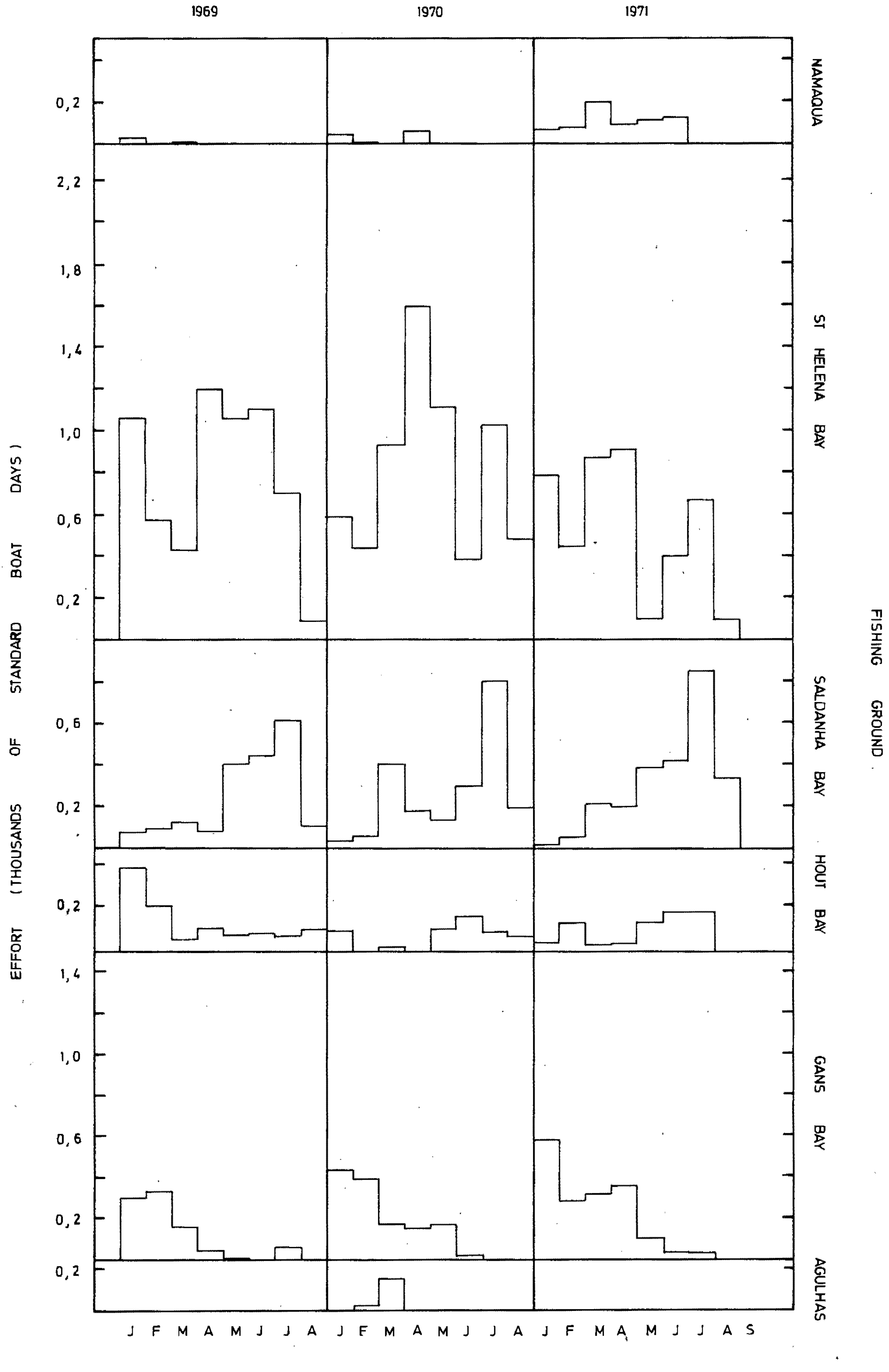

Fig 4c Deployment of fishing effort in the South African purse-seine fishery, 1969-1971.

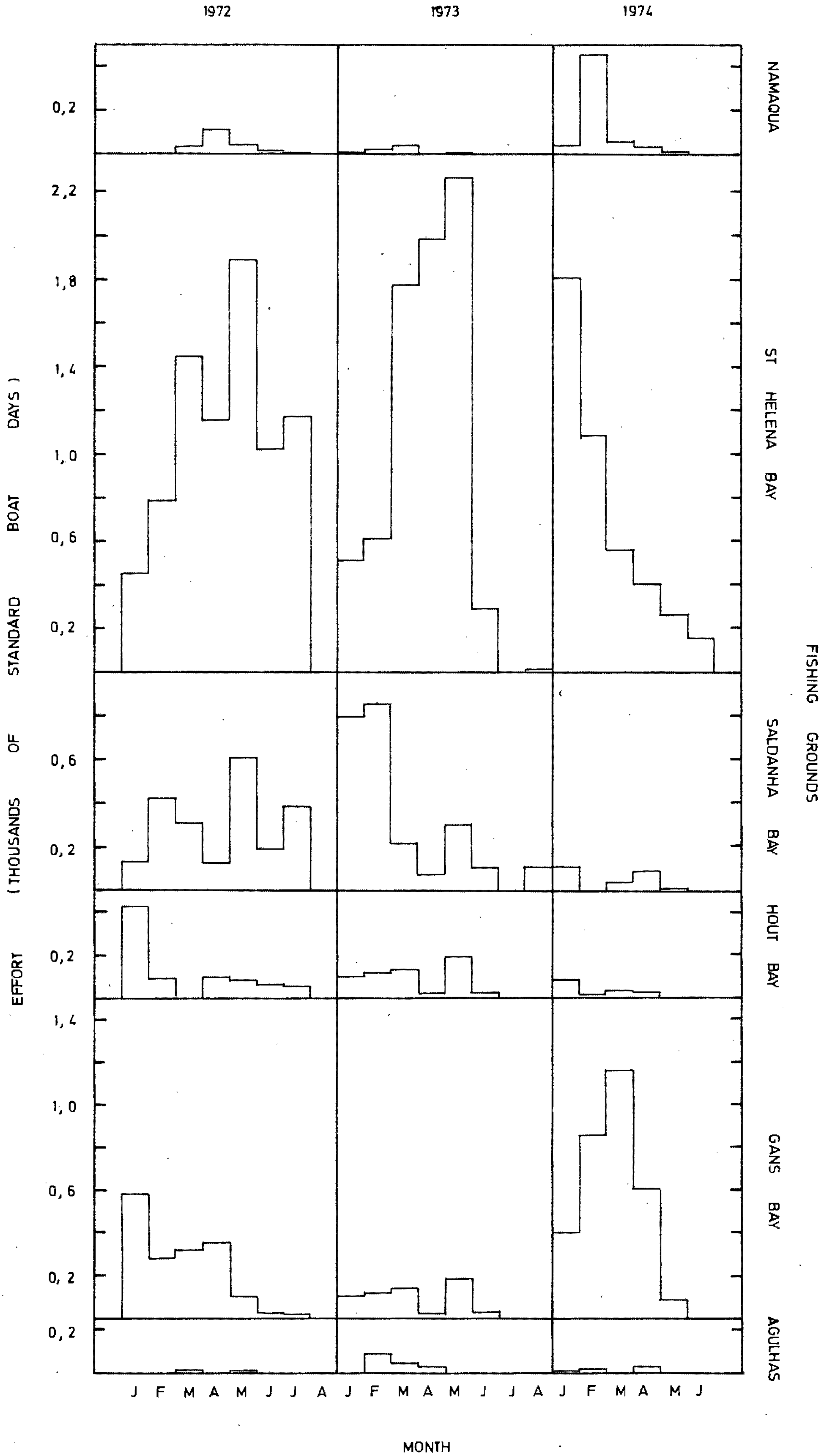

Fig 4d Deployment of fishing effort in the South African purse-seine fishery, 1972-1974.

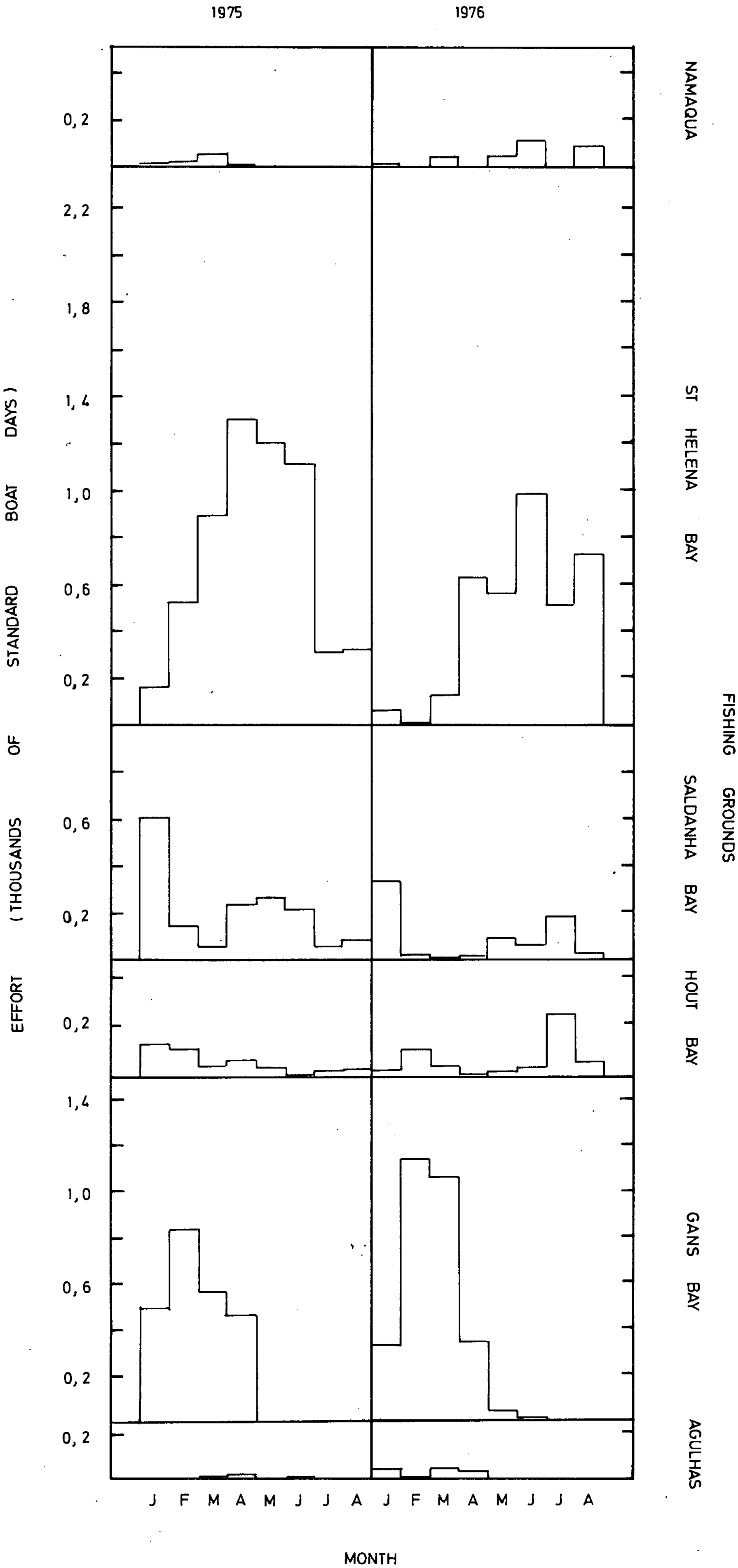

Fig 4e Deployment of fishing effort in the South African purse-seine fishery, 1975-1976.

From 1964 - 1966 the potential of the anchovy stock had not been clearly established and managers were looking for alternative resources to supplement the rapidly diminishing pilchard catch.

Saldanha Bay ground

Increased availability of mackerel during the autumn and winter months of 1967 - 1972 was responsible for much of the effort expended on the Saldanha Bay ground. This was primarily the result of exceptionally strong 1966 and 1967 year classes (Newman and Crawford in press). The region is also one of the best for round herring (Centurier-Harris and Crawford 1974). Good catches of pilchard were recorded in autumn of 1965 and summer of 1975 and of anchovy in the summers of 1973 and 1975.

Hout Bay ground

There has been no regular pattern to fishing operations on the Hout Bay ground, which is the least productive of the four at the centre of the fishery. Shoals of adult pilchard or of adult anchovy are sometimes present at the start of the season but rapidly move towards the east. Mackerel and round herring have also, on occasion, contributed rewarding catches.

Gans Bay and Agulhas grounds

To the east of Cape Point a large proportion of the fishing has been conducted during the first three to four months of each year, when shoals of adult pilchard and adult anchovy are frequently encountered in these waters (Crawford et al. in press). Later in the season they exhibit a tendency to move towards the east. These migrations probably account for the fact that effort expended off Cape Agulhas is sometimes at a peak in the months immediately following those which have provided the most intensive fishing on the Gans Bay ground. However exploitation east of Quoin Point has seldom been at a significant level.

DISCUSSION

Catch-per-unit-effort levels (Table V) demonstrate a considerable decline in the overall abundance of fish in the mixed-species resource since 1964. There is some evidence (Figs 2 and 3) to suggest that this may in part be attributed to reduced biomass levels in both the pilchard and anchovy populations. In the case of pilchard this situation has been the result of two factors: a return to lower levels of recruitment after exceptionally strong year classes had passed through the fishery (Newman and Crawford in press) and a younger age structure caused by the introduction of a small-meshed net (Crawford et al. in press). A decrease in anchovy stock size, as indicated by catch rates, would not have been unexpected during the early years of exploitation and, although virtual population estimates reveal no trend, it may be concluded that the anchovy resource has not expanded subsequent to the decline in pilchard biomass levels. A similar opinion has been expressed by other authors (Centurier-Harris 1977, Crawford and Shelton 1978, Newman and Crawford in press).

One of the more important changes to have taken place in the fishing strategy during the past decade has been the ever increasing deployment of effort on the southern grounds, particularly during the early months of the season. This pattern has been coincident with a drop in the mackerel catch and considerably reduced fishing in the Saldanha Bay vicinity. It thus appears that the portion of effort, which from 1966 - 1973 was directed at the mackerel population, has now been diverted towards those shoals of adult pilchard and adult anchovy occurring in the south. Following the introduction of the small-meshed nets the older pilchard age classes disappeared from the northern areas (Crawford et.al. in press) and juvenile pilchard and anchovy recruiting on these grounds in late autumn and winter were fished intensively.

The prevailing situation, therefore, is one of reduced catch rates, high levels of effort and a fishery largely dependant on the pilchard and anchovy resources. The pilchard population has been at a low ebb since 1964, whereas the anchovy stock has possibly also been depleted. Both have assumed a considerably younger age structure since the introduction of the 12,7 mm net (Crawford et al. 1978) and their remaining age components are subject to high levels of exploitation.

In previous years exceptionally strong horse mackerel (Geldenhuys 1973), pilchard and mackerel (Newman and Crawford in press) year classes played a major role in maintaining a high annual catch over a number of years. More recently large quantities of two-year-old pilchard were landed in 1976, suggesting good recruitment in 1974. Significantly there was little fishing during the latter part of the season in this year and no nought-year-old pilchard were caught (Crawford et al. 1978). After intensive exploitation on the southern grounds in 1976, however, these fish failed to provide big catches in subsequent seasons and it is doubtful whether good year classes of any species will find it any easier to establish themselves in future.

It is apparent that in 1976 too much effort was still involved in the fishery, especially since the failure of either the pilchard or anchovy populations, towards which most of the effort is currently directed, could result in severe repercussions for processors and fishermen alike, as well as any natural predators (Crawford and Shelton 1978).

CHAPTER 5. DISTRIBUTION, AVAILABILITY AND MOVEMENTS OF PILCHARD *SARDINOPS OCELLATA* OFF SOUTH AFRICA, 1964 TO 1976.

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CHAPTER 5. DISTRIBUTION, AVAILABILITY AND MOVEMENTS OF PILCHARD SARDINOPS OCELLATA OFF SOUTH AFRICA, 1964 TO 1976.

Commercial purse-seine fishing for pilchard Sardinops ocellata was initiated in the St Helena Bay area (Fig. 1) in 1943 under the stimulus of a war-time demand for canned fish. Although no accurate records were kept, the catch of pilchard during that season was estimated at 3 900 metric tons. Over the next few years the industry expanded rapidly and by 1949 the quantity landed had risen to some 68 000 tons (Du Plessis 1959). This prompted the introduction of certain control measures which have since come to include restrictions on the number and capacity of processing plants and vessels, maximum allowable catch, duration of the fishing season and minimum mesh size (Du Plessis op. cit., Stander and Le Roux 1968, Gertenbach 1973, Newman and Crawford in press).

It is apparent from annual catch figures (Table IX) that the performance of the pilchard stock has been dominated by the exceptionally large catches which were recorded during the late 'fifties and early 'sixties. These have been attributed to the strong recruitment experienced between 1956 and 1959 (Newman and Crawford in press). The increased abundance of pilchard in these years led to considerable rises in fishing effort, of which much was later diverted to anchovy Engraulis capensis and other resources through the introduction of a small-meshed (12,7 mm) net.

After 1966 anchovy displaced pilchard as the main contributor to the commercial landings, but that the pilchard remains an important component of the multi-species fishery is evidenced by both the large catch of 176 000 tons recorded in 1976 and the considerable influence exerted by pilchard availability on overall catch rates (chapter 4).

Previous investigations into the distribution and movements of this species in South African waters have been conducted by Davies (1956b), Baird (1970, 1971) and Heydorn et al. (1978). These studies, however, concentrated on particular sections of the pilchard population only, whereas it is the purpose of this paper, through analysis of catch statistics collected between 1964 and 1976, to consider the patterns of distribution and availability exhibited by each of the major age-structured components of the stock and to document these in such a manner that they may be incorporated in future simulation models of the fishery.

TABLE IX : ANNUAL CATCHES OF PILCHARD AND PERCENTAGE CONTRIBUTION TO COMBINED PURSE-SEINE LANDINGS, 1950 TO 1976.

Year	Catch (metric tons)	Percentage of combined purse-seine catch
1950	85 317	63,1
1951	101 879	50,8
1952	170 032	62,4
1953	132 481	60,9
1954	88 303	41,9
1955	121 949	55,2
1956	76 589	49,4
1957	109 475	54,3
1958	194 390	71,1
1959	260 210	82,6
1960	318 030	77,2
1961	402 192	81,9
1962	410 159	82,5
1963	390 129	91,4
1964	256 096	60,2
1965	204 481	42,6
1966	118 031	33,1
1967	69 651	13,7
1968	107 777	29,2
1969	56 057	15,9
1970	61 808	17,2
1971	87 628	27,0
1972	104 153	24,0
1973	68 982	15,5
1974	15 977	4,0
1975	89 182	21,9
1976	176 434	43,3

DISTRIBUTION OF COMMERCIAL CATCHES

Stastistics submitted by the skippers of purse-seine vessels were reasonably comprehensive for the period 1964 - 1976 (Crawford et al. 1978) and were used to determine monthly distribution patterns for commercial catches. These are illustrated in map form in the Appendix. The geographical location of shoals was delimited by dividing the fishing region into 43 longshore and offshore areas (Fig. 5) and noting the incidence of pilchard catches in each. In certain instances, especially when effort was deployed at the northern or eastern extremities, further clarification was obtained by plotting actual catch positions.

Catch rates are indicated in order to depict spatial variations in the density of fish. These were derived from catch (Crawford et al. 1978) and effort (chapter 4) estimates for 20 somewhat larger areas, formed by re-grouping the original 43. The catch-per-unit-effort levels are expected to be influenced to a certain degree by variations in the availability of other species but, within the four broad categories chosen (<10, 10-25, 25-50 and > 50 metric tons per standard boat day), they should nevertheless provide a fair measure of abundance. It should be noted that, although the 1964 and 1965 seasons were closed for pilchard from August to December inclusive, limited quantities of pilchard were sometimes caught in these months as a result of fishing for anchovy. These catches have been included on the maps but catch rates are likely to be unrealistically low since skippers endeavoured to avoid pilchard. To assist in interpretation of the results areas in which no fishing was conducted are also shown.

Pelagic fish often shoal by size, examples being *Sardina pilchardus* (Muzinic 1977), *Sardinella aurita* (Ben-Tuvia 1960) and *Scomber scombrus* (Sette 1950). A likely reason for this form of segregation is that small fish would be required to expend more energy to keep pace with larger individuals (Munzinic 1977). The normal size range encountered in shoals of pilchard in South African waters was examined by investigating the length distributions of fish from 310 purse-seine catches. The results demonstrate that fish in any one shoal seldom vary in caudal length by more than 5,5 - 6,0 cm (Fig. 6). On account of this the modal length of fish caught in known areas, whenever available from field observations, has been indicated on the distribution maps to give some idea of geographic and seasonal variations in the size of pilchard encountered.

Davies (1956a) examined the gonad activity of 1 872 pilchard collected between 1950 and 1954 during the main spawning season (September - February). His information suggests that no fish were mature before four years of age, that 50 per cent were reproductively active at five and that all six-year-olds could have been expected to spawn.

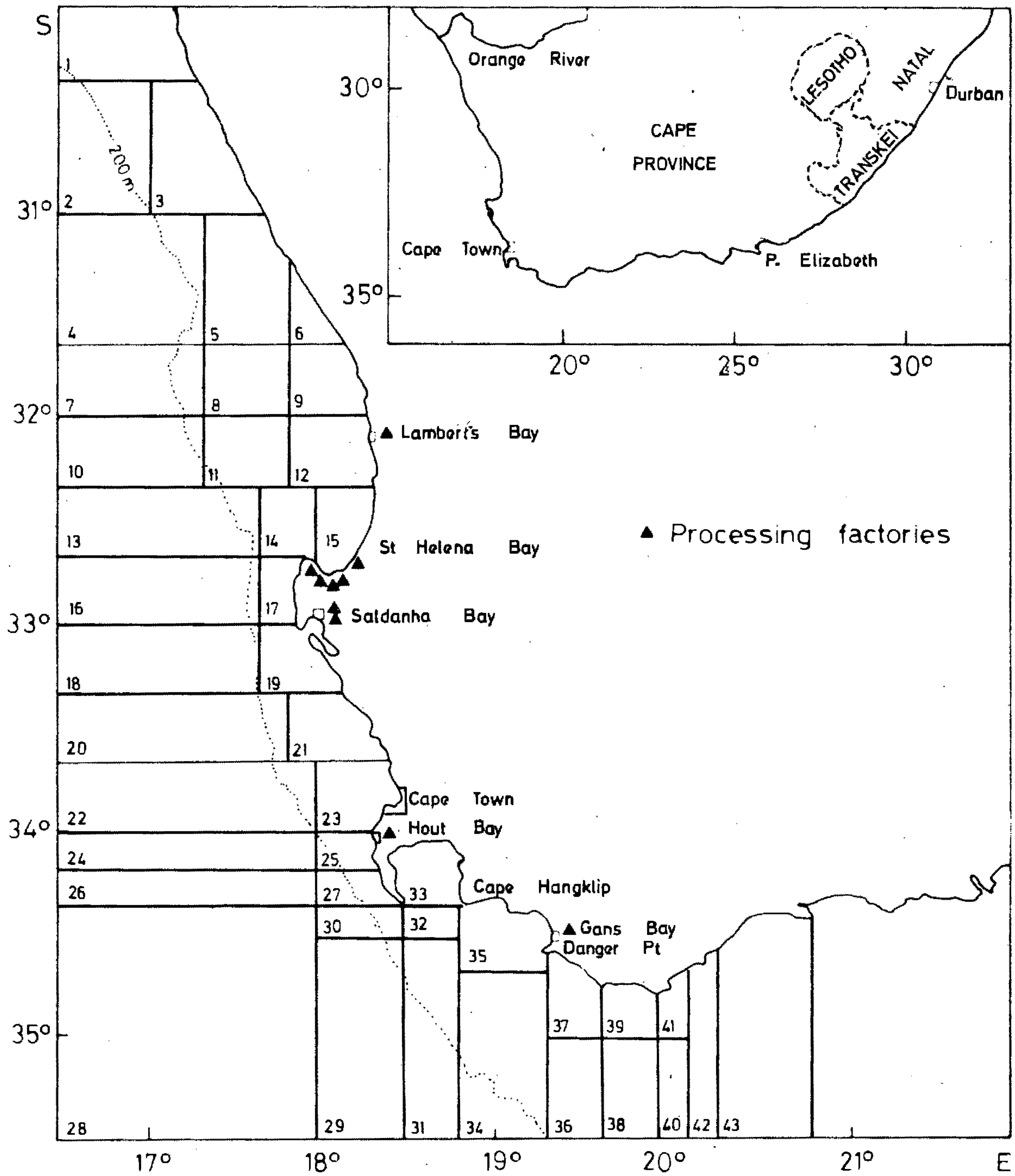


Fig 5 The 43 areas used to delimit the distribution of pilchard shoals, showing the locations of the processing factories which were operative in 1976. Area 1 extends north to the Orange River (inset).

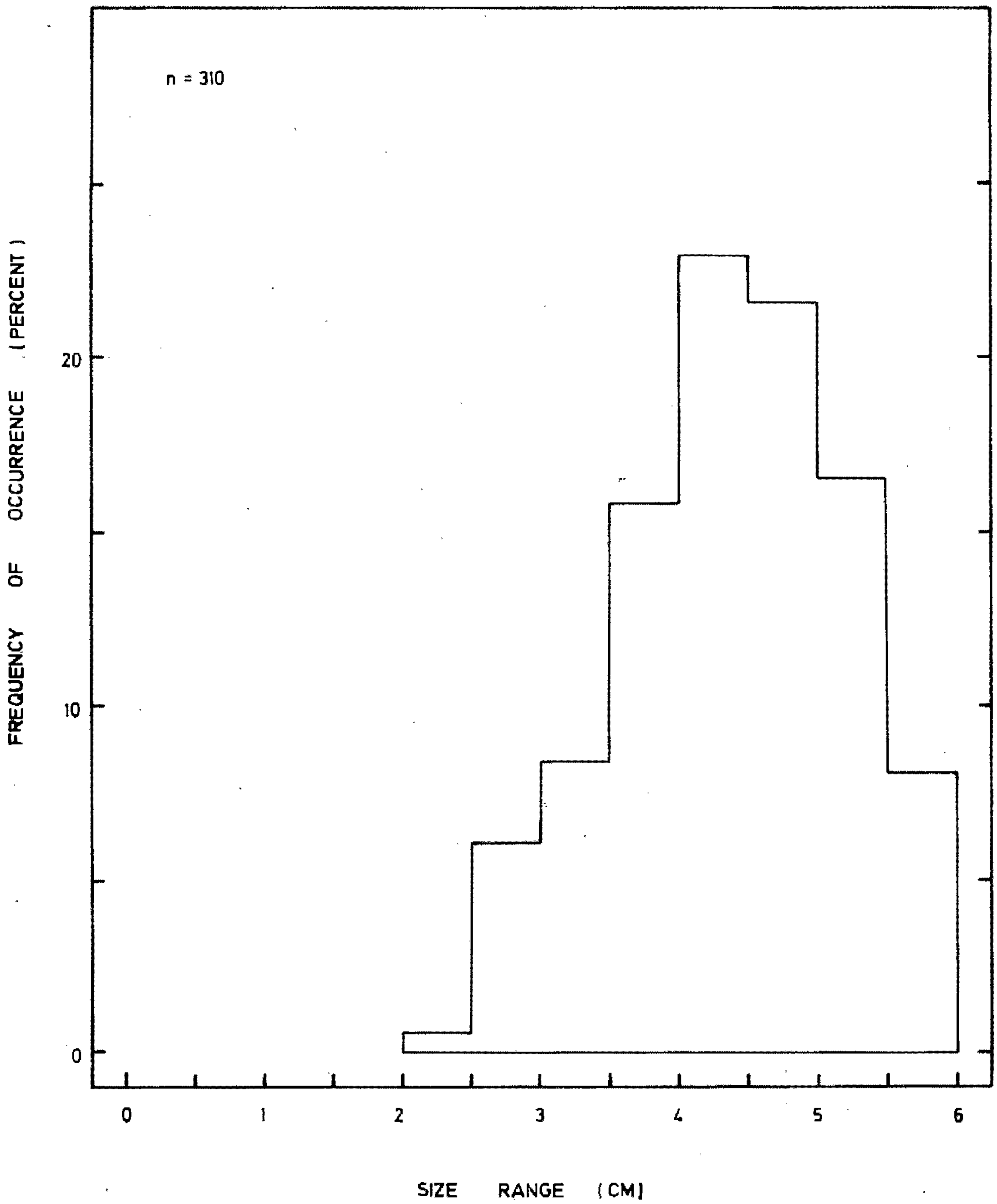


Fig 6 Frequency of occurrence of pilchard size-range (caudal length) variations between largest and smallest fish sampled from individual purse-seine catches.

Analysis of 2 374 fish sampled during the 1975/76 season, however, provided significantly different results, indicating that fish were maturing at a much earlier age. Some one-year-olds, 50 per cent of the two's and all four's proved to be reproductively active. This change may well have been caused by the considerably reduced age structure which resulted from a lowering of the minimum mesh size for nets from 32 to 12,7 mm over the period 1963 - 1965 (Fig. 7). For mapping purposes fish less than one year old were considered to be juveniles and have been illustrated in different shading to that used for all older age groups. Thus the distribution of recruit year classes has been highlighted.

The results show that the great majority of pilchard catches are made inside the 200 m bottom contour, except in the vicinities of Cape Columbine and Cape Point where this line converges with the mainland. This pattern could be influenced to some extent by the preference of skippers to remain within sight of the coast. Most of the catches recorded further offshore were located on the northern grounds, as those of nought-year-old fish north-west of the Olifants River in February and May 1967 and January 1968, west of the Olifants River in February and June 1971 and north-west of Cape Columbine in February and April 1968 and May and June 1969; of one-year-olds north-west of and west of the Olifants River in March 1971 and February 1970, respectively; and of four-year-olds west of the Olifants River in January 1972 and west of Saldanha in January 1964 and January, February and April 1966. However, catches of this last age class were also made well to the south of Walker Bay in April 1970.

Commercial catches have been recorded as far north as the Orange River (nought-year-olds in March and June 1971; five-year-olds in July 1964, May, June, July and August 1966; six-year-olds in April 1966) and as far east as Cape Infanta (nought-year-olds in January 1970; one-year-olds in January 1970 and June 1975; two-year-olds in May 1976; three-year-olds in June 1965, March 1972, March 1973, February, March and April 1976; four-year-olds in January 1973 and February 1974; five-year-olds in April 1967). But although the pilchard appears to range continuously along the South African coastline between the Orange River and Cape Infanta, there is no evidence as yet that fish aged one to four occur in the extreme north or that six-year-olds are found in sizeable quantities off Cape Infanta. Further east pilchard have been recorded in the stomachs of hake _Merluccius_ sp. trawled off Port Elizabeth (Hecht 1976) and they occur regularly off the coasts of Transkei and Natal (Fig. 5) each winter (Davies 1956b). Baird (1971) notes that nought-, five- and six-year-olds are virtually absent from these latter shoals and that one-year-olds are also encountered only infrequently (Table X). Subsequent to his study fish with a caudal length ranging between 6,0 and 9,5 cm (presumeably nought-year-olds) were washed ashore in Natal in 1974 (Heydorn _et al_. 1978) but this is an isolated instance and young pilchard may be regarded as scarce off Natal. Pilchard spawning has been recorded off Port Elizabeth and East London (Anders 1975).

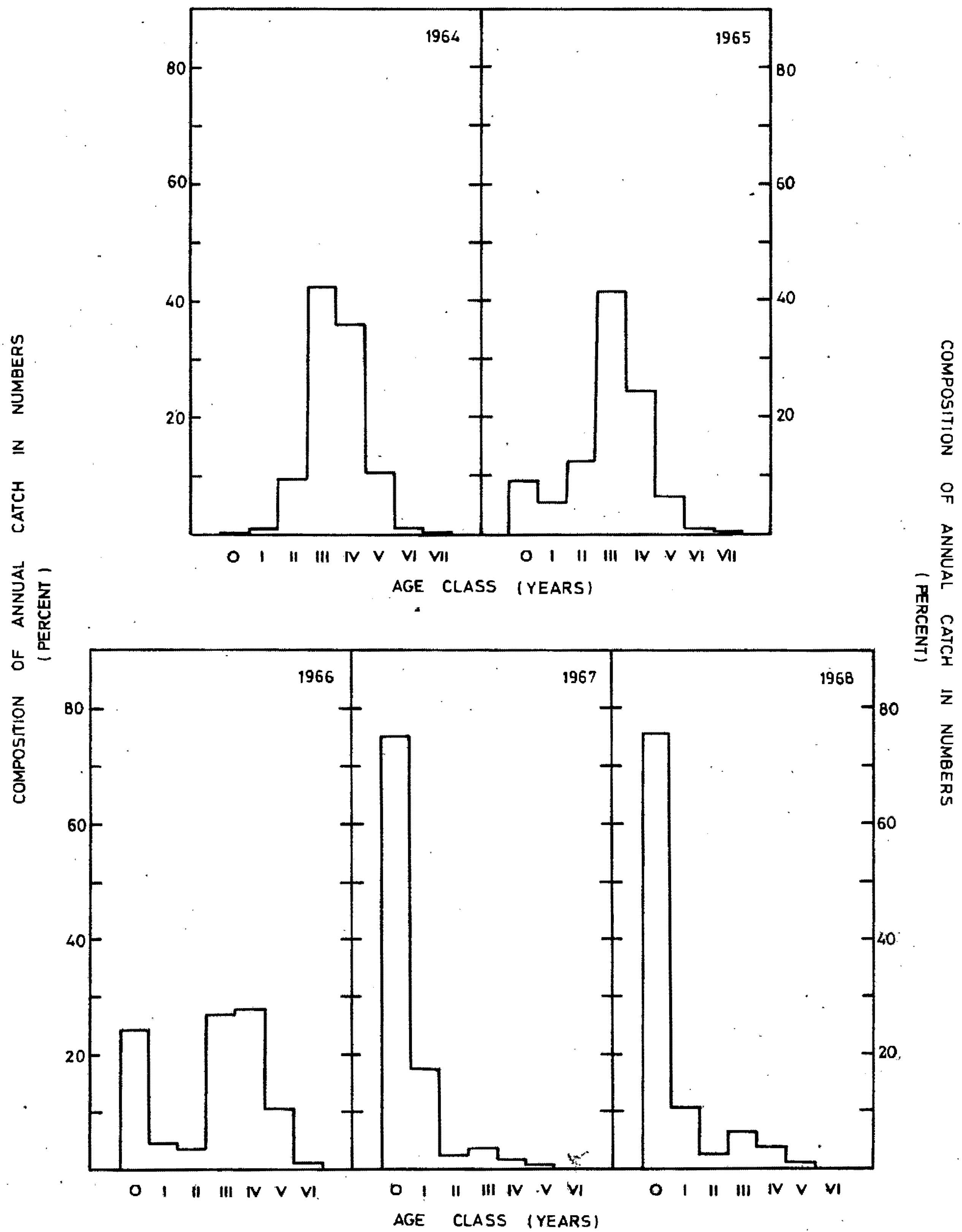


Fig 7a Age composition of South African pilchard landings, 1964 - 1968.

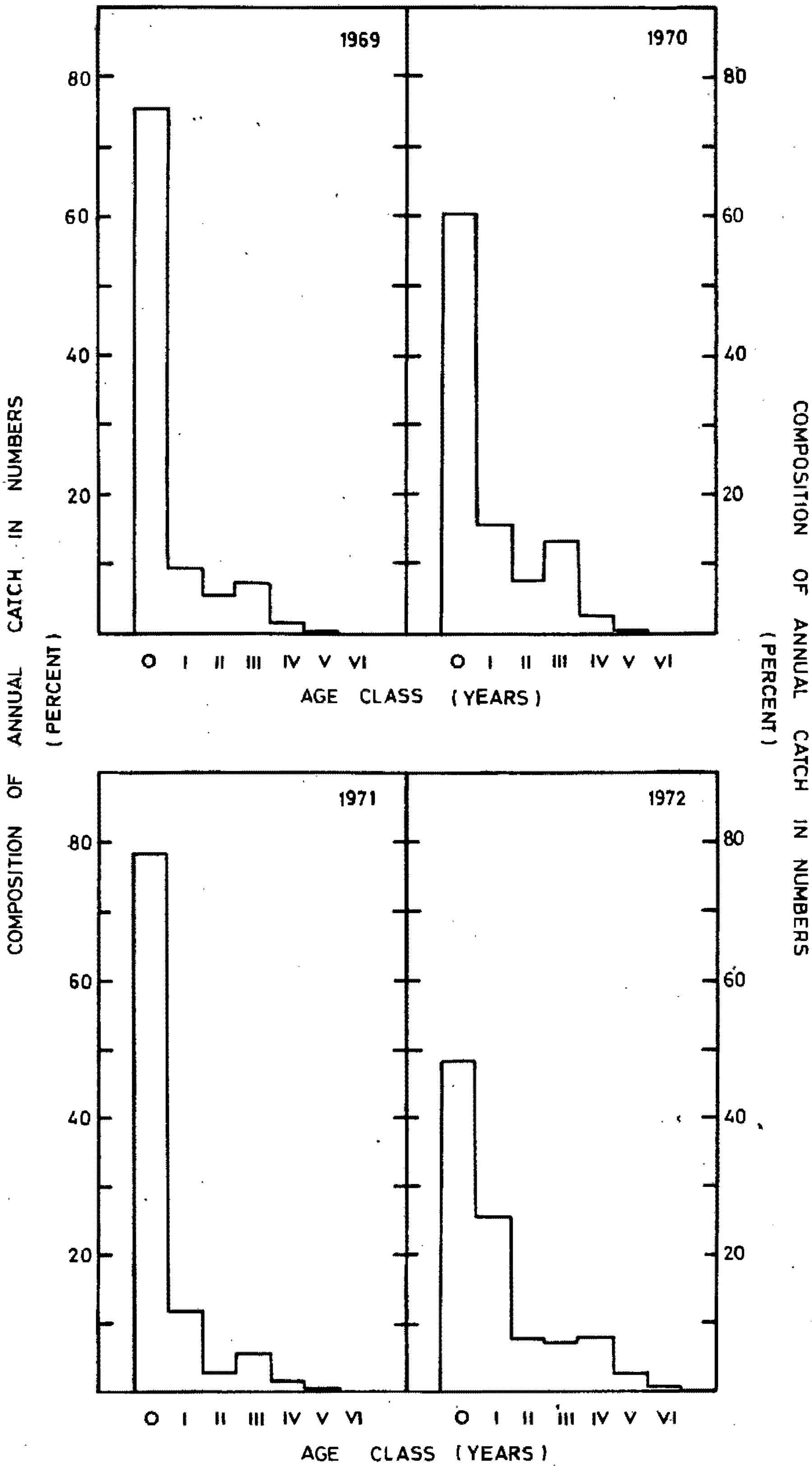


Fig 7b Age composition of South African pilchard landings, 1969 - 1972.

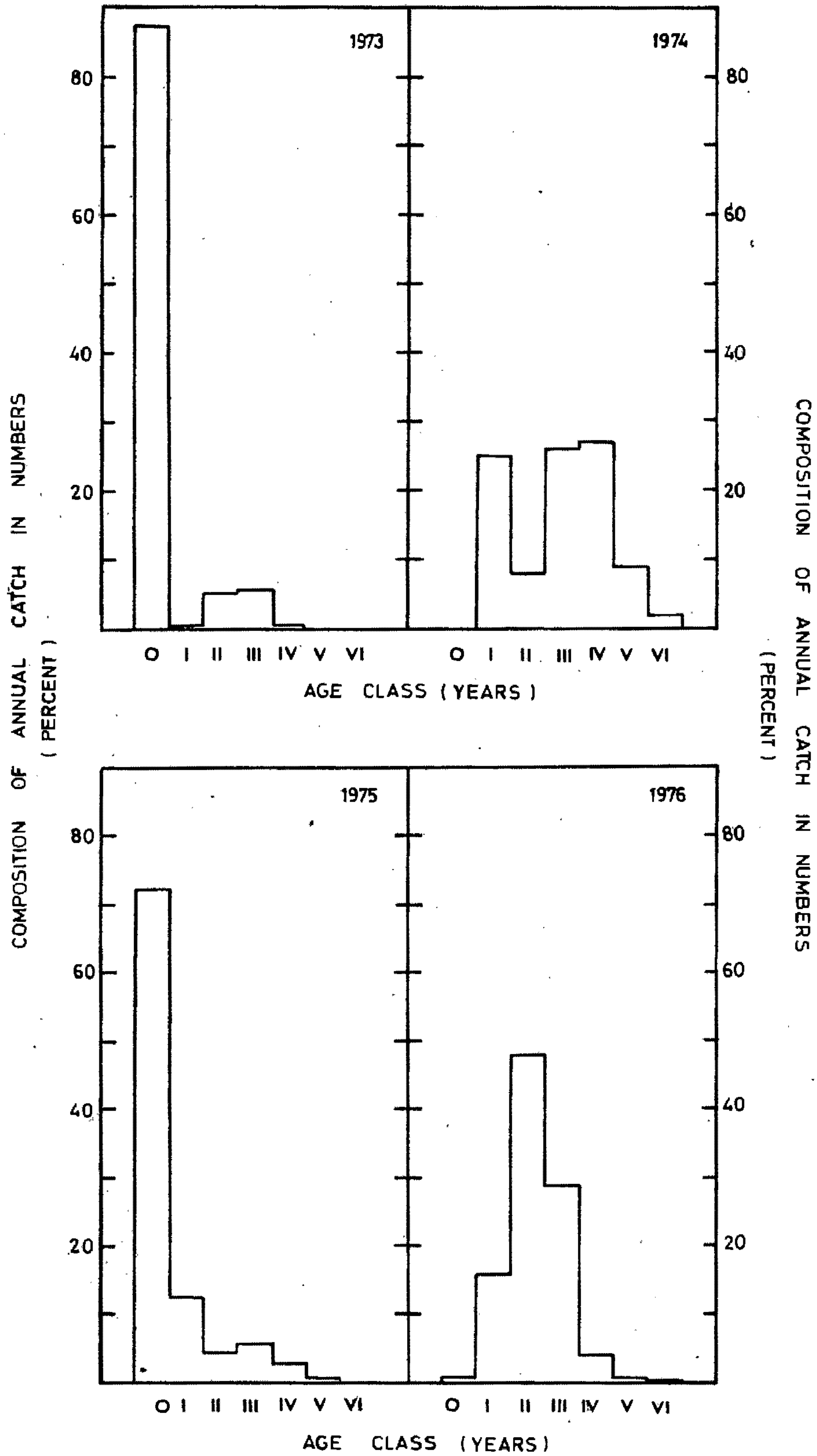


Fig 7c Age composition of South African pilchard landings, 1973 - 1976.

TABLE X : PERCENTAGE AGE COMPOSITION OF PILCHARD SAMPLES COLLECTED IN NATAL, 1955 TO 1969 (FROM BAIRD 1971)

Year	Age Class						
	0	I	II	III	IV	V	VI
1955	-	5,4	46,6	44,1	3,0	0,9	-
1958	-	1,9	62,9	29,7	4,8	-	-
1962	-	2,3	25,6	7,2	56,6	8,2	-
1963	-	2,3	40,0	46,5	11,2	-	-
1964	-	-	40,1	38,4	21,4	-	-
1965	-	16,7	56,5	25,3	1,4	-	-
1968	-	7,6	31,1	48,5	12,7	-	-
1969	-	0,5	34,1	45,8	17,9	0,9	0,7

TABLE XI : MONTHS IN WHICH CATCH RATES GREATER THAN 25 METRIC TONS PER STANDARD BOAT DAY WERE RECORDED FOR NOUGHT-YEAR-OLD PILCHARD.

Month	Seasons
January	1967, 1968, 1969, 1970, 1971
February	1967, 1968, 1971
March	1967, 1969, 1971
April	-
May	1967, 1969, 1970, 1971, 1973, 1975,1976
June	1965, 1967, 1968, 1971, 1973, 1975
July	1967, 1971, 1975
August	1965, 1968
September	1965, 1968

AVAILABILITY, ABUNDANCE AND MOVEMENTS

To quantify seasonal patterns of availability and distribution the 43 areas were combined into six fishing grounds (Fig. 1), chosen to correspond with the major environmental regions of the South-western Cape (Crawford et al. in press). As may be seen from the Appendix, the seaward extension of these grounds is seldom greater than 50 km and they are thus of approximately equal size, except for the extensive but relatively lightly exploited Namaqua area.

Monthly levels of catch per unit effort on each of the six grounds were calculated for the different age components of the pilchard stock. In this process each catch was allocated to a particular age class by comparing the modal age of fish sampled with the corresponding age-length key (Crawford et al. 1978).

Monthly indices of availability were then derived by summing over all grounds the mean catch rates for the month under consideration during the thirteen year (1964 - 1976) period. Estimates of the relative abundance of fish that could, as a rule, be expected to be present on each of the six fishing grounds during any particular month were established in a similar manner (the summation over grounds being omitted). Catches of nought- and one-year-olds were minimal in 1964 and 1965 when fishing with the small-meshed (12,7 mm) net was restricted to the anchovy population. Thus only the period 1966 - 1976 was considered for these groups. Additionally no values were calculated for October, November or December for any age class, fishing in these months being prohibited after 1965.

The resulting indices, expressed as percentages of the maxima, appear in (Figs. 8 and 9). Patterns for fully recruited age groups (one, two to four and five to six) are probably determined to a certain extent by mortality, and especially that due to fishing, with catch rates falling as the season progresses. However, unrealistically high values of total mortality (Z= 3,8; 5,9 and 3,3 respectively) would be required to produce the observed declines in availability. Newman (1970a) demonstrated that the natural mortality coefficient for pilchard in South West African waters during the period 1963 - 1966 was less than 0,59 whereas estimates of fishing mortality in South Africa for the period 1964 - 1976 have ranged between 0,01 and 0,79 (mean 0,42) (Centurier-Harris et al. 1977). Undoubtedly, therefore, movements of fish shoals also exert a considerable influence. These will be discussed in greater detail when considering the various age components of the population.

Spawning

Both migrations and seasonal trends in availability may be expected to be closely related to reproductive behaviour.

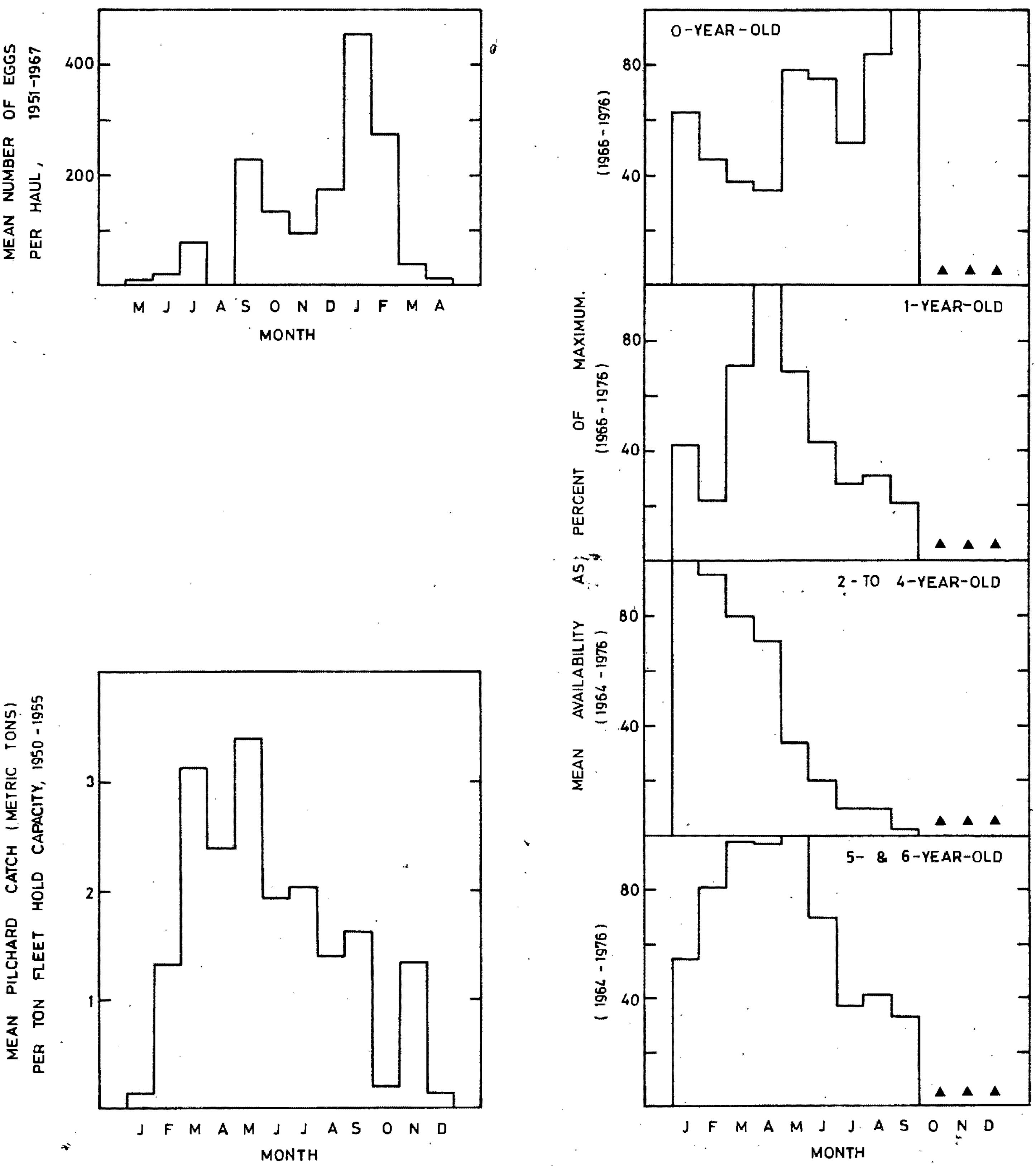


Fig 8 Egg production and availability indices for pilchard.
(▲ no data)

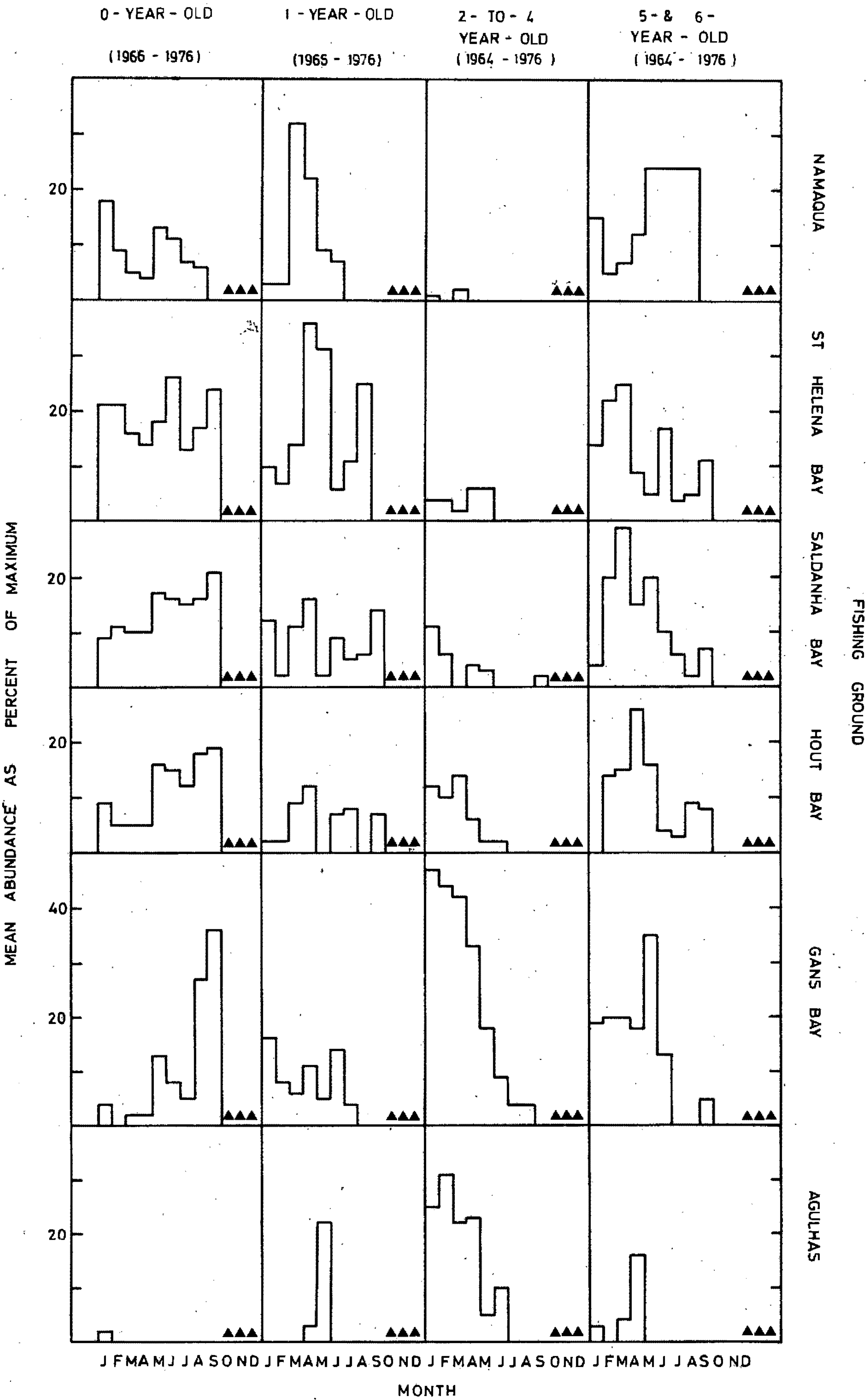


Fig 9 Abundance indices for pilchard.
(▲ no data)

The pilchard is a serial spawner (O'Toole 1977) and surface plankton tows, conducted on a regular basis between 1951 and 1967 (Sea Fisheries Branch unpublished data) have demonstrated that in South African waters most of the spawning takes place between September and February (Fig. 8). Eggs were initially especially abundant offshore of St Helena Bay but the intensity of spawning in this region later declined and yields during the final two years of the survey (1966 - 1967) were negligible (Fig. 10). Large concentrations were also encountered between Cape Point and St Sebastian Bay though here, unlike the northern area, there was no apparent decrease in spawning.

Nought-year-olds

There is a sharp rise in the availability of nought-year-old pilchard during May and from then until September they are generally caught in large numbers (Fig. 8). A close similarity between the pattern in these months and the egg abundance indices for September to January suggests that young pilchard recruit to the fishery approximately eight months after they were spawned. Between October and December there are no adequate data on the availability of this age group but the moderately high level in January suggests that it remains fairly high. Thereafter a steady decrease in apparent, catch rates reaching a minimum in April. A converse trend is exhibited by one-year-olds, indicating that, as expected, fish at this time are entering their second year of life. These findings lend an element of confidence to the age-determination techniques.

Although recruitment in May and June takes place along the entire west coast (Fig. 9), there is a tendency for these juveniles to occur initially in their largest numbers on the northern fishing grounds. Then, as the year progresses, a distinct movement towards the south is apparent, 30 to 40 per cent of the nought-year-old age group being located east of Cape Point in August and September. The relatively high levels of abundance of these fish in the Namaqua and St Helena Bay regions in summer, however, indicates that significant quantities remain in the north. Alternatively it is possible that some return to these grounds during spring.

It is evident from the Appendix that this pattern of nought-year-old recruitment is fairly regular. Catch rates in excess of 25 metric tons per standard boat day were frequently recorded in the latter part of the season, were fairly common in January, less so in February and March and were never attained in April (Table XI). Analysis of the size of fish landed clearly indicates that the main nursery grounds are in the waters to the west of Cape Point. The modal caudal length of pilchard caught on the Namaqua and St Helena Bay grounds was less than 9,0 cm for 47 of the possible ground-month combinations, as compared with 43 instances for the Saldanha Bay and Hout Bay regions and 10 for those of Gans Bay and Agulhas.

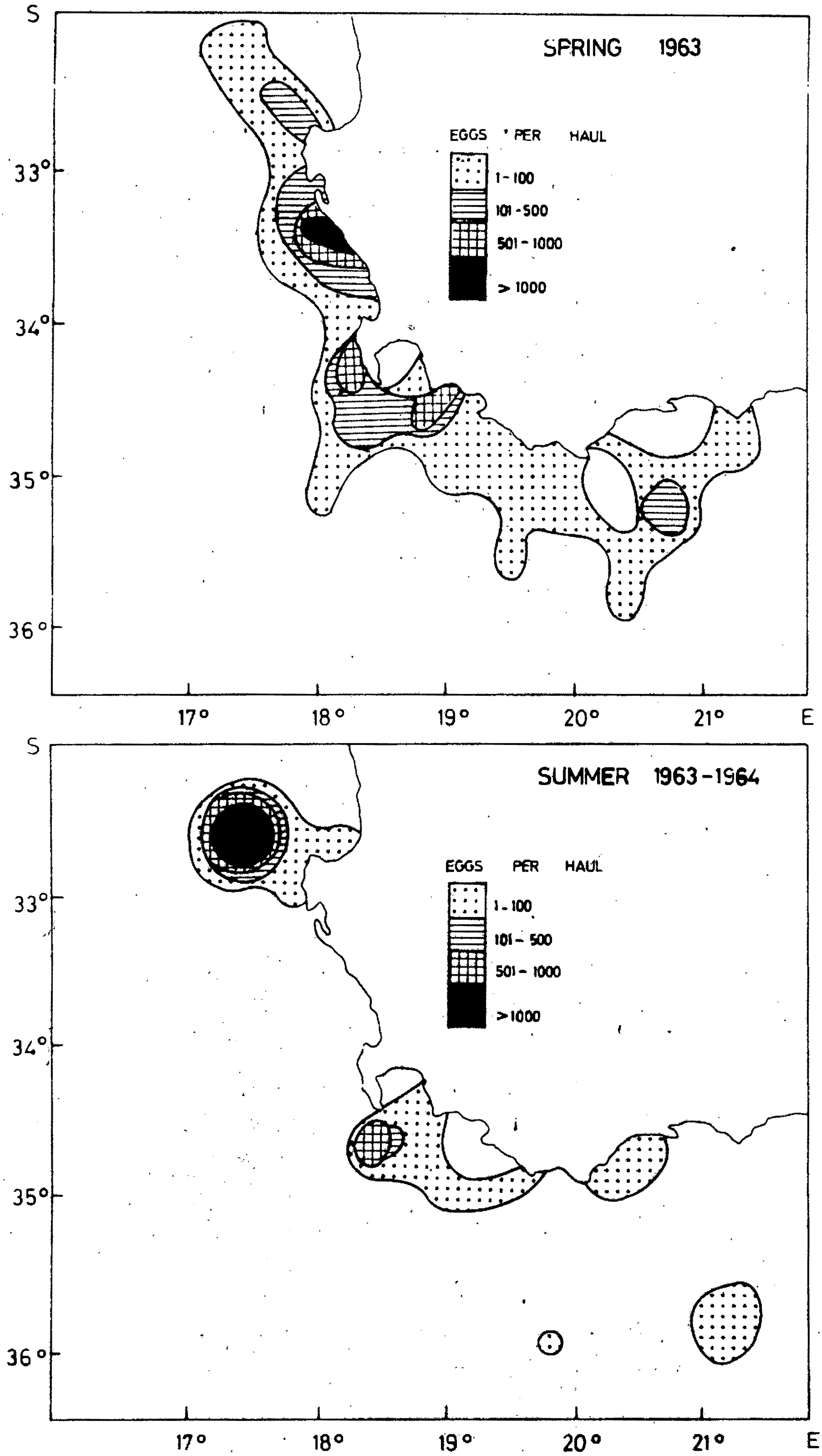
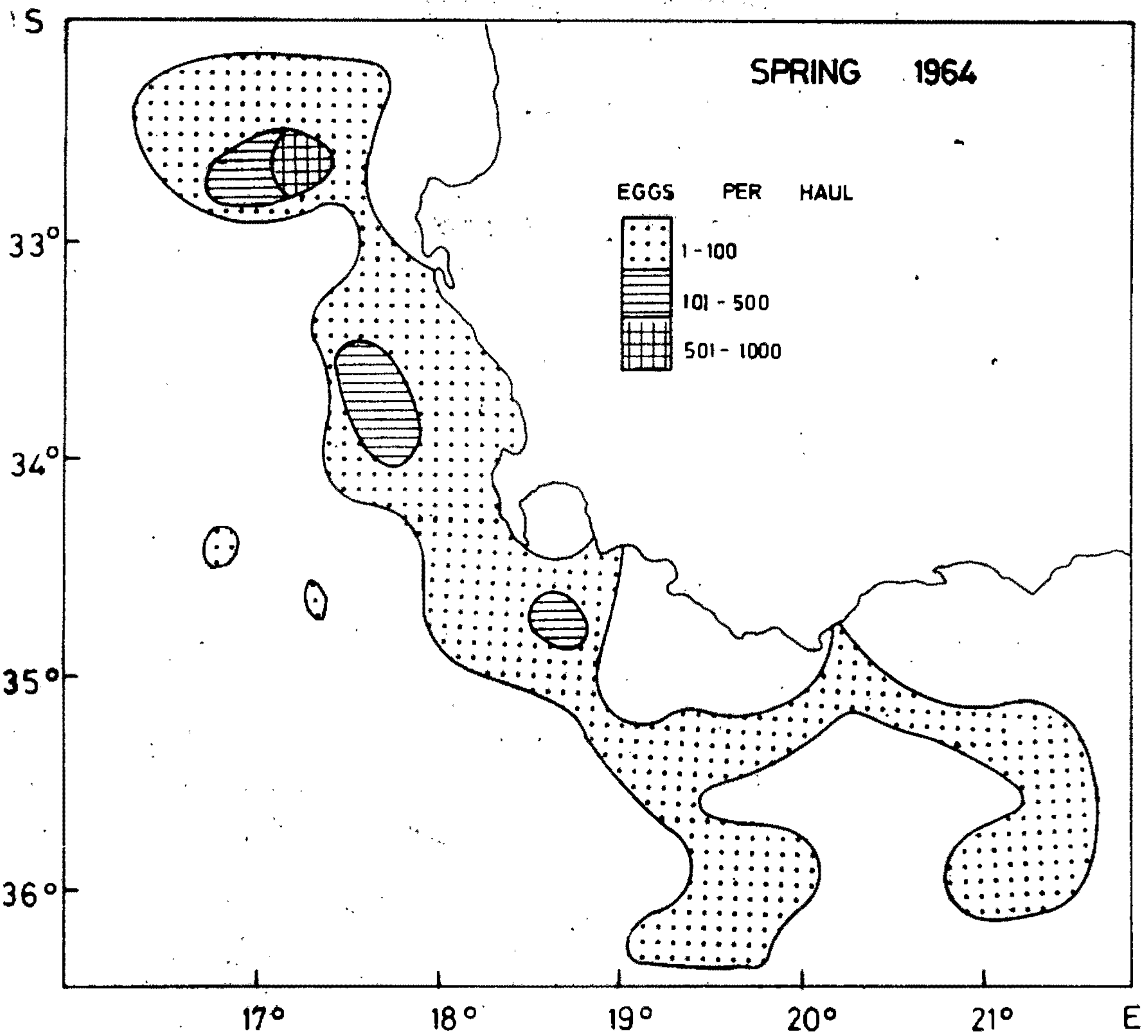


Fig 10a Surface distribution of pilchard eggs, 1963 - 1964. (Sea Fisheries Branch unpublished data)



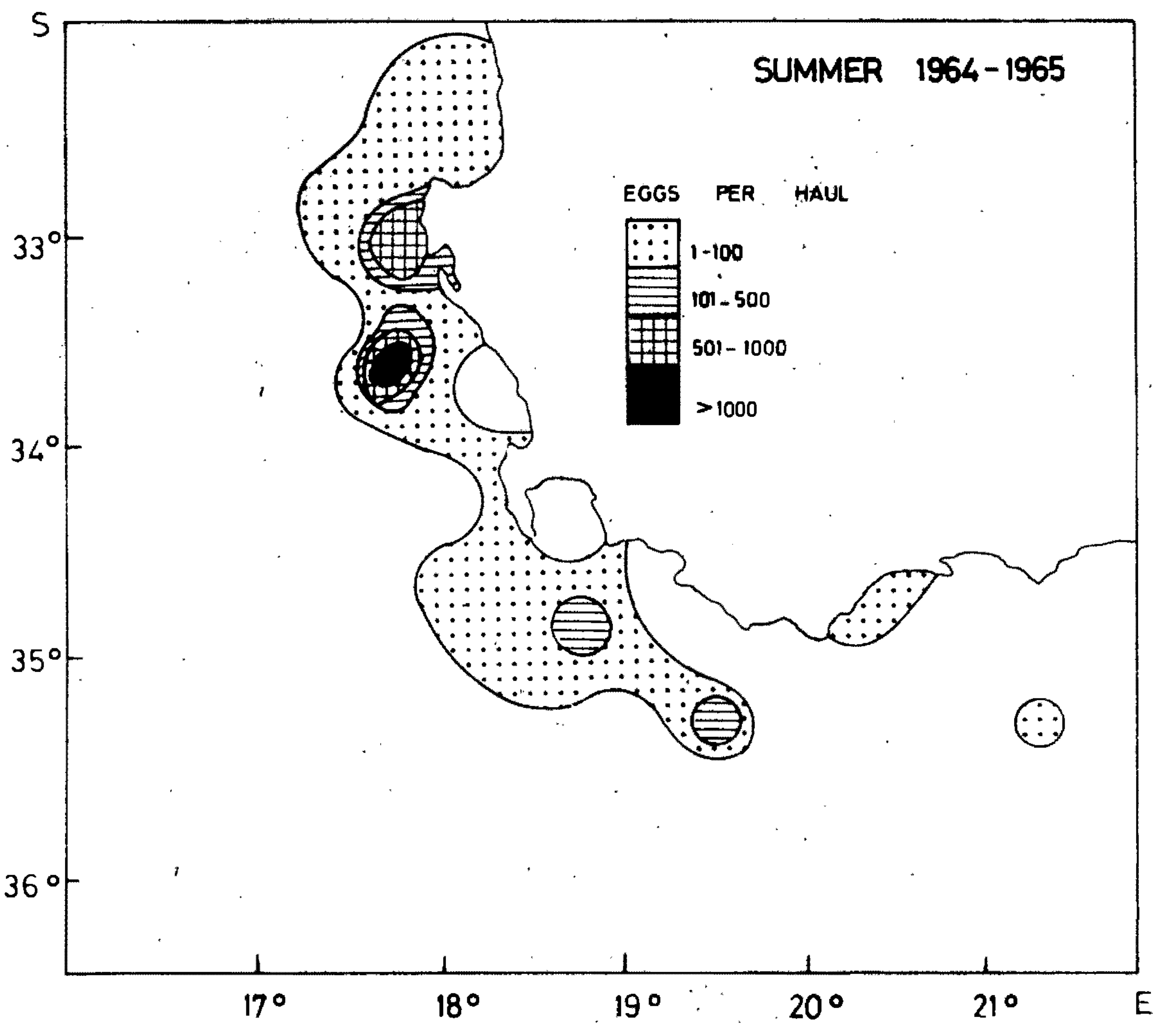


Fig 10b Surface distribution of pilchard eggs, 1964 - 1965. (Sea Fisheries Branch unpublished data)

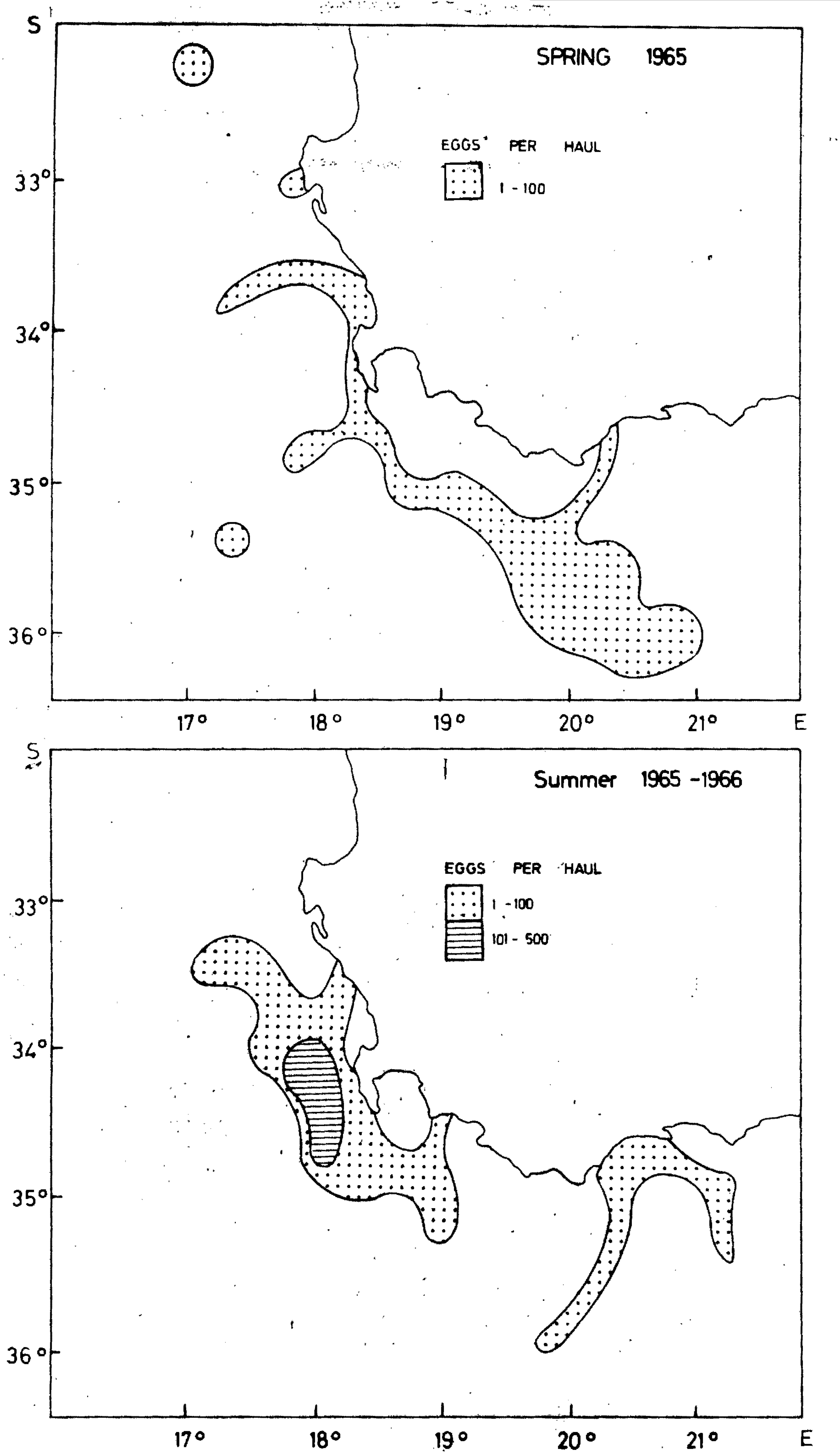


Fig 10c Surface distribution of pilchard eggs, 1965 - 1966.
Sea Fisheries Branch unpublished data)

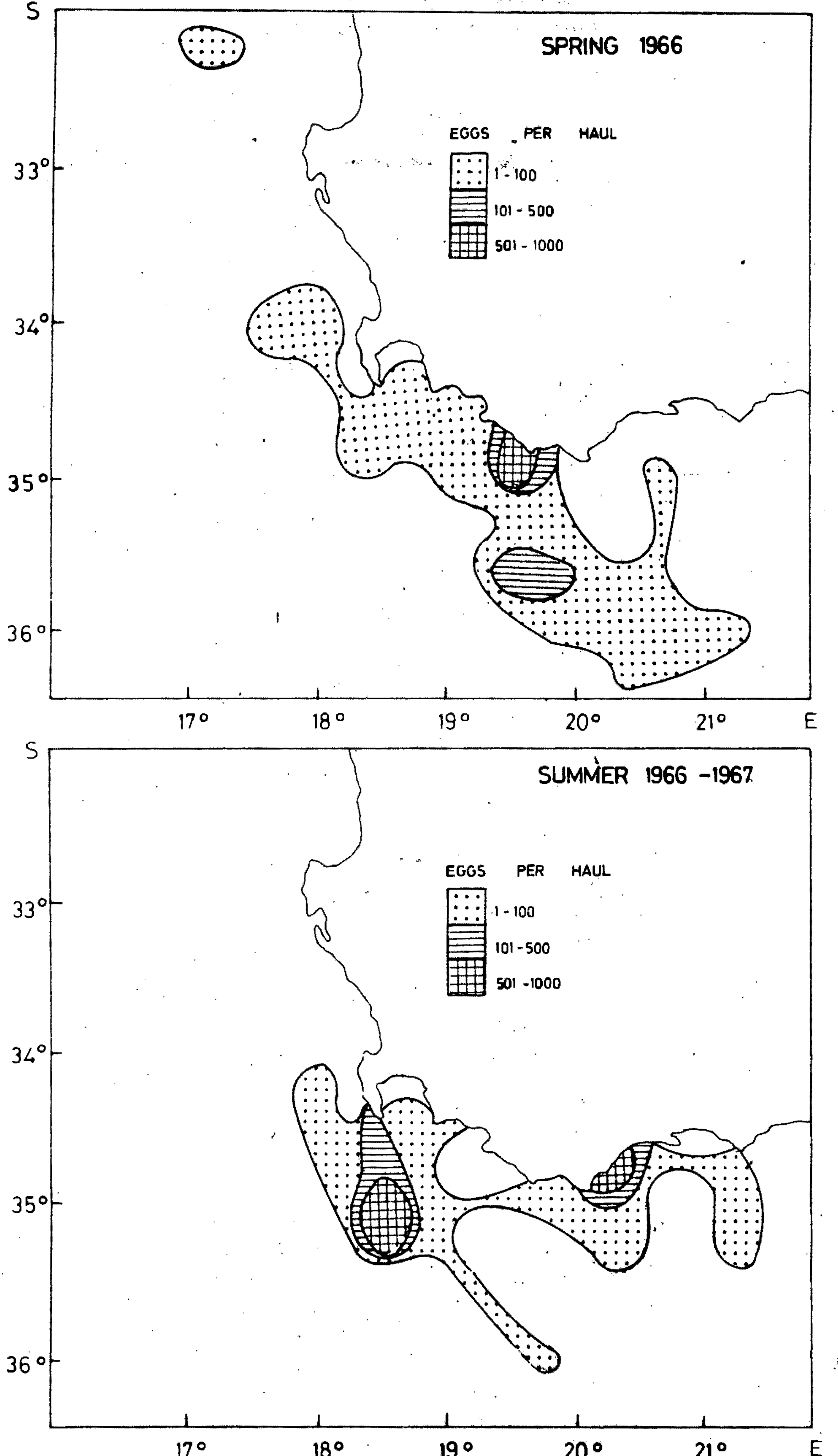


Fig 10d Surface distribution of pilchard eggs, 1966 -1967.
(Sea Fisheries Branch unpublished data)

The movement of nought-year-old pilchard towards the south is apparent in a number of years from the increased fishing south of Cape Columbine during winter or spring (August/September 1965; July/August/September 1966; June/August 1967; July/September 1968; July/August 1969; July 1971; July 1972; July/August 1975). In 1974 there were no catches of this age class (Crawford et al. 1978), an anomaly which will be dealt with in greater detail later.

One-year-olds

Availability of one-year-olds is at a peak in April, catch rates being relatively low in summer and winter (Fig. 8). Similarly to the youngest age class, these pilchard favour the west coast grounds and are encountered only infrequently in the Agulhas region (Fig. 9). In addition abundance indices suggest that they, too, move south during autumn and winter. They are absent from the Namaqua ground after June and from St Helena Bay after August. Since fish of this age and most two-year-olds are found to the east of Cape Point in January, it appears that this southward movement continues through spring.

Autumn catches of nought-year-olds were made in all years, except 1964 (when fishing for pilchard with the 12,7 mm net was prohibited) and 1976, and were especially good in 1967, 1968, 1969, 1970, 1971, 1972 and 1975 (Appendix).

Two- to four-year-olds

Trends in the availability and distribution of pilchard aged two to four are very similar and these groups may be considered together. All occur characteristically on the southern fishing grounds and in doing so differ markedly from both younger and older pilchard. They are most available at the beginning of the season (Fig. 8) and from late summer or early autumn move in a south-easterly direction past Cape Agulhas, being seldom caught in large numbers after April or May (Fig. 9).

This migration was especially noticeable, for example, in 1964 (Appendix). Fish of these ages were located between Saldanha Bay and Cape Agulhas in January, but by February were encountered only in the waters east of Cape Point and by March were situated off Gans Bay. Except for an isolated pocket, northwest of Cape Columbine, they were absent from the fishing grounds in April. In 1965 they remained on the west coast somewhat later than normal, ranging as far north as the Olifants River in May. By June, however, they were located east of Cape Point, providing particularly rewarding catches in the vicinity of Cape Infanta, and in July were only caught in limited quantities outside Walker Bay. Similar clear trends are apparent for 1966 (January - April), 1967 (January - March), 1968 (January - April), 1969 (February - April), 1970 (February - April), 1971 (February - May), 1972 (February - May), 1973 (January - April), 1974 (January - May), 1975 (January - April) and 1976 (February - June). The movement, therefore, has proved to be highly regular during the past thirteen years.

Two-year-olds are noticeably absent from the commercial pilchard catch in most years (Fig. 7) and often leave the southern fishing area earlier than the three and four age groups. Evidence to suggest that this cohort tends to be located to the east of the main fishing grounds comes from the regular winter occurrence of shoals of similar-sized pilchard off the Transkei and Natal coasts. These fish are frequently stranded on the beaches, giving rise to the well known Natal "sardine run" (Davies 1956b, 1970, Baird 1971, Heydorn et al. 1978). Although pilchard are infrequently observed between Cape Agulhas and the Transkei during autumn and limited experimental fishing in the region has failed to reveal large concentrations of fish, Hecht (1976) records that pilchard are preyed on extensively by hake trawled to the south of Port Elizabeth from April to June. In fact in May and June they comprised the entire stomach contents of more than 85 per cent of the fish sampled. Conversely pilchard have not been found to contribute to the diet of hake caught in the Benguela Current region (Chłapowski 1977). In addition Bulgarian trawlers using mid-water gear recorded catches of pilchard off Mossel Bay (34° 58'S, 22° 53'E) and off Port Elizabeth (34° 21'S, 25° 51'E) in September 1977. Unfortunately there is no information on the size of these fish. However, it would seem that pilchard, after passing Cape Agulhas, move to the mid-water and thus become available to hake in the Port Elizabeth vicinity.

Five- and six-year-olds

Five- and six-year-old pilchard have not been caught in large numbers since 1966 (Crawford et al. 1978), the year in which fishing for all species with the small-meshed (12,7 mm) net was first permitted. Use of this net was initially restricted to the anchovy resource, but the frequent occurrence of anchovy with other species in mixed shoals rendered enforcement of such legislation impractical.

The older pilchard age-groups are most available from February to May or June (Fig. 8). Although they have contributed in some measure to the summer/autumn catch east of Cape Point, abundance indices (Fig. 9) show that they occur more commonly on the northern fishing areas, where catch rates, especially on the Namaqua ground are highest during autumn and winter.

These observations are, to a large extent, based on three years' data (1964 - 1966) only, but confirmation comes from the findings of Davies (1956b) and from pilchard catch rates calculated for the period 1950 - 1955 (Fig. 8), when 92 per cent of all catches were located between Lambert's Bay and St Helena Bay (Davies 1956b) and only few pilchard aged less than four contributed to the landings (Crawford et al. 1978).

DISCUSSION

The behaviour of the pilchard population off South Africa is closely related to the environmental conditions of the region (Crawford et al. in press). Spawning is almost entirely confined to spring and summer, the main upwelling season, thus ensuring an abundant food supply for developing larvae and juveniles. In recent years the largest concentrations of eggs have been encountered to the east of Cape Point, where due to the influence of the Agulhas Current, the water in the upper layers is well-mixed and warm. Previously heavy spawning was also recorded on the St Helena Bay and Saldanha Bay grounds. In these areas the eggs were generally located offshore (Fig. 10), in warm water of oceanic origin. As the initial rate of development increases exponentially with temperature (King 1977a), spawning in warmer water is likely to enhance survival of the early ichthyoplankton stages by reducing the age at which complete retinal pigmentation is attained and so decreasing mortality caused by predation (Lasker 1964). In addition abnormal development occurred under experimental conditions at temperatures less than 13°C (King 1977a).

It is on the Namaqua and St Helena Bay grounds that the initial recruitment of young fish, in May or June, is heaviest, even now that spawning in the northern region has been virtually terminated. Thus much of the ichthyoplankton originating from the southern areas must subsequently be carried in a westerly and then a northerly direction. The eggs and larvae are planktonic and surface currents, set in motion by the prevailing south-easterly winds of spring and summer, suggest that large quantities are transported westwards around Cape Point (Duncan and Nell 1969). In addition Bang and Andrews (1974) have demonstrated the presence of a strong shelf-edge frontal jet, which shoots large volumes of water at rapid speed (100 cm/sec at the core) in a northerly direction along the west coast. Shelton and Hutchings (1979) are of the opinion that this jet may be important in the dispersal of anchovy ichthyoplankton and it is probably also for pilchard.

In winter the highest plankton concentrations are found in a narrow strip inshore, with maximum standing stocks in the north (Crawford et al. in press). It is here that catch rates for nought-year-old pilchard, which feed predominantly on zooplankton (King and Macleod 1976), are initially best. The sharp increase in their availability may result from both growth to a size at which they are fully selected by the fishing gear and an initiation of shoaling behaviour.

As upwelling recommences during spring many of these fish move southwards into newly productive areas (Crawford et al. in press). Inshore countercurrents (Duncan and Nell 1969) may assist in the migration. However, significant quantities also remain on the northern grounds until late winter or spring of the following season, when they join with the latest recruits in their movements towards and around Cape Point.

Pilchard generally do not become reproductively active until well into their second year of life. In spring and summer two- to four-year-olds occupy the southern fishing areas. Here, as mentioned earlier, relatively warm water promotes rapid development of the early ichthyoplankton stages. Then, from April or May, these age groups move in an easterly direction past Cape Agulhas, where it appears that they occur in the mid-water. When about one year old the pilchard develops a fine filtering mechanism (King and Macleon 1976) which enables it to feed on phytoplankton in addition to zooplankton. The chlorophyll maximum layer is frequently sub-surface east of Cape Agulhas (Crawford et al. in press) and presumeably the location of these fish in the water column is related to food abundance.

The best yields of five- and six-year-olds have been recorded off the west coast, where catch rates have been highest in autumn and winter. Though occurring in the same area as juvenile pilchard at this time, they need not necessarily be in direct competition with these latest recruits for food, on account of their ability to make maximum use of the phytoplankton resources. Davies (1956b) attributed their low availability in spring and summer to the fact that they consistently moved offshore to spawn. A severe decline in egg abundance in the St Helena Bay vicinity has coincided with a greatly reduced contribution by these age groups to the commercial landings.

It is generally recognised that the pilchard stocks off South Africa and South West Africa are independent entities. There is little evidence of large scale movement between the two regions (Stander and Le Roux 1968, Newman 1970b) and catch-per-unit-effort trends have shown considerable discrepancies.

In South West African waters the pilchard has two main spawning seasons, spring and summer, which are associated with separate geographical areas, Walvis Bay and Möwe Point respectively. These regions have contrasting hydrological conditions, leading to speculation that two South West African stocks exist (King 1977b, O'Toole 1977). Closer investigation, however, may yet reveal a situation analogous to that which previously obtained in South Africa, that is two isolated spawning areas arising from the different distribution patterns of the various age components of one population. A number of similarities in the behaviour of the pilchard in these two territories are already apparent. Spawning off Walvis Bay, for example, coincides with a peak in upwelling and the subsequent dispersal of ichthyoplankton is in a northerly direction (O'Toole 1977). In addition Schülein (1973) has demonstrated that the appearance of juvenile pilchard in the catches is associated with southerly currents and has postulated with the nursery grounds are situated to the north of the fishing area.

Two other commercial fisheries, those of the Californian sardine Sardinops caerulea and the Japanese sardine S. melanosticta, also bear mention here. Off California a decline in the sardine landings was accompanied by a progressive southward shift in the position of most catches, until the majority were located in the relatively warm water off Baja California (Murphy 1966). A parallel situation developed in the South African pilchard fishery when catches of this species fell dramatically during the mid-1960's. Elimination of the older age classes meant that the range of adult fish contracted to the south and particularly to the warmer waters east of Cape Point. Interestingly, examination of the age composition of the Californian sardine landings, as presented by Murphy (1966), reveals that the decrease in the range of this species coincided with a considerably reduced contribution to the commercial catch of fish aged five and older.

The performance of the sardine fishery in Japan has been characterised by the same enormous fluctuations which have dominated those off South Africa, South West Africa and California. Most of the spawning occurs in the southern areas, which are influenced by the warm Kuroshio Current, and within 20 to 30 miles of the coast. Dispersal of the ichthyoplankton is in a northerly direction towards the more productive, cooler water of the south-flowing Oyashio Current (Nagasaki 1973). Spawning by S. ocellata in warm water east of Cape Point aid the subsequent transportation of eggs and larvae into the Benguela Current system is similar to this mechanism.

The high degree of regularity in the seasonal distribution and availability of the various age components of the South African pilchard population should greatly facilitate the incorporation of these patterns in a simulation model of the fishery and also holds considerable practical advantages for assessment and management of the resource (Crawford and Shelton 1978, Crawford et al. in press). Only one major anomaly has occurred during the period of observation: the complete absence of nought-year-old pilchard from the commercial landings of 1974. Two possible explanations have been postulated for this phenomenon. Heydorn et al. (1978) suggested that it may have resulted from an eastward displacement of the parent stock during the 1973/1974 spawning season and drew attention to the unusual occurrence of nought-year-old pilchard off the Natal coast in 1974. On the other hand, the 1974 fishing season was brought to a premature conclusion on account of the early completion of catch quotas. Recruits of the year are generally caught after April but, by that time, much of the fishing activity had already been suspended (Newman and Crawford in press). Whatever the cause, the 1974 year class was only lightly exploited during its first two seasons in the fishery with the result that large yields of two-year-old pilchard were harvested in the 1976 season, thus suggesting that considerable benefits might accrue from directed fishing at particular year classes only (Crawford et al. in press).

CHAPTER 6. DISTRIBUTION, AVAILABILITY AND MOVEMENTS OF ANCHOVY ENGRAULIS CAPENSIS OFF SOUTH AFRICA, 1964 TO 1976.

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CHAPTER 6. DISTRIBUTION, AVAILABILITY AND MOVEMENTS OF ANCHOVY ENGRAULIS CAPENSIS OFF SOUTH AFRICA, 1964 TO 1976.

The latent economic potential of the anchovy Engraulis capensis in South African waters was first recognised by Gilchrist (1913), who brought it to "the attention of fishermen and fish merchants", noting that it provided "an opening for fishery enterprise." However, it was not until some fifty years later that catches of this species were to assume any real importance (Table XII).

Upon its inception in 1943, the South African purse-seine fishery was largely pre-occupied with exploitation of the pilchard Sardinops ocellata and horse mackerel Trachurus trachurus resources (Du Plessis 1959) and these two stocks continued to dominate the landings until the early 1960's. In particular exceptionally strong 1956, 1957, 1958 and 1959 pilchard year classes (Newman and Crawford in press) led to considerable increases in fishing effort and catches in excess of 400 000 metric tons were recorded. Subsequently, when recruitment returned to more normal levels, it was not possible to maintain these yields and managers of processing plants sought alternative resources to bolster their diminishing returns.

With this in mind exploratory fishing for anchovy was initiated in 1963, during the closed season for pilchard, under supervision of the Fisheries Development Corporation. From September six boats were equipped with small-meshed (12,7 mm) nets and power blocks but it took several months for skippers to master the operation of this new gear and it was not until December, when 282 tons were landed, that the experiment eventually started to provide encouraging results. The January opening of the 1964 season resulted in a further delay, as the six skippers preferred to concentrate on the traditional pilchard resource, but in April they again recorded large catches of anchovy, up to 100 tons for a single haul, and it was soon apparent that this species was distributed over a wide area off South Africa's west coast. Accordingly it was decided to expand the experiment and permission was granted for a total of 42 small-meshed nets to be used for anchovy fishing during the closed season of that year, three for each of the 14 fishmeal factories then in operation. The balance of these nets had all been delivered from overseas manufacturers by the end of September 1964, at a cost of approximately R10 000 each (Robinson 1966), and subsequent catches were sufficiently goof for authorities to sanction the use of this net by all purse-seine boats (except those licensed for bait catches only) from 1st January 1965. Thereafter the rise in the importance of the anchovy was rapid and since 1966 it has consistently been the main contributor to the South African purse-seine catch, with a peak of 349 829 tons being recorded in 1974.

TABLE XII : ANNUAL CATCHES OF ANCHOVY AND PERCENTAGE CONTRIBUTION TO COMBINED PURSE-SEINE LANDINGS, 1950 TO 1976.

Year	Catch (metric tons)	Percentage of combined purse-seine catch
1950	-	-
1951	-	-
1952	-	-
1953	-	-
1954	-	-
1955	-	-
1956	-	-
1957	-	-
1958	172	0,1
1959	1 375	0,4
1960	-	-
1961	-	-
1962	-	-
1963	282	0,1
1964	92 437	21,7
1965	171 014	35,6
1966	143 916	40,3
1967	270 633	53,1
1968	138 062	37,5
1969	149 195	42,4
1970	169 301	47,2
1971	157 282	48,4
1972	235 642	54,3
1973	250 910	55,6
1974	349 829	87,3
1975	223 612	54,9
1976	218 307	53,6

In other commercial anchovy fisheries the populations exhibit a reproductive and migratory behaviour that is linked to environmental factors. The northern anchovy Engraulis mordax, for example, though producing eggs throughout the year, has its main spawning season during the boreal winter and spring. At this time prevailing northerly and north-westerly winds off the coast of California give rise to upwelling of cold, nutrient-laden water along the shoreward side of the south-flowing California Current (Tillman 1972). Adults at this time move offshore to spawn and the ichthyoplankton is subsequently carried towards the mainland by surface currents (Sette 1960). In summer and winter large schools of juvenile anchovy are often found mixing with those of young sardine Sardinops caerulea (Phillips 1952). The adult stocks, meanwhile, undertake extensive coastwise migrations (Haugen et al. 1969), moving north during late summer with the Davidson countercurrent and south again in winter.

Fishing for the Argentinian anchovy E. anchoita is limited to a few months during spring when large concentrations approach the coast for spawning. Adults then migrate offshore and for the remainder of the year are intimately associated with the upwelling of the Falkland Current system. In summer the upwelling zone is at its southernmost position (latitude 39°- 40°S) but, as the year progresses, it moves north along the continental slope, until located off the coast of Uraguay (35°- 36°S) in winter. The anchovy concentrations follow this shift (FAO 1973).

Off Peru and Chile the distribution of the anchoveta E. ringens is practically restricted to the upwelling area of the Humbolt Current system and especially to the region between latitudes 5° and 25°S, within about 80 km of the shore (Boerema and Gulland 1973). Spawning takes place in patches throughout this area, the main season being spring to summer (Einarsson and De Mendiola 1967). Unusual environmental conditions, knowns as "El Nino", occur at intervals of several years when warm tropical water penetrates south along the Peruvian coast, decreasing or stopping upwelling. This phenomenon upsets the normal distribution pattern of the anchoveta causing it to concentrate in the remaining areas of cool water or to disperse (Boerema and Gulland 1973).

The Australian anchovy E. australis is found along most sections of the coast south of the Tropic of Capricorn, inhabiting estuaries, bays and open waters over the generally narrow continental shelf. The main spawning season is spring through summer and, in some areas at any rate, there appears to be a tendency, increasing with age, for individuals to move from inlets to the open sea in autumn and back again for the spawning period in spring. In autumn the inlets become colder, and in spring warmer, than the sea (Blackburn 1967).

Spawning of the Japanese anchovy E. japonica takes place off the southern Pacific coast of that country, a region that comes under the influence of the warm Kuroshio Current. The densest concentrations of eggs are encountered during winter or spring. Juveniles occur predominantly in bays and inlets but adults are also distributed offshore (Hayasi 1967) and further north in the cooler, more productive waters of the Oyashio Current (Nagasaki 1973).

The South African anchovy, too, has definite patterns of distribution and availability, which exert a considerable influence on the deployment of fishing effort (chapter 4) and, as in the above instances, are in large measure related to environmental factors. It is the purpose of this paper to both document and quantify these trends and to provide a basis for improving regulatory strategies.

DISTRIBUTION OF COMMERCIAL CATCHES

Monthly distribution patterns of commercial catches of anchovy for the period 1964 - 1976 were derived in a similar manner to that described for pilchard (chapter 5). The results are presented in map form in the Appendix, areas in which no fishing was conducted being illustrated to assist in their interpretation and catch rates to depict regional differences in the density of fish.

The length compositions of 300 purse-seine catches were examined and, as with the pilchard (chapter 5), it was determined that anchovy in South African waters generally shoal by size, individuals from any one haul seldom varying in caudal length by more than 4,0 - 4,5 cm (Fig. 11). Accordingly the modal length of fish caught in known areas, whenever available form field observations, has been included on the distribution maps to give some indication of geographic and seasonal differences in the size of anchovy encountered.

Reproductive activity in 1 265 individuals sampled during the 1963/64 and 1964/65 spawning seasons (October - January) was investigated by Robinson (1966). His information suggests that 50 per cent of the anchovy attained sexual maturity by the end of their first year and that all were mature before they were two years old. For mapping purposes nought-year-old fish were considered to be juveniles and have been illustrated in different shading to that used for all older age groups. Thus distribution of recruit year classes has been highlighted.

The results indicate that, as with pilchard (chapter 5), almost all catches of anchovy are made inside the 200 m bottom contour, except in the vicinities of Cape Columbine and Cape

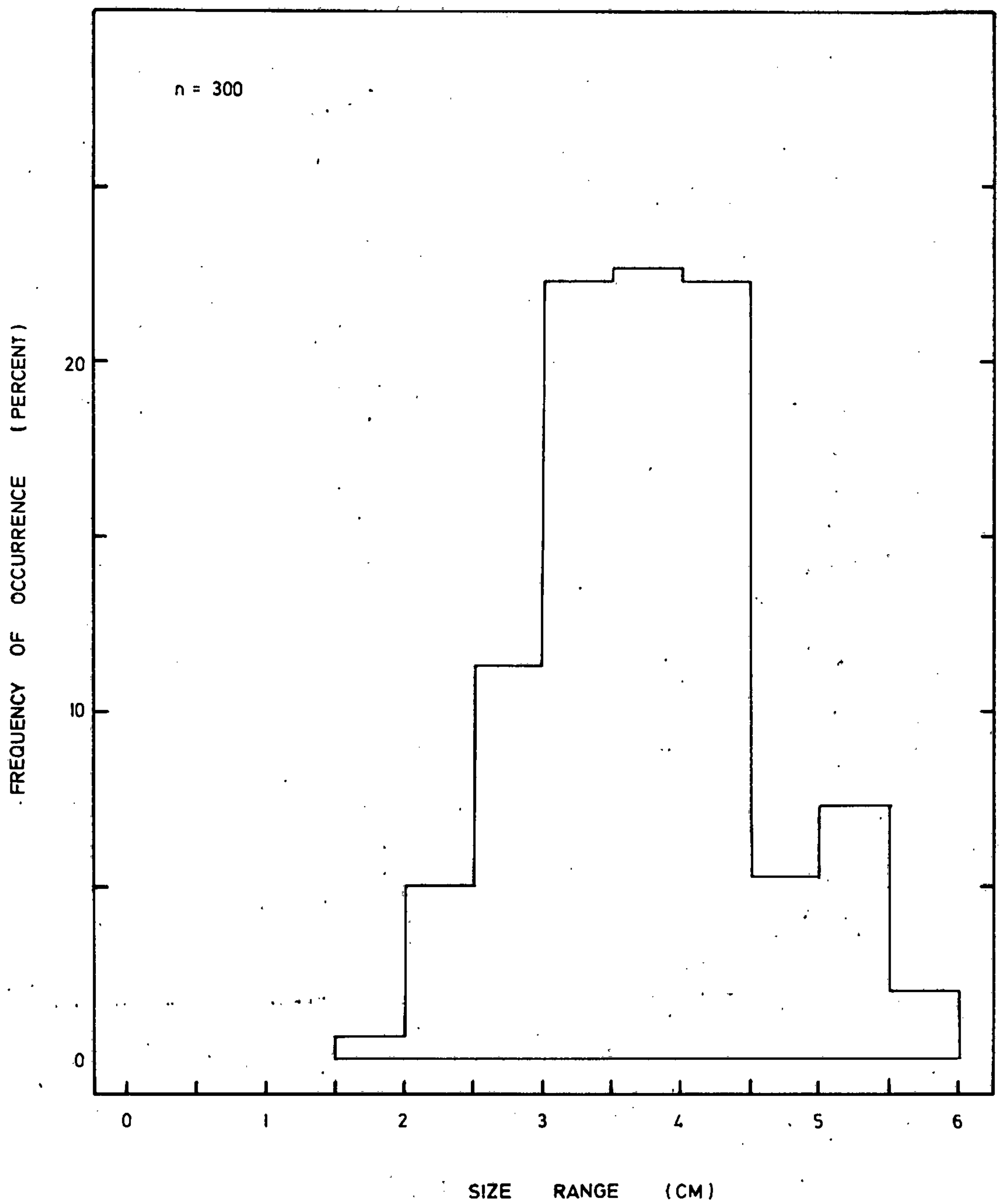

Fig 11 Frequency of occurrence of anchovy size-range (caudal length) variations between largest and smallest fish sampled from individual purse-seine catches.

Point where this line approaches the mainland. This pattern could be influenced by the fact that skippers generally choose to stay within sight of the coast, especially when fishing alone, since they rely to a large extent on prominent topographical features for navigation. By 1976 no boats had been equipped with Decca navigation equipment. Notable exceptions were catches of juvenile anchovy north-west of the Olifants River in June 1966, January 1968, April 1971 and August 1976, west of the Olifants River in January 1974, March, May and June 1976, north-west of Cape Columbine in April, May and June 1969 and west of Saldanha in January 1976; and of adults north-west of the Olifants River in May 1971 and north-west of Cape Columbine in July 1972. It is immediately apparent that all these records are from the northern half of the fishing grounds.

Catches of both nought-year-olds and older age classes have been recorded as far north as the Orange River (juveniles in June, July and August 1966; adults in March 1971) and as far east as Cape Infanta (juveniles in April 1967, January 1970 and February 1974; adults in June 1964, January 1966, May 1973, April 1974 and June 1975). It has seldom been necessary for boats to travel such distances, however, and fishing in these areas has not been intensive (chapter 4). Further east anchovy have been recorded in the stomachs of hake, Merluccius sp. trawled off Port Elizabeth (Hect 1976) and spawning has been noted off East London and Natal (Anders 1975).

AVAILABILITY, ABUNDANCE AND MOVEMENTS

Seasonal patterns of availability and distribution were quantified by dividing the fishing area into six grounds (Fig. 1), selected to correspond with the major environmental regions of the South-western Cape (Crawford et al. in press). As may be seen from the Appendix, the seaward extension of these grounds is seldom greater than 50 km and they are thus of approximately equal size except for the extensive but relatively lightly exploited Namaqua area.

Monthly indices of availability and of the relative abundance of fish that could, as a rule, be expected to be present on each of the six grounds were determined in a method analogous to that described for the pilchard population (chapter 5) for both nought-year-old anchovy and the older age groups. Only the years 1965 - 1976 were considered because fishing with the small-meshed net in 1964 was restricted to between 6 and 42 boats only. Values were not calculated for October, November or December, the season being closed during these months after 1965.

The resulting estimates, expressed as percentages of the maxima, appear in Figs. 12 and 13. The trends exhibited by the fully recruited age classes are probably determined to some extent by

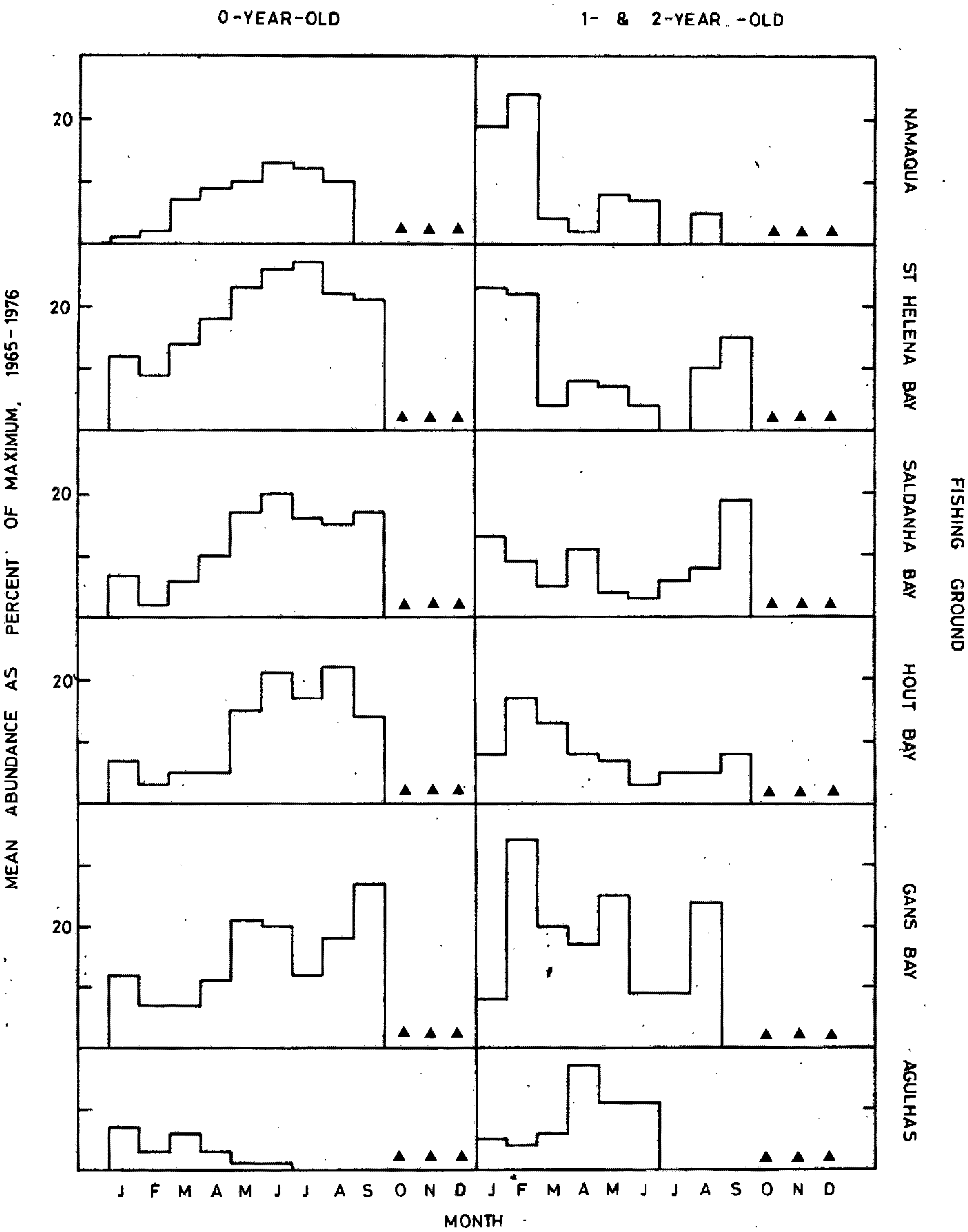

Fig 13 Abundance indices for anchovy
(▲ no data)

mortality, especially that due to fishing, with catch rates falling as the season progresses. However, an unrealistically high value of total mortality (Z = 3,9) would be required to produce the observed decline in availability. A natural mortality value of 0,8 was calculated for this population from the age composition of the relatively unfished stock in 1965, whereas estimates of fishing mortality for the period 1965 - 1976 have ranged between 0,57 and 1,09 (mean 0,70) (Centurier-Harris et al. 1977). Undoubtedly, therefore, fish movements also exert a considerable influence, as is evident from a bimodality in abundance indices for the St Helena Bay, Saldanha Bay, Hout Bay and Gans Bay grounds. These will be discussed in greater detail when considering the adult population.

Spawning

Both migrations (Jones 1965) and patterns of recruitment may be considerably influenced by spawning behaviour. Information on the surface distribution of anchovy eggs between Lambert's Bay and St Sebastian Bay is available for the period 1964 - 1969 (Sea Fisheries Branch unpublished data). Although the data are not strictly quantitative, the survey having been conducted with the surface-sampling N 100 H net whereas the vertical distribution of eggs of this species extends to the thermocline (Shelton and Hutchings 1979), it is evident from Fig. 12 that spawning was largely confined to the period October to January. Eggs were generally present in their densest concentrations in the waters to the east of Cape Point (Fig. 14).

Nought-year-olds

Juvenile anchovy recruit to the fishery in steadily increasing numbers after February with availability reaching its highest level in June (Fig. 12), six months after the peak in egg production. This time lag is similar to those for the Peruvian anchoveta (Schaefer 1967) and northern anchovy (Tillman 1972) fisheries. From June until September the young anchovy are generally caught in large quantities. The pattern thus resembles closely the one exhibited by their pilchard counterparts (chapter 5) and is likely to account for the fact that the two species frequently shoal together during their early stages. Furthermore, like pilchard, the anchovy recruits move south, catches on the two northern grounds declining after June or July and fishing for this age group being most rewarding to the east of Cape Point in September (Fig. 13).

Although indices were not calculated for October to December, fairly good catch rates were recorded during these months in 1964 (Appendix). Availability at this time probably decreases to the moderate level estimated for January, when, on average, over 40 per cent of the age group is located east of Cape Point and more than 70 per cent south of Cape Columbine.

As may be seen from the Appendix the pattern of recruitment is highly regular, being clearly evident in every season with the possible exception of 1974, which was closed from 26th June as a result of the quota being filled considerably earlier than usual (Table III). Catch rates greater than 50 metric tons per standard boat day were frequently recorded from May onwards but were uncommon during the first four months of the season (Table XIII). The good catches of juvenile anchovy during summer and early autumn of 1974 and 1975 can probably be attributed to the premature closure of the previous (1973 and 1974) seasons, in both of which no catches of anchovy were permitted after the end of June. Thus exploitation of nought-year-olds in these two years was curtailed, enabling the better than normal catches that followed.

Southward movement is apparent from the increased tendency to fish south of Cape Columbine during winter or at the onset of spring (August/September 1964; July/August 1965; August/September 1966; August/September 1967; July/September 1968; August 1969; August 1970; July/August 1971; July 1972; June 1973; August 1975; July 1976), though good catches often continue to be recorded from the northern areas at this time. In addition the size of nought-year-old anchovy tends to increase in the southern and eastern fishing areas, suggesting that individuals occurring in these waters are somewhat older than those encountered further north. The modal caudal length of fish caught on the Namaqua and St Helena Bay grounds was less than 8,0 cm for 26 of the possible ground-month combinations, as compared with 13 instances for the Saldanha Bay and Hout Bay regions and only 4 for those east of Cape Point.

One- and two-year-olds

Preliminary analysis revealed that the adult anchovy age classes behaved in a similar fashion and they are here considered together. These fish consist mainly of one- and two-year-olds (Fig. 15), a high mortality rate resulting in very few older individuals surviving. They are most available in summer and catch rates decline as winter approaches (Fig. 12). As mentioned earlier this may be partly attributable to fishing pressure but fish movements probably also exert an important influence. At the start of the year the adults are distributed throughout most of the fishing region but thereafter frequently undertake a migration to the south and east (Fig. 13). This is similar to that of pilchard aged between two and four (chapter 5) though these latter are usually positioned slightly further to the east. In autumn and winter large anchovy are most abundant in the waters to the east of Cape Point, then, at the beginning of spring they show a definite tendency to return to the western areas.

The south-east displacement during the austral winter is evident from the distribution of the commercial catches in 1964, 1965,

TABLE XIII : MONTHS IN WHICH CATCH RATES GREATER THAN 50 METRIC TONS PER STANDARD BOAT DAY WERE RECORDED FOR NOUGHT-YEAR-OLD ANCHOVY.

Month	Seasons
January	1974, 1975
February	1974
March	1971, 1974
April	1969, 1975
May	1966, 1967, 1973, 1974, 1976
June	1965, 1966, 1967, 1968, 1969, 1973, 1975, 1976
July	1965, 1966, 1967, 1975, 1976
August	1964, 1965, 1967, 1975, 1976
September	1964, 1965, 1966, 1968
October	1964
November	1964
December	-

TABLE XIV : POPULATION ESTIMATES FOR SOUTH AFRICAN PENGUIN COLONIES, 1956 AND 1978.

Colony	No. breeding adults 1956*	1978**	Change 1956 - 1978 Actual	Percentage
Lambert's Bay	500	14	-486	-97,2
Malagas	5 000	1 152	-3 848	-77,0
Marcus	9 500	748	-8 752	-92,1
Jutten	15 000	4 794	-10 206	-68,0
Vondeling	600	552	-48	-8,0
Dassen	145 000	22 440	-122 560	-84,5
Seal	500	100	-400	-80,0
Dyer	8 000	37 424+	+29 424	+367,9
St Croix	12 000	12 000+	0	0,0
Bird	500	500+	0	0,0

* Data from Rand (1963). Census technique aerial photography.

** Own data. Census technique nest count.

\+ Approximate figures from Randall (pers. comm.).

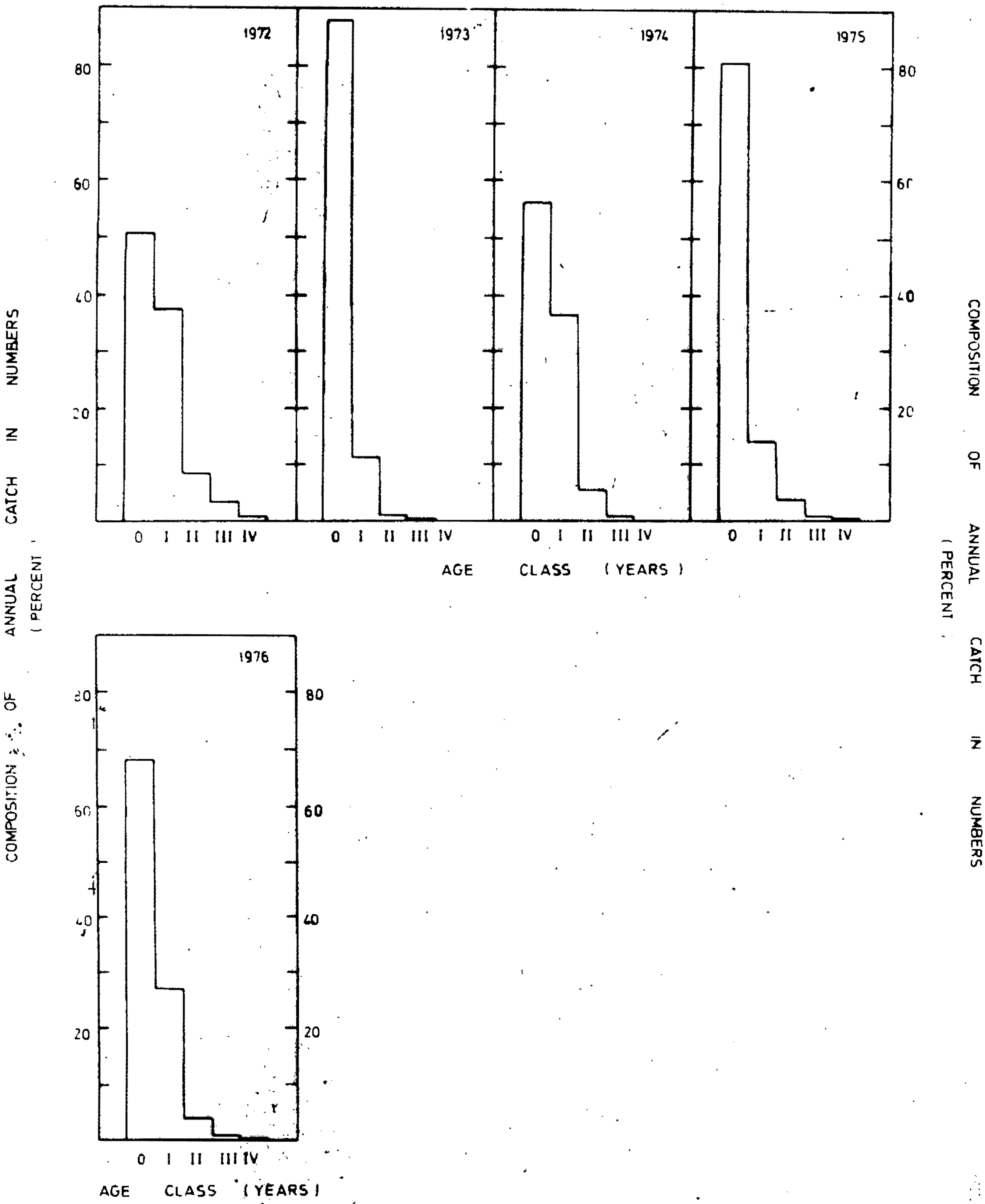

Fig 15b Age composition of South African anchovy landings, 1972 - 1976.

1966, 1968, 1969, 1970, 1973 and 1975 (Appendix). Good hauls of adult anchovy may also be made off the west coast at this time, as was the case in 1964, 1965, 1971 and 1974. During 1964 and 1965, however, these catches could have resulted from the virgin stock not yet being substantially reduced because rewarding fishing was also recorded further south. The summers of 1971 and 1974 provide the only known instances of adult anchovy being caught north of latitude 30°S and even in these years there was a slight movement to the south in winter.

DISCUSSION

Comparison of the behaviour of the anchovy population with that of the pilchard (chapter 5) reveals close similarities, which can be related to the environmental features of the region (Crawford et al. in press). Most catches of both species are recorded inside the 200 m bottom contour and, in the few instances that successful hauls have been made further offshore, they have almost invariably been from the northern regions and have generally been of juveniles. It is possible that the positioning of these fish may have resulted from the larvae being carried away from the west coast by surface currents, which during summer frequently flow in a northerly to north-westerly direction (Shannon 1966).

Since 1966 spawning by both anchovy and pilchard has been heaviest to the east of Cape Point where relatively warm temperatures promote the rapid development of eggs and larvae. Subsequent dispersal of the ichthyoplankton is into the Benguela Current system. Here spring and summer upwelling ensures an abundant food supply for the early stages. Shelton and Hutchings (1979) have demonstrated the importance of the Good Hope Jet (Bang and Andrews 1974) in the transportation of eggs and larvae towards the northern nursery areas and it is on these grounds that juveniles of both species, frequently shoaling together, recruit to the fishery in their highest numbers in late autumn or early winter. At the advent of spring they move south for the next spawning season, possibly taking advantage of inshore countercurrents (Duncan and Nell 1969). After spawning, anchovy and the younger pilchard adults frequently migrate off the fishing grounds in an easterly direction.

Certain differences in the behaviour of the two species are also apparent and can mainly be attributed to the younger age at maturity of the anchovy and the longer lifespan of the pilchard. Substantial numbers of juvenile pilchard, for example, remain on the west coast until well into their second year of life. They are only at that age first starting to become reproductively active (chapter 5) and so have no need to position themselves at the beginning of their first spring in the warmer water further south. Instead they are able to stay in the highly productive upwelling regions found to the west of Cape Point. Furthermore large quantities of five- and six-year-old pilchard contributed to the commercial landings prior to the introduction of the 12,7 mm net, being especially abundant in the northern fishing areas. Here they consistently gave rise to dense concentrations of eggs during spring and summer. By contrast a high natural mortality rate means that anchovy seldom attain this age (Fig. 15). Anchovy spawning is generally limited to the southern grounds (Fig. 14), which may be due to the fact that pilchard eggs and larvae are slightly more tolerant of cold water than anchovy, having a lower lethal limit of 13°C as opposed to 14°C (King _et al._ 1978). Between 1964 and 1967, when measurements were stopped, surface temperatures in the northern pilchard spawning region never dropped below 13°C during spring and summer. Values of 14°C, or slightly lower, were observed however.

Moreover, although their spring and autumn migrations always appear to be in the same direction, the adult anchovy age groups have a less consistent distribution than those of pilchard. In winter they may occur in dense concentrations on the northern fishing grounds or alternatively be situated to the east of Cape Point. Flightlessness limits the feeding range of the jackass penguin _Spheniscus demersus_, leading Frost _et al._ (1976) to suggest that this bird must be able to rely on a highly predictable temporal and spatial distribution pattern of its prey. As pilchards satisfy this requirement to a greater extent than anchovies, the decline of the pilchard resource during the early 1960's could have been expected to have had a particular significance for the penguin population, in spite of the availability at that time of a large anchovy stock. Recent census figures support this idea (Table XIV). Since 1956 there has been a substantial decrease in the numbers of penguins at all colonies located to the west of Cape Hangklip (Fig. 16). By contrast those occuring further east have remained relatively stable or, in the case of Dyer Island, increased. This latter group falls within the distributional range of pilchard aged two to four, which still contribute substantial purse-seine catches, whereas the remaining colonies would have been largely dependant on the older pilchard age classes, which have been virtually eliminated.

Anchovy spawning and the pattern of nought-year-old recruitment are highly predictable and greatly facilitate control of the fishery. Thus amid other considerations, the current closed fishing season in South Africa (September - December inclusive) has been selected to include those three months in which the highest anchovy egg yields have been recorded (Fig. 12). Additional possibilities also exist, such as the differential exploitation of particular age classes or increasing the age at first captive through regulating deployment of fishing effort.

CHAPTER 7. DISTRIBUTION AND AVAILABILITY OF HORSE MACKEREL <u>TRACHURUS</u> <u>TRACHURUS</u> OFF SOUTH AFRICA, 1964 TO 1976.

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CHAPTER 7. DISTRIBUTION AND AVAILABILITY OF HORSE MACKEREL *TRACHURUS TRACHURUS* OFF SOUTH AFRICA, 1964 TO 1976.

On the basis of differences in catch-per-unit-effort trends (De Villiers 1977) and also biological evidence (Draganik 1977) it is now recognised that two separate stocks of horse mackerel *Trachurus trachurus* are present in South African waters. The one is found in ICSEAF Divisions 1.5 and 1.6 and the other in Divisions 2.1 and 2.2 (Fig. 1). In addition a third is located off the South West African coast (Divisions 1.3 and 1.4). These three populations belong to the Cape sub-species *T.t. capensis* (Cast), as recognised by the ICSEAF Working Group on Demersal Species at their first meeting (Madrid, May 1973), whereas Angolan catches often include the Cunene horse mackerel *T.t. trecae* (Cadenat) (Draganik 1977). The former may be distinguished by the longer length of the secondary dorsal line, which ends at the posterior edge of the second dorsal fin. By contrast that of the Cunene form terminates near the middle of the base of the first dorsal fin.

Horse mackerel contribute to both the South African demersal and purse-seine landings. Following De Villiers (1977) a breakdown of annual demersal catches from the various ICSEAF divisions is presented in Table XV. It may be seen that the combined catch rose from 445 metric tons in 1950 to 11 661 tons in 1976, largely as a result of increased fishing to the east of Cape Agulhas after 1965, It is with the purse-seine fishery of Divisions 1.5 and 1.6, however, and in particular the distribution of and seasonal changes in the availability of the horse mackerel population in these divisions, that this paper is primarily concerned.

Under the stimulus of a war-time demand for canned food commercial purse-seine fishing for horse mackerel and pilchard *Sardinops ocellata* was initiated in the St Helena Bay area (Fig. 1) in 1943. Although no accurate records were kept prior to 1950, Du Plessis (1959) estimated that over this period, the combined landings increased from about 6 500 tons to approximately 113 000 tons. Of the latter total horse mackerel was thought to account for some 40 per cent.

The fishery continued to develop in the early 1950's, with the same two species maintaining their domination of the catches (Crawford *et al*. 1978). The horse mackerel harvest attained a peak of 118 142 tons in 1954 (Table XVI), the only occasion on which it became the most important contributor to the mixed-species landings. This has been attributed to the excellent price which canned horse mackerel fetched on the U.S.A. market in that year (Du Plessis 1959). During other seasons, however, there was no preferential fishing for horse mackerel.

TABLE XV : APPROXIMATE SOUTH AFRICAN DEMERSAL LANDINGS OF HORSE MACKEREL PER ICSEAF DIVISION, 1950 TO 1976 (METRIC TONS) (FROM DE VILLIERS 1977).

YEAR	ICSEAF DIVISION				TOTAL
	1.5	1.6	2.1	2.2	
1950	-	316	5	124	445
1951	-	905	8	192	1 105
1952	-	1 109	2	115	1 226
1953	-	1 407	3	46	1 456
1954	-	2 478	0	72	2 550
1955	4	1 733	1	192	1 930
1956	22	1 006	1	327	1 356
1957	26	769	7	183	985
1958	-	1 836	18	219	2 073
1959	-	1 636	101	338	2 075
1960	-	3 283	169	260	3 712
1961	-	3 174	187	266	3 627
1962	-	2 525	204	350	3 079
1963	-	880	273	248	1 401
1964	19	1 151	405	396	1 971
1965	54	1 188	537	582	2 361
1966	88	1 472	374	1 150	3 084
1967	3	1 296	450	1 633	3 382
1968	58	309	1 035	1 962	3 364
1969	81	1 382	2 571	1 859	5 893
1970	3	3 600	2 253	1 309	7 165
1971	17	2 057	4 379	1 299	7 752
1972	0	1 259	2 243	1 450	4 952
1973	13	1 814	3 045	2 158	7 030
1974	85	1 721	5 847	2 850	10 503
1975	139	1 657	4 544	2 271	8 611
1976	151	2 424	7 116	1 970	11 661

TABLE XVI : ANNUAL PURSE-SEINE CATCHES OF HORSE MACKEREL AND PERCENTAGE CONTRIBUTION TO COMBINED LANDINGS, 1950 TO 1976.

Year	Catch (metric tons)	Percentage of combined purse-seine catch
1950	49 913	36,9
1951	98 545	49,2
1952	102 607	37,6
1953	85 216	39,1
1954	118 142	56,1
1955	78 821	35,7
1956	45 752	29,5
1957	84 615	42,0
1958	56 428	20,6
1959	17 655	5,6
1960	62 926	15,3
1961	38 936	7,9
1962	66 650	13,4
1963	23 168	5,4
1964	24 351	5,7
1965	54 965	11,4
1966	26 329	7,4
1967	8 786	1,7
1968	1 433	0,4
1969	26 832	7,6
1970	7 942	2,2
1971	2 226	0,7
1972	1 335	0,3
1973	1 614	0,4
1974	2 451	0,6
1975	1 638	0,4
1976	417	0,1

From 1950-1958 horse mackerel catches were based primarily on two large year classes, those of 1947 and 1948 (Geldenhuys 1973), and landings averaged about 80 000 tons (Table XVI). On the passing of these two cohorts from the fishery, however, yields dropped to a somewhat lower level of about 40 000 tons, which persisted, albeit with fluctuations, until 1966 (Centurier-Harris et al. 1977). In this year fishing for all species with a small-meshed (12,7 mm) net was first sanctioned and the result for horse mackerel was disastrous. Fishing pressure on the younger age groups increased and only once between 1967 and 1976 did the landings again exceed 10 000 tons.

DISTRIBUTION OF COMMERCIAL PURSE-SEINE CATCHES

Distribution patterns for commercial purse-seine catches made between 1964 and 1976 were derived in a similar manner to that described for the pilchard resource (chapter 5). These are presented in map form in the Appendix, catch rates being illustrated to depict spatial differences in the density of fish and areas in which no fishing was conducted to assist in interpretation of the results. It should be borne in mind that in 1964 and 1965 the season was closed for horse mackerel from August to October inclusive. Thus, although good by-catches were sometimes made while fishing for anchovy Engraulis capensis, catch per unit effort cannot be expected to provide an adequate measure of abundance in these months. The modal length of fish caught in known localities is also indicated, whenever this was available from field observations, to give some idea of geographic and seasonal differences in the size of horse mackerel encountered. Examination of 134 purse-seine catches revealed that horse mackerel from any one shoal can vary in caudal length by up to 11,0 cm, but generally by not more than 7,0 cm (Fig. 17). It is possible, therefore, that modal length may give a somewhat biased picture in certain instances but this is not expected to be the case often.

Age at maturity has not yet been determined for horse mackerel in South African waters. In the North Atlantic the majority do not spawn until they are three or four years old (Macer 1974) and similar results have been obtained off South West Africa (Ja Lipskaja 1972). In the Appendix, however, only nought-year-old fish are depicted as juveniles. The procedure adopted therefore conforms to that employed for pilchard and anchovy (chapter 5 and 6) in highlighting the distribution of recruit year classes.

As with pilchard and anchovy purse-seine catches of horse mackerel are seldom made to the seaward side of the 200 m bottom contour, except where this line approaches the mainland in the vicinities of Cape Columbine and Cape Point. The only known instances between 1964 and 1976 were of predominantly nought-year-old fish west of Dassen Island in August 1971; of four-year-olds north-west of the Olifants River in January 1965; and of seven-year-olds west of Cape Town in May 1969.

Although a few catches have been made off the Orange River (two-year-olds in May 1966; four-year-olds in July 1966; five-year-olds in June 1966), there are no additional records from north of latitude 30°S and fishing has also been poor at the other extremity of the grounds. The only successful hauls from east of Quoin Point were of one-year-old fish in January 1971 and April 1974 and of two-year-olds in April 1971. The geographical distribution of commercial purse-seine catches, therefore, provides strong supporting evidence for the hypothesis that horse mackerel inhabiting the waters between the Orange River and Cape Agulhas form a discrete population, which may be distinguished from others located off Port Elizabeth and off South West Africa.

AVAILABILITY AND ABUNDANCE

Preliminary analysis of distribution data suggested that the horse mackerel population of ICSEAF Divisions 1.5 and 1.6 was comprised of three distinct age components, viz. nought-year-olds, fish aged one or two, and all older individuals. Accordingly monthly indices of availability and of the relative abundance of fish that could, on average, be expected to be present on each of six fishing grounds (Fig. 1) were determined for these categories. The method employed was analogous to that previously adopted for the pilchard (chapter 5) though lack of adequate sample information preclude the use of data from 1968, 1975 and 1976. In addition 1964 and 1965 were also not considered for the two youngest categories as fish aged two or less were not fully selected prior to the introduction of the small-meshed net (Fig. 18). The resulting estimates, expressed as percentages of the maxima, appear in Figs. 19 and 20.

Nought-year-olds

Availability indices for nought-year-old horse mackerel are difficult to interpret, with peaks in January and May/June interspersed by relatively low catch rates (Fig. 19). The trend is somewhat similar to those exhibited by three typical spring/summer spawners, viz. pilchard, anchovy and round herring, with the exception that availability of these species remains at a high level during late winter and early spring (chapters 5,6 and 9). Furthermore, although Geldenhuys (1973), on the basis of an increased availability of large fish, postulated that spawning may take place in winter, the initial results of a recent plankton survey (Shelton pers. comm.) suggest that most egg production occurs in spring and early summer between Saldanha Bay and Cape Hangklip in deep offshore water. Off South West Africa the main spawning season is summer and early autumn (O'Toole 1977). The low availability indices calculated for July, August and September may, therefore, be an incorrect representation of the general pattern. Between 1966 and 1976 yields of horse mackerel were frequently low (Table XVI) and this may have resulted in an inaccurate

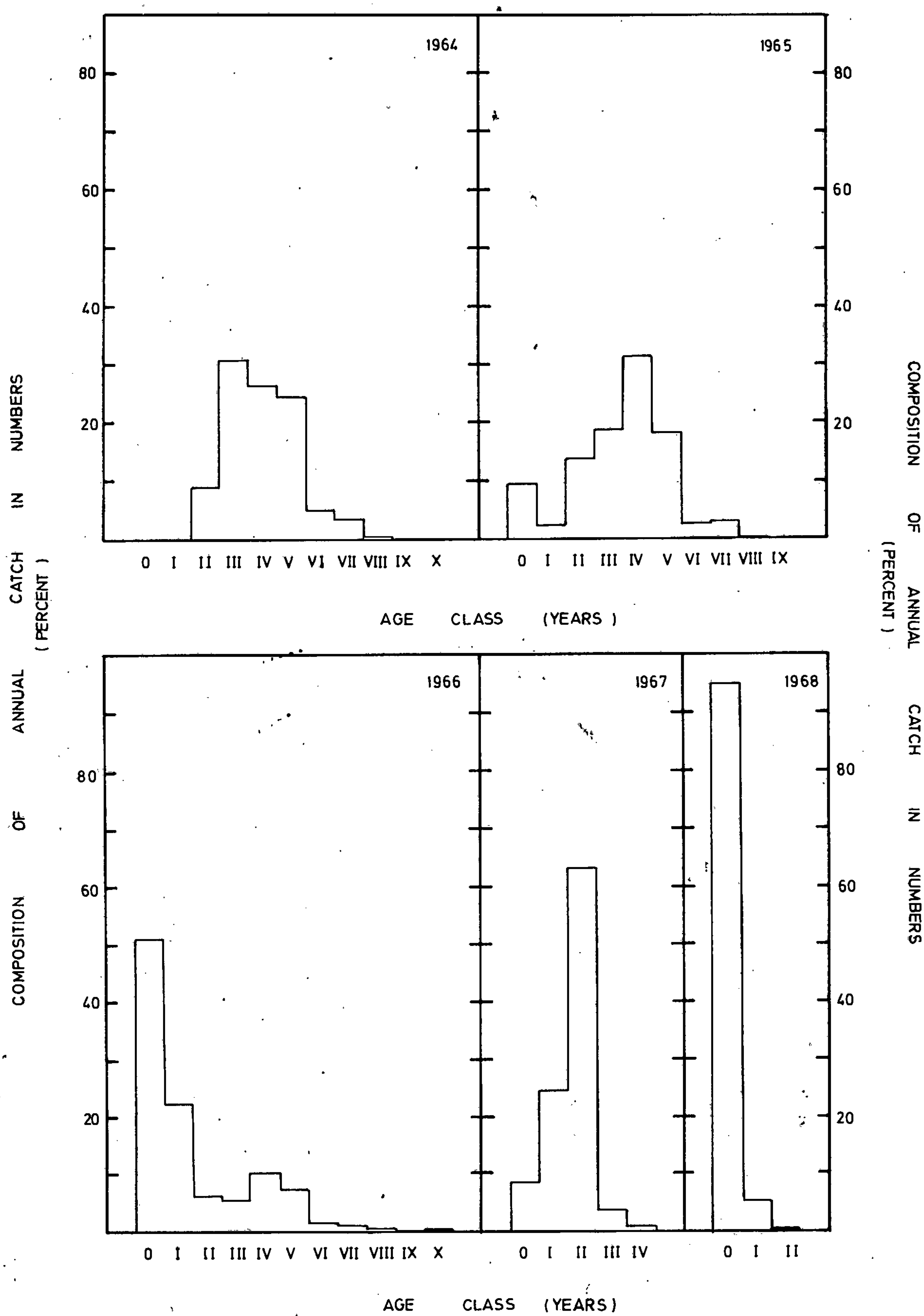

Fig 18a Age composition of South African horse mackerel landings, 1964 - 1968.

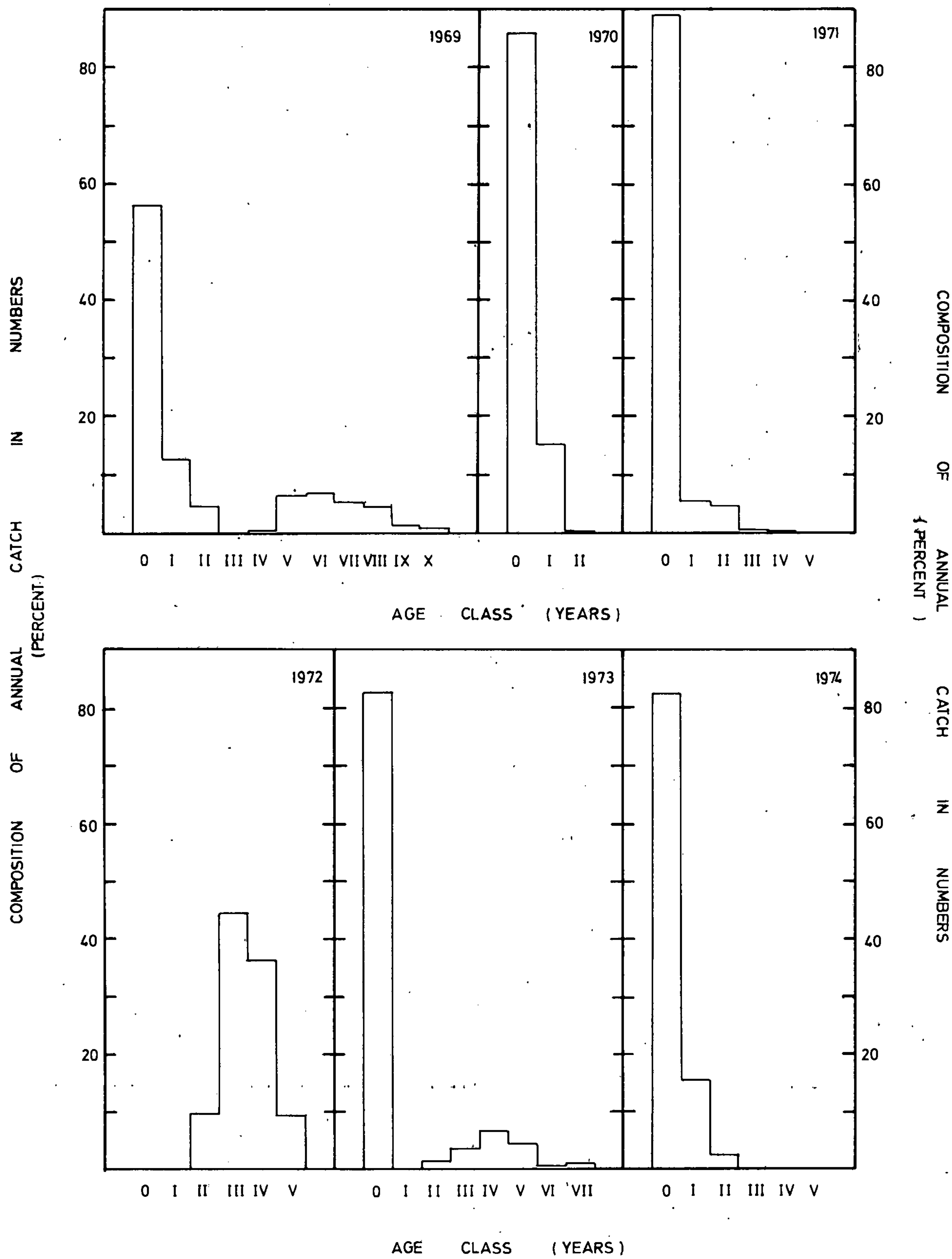

Fig 18b Age composition of South African horse mackerel landings, 1969 - 1974.

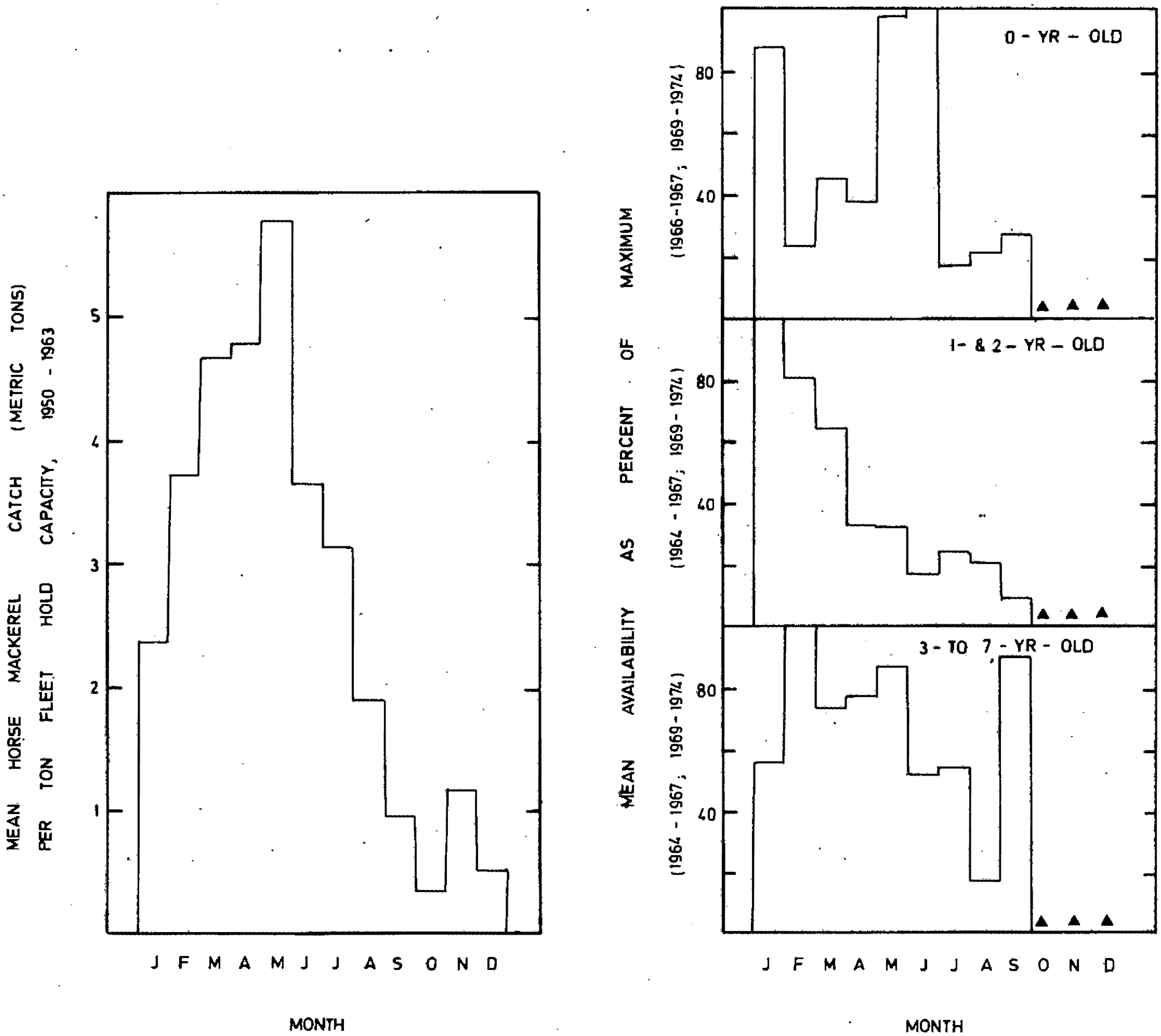

Fig 19' Availability indices for horse mackerel.
(▲ no data)

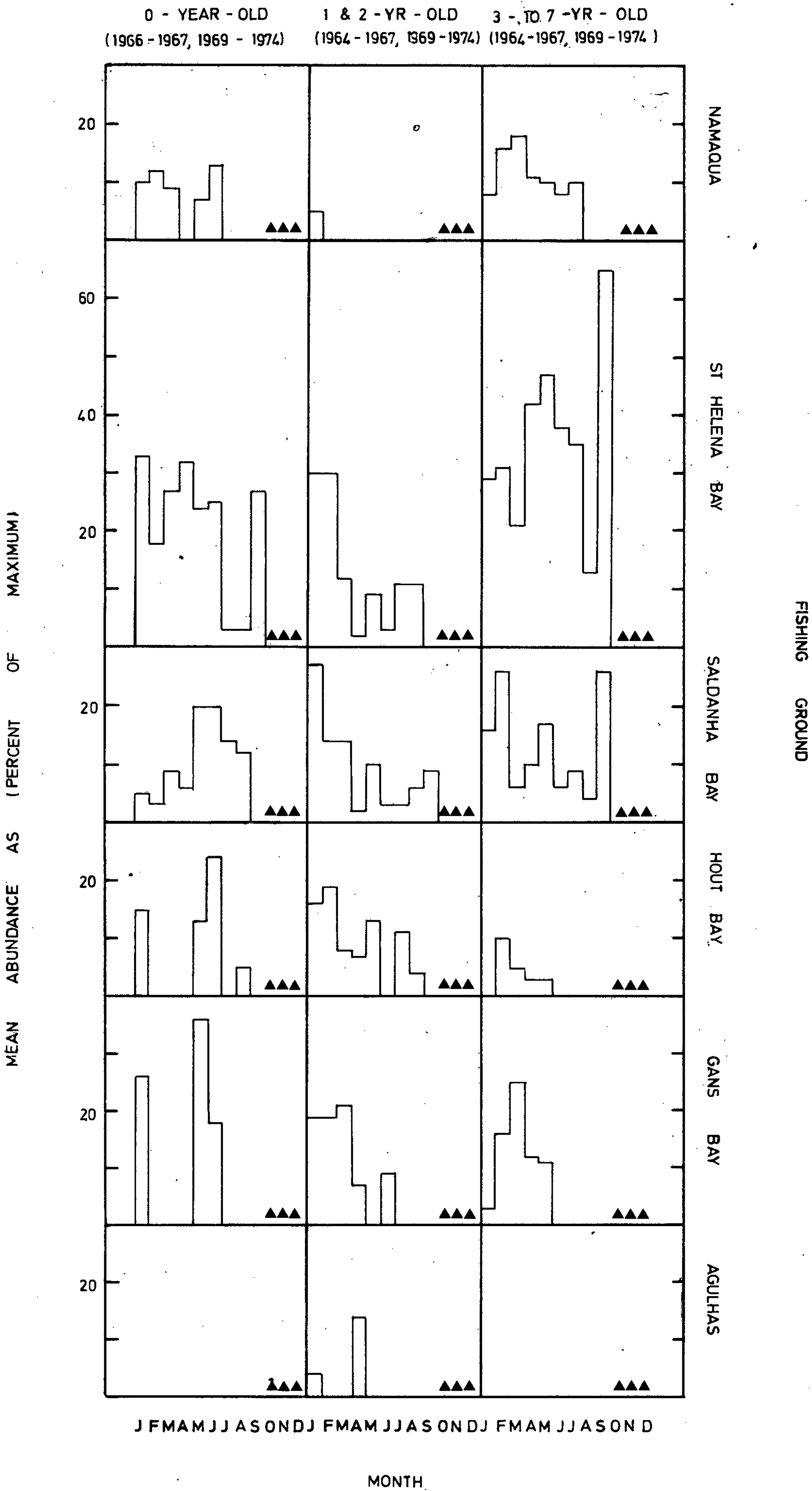

Fig 20 Abundance indices for horse mackerel.
(▲ no data)

allocation of effort (chapter 4). In particular nought-year-olds were not encountered in 1964, probably on account of unsuitable gear, or in 1972 and relatively insignificant catches, for which no age information is available, were made in 1975 and 1976. Even in other years catch rates never exceeded 10 metric tons per standard boat day(Appendix).

From Fig. 20 it is evident that this age class was most abundant in the St Helena Bay region, entirely absent from the Agulhas area, and contributed only moderate yields on all the other fishing grounds.

One- and two-year-olds

The availability of one- and two-year-old horse mackerel is at its highest in January and decreases steadily thereafter (Fig. 19). A total mortality coefficient of 3,6 would be required to produce the observed trend but this seems unrealistic in view of the fact that natural mortality of horse mackerel in the South East Atlantic is not expected to exceed 0,25 (Draganik 1977), whereas estimates of the fishing mortality inflicted on this species by the South African purse-seine fishery ranged from 0,01 to 0,13 (mean 0,07) between 1950 and 1962 (Centurier-Harris et al. 1977). Unfortunately no estimates of this parameter are available for the period under consideration but they are not expected to be greatly different.

These age groups occur primarily on the four centre fishing grounds (Fig. 20) but, although they appear to assume a slightly more southerly distribution than either younger or older individuals, no regular migrations off the fishing grounds can be discerned. In 1971, two-year-old fish were caught between Dassen Island and Cape Point in February, from Hout Bay to Quoin Point in March, and in Walker Bay and east of Cape Agulhas in April (Appendix). In 1974 one-year-olds were encountered off Cape Town and from Cape Point to Quoin Point in March and were located off Cape Town and to the west of Cape Infanta in April. It is possible, therefore, that in these two years the relevant year classes moved in a south-easterly direction, as do pilchard aged between two and four during similar months (chapters 5) and, sometimes, shoals of adult anchovy (chapter 6). This is not always the case, however, and cannot by itself account for the decline in availability.

Other possible reasons for the fall in catch rates are not easy to determine. In the North Atlantic horse mackerel gradually change their diet from zooplankton to include a greater proportion of fish and are often present in substantial numbers in dense overwintering shoals, which form along the edge of the continental shelf from southern Biscay to about latitude 49°N at depths of between 180 and 250 m (Lockwood and Johnson 1977). Should a similar pattern of behaviour occur in South African waters, it would certainly result in a reduced availability of these young fish to purse-seine boats. Feeding studies conducted off South West Africa and Angola indicate that copepods and euphausids dominate in the diet of most age classes, although myctophids are also ingested by fish aged four and older (Ja Lipskaja 1972, Kompowski and Sčosarczyk 1976). Data on changes in feeding habits are at present scarce, however.

Three- to seven-year-olds

Indices for the older horse mackerel age groups suggest that these fish are most available from late summer through midwinter (Fig. 19). The high catch rates recorded in September may not be an accurate reflection of the true situation. As mentioned earlier, there was a lack of adequate data for the period under consideration, when horse mackerel harvests were generally poor. Moreover, a change in the prescribed minimum mesh size from 32,0 to 12,7 mm meant that the fishing mortality inflicted on young fish was increased and resulted in smaller quantities of those aged three or older contributing to the landings (Fig. 18). Between 1950 and 1963 yields were considerably higher (Table XVI), nought-, one- and two-year-olds were not fully selected by the fishing gear (Crawford et al. 1978), and mean monthly levels of catch per unit effort, though confirming the increased availability experienced between February and July, indicate that only low returns were forthcoming in September (Fig. 19). In arriving at these estimates the effort expended during any particular month was allocated to individual species pro rata to their contribution to the combined catch. The general pattern of availability was first noted by Geldenhuys (1973), who demonstrated that large horse mackerel dominated the winter catches in a highly regular fashion.

These fish are most abundant in the St Helena Bay area and moderately so on the Namaqua and Saldanha Bay grounds, with catches deteriorating further to the south (Fig. 20). Their distribution is thus similar to that of the youngest age group.

Five- and six-year-old pilchard and adult mackerel also favour the northern fishing grounds and both these components of the mixed-species pelagic stocks show similar trends in availability to that exhibited by older horse mackerel (chapters 5 and 8). In the case of pilchard the low catch rates of spring and summer have been attributed to these fish moving away from the coast to spawn (Davies 1956b), whereas Baird (1978) described a winter spawning migration of adult mackerel from offshore to inshore waters. It is probable that horse mackerel in South African waters spawn between spring and early autumn and their behaviour would thus seem to be more in accord with the pilchard population. Although wind-driven upwelling is at a minimum in winter, storm-induced mixing maintains a narrow strip of cool, plankton-rich water close to the coast in the region north of Cape Columbine (Crawford et al. in press). The inshore presence of adult pilchard and horse mackerel, when not spawning, might thus be associated with feeding.

DISCUSSION

The domination of commercial and other fisheries by strong horse mackerel year classes has been described by a number of authors (Geldenhuys 1973, Macer 1977, Newman and Centurier-Harris 1977). Unofrtunately no exceptional recruitment of this species took place in South African waters during the period under review, but it is nevertheless possible to trace the progression of certain cohorts on the distribution maps. As has been mentioned, nought-year-olds were not fully selected prior to 1966 but, in spite of this, they appeared in the catches during the latter part of 1965, being fairly frequently encountered in the region between Lambert's Bay and Cape Town (Appendix). Fish aged one were common during the first four months of 1966, especially in January, when catches were made from north of the Olifants River to Cape Columbine, outside Hout Bay and in False Bay. The same cohort dominated the landings of 1967 as two-year-olds (Fig. 18). Again they were fished between Lambert's Bay and Cape Point (January, April, August), though good yields were also recorded in the Walker Bay vicinity (January - May), where catch rates exceeded 25 metric tons per standard boat day on occasion.

In 1969 26 832 metric tons of horse mackerel were landed the only occasion that this figure exceeded 10 000 tons since fishing for all species with the 12,7 mm net was first sanctioned in 1966. This was largely due to good catches of the latest recruits (Fig. 18), which were present on the northern fishing grounds in January, March, April and June, as well as in the vicinity of Cape Point in January. The following season relatively high yields of one-year-olds were recorded between Cape Columbine and Cape Town in January. These fish were also caught from north of the Olifants River to St Helena Bay and they continued in the catches during February and March. In January 1971 they reappeared as two-year-olds on the southern grounds, where they were fished until early winter, and the same cohort dominated the landings of the two succeeding years (Fig. 18). In 1972 they were caught between January and May from the Olifants River in the north to Gans Bay in the east and in 1973 during late summer and autumn over much the same area.

The 1965 and 1969 year classes thus conformed in large measure with the general patterns of distribution and availability outlined above. That of 1969 may well have developed into a significant factor in the fishery had it not been subjected to intensive exploitation during its early stages. Indeed a feature of the horse mackerel landings between 1966 and 1976 was the noticeably young age structure of the catches (Fig. 18) and there seems little doubt that this was primarily responsible for the greatly reduced yields (Table XVI). The situation is unlikely to improve until some means of avoiding the latest recruits is found but, on account of the almost identical behaviour exhibited by nought-year-old pilchard, anchovy and horse mackerel, this is expected to be no easy task.

CHAPTER 8. DISTRIBUTION, AVAILABILITY AND MOVEMENTS OF MACKEREL *SCOMBER JAPONICUS* OFF SOUTH AFRICA, 1964 TO 1976.

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CHAPTER 8. DISTRIBUTION, AVAILABITY AND MOVEMENTS OF MACKEREL *SCOMBER JAPONICUS* OFF SOUTH AFRICA, 1964 TO 1976.

Mackerel *Scomber japonicus* made its first appearance in the commercial landings of the South African purse-seine fishery in 1954 and, as a result of exceptionally good 1966 and 1967 year classes (Newman and Crawford in press), became one of the main contributors to the combined mixed-species catch during the late 1960's (Table XVII). By this time the age structure of the pilchard *Sardinops ocellata* stock had been considerably reduced through the introduction of a small-meshed (12,7 mm) net and individuals sufficiently large for use in cans were seldom encountered in the vicinity of those factories that were capable of canning (Crawford *et al.* in press). Therefore, as far as the fishing industry was concerned the increased abundance of mackerel came at a most opportune time and enabled the overall production of canned fish to be maintained at a moderate level for a number of years (Table XVIII). However, there was no further strong recruitment and the mackerel population declined in a manner similar to the horse mackerel *Trachurus trachurus* and pilchard resources, with disastrous results to the industry.

The reasons for these declines remain the subject for much speculation. Recent opinion is that they were precipitated by returns to normal levels of recruitment after large, natural increases in population sizes and also by intensive fishing pressure on the younger age classes reducing spawning stocks (Centurier-Harris *et al.* 1977, Newman and Crawford in press). Whatever the cause, it is evident that previous uncertainty regarding the population biology of the component species resulted in management strategies and economic planning within the fishery that were largely inadequate and considerable overinvestment of effort (Newman *et al.* 1978). It is also increasingly clear that the sequential depletion of traditional resources, *viz.* horse mackerel, five- and six-group pilchard and mackerel (chapter 4), is making the possibility of improving or even maintaining current yields progressively more remote.

Barring drastic cutbacks in effort, which may eventually prove inevitable but are likely to result in a considerable reduction in employment, the industry faces two alternatives: diversification to exploit new resources or improved utilisation of the raw materials already being harvested. Both these options may become realities within the immediate future. The industry is already showing increased interest in the first possibility. Unsuccessful fishing surveys were conducted off Port Elizabeth during November and December 1976 and June 1977 and in 1978 permission was granted to 16 purse-seine vessels to experiment

TABLE XVII : ANNUAL CATCHES OF MACKEREL AND PERCENTAGE CONTRIBUTION TO COMBINED PURSE-SEINE LANDINGS, 1950 TO 1976.

Year	Catch (metric tons)	Percentage of combined purse-seine catch
1950	-	-
1951	-	-
1952	-	-
1953	-	-
1954	4 044	1,9
1955	20 228	9,2
1956	32 593	21,0
1957	7 364	3,7
1958	21 580	7,9
1959	33 088	10,5
1960	30 985	7,5
1961	49 690	10,1
1962	20 355	4,1
1963	13 201	3,1
1964	50 024	11,8
1965	41 426	8,6
1966	53 426	15,0
1967	128 219	25,2
1968	91 023	24,7
1969	91 702	26,1
1970	77 939	21,7
1971	54 206	16,7
1972	56 680	13,1
1973	58 835	13,0
1974	30 665	7,7
1975	69 344	17,0
1976	546	0,1

TABLE XVIII : PRODUCTION OF FISH MEAL, FISH OIL AND CANNED FISH FROM SOUTH AFRICAN PURSE-SEINE FISH LANDINGS, 1950 TO 1976

Year	Purse-seine catch (thousands of metric tons)	Fish meal (thousands of metric tons)	Fish oil (thousands of metric tons)
1950	135,2	21,6	8,5
1951	200,4	31,3	9,6
1952	272,6	38,1	12,2
1953	217,7	31,3	11,3
1954	210,5	31,4	11,4
1955	221,0	37,3	10,9
1956	154,9	26,7	6,7
1957	201,5	37,2	10,3
1958	273,4	48,8	12,3
1959	314,9	64,9	15,1
1960	412,0	89,3	26,4
1961	490,9	108,7	40,9
1962	497,3	113,9	35,0
1963	427,0	100,8	28,4
1964	425,6	98,7	22,1
1965	480,1	112,5	20,4
1966	357,1	82,0	12,8
1967	509,3	115,8	17,5
1968	368,6	86,5	16,0
1969	352,0	80,0	20,1
1970	358,9	80,3	21,9
1971	324,9	74,2	16,5
1972	433,6	96,9	16,1
1973	451,4	98,4	24,4
1974	400,5	89,9	22,9
1975	407,4	97,8	14,2
1976	407,5	102,1	24,5

Canned fish (metric tons)

Year	Pilchard	Horse mackerel	Mackerel	Round herring	Total
1950	6 155	1 521	0	0	7 676
1951	5 164	4 615	0	0	9 779
1952	8 695	7 615	0	0	16 310
1953	16 411	7 949	0	0	24 360
1954	7 475	20 488	672	0	28 635
1955	7 614	8 119	1 842	0	17 575
1956	2 577	7 794	3 769	0	14 140
1957	3 903	8 227	607	0	12 737
1958	3 263	6 205	2 060	0	11 528
1959	419	3 140	5 798	0	9 357
1960	2 854	9 166	4 173	0	16 193

Continued.....

TABLE XVIII : PRODUCTION OF FISH MEAL, FISH OIL AND CANNED FISH FROM SOUTH AFRICAN PURSE-SEINE FISH LANDINGS, 1950 TO 1976 CONTD.

Year	Canned-fish (metric tons)				
	Pilchard	Horse mackerel	Mackerel	Round herring	Total
1961	9 404	5 012	5 432	0	19 848
1962	6 765	8 705	3 581	0	19 051
1963	7 722	1 897	1 585	0	11 204
1964	2 128	1 604	7 419	0	11 151
1965	1 318	4 635	4 478	0	10 431
1966	709	942	3 777	0	5 428
1967	71	132	3 669	0	3 872
1968	18	30	4 488	16	4 552
1969	7	1 168	4 561	30	5 766
1970	0	0	3 147	9	3 156
1971	54	0	3 237	32	3 323
1972	23	0	2 975	0	2 998
1973	105	16	3 348	7	3 476
1974	13	0	1 929	0	1 942
1975	349	0	3 822	47	4 218
1976	21	0	0	0	21

with the use of mid-water gear. There is some danger that should too much emphasis be placed on diversification without stricter control being applied to the present modus operandi, the successive elimination of more resources will follow, with the industry degenerating to the exploitation of less and less rewarding species. It is thus important that consideration be given to the second alternative, which presupposes an understanding of the distribution and availability of the various species involved in the fishery.

For mackerel preliminary analyses have already been documented by Centurier-Harris and Crawford (1974) and by Baird (1978a). This paper uses catch and effort data collected between 1964 and 1976 to quantify these trends. In addition monthly distribution charts are employed to elucidate the behaviour of two dominant mackerel year classes and an attempt is made to establish a means of predicting, at an early stage, the likelihood of similar future occurrences.

DISTRIBUTION OF COMMERCIAL CATCHES

Distribution patterns of commercial catches were derived in a similar manner to that described for the pilchard population (chapter 5). These are presented in map form in the Appendix, catch rates being illustrated to depict regional differences in the density of fish. The modal length of fish caught in known localities has also been indicated, whenever this information was available from field observations, to give some idea of geographic and seasonal variations in the size of mackerel encountered. Examination of 220 purse-seine catches revealed that mackerel from any one shoal can differ in caudal length by up to 13,0 cm, but generally by not more than 7,0 cm (Fig. 21). It is therefore possible that modal length may give a somewhat biased picture in certain instances but this is not often expected to be the case.

Age at maturity has been discussed by Baird (1977), who found that the onset of reproductive activity takes place when mackerel are in their third year. Fifty per cent are mature at about three years of age and all before they turn four. However, to conform with the procedure used for other species (chapters 5,6,7 and 9) only nought-year-old fish have been indicated with the shading adopted for juveniles. The distribution of recruit year classes has thus been highlighted.

The Appendix reveals that, unlike other species involved in the fishery, mackerel occur fairly frequently some distances from the mainland. As noted by Baird (1978a) most offshore catches were made after introduction of aerial fish spotting in 1967 and there seems little doubt that this innovation was largely responsible for persuading many skippers, on occasion, to forsake their tendency to remain close to the coastline and

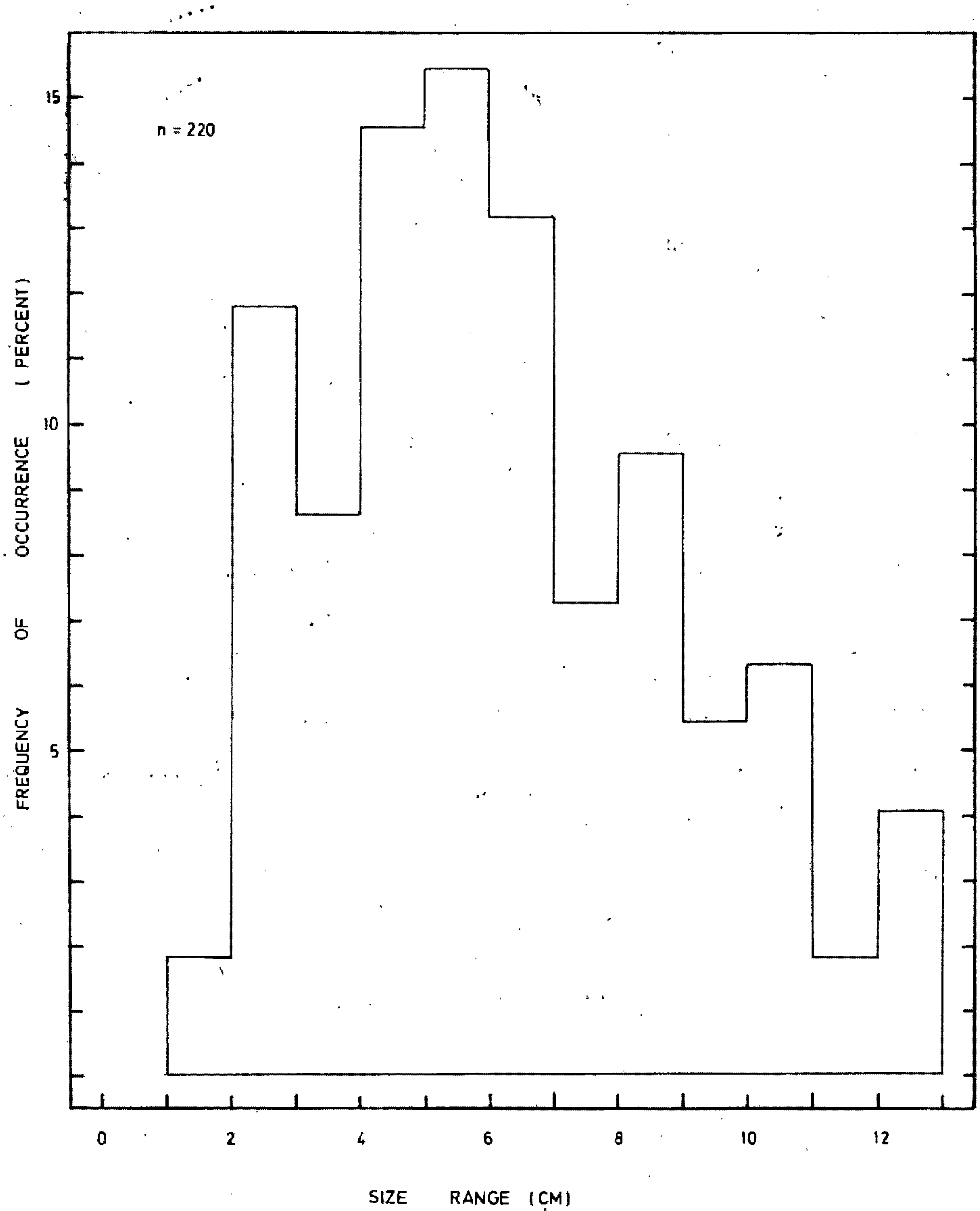

Fig 21 Frequency of occurrence of mackerel size-range (caudal length) variations between largest and smallest fish sampled from individual purse-seine catches.

to venture further out to sea with the expectation of more rewarding catches. After locating fish the aircraft often remained in the immediate vicinity, directing boats onto individual shoals.

All offshore catches have been from the St Helena Bay, Saldanha Bay or Hout Bay grounds and so far none have included the most recent year classes. Nearshore catches have ranged as far north as the Orange River (three-year-old fish in April and June 1966) and eastwards to Cape Infanta (one-year-olds in March 1967 and March 1973) but records north of latitude 31°S or east of Quoin Point have been infrequent and most fishing for mackerel is confined to the intervening areas.

Hecht (1976) notes that small quantities of mackerel (less than 25 metric tons per annum) are caught by the demersal fishery which operates off the Eastern Cape Coats. The maximum total length recorded was 23 cm, which suggests that all are less than one year old.

Additional information on the distribution of mackerel off the west coast between 9th June and 16th October 1973 is available from observations made aboard the commercial fish spotter <u>Oceana Maan</u>. Some 310 hours were spent in the air, mostly at night and in the absence of bright moonlight thus ensuring optimal conditions for spotting. In the Benguela Current system species of luminescent phytoplankton are sufficiently numerous to clearly outline the shape of fish shoals moving through them at night (Cram 1974) and on all night flights spotlights were regularly flashed at the water's surface in an attempt to stimulate immobile or slowly-moving fish to greater activity. After such stimulation mackerel shoals tend to "glow" brightly for periods of up to 60 seconds but after repeated flashing they often sound to greater depths. Confirmation of airborne identification of mackerel was provided by purse-seine catches made in August 1973. The area searched is shown in Fig. 22 and the positions of all shoals sighted in Fig. 23. These conform with the catch patterns which were recorded during similar months between 1968 and 1973.

AVAILABILITY, ABUNDANCE AND MOVEMENTS

Monthly indices of availability and of the relative abundance of fish that could, on average, be expected to be present on each of six fishing grounds (Fig. 22) were determined for three age components of the mackerel population. The method employed was analogous to that previously adopted for the pilchard (chapter 5) and the three age categories were those distinguished by Baird (1978a), <u>viz</u>. nought-year-olds, fish aged one or two, and all older individuals. For the youngest age class only the period 1966-1976 was considered, as nought-year-old

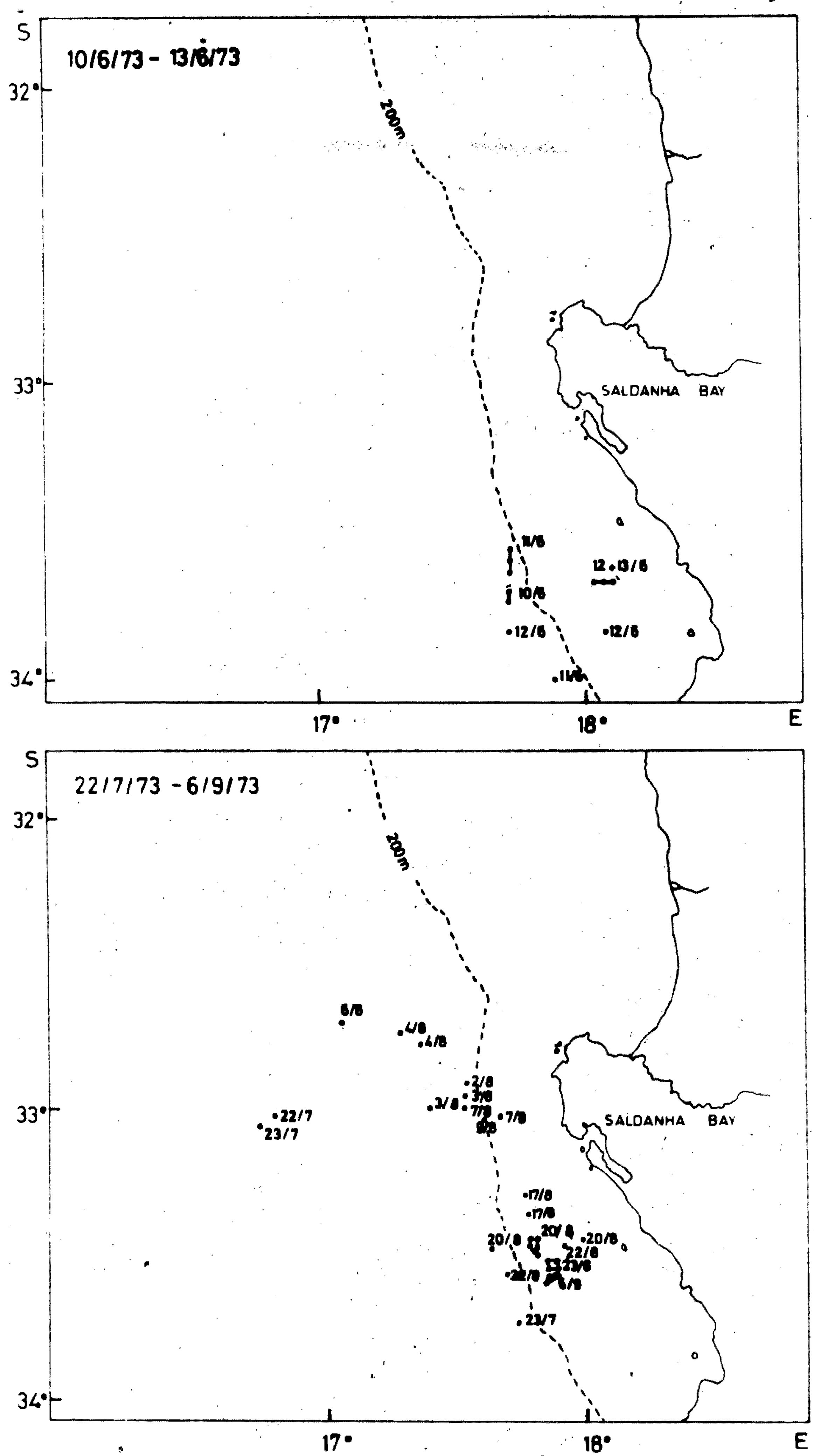

Fig 23a Aerial sightings of mackerel, 10th June -6th September 1973 (dates are indicated)

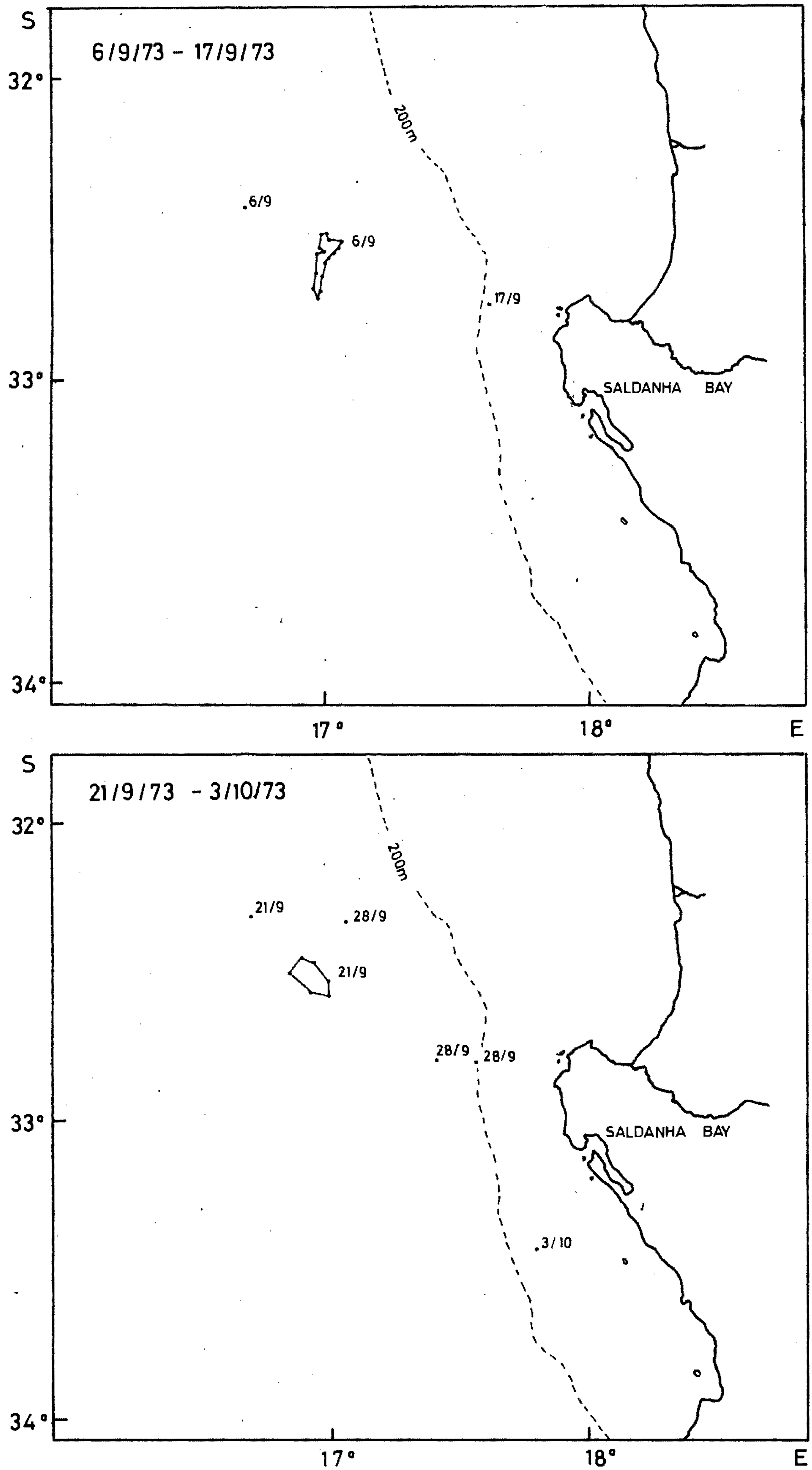

Fig 23 b Aerial sightings of mackerel, 6th September - 3rd October 1973 (dates are indicated) fish were not fully selected by the fishing gear in earlier years. No values were calculated for October, November or December, insufficient fishing being conducted during these months. The resulting estimates, expressed as percentages of the maxima, appear in Figs. 24 and 25.

Spawning

Baird (1977) defines the spawning season of mackerel as June - September. During 1973 the highest concentrations of eggs in these months were encountered between Lambert's Bay and Dassen Island in temperatures ranging from 11,5 to 16,9°C and salinities from 34,70 to 35,59‰ (Baird 1975). The area roughly coincided with the distribution of reproductively active mackerel (Fig. 23), leading Baird (1978a) to speculate that the frequent winter appearance of these older age groups was linked to spawning.

Nought-year-olds

Nought-year-old mackerel are fully recruited by the start of the fishing season in January of each year, seven months after the initiation of spawning, and availability remains at a moderate level until May. In winter catch rates drop sharply (Fig. 24). An unrealistically high value of total mortality ($Z = 3,7$) would be required to account for the observed decline and, although there appears to be a southward shift in the distribution of this age class, from north of Cape Columbine in summer to the Saldanha Bay, Hout Bay and Gans Bay grounds in winter (Fig. 25), no longshore migration off the fishing grounds is evident. These young mackerel are often found in association with adult round herring Etrumeus teres (Baird 1978a), which exhibit similar trends in behaviour (chapter 9), and it is possible that both move away from the coast in winter. The increasing importance of lantern-fish Lampanyctodes hectoris in the mackerel's diet once it has attained the age of one (Baird 1978b) could be the cause of such a move to deeper water.

Though catch-per-unit-effort levels greater than 10 metric tons per standard boat day were fairly frequently recorded between January and May and were never forthcoming in winter (Table XIX), the pattern is not altogether regular as nought-year-old mackerel often failed to contribute in significant quantities to the landings at any time during the season. It may be seen from the age composition of the commercial catches (Fig. 26) that this was the case in 1965, 1968, 1972, 1973 and 1975. In addition catches of all age groups were exceptionally poor during 1976 (Crawford et al. 1978).

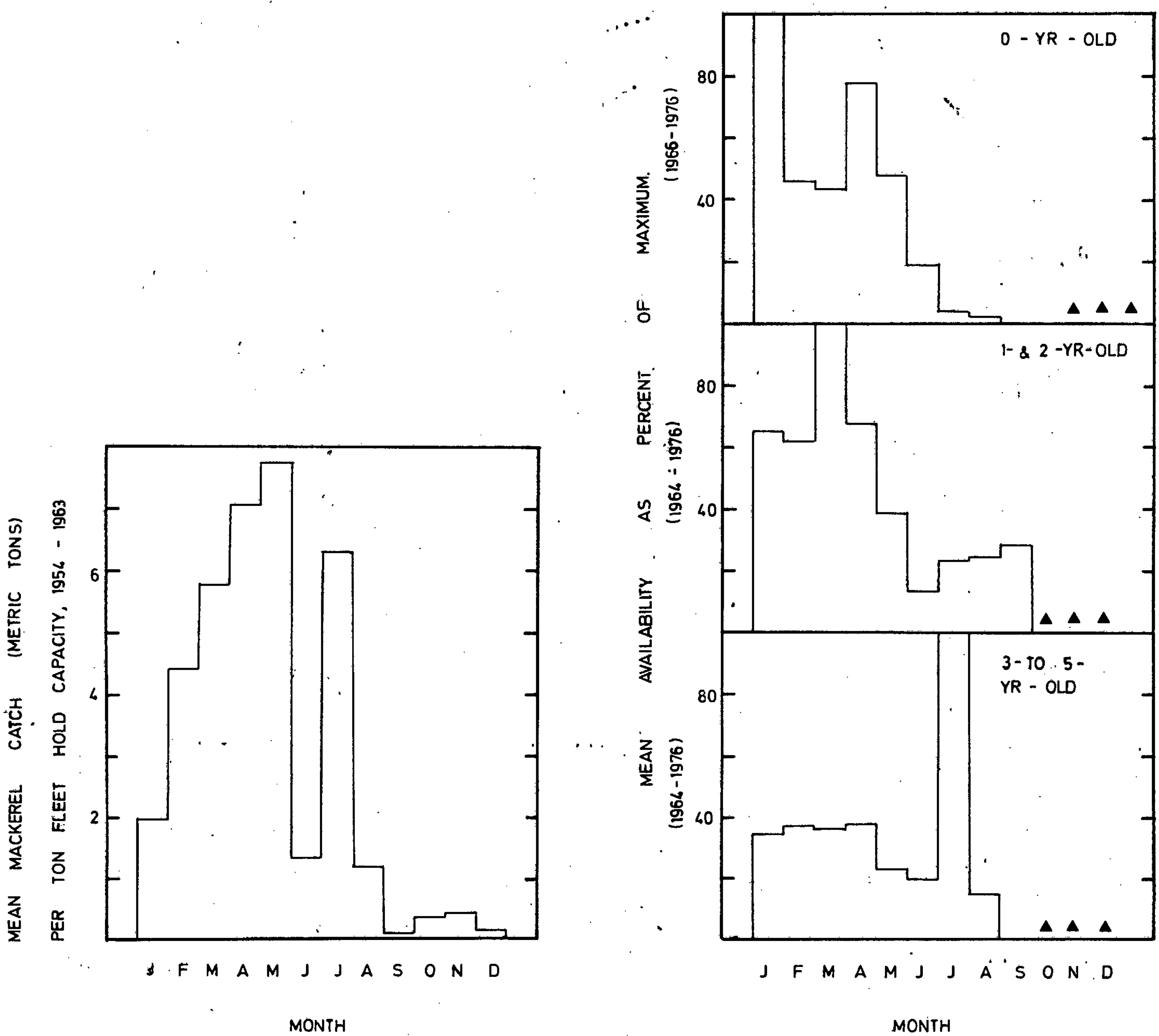

Fig 24 Availability indices for mackerel.
(▲ no data)

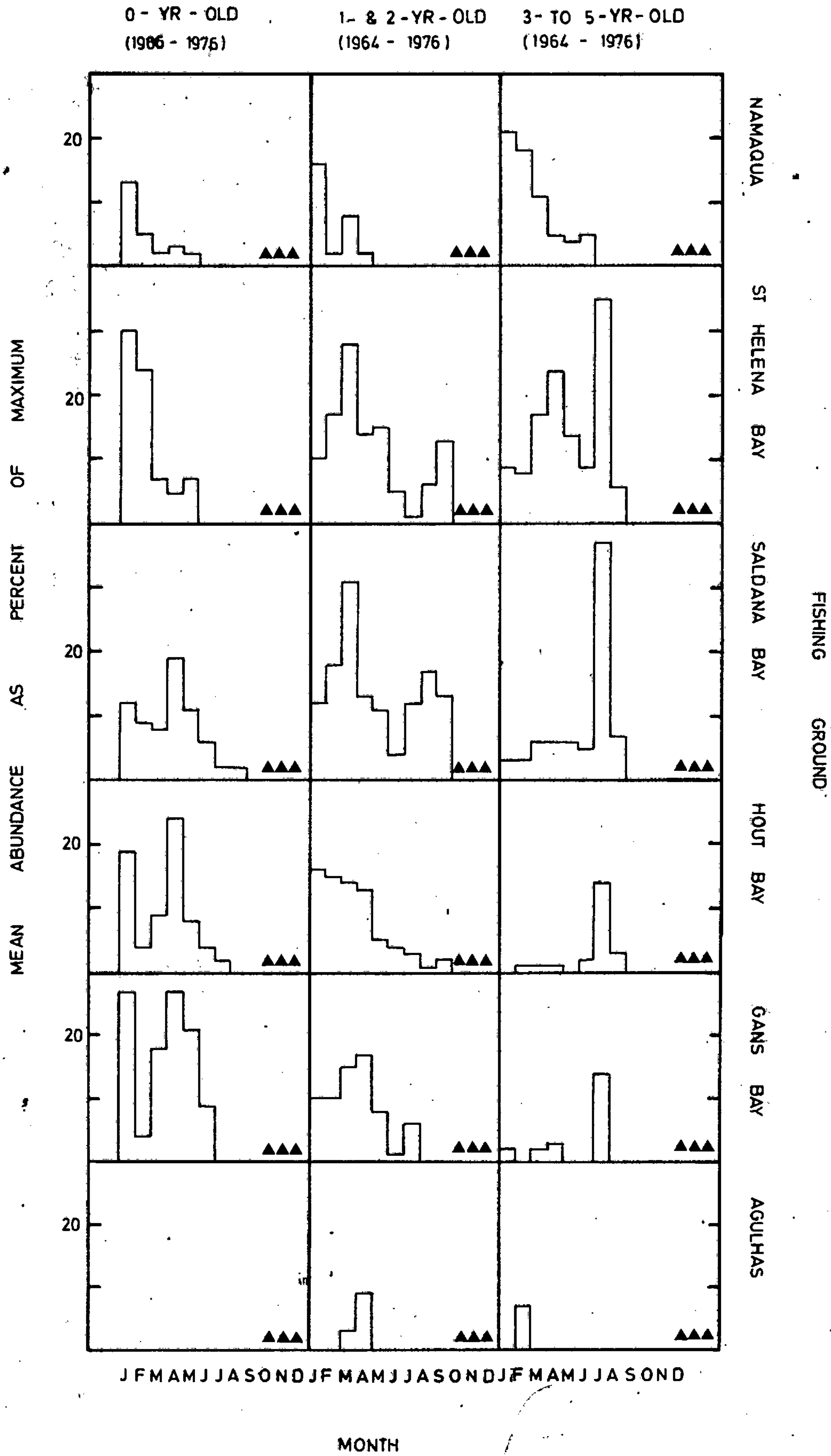

Fig 25 Abundance indices for mackerel.
(▲ no data)

TABLE XIX : MONTHS IN WHICH CATCH RATES GREATER THAN 10 METRIC TONS PER STANDARD BOAT DAY WERE RECORDED FOR NOUGHT-YEAR-OLD MACKEREL.

Month	Seasons
January	1966, 1967, 1969
February	1966
March	1964, 1966
April	1966, 1967, 1971
May	1964, 1966, 1967, 1971, 1972
June	-
July	-
August	-
September	-
October	-
November	-
December	-

TABLE XX : MONTHS IN WHICH CATCH RATES GREATER THAN 10 METRIC TONS PER STANDARD BOAT DAY WERE RECORDED FOR ONE- AND TWO-YEAR-OLD MACKEREL.

Month	Seasons
January	1964, 1968, 1969, 1975
February	1964, 1967, 1975
March	1964, 1967, 1973, 1974
April	1964, 1968, 1972, 1974
May	1964, 1968, 1969
June	1975
July	1964, 1968, 1969
August	1969, 1971, 1973
September	1971
October	-
November	-
December	1964

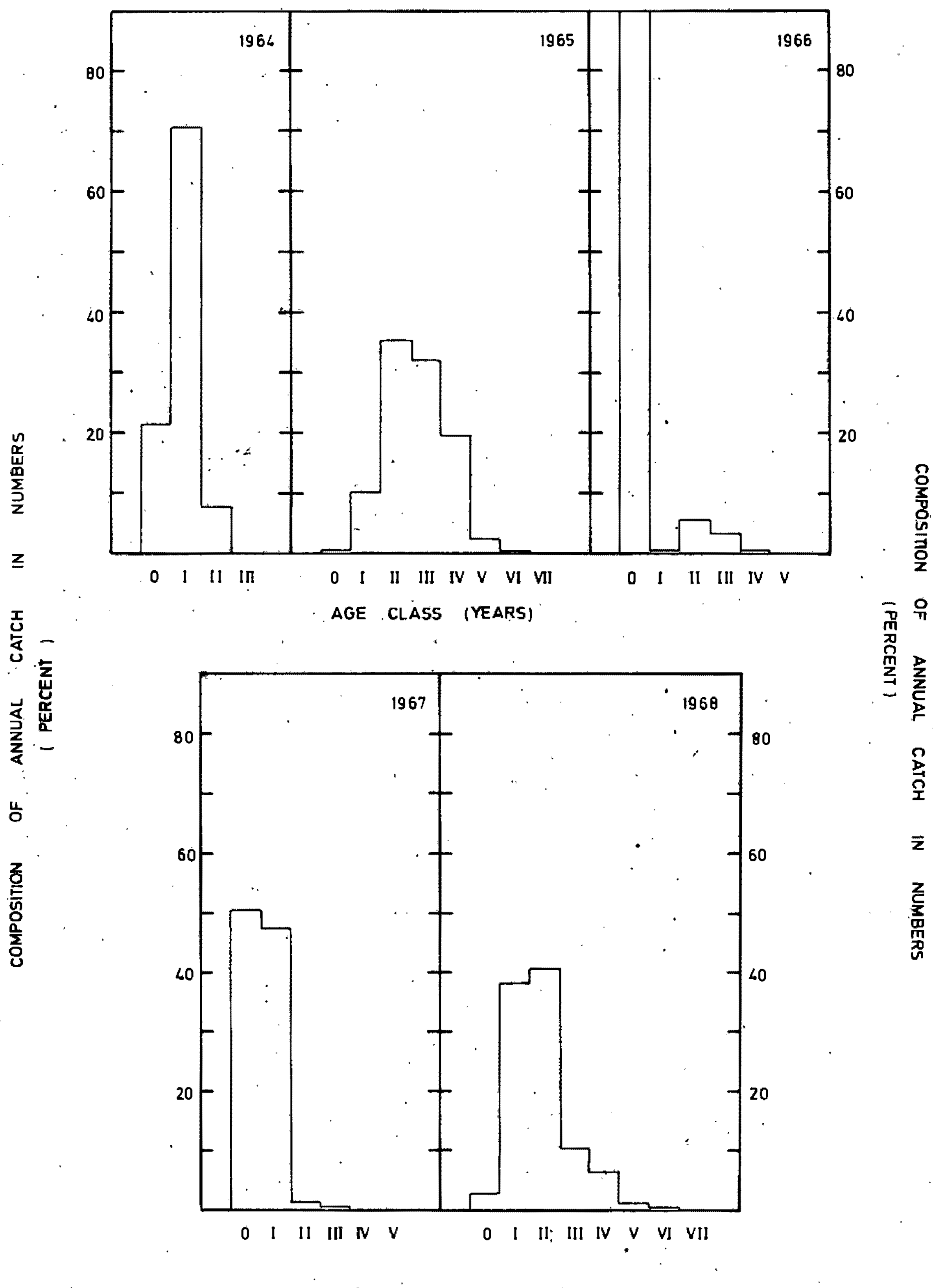

Fig 26a Age composition of South African mackerel landings, 1964 - 1968.

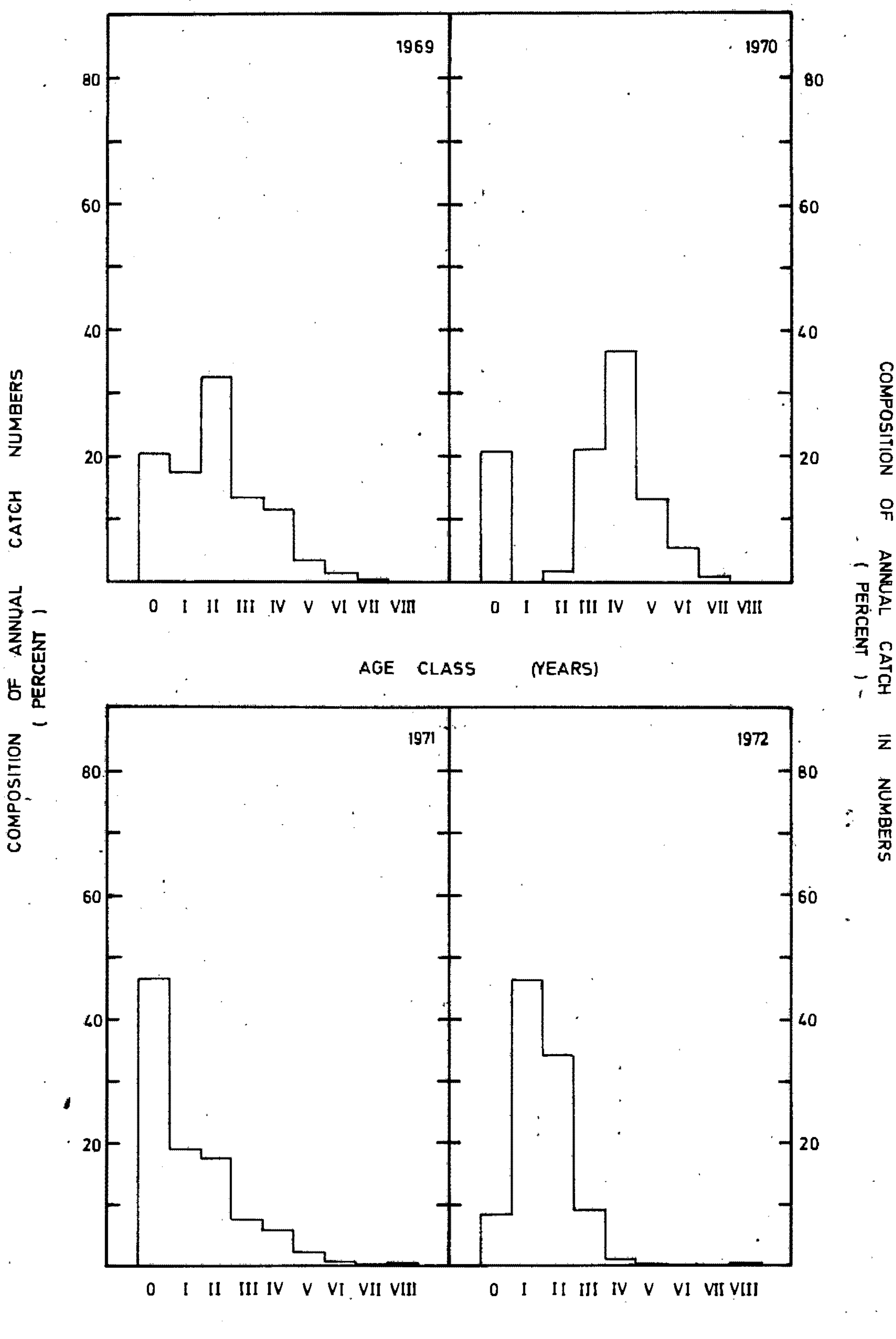

Fig 26b. Age composition of South African mackerel landings, 1969 - 1972.

One- and two-year-olds

One- and two-year-old mackerel are also most available during summer and autumn, with catch rates again declining to only a low level in winter (Fig. 24). As noted by Baird (1978a) the best catches of these age groups are made on the St Helena Bay and Saldanha Bay grounds, though reasonable yields are also forthcoming from the Hout Bay and Gans Bay regions (Fig. 25). Although these mackerel show an increasing preference for lantern-fish, zooplankton continues to form an important component of their diet (Baird 1978b), which probably accounts for their presence in the major upwelling regions during summer and early autumn.

Catch-per-unit-effort levels greater than 25 metric tons per standard boat day have been most frequently recorded during summer and autumn but equally rewarding fishing has, on occasion, also been realised in winter or early spring, especially since the introduction of aerial fish spotting in 1967 (Talbe XX).

Three- to five-year-olds

The adult component of the mackerel stock comprises dominantly three- to five-year-old fish (Fig. 26). Availability indices show a noticeable peak in July and indicate that usually only moderate or poor fishing was recorded during all other months (Fig. 24). The abruptness of this pattern is difficult to explain but may be partially due to a lack of adequate data. An attempt was made to gauge its reliability by calculating mean monthly catch rates for mackerel over the period 1954 - 1963, when only fish aged three and older contributed in a significant manner to the landings (Crawford _et al_. 1978). The effort during any particular month was allocated to individual species _pro rata_ to their contribution to the combined catch and the results suggest a steady increase in availability during late summer and autumn, with high catch rates again being experienced in July but availability dropping rapidly thereafter (Fig. 24). This trend is possibly more realistic, though again there is no satisfactory way of accounting for the poor returns in June. On the other hand, the discrepancy between the two patterns could have been influenced by the introduction of aerial fish spotting in 1967. Reference to the Appendix will reveal that levels of catch per unit effort greater than 25 metric tons per standard boat day were recorded in January 1965 and 1968, March 1965 and 1967, April 1964 and 1966, May 1966 and 1969, June 1969 and 1970, July 1968, 1969, 1970, 1971, 1972 and 1975 and August 1973. Of these the last ten instances may all be attributed to fish spotting.

The distribution of these age groups is largely confined to the three northern fishing grounds (Fig. 25), with only isolated catches being recorded further south. During summer catch rates are highest off the Namaqua coast but later in the year the St Helena Bay and Saldnaha Bay regions are most productive. Although large amounts of zooplankton continue to be ingested, lantern-fish dominate the diet of this component of the mackerel population (Baird 1978b) and it is noteworthy that the bulk of the lantern-fish catch is recorded from similar areas (chapter 10).

Baird (1978a) describes an offshore/inshore migration of adult mackerel during the winter months, which he relates to spawning and to an onshore current set in motion by north-westerly winds that brings relatively warm (14 - 15°C) water nearer to the coast (Shannon 1976). The migration generally takes place in the vicinity of Cape Columbine with the mackerel often later moving in a southerly direction as far as Dassen Island (Baird 1974). These trends are clearly apparent from the positions of shoals sighted from the air between 22nd July and 6th September 1973, between 6th and 17th September 1973, and between 21st September and 3rd October 1973 (Fig. 23). In addition southward movements of three-year-old fish between April and May 1967 and between March and August 1967, of four-year-olds between June and July 1969 and of five-year-olds between June and July 1971 are evident from the Appendix.

DISCUSSION

The performance of the mackerel fishery has been dominated by the two exceptionally good year classes of 1966 and 1967. The development of these two cohorts is easily traced on the distribution maps (Appendix).

Nought-year-old fish were relatively scarce in 1964 and 1965, but during January 1966 were caught over a large area with especially good returns coming from north of the Olifants River and outside Hout Bay. From February to May they continued to contribute rewarding catches, primarily in the vicinity of Dassen Island or north-west of Cape Columbine and, although availability declined towards the end of the season, there was a notable build up of one-year-olds between Saldanha Bay and Hout Bay in February of the following year. The stage was thus prepared for the remarkable landing of 91 774 metric tons of mackerel in March 1967, an amount greater than the total mackerel catch of any other year. Almost all of this (90 343 metric tons) came from the area between Saldanha Bay and Cape Point for levels of effort were low elsewhere, although good catch rates were experienced. Had it not been exceptionally powerful, such intensive exploitation may well have destroyed the cohort. It reappeared in the same vicinity in May of 1968, however, and was harvested successfully until August. It is of interest to note that in July its distribution tended to be offshore, being centered on the 100 fm bottom contour outside Dassen Island. Catches to the north of Cape Columbine during this month were mainly of four-year-old fish but all other mackerel landed between May and August were from the 1966 year class.

Following sporadic catches in January 1967, that year's cohort began to reveal its full potential in April with catch rates greater than 25 metric tons per standard boat day being recorded in the vicinities of Dassen Island and Cape Point and outside False Bay. The next year one-year-old fish were abundant, especially during the first four months. Again the most productive region was between Saldanha Bay and Cape Point but, although catches were made both near to the shore and outside the 100 fm bottom contour, they never attained the level of the previous March. By contrast the best yields from this year class in 1969 were during late autumn and winter, inital-ly around Dassen Island and later north-west of Cape Columbine. The March and April catches outside Lambert's Bay had, in the meantime, been contributed by the 1966 cohort.

From 1970 the 1966 and 1967 year classes are best considered together. They appeared outside Dassen Island in June and July 1970, midway between Port Nolloth and Lambert's Bay in June 1971 and from the Olifants River to Hout Bay in July 1971. In both these years, especially 1971, they often extended a considerable distance offshore. By this stage, however, they were beginning to disappear from the fishery (Fig. 26) and the mackerel catch was on its way down (Table XVII).

It is possible to trace other less prominent year classes in a similar manner but these two suffice to demonstrate that the trends illustrated in Figs. 24 and 25 are an adequate description of the typical behaviour of the mackerel population. They also confirm Baird's (1978a) observation that this species tends to assume a more offshore distribution as it grows older, probably because of the progressive charge in its diet (Baird 1978b). On account of the inshore location of the younger age groups and their preference for the centre fishing grounds, it might be expected that any dominant year class should provide significant yields during its first full year in the fishery, or at least before attaining the age of two, as was the case during 1966, 1967 and 1968. Bearing in mind the very real possibility of over-exploitation at these early stages, similar good catches could be a pointer to profitable years to come. Reference to Table XVII reveals that this was not the situation during 1976. Conversely the catch was the lowest on record and the mackerel population will require careful management in future years to establish and maintain an adult stock that is capable of again producing such favourable recruitment. In 1973, 1974 and 1975 the South African purse-seine fishing season was extended and additional quotas were granted specifically for the capture of adult mackerel. In retrospect this does not appear to have been a wise move and it is recommended that it should not be repeated in future.

CHAPTER 9. DISTRIBUTION, AVAILABILITY AND MOVEMENTS OF ROUND HERRING *ETRUMEUS TERES* OFF SOUTH AFRICA, 1964 TO 1976.

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CHAPTER 9. DISTRIBUTION, AVAILABILITY AND MOVEMENTS OF ROUND HERRING ETRUMEUS TERES OFF SOUTH AFRICA, 1964 TO 1976.

Official records indicate that commercial landings of round herring Etrumeus teres prior to 1964 were minimal (Table XXI). Though this may in part have been due to misidentification of catches (Geldenhuys 1978), the grounds favoured by fully recruited age groups were relatively lightly exploited in these earlier years (Crawford et al. 1978). More recently, however, the species has become a small but valuable (ca. R900 000 in 1976 after processing) and fairly regular contributor to the combined purse-seine landings, catches generally fluctuating between 10 000 and 35 000 metric tons per annum. The figure for 1974 was unusually low, but in this year availability of anchovy Engraulis capensis was good and the season was brought to a premature conclusion on account of the early completion of catch quotas (chapter 6).

Growth of round herring has been investigated by Geldenhuys (1978) but little is known of its distribution or seasonal changes in its availability to the purse-seine fleet, factors which could prove significant in any future attempts to direct fishing operations. This paper attempts to elucidate these patterns through the analysis of catch and sample information collected over the period 1964 - 1976.

DISTRIBUTION OF COMMERCIAL CATCHES

Monthly distribution patterns of commercial catches of round herring for the period 1964 - 1976 were derived in a similar manner to that described for the pilchard Sardinops ocellata population (chapter 5). The results are presented in map form in the Appendix, areas in which no fishing was conducted being illustrated to assist in their interpretation and catch rates to depict regional differences in the density of fish.

Examination of the length compositions of 120 purse-seine catches revealed that in South African waters round herring from any one shoal seldom differ in caudal length by more than 5,5 to 6,5 cm (Fig. 27), a slightly larger variation than exists in pilchard and anchovy shoals (chapters 5 and 6). The modal length of fish caught in known areas has been included on the distribution maps, whenever this information was available from field observations, to give some indication of geographic and seasonal differences in the size of fish encountered.

TABLE XXI : ANNUAL CATCHES OF ROUND HERRING AND PERCENTAGE CONTRIBUTION TO COMBINED PURSE-SEINE LANDINGS, 1950 TO 1976.

Year	Catch (metric tons)	Percentage of combined purse-seine catch
1950	-	-
1951	-	-
1952	-	-
1953	-	-
1954	-	-
1955	-	-
1956	-	-
1957	-	-
1958	802	0,3
1959	2 553	0,8
1960	88	0,0
1961	130	0,0
1962	110	0,0
1963	197	0,0
1964	2 718	0,6
1965	8 243	1,7
1966	15 432	4,3
1967	31 961	6,3
1968	30 298	8,2
1969	23 301	6,6
1970	23 694	6,6
1971	21 644	6,7
1972	20 567	4,7
1973	28 657	6,3
1974	1 276	0,3
1975	23 551	5,8
1976	11 709	2,9

Geldenhuys (1978) investigated reproductive activity in round herring collected between 1965 and 1971 and found that 50 per cent of the fish examined were mature at a caudal length of 17,0 cm and 100 per cent at a length of 22,0 cm. Unfortunately he gives no indication of sample size or of the smallest length at which active gonads were encountered. In addition he assumed that spawning took place throughout the year. Shelton (pers. comm.) is of the opinion that although eggs may be produced in limited quantities at any time, a distinct spawning season, similar to that of pilchard and anchovy, may nevertheless be distinguished. This conforms to trends in the availability of nought-year-olds, which will be discussed later. Size at maturity was therefore re-examined using only material that had been collected during the summers of 1973 - 1977. No samples were available for spring. Gonads of 1 399 individuals were classified according to the method adopted by Davies (1956a) and first, 50 per cent and 100 per cent maturity were found to occur at caudal lengths of about 12,0 cm (one to two years old), 15,0 cm (two to three years old) and 20,5 cm (four to five years old) respectively (Table XXII). For mapping purposes nought-year-old fish were considered to be juveniles and have been illustrated in different shading to that used for all older age groups. The technique is thus similar to that used previously for pilchard and anchovy (chapters 5 and 6) and highlights the distribution of recruit year classes.

As with the pilchard and anchovy populations the results indicate that the bulk of the round herring catches are made inside the 200 m bottom contour, except where this line approaches the mainland in the vicinities of Cape Columbine and Cape Point. Offshore catches of nought-year-olds were recorded west of Cape Town in January 1968; of one-year-olds north-west of Cape Columbine in January 1970; of two-year-olds between Dassen Island and Cape Town in February 1970; of four-year-olds north-west of Cape Columbine in February 1972 and west of Cape Town in February 1969 and January 1972; and of five-year-olds west of Cape Town in March 1969.

The furthest north round herring have been encountered in South African waters was latitude 30°S in May 1965 (four-year-olds). A few additional records exist of catches to the north of latitude 31°S (nought-year-olds in April 1968, January and June 1969 and May 1973; one-year-olds in May and June 1971; two-year-olds in February 1974), but the shoals have usually been small and catch rates low. Catches to the east of Cape Agulhas have also been infrequent (one-year-olds in June 1975; two-year-olds in February and April 1970, April 1971 and March 1976; three-year-olds in March 1973; four-year-olds in March 1967) and again have generally resulted in low levels of catch per unit effort. The greater part of the round herring population, therefore, appears to be confined to the region south of latitude 31°S and west of Cape Agulhas.

TABLE XXII : GONAD ACTIVITY AT CAUDAL LENGTH IN ROUND HERRING, 1973 TO 1977.

Caudal length (cm)	Stage of activity*								Total
	0	1	2	3	4	5	6	7	
5,0	-	1	-	-	-	-	-	-	1
5,5	-	1	-	-	-	-	-	-	1
6,0	-	-	-	-	-	-	-	-	-
6,5	-	13	-	-	-	-	-	-	13
7,0	-	57	-	-	-	-	-	-	57
7,5	-	87	-	-	-	-	-	-	87
8,0	-	56	-	-	-	-	-	-	56
8,5	-	29	-	-	-	-	-	-	29
9,0	-	20	-	-	-	-	-	-	20
9,5	-	10	-	-	-	-	-	-	10
10,0	-	5	-	-	-	-	-	-	5
10,5	-	8	-	-	-	-	-	-	8
11,0	-	3	-	-	-	-	-	-	3
11,5	-	2	-	-	-	-	-	-	2
12,0	-	7	-	5	-	-	-	-	12
12,5	-	13	-	5	-	-	-	-	18
13,0	-	4	-	5	-	-	-	-	9
13,5	-	4	-	2	-	-	-	-	6
14,0	-	4	-	12	-	-	-	-	16
14,5	-	16	-	8	-	-	-	-	24
15,0	-	26	-	25	-	-	-	-	51
15,5	-	38	-	37	-	-	-	-	75
16,0	-	31	-	50	-	2	-	-	83
16,5	-	27	-	60	-	1	-	-	88
17,0	-	22	-	74	-	3	-	-	99
17,5	-	28	-	88	-	6	-	-	122
18,0	-	13	-	107	-	11	-	-	131
18,5	-	11	-	90	-	11	-	-	112
19,0	-	4	-	72	-	21	-	-	97
19,5	-	1	-	38	-	15	-	-	54
20,0	-	1	-	29	-	8	-	-	38
20,5	-	-	-	12	-	12	-	-	24
21,0	-	-	-	10	-	12	-	-	23
21,5	-	1	-	3	-	9	-	-	12
22,0	-	-	-	-	-	6	-	-	6
22,5	-	1	-	1	-	4	-	-	6
23,0	-	1	-	-	-	-	-	-	1
Total	-	545	-	733	-	121	-	-	1 399

* Classification according to Davies (1956a)

Additional information on the distribution of this species is available from aerial observations made between June 9th and October 16th 1973. During this period some 310 hours were spent in the air, mainly at night, searching for patches of fish (chapter 8). The area covered is illustrated in Fig. 22. Off Southern Africa the Benguela Current system contains many species of phytoplankton which are luminiscent and sufficiently numerous to clearly outline the shape of fish shoals moving through them at night (Cram 1974). Round herring are frequently activated to movement by the noise of an aircraft's engines, often lighting up the sea in a brilliant and characteristic fashion, whereas they do not always respond to flashing spotlights.

Sightings of round herring shoals are illustrated in Fig. 28. It is noteworthy that most of the observations were more than 15 km from the mainland and that a number of shoals were located outside the 200 m bottom contour, suggesting that the distribution of the commercial catches of this species is influenced to a large extent by the preference of skippers to remain within sight of the coast (chapter 6). West of Cape Columbine and west of Cape Town shoals were encountered more than 100 km out to sea. The majority of observations were located in the Saldanha Bay and Hout Bay regions. An exceptionally large patch of round herring was seen on the night of June 18th, stretching discontinuously for more than 80 km between 33°53'S, 17°05'E and 33°57'S, 18° 00'E.

AVAILABILITY ABUNDANCE AND MOVEMENTS

Seasonal patterns of availability and distribution were quantified by dividing the fishing area into six grounds (Fig. 1), chosen to correspond with the major environmental regions of the South-western Cape (Crawford _et al_. in press). Most catches are located within 50 km of the mainland (Appendix) and the grounds are thus of approximately equal size except for the extensive, but relatively lightly exploited, Namaqua area.

Monthly indices of availability and of the relative abundance of fish that could, as a rule, be expected to be present on each of the six grounds were determined in a manner analogous to that described for the pilchard population (chapter 5). The years 1964 - 1976 were used for fish aged two and older, but only 1966 - 1976 were considered for nought- and one-year-olds. Fishing for round herring with the 12,7 mm net was not permitted in earlier years and the age composition of commercial landings (Fig. 29) suggests that these young fish were not fully selected in 1964 and 1965. Values were not calculated for October, November or December, the season being closed for round herring during these months in every year.

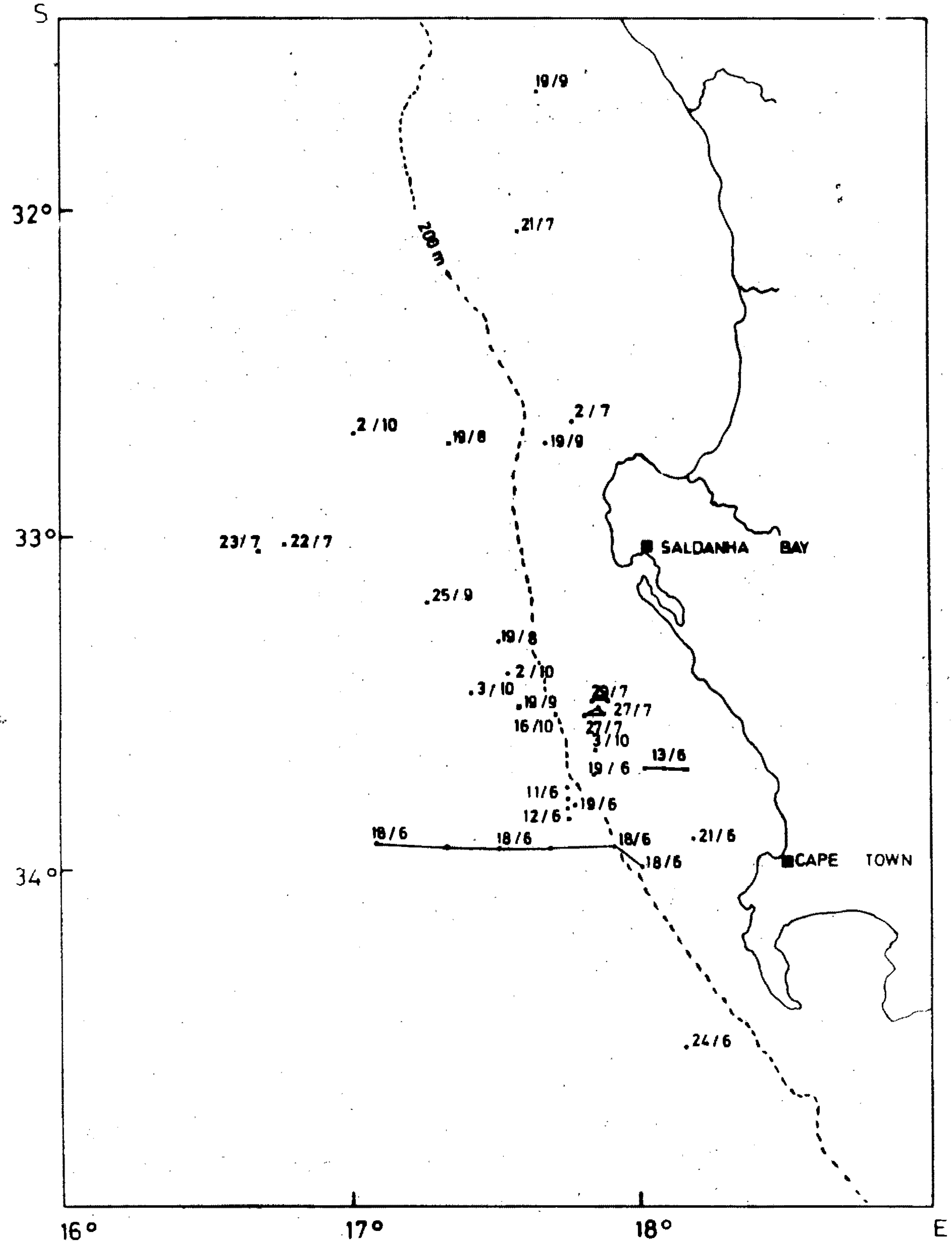

Fig 28 Aerial sightings of round herring, 10th June - 3rd October 1973 (dates are indicated).

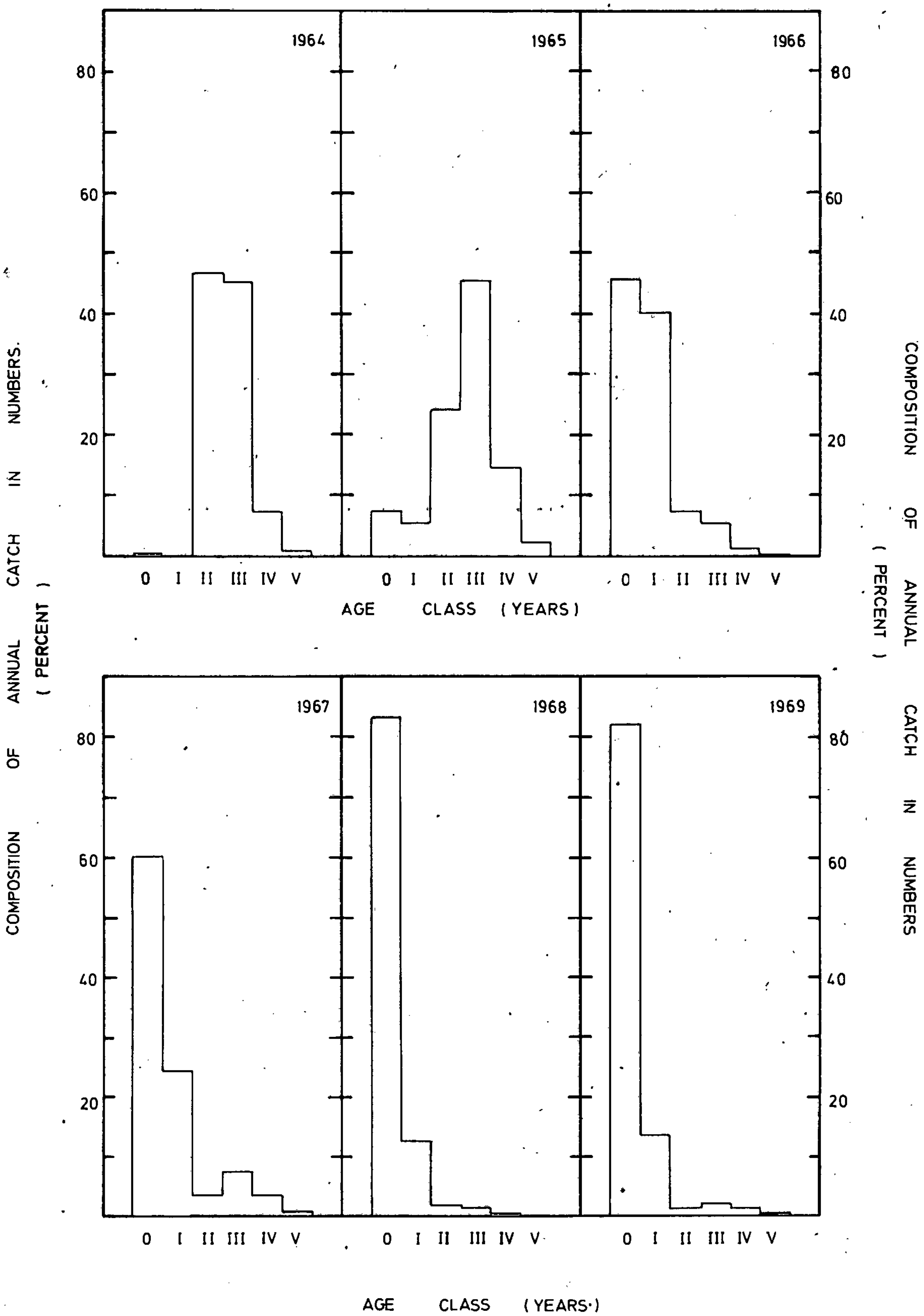

Fig 29a Age composition of South African round herring landings, 1964 - 1969.

The resulting estimates, expressed as percentages of the maxima, appear in Figs. 30 and 31. Mortality is expected to influence trends exhibited by fully recruited age classes (one-year-olds and two- to five-year-olds) but unrealistically high values ($Z = 5,3$ and $7,0$ respectively) would be required to account for the observed declined in availability. No reliable coefficient of natural mortality is available for round herring in South African waters but it is thought to be less than that of 0,8 for anchovy, a shorter-lived species. Between 1964 and 1976 round herring fishing mortality ranged from 0,03 to 1,58 (mean 0,54) (Centurier-Harris et al. 1977). Undoubtedly fish movements and behaviour also exert a considerable influence on patterns of availability and abundance. These will be dealt with in greater detail when considering the various age components of the population.

Nought-year-olds

Availability of nought-year-old round herring is at a moderate level in January but falls sharply during February and March before rising again in April. Catch rates are highest in September (Fig. 30). The pattern is thus similar to that observed for pilchard (chapter 5), though recruitment of round herring possibly commences one month earlier. As do their pilchard and anchovy (chapter 6) counterparts, these young fish also appear to move south towards the end of winter or at the beginning of spring. Catch rates on the Namaqua ground decline after June, whereas those in the Gans Bay region increase markedly in August and September (Fig. 31).

The trend in availability is fairly regular, as revealed in the Appendix for the years 1967, 1968, 1969, 1970, 1973, 1976 and possibly 1966. Moreover, although 1971, 1972 and 1975 provided no landings of juveniles in January, catch rates improved as usual during the latter part of the season. In 1964 and 1965 nought-year-olds were not fully selected by the fishing gear in use (Fig. 29) and, as with pilchard (Crawford et al. in press), their scarcity in 1974 may have resulted from an early closure to the fishing season.

A southward expansion in the distribution of this age class during winter is apparent for a number of years (June 1967; June/August 1970; June 1971; June 1972; May 1975; August 1976). In addition there was a noticeable build-up in catches to the south of Cape Columbine in August 1966.

One-year-olds

Availability of one-year-old round herring increases after February, probably as a result of large numbers of nought-year-old fish entering their second year of life at this time,

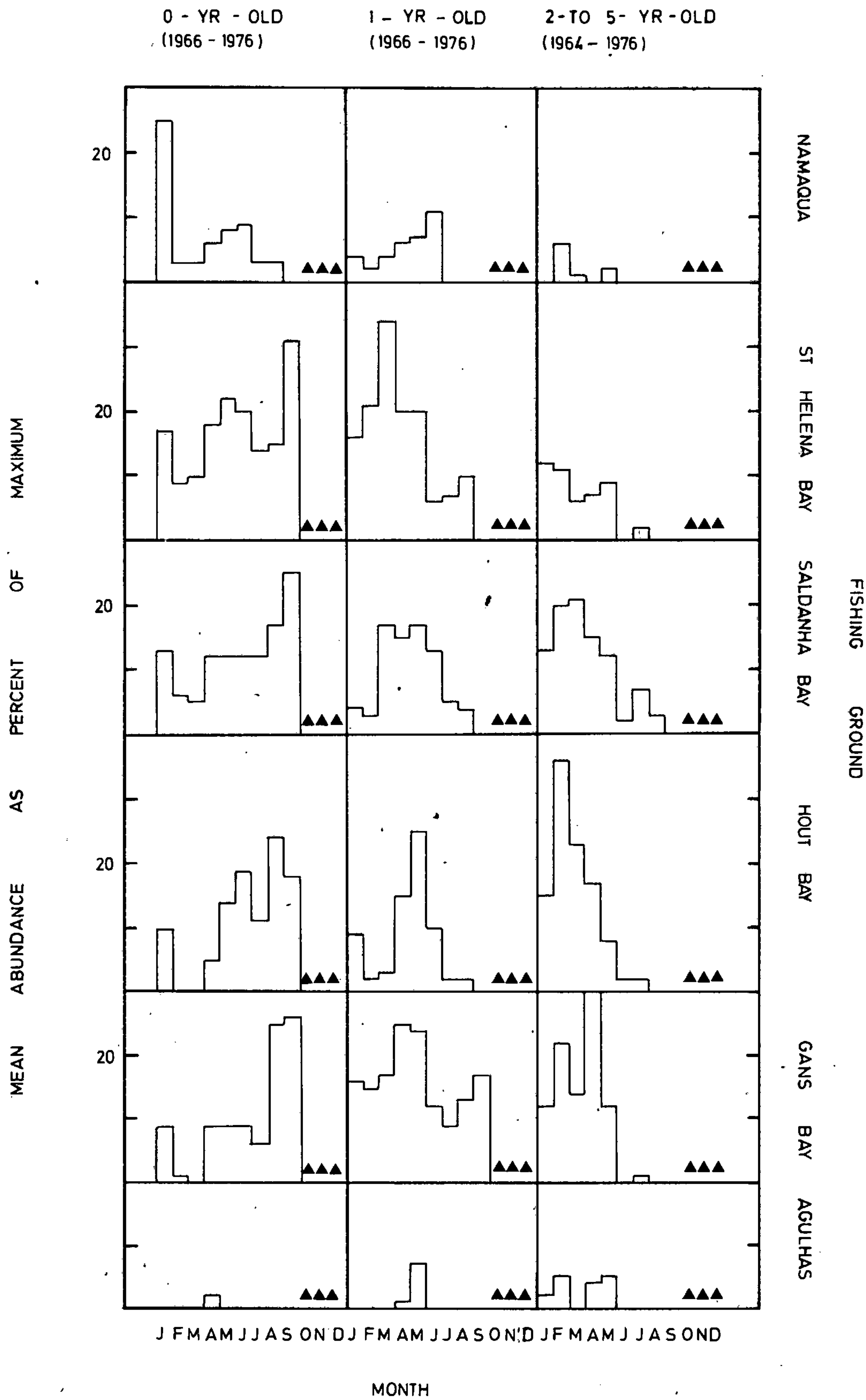

Fig 31 Abundance indices for round herring.
(▲ no data)

and reaches its highest level in May. Thereafter there is a sharp decline, with generally poor catch rates being experienced at the end of winter (Fig. 30). Again the pattern is almost identical to that of the pilchard population (chapter 5) and the analogy is carried one step further by a southward shift in abundance during autumn (Fig. 31). Unlike the pilchard, however, a substantial proportion of this component of the stock is caught in the Gans Bay area, whereas much smaller returns are forthcoming from the Namaqua ground. The round herring thus assumes a more southerly distribution.

This age group also was not fully selected in 1964 and 1965 but fairly good catches were recorded during the autumns of 1966, 1967, 1969, 1971, 1972,1973 and 1976 and lesser totals in 1968, 1970, 1974 and 1975 (Appendix).

There was a clear migration to the south in 1967. One-year-olds were caught off Lambert's Bay in January and February, between the Olifants River and Cape Columbine in March, from the Olifants River to Saldanha Bay and off Hout Bay in April and from Dassen Island to Walker Bay in May. A similar movement is also apparent for 1966 (March/April and May/June), 1968 (March/May), 1969 (April/June), 1970 (February/April), 1971 (April/May), 1972 (March/April), 1973 (March/April) and 1976 (April/May).

Two- to five-year-olds

Preliminary analysis revealed that the behaviour of round herring aged between two and five was similar and these fish are here considered together. As with two- to four-year-old pilchard and the adult anchovy age groups, they are most abundant in summer and catch rates decline with the advent of winter (Fig. 30). Although mortality can only partially account for the observed decrease in availability, no distinct and regular migration off the fishing grounds in a longshore direction could be detected. It is possible, however, that adults move offshore at this time. Between June and October 1973 aerial observations indicated that most shoals were located further than 15 km from the mainland (Fig. 28) and the initial results of a recent plankton survey (Shelton pers. comm.) suggest that most of the spawning occurs offshore.

The preferred grounds for these adult age classes are those of Saldanha Bay, Hout Bay and Gans Bay (Fig. 31). By contrast, two- to four-year-old pilchard favour the Gans Bay and Agulhas areas and may be distributed even further east, though those aged five or six occur predominantly on the west coast (chapter 5).

Reference to the Appendix shows that round herring adults were relatively abundant during summer or autumn of every year with the possible exception of 1974. Catch rates greater than 10 metric tons per standard boat day were often experienced in these seasons but were infrequent later in the year (Table XXIII).

DISCUSSION

Patterns of distribution and availability, as well as migrational tendencies, for both nought- and one-year-old round herring are similar to those exhibited by the corresponding pilchard age groups, suggesting that those environmental factors which determine the behaviour of the latter (Crawford et al. in press), are applicable also to the round herring during its first two years of life. As a consequence of this young round herring are frequently found in mixed shoals with either pilchard or anchovy. Of all juveniles landed during the thirteen year period 98 per cent were combined with other species in mixed catches.

Older individuals tend to assume a slightly more northerly, and possibly offshore, distribution than their pilchard counterparts. This may be linked to spawning as the densest egg concentrations are encountered between Lambert's Bay and Cape Agulhas in offshore water (Shelton pers. comm.). O'Toole and King (1974) have demonstrated that the rate of development of round herring eggs increases exponentially with temperature over the range 11,5 - 20,5°C , but identified no lower lethal limit. Lower lethal limits of 13,0 and 14,0°C, respectively, were measured for pilchard and anchovy in Southern African waters (King et al. 1978). Round herring eggs are thus considerably more tolerant of cold water masses than those of the other two species, which may explain their presence in regions that are subject to the influence of the cool upwelling plumes as well as to the east of Cape Point. The presence of the older age groups on the Saldanha Bay and Hout Bay grounds often results in round herring co-occuring with mackerel Scomber japonicus in mixed shoals (Geldenhuys 1978). Of all round herring landed between 1964 and 1976 15 per cent were from such shoals.

Round herring have relatively large scales, which they shed readily when disturbed. This frequently leads to clogged meshes and a net that is both difficult to purse and that will later require considerable time and effort to clean. Fishermen, therefore, generally avoid this species when it can be recognised and when other fish types are plentiful in the vicinity. The population may thus be capable of sustaining higher harvests than those hitherto attained and in future years may attract a greater proportion of the fishing effort, especially as the past two decades have witnessed a

TABLE XXIII : MONTHS IN WHICH CATCH RATES GREATER THAN 10 METRIC TONS PER STANDARD BOAT DAY WERE RECORDED FOR TWO- TO FIVE-YEAR-OLD ROUND HERRING

Month	Seasons
January	1966, 1972, 1973, 1975
February	1965, 1966, 1969, 1970, 1971, 1972, 1973, 1975
March	1967, 1969, 1970, 1971, 1973, 1974, 1976
April	1966, 1967, 1968, 1971, 1972, 1975
May	1964, 1975
June	1968
July	1976
August	1968
September	-
October	-
November	-
December	-

TABLE XXIV : VIRTUAL POPULATION ESTIMATES OF PILCHARD, ANCHOVY AND ROUND HERRING RECRUITMENT (NUMBERS x 10^{-10}), 1964 TO 1976 (from Centurier-Harris *et al.* 1977)

Year	Pilchard	Anchovy	Round herring
1964	0,32	3,91	0,13
1965	0,32	3,30	0,15
1966	0,52	5,66	0,20
1967	1,03	6,80	0,32
1968	1,03	4,98	0,74
1969	0,62	5,56	0,63
1970	0,62	6,10	0,53
1971	0,89	4,55	0,13
1972	0,43	4,32	0,14
1973	1,12	9,01	0,07
1974	1,81	5,39	0,06
1975	1,39	7,58	0,39
1976	0,01	5,60	0,19
Mean 1964 - 1976	0,78	5,59	0,28

sequential depletion of some traditional resources: those of horse mackerel <u>Trachurus trachurus</u>, of pilchard aged five and older, and of mackerel. In addition the remaining age components of the pilchard and anchovy stocks are being subjected to increasingly high levels of exploitation and are in danger of being overfished (chapter 4).

The tendency of juvenile round herring to shoal with other species makes it difficult for skippers of purse-seine vessels to deliberately avoid this particular component of the population and virtual population estimates of recruitment are considerably less than those for pilchard and anchovy (Table XXIV). It would thus seem unwise at this stage to pin too much hope on greatly improved catches of this species in forthcoming seasons.

CHAPTER 10. OCCURRENCE OF LANTERN-FISH <u>LAMPANYCTODES HECTORIS</u> IN SOUTH AFRICA'S WESTERN CAPE PURSE-SEINE CATCHES, 1968 TO 1976.

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CHAPTER 10. OCCURRENCE OF LANTERN-FISH LAMPANYCTODES HECTORIS IN SOUTH AFRICA'S WESTERN CAPE PURSE-SEINE CATCHES, 1968 TO 1976.

Lantern-fish *Lampanyctodes hectoris* made its first documented appearance in South Africa's Western Cape purse-seine catches in 1966, shortly after the introduction of small-meshed (12,7 mm) nets, but was only recorded separately from anchovy *Engraulis capensis* during 1968 and subsequently (Crawford *et al.* 1978). Its contribution to the combined landings has been sporadic, a maximum of 42 369 metric tons being recorded in 1973 but annual totals only exceeding 10 000 tons on two other occasions (Table XXV). This can probably be attributed to a preference for the oceanic mid-waters (Centurier-Harris 1974, Ahlstrom *et al.* 1976) making lantern-fish rarely available to purse-seine boats. In addition its high oil content has resulted in the clogging of machinery at fish meal plants (Centurier-Harris 1974) and when lantern-fish dominate the landings factory managers often direct their skippers to search for other species.

Off Southern Africa, as elsewhere (Manzer 1968, Peyeyra *et al.* 1969, Pinkas *et al.* 1971), the family Myctophidae forms an important component in the diet of many pisciverous fish. It comprises more than 75 percent by weight of the food of young (caudal length 20 - 60 cm) hake *Merluccius* sp., is important in the diets of John Dory *Zeus capensis*, jacopever *Helicolenus maculatus* and angelfish *Brama raai* and is also eaten by large-scaled rattail *Coelorhynchus fasciatus*, smooth rattail *Lionurus nigromaculatus* and horse mackerel *Trachurus trachurus* (Davies 1949). Myctophids are ingested in large quantities by four tuna species, the bluefin *Thunnus maccoyii*, the longfin (albacore) *T. alalunga*, the yellowfin *T. albacares* and the bigeye *T. obesus* (de Jager *et al.* 1963, Nepgen 1970), are present in the stomachs of trawl-caught snoek *Thyrsites atun* (Nepgen 1979) and contribute 23 and 44 percent of the food of medium (caudal length 26 - 45 cm) and large (caudal length $\geq$46 cm) mackerel *Scomber japonicus* respectively (Baird 1978b).

Lantern-fish readily shed their skins and for this reason identification is frequently difficult (Centurier-Harris 1974), especially when the stomach contents are well digested as is often the case (de Jager *et al.* 1963). In view of the predominance of *L. hectoris* in the commercial purse-seine landings, however, and also in an extensive plankton survey conducted off the coast of South West Africa between August 1972 and April 1974, when this species comprised more than 85 per cent of all myctophid larvae collected (Ahlstrom *et al.* 1976), it is thought likely that in many of the above instances *L. hectoris* was the main contributor. It is of particular interest because of the commercial importance of its predators hake and mackerel and the possibility of mid-water trawling

TABLE XXV : ANNUAL CATCHES OF LANTERN-FISH AND PERCENTAGE CONTRIBUTION TO COMBINED PURSE-SEINE LANDINGS, 1968 TO 1976.

Year	Catch (metric tons)	Percentage of combined purse-seine catch
1968	56	0,0
1969	4 945	1,4
1970	18 201	5,1
1971	2 047	0,6
1972	15 153	3,5
1973	42 369	9,4
1974	301	0,1
1975	87	0,0
1976	75	0,0

TABLE XXVI : SEX RATIO OF LANTERN-FISH OCCURING IN COMMERCIAL LANDINGS, 1968 TO 1976.

Year	Individuals with gonads too small to ascertain sex	Males	Females	Total
1968	40	-	50	90
1969	23	-	81	104
1970	-	-	250	250
1971	No sample information			
1972	No sample information			
1973	6	34	210	250
1974	No sample information			
1975	No sample information			
1976	19	-	25	44
1968-1976	88	34	616	738

for lantern-fish. This paper therefore documents present knowledge of the distribution and availability (to purse-seine catchers) of L. hectoris. Basic information on length and mass relationships is also presented.

DISTRIBUTION OF COMMERCIAL CATCHES

Monthly distribution patterns of commercial catches for the period 1968 - 1976 were derived in a manner similar to that already described for pilchard Sardinops ocellata (chapter 5). The results are presented in map form in the Appendix.

Examination of the length compositions of 31 purse-seine catches revealed that in South African waters lantern-fish from any one shoal seldom differ in caudal length by more than 3 or 4 cm (Fig. 32). The modal length of fish caught in known areas, whenever available from field observations, has therefore been included on the distribution maps to give some indication of the size of fish encountered.

As observed by Centurier-Harris (1974) and Centurier-Harris and Crawford (1974), the majority of catches have been made close to the mainland and in the region between the Olifants River and Dassen Island (Appendix). Successful hauls from further north occured infrequently (January and February 1969, March 1971, January and February 1973 and February 1974) and to the east of Cape Point on only three occasions (March 1970, February 1972 and February 1973). In South African waters the species has not been commercially exploited north of latitude 30°S or further east than Cape Agulhas and the only truly offshore catch to have been reported was that to the south-west of Cape Point in February 1972.

AVAILABILITY AND ABUNDANCE

Monthly indices of availability and of the relative abundance of lantern-fish that could, as a rule, be expected to be present on each of six fishing grounds (Fig. 33), chosen to correspond with the major environmental regions of the South-western Cape (Crawford et al. in press), were determined in a manner analagous to that previously described for the pilchard population (chapter 5). A technique for ageing this species in South African waters has yet to be developed (Newman and Crawford in press) and the population was therefore considered as an entity. Over the period 1968 - 1976 fishing for L. hectoris was not permitted between September and December, with the exception of September 1968. Values were thus not calculated for these months. Estimates for the remainder of the year, expressed as percentages of the maxima, appear in Figs. 34 and 35.

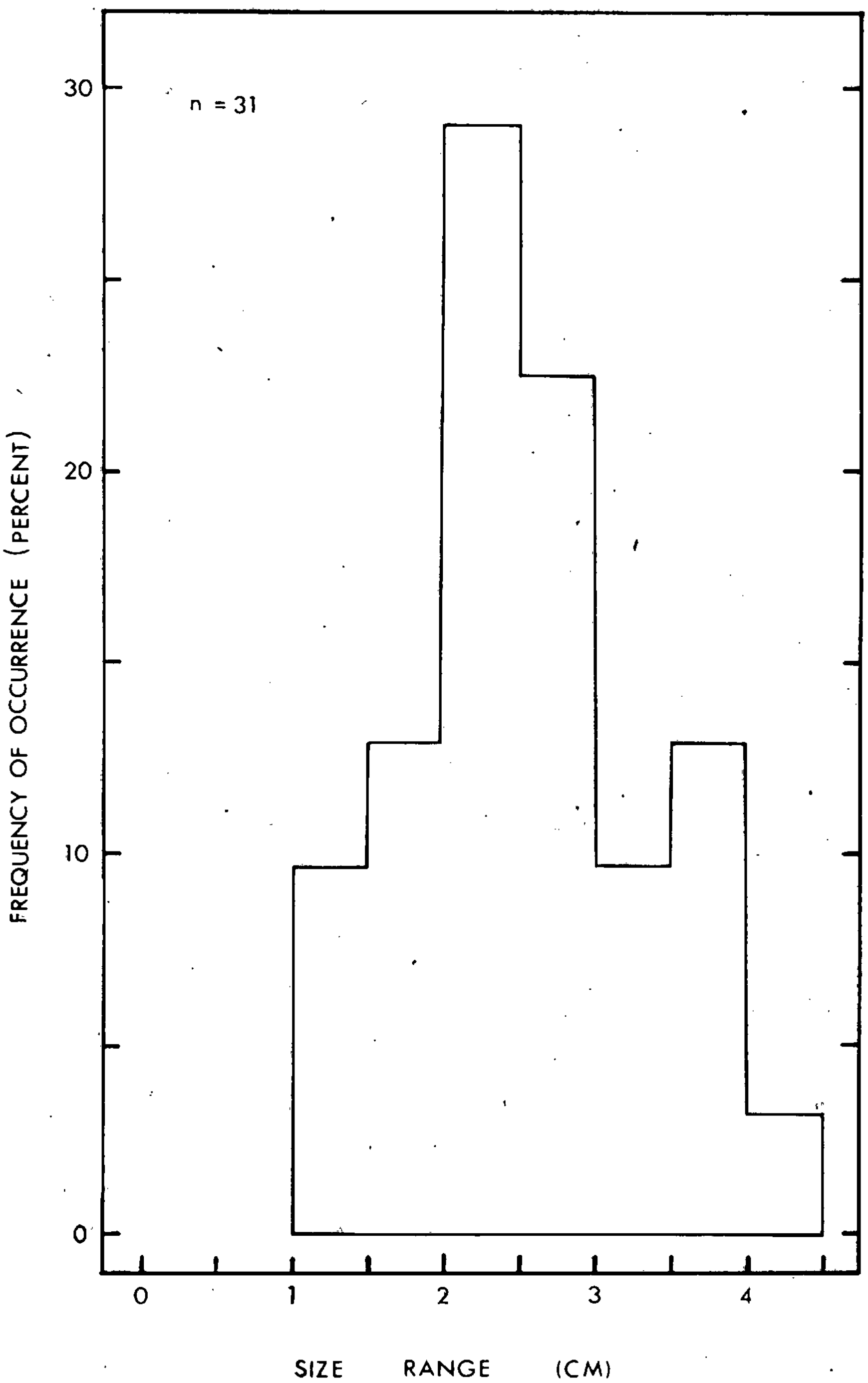

Fig 32 Frequency of occurrence of lantern-fish size-range (caudal length) variations between largest and smallest fish sampled from individual purse-seine catches.

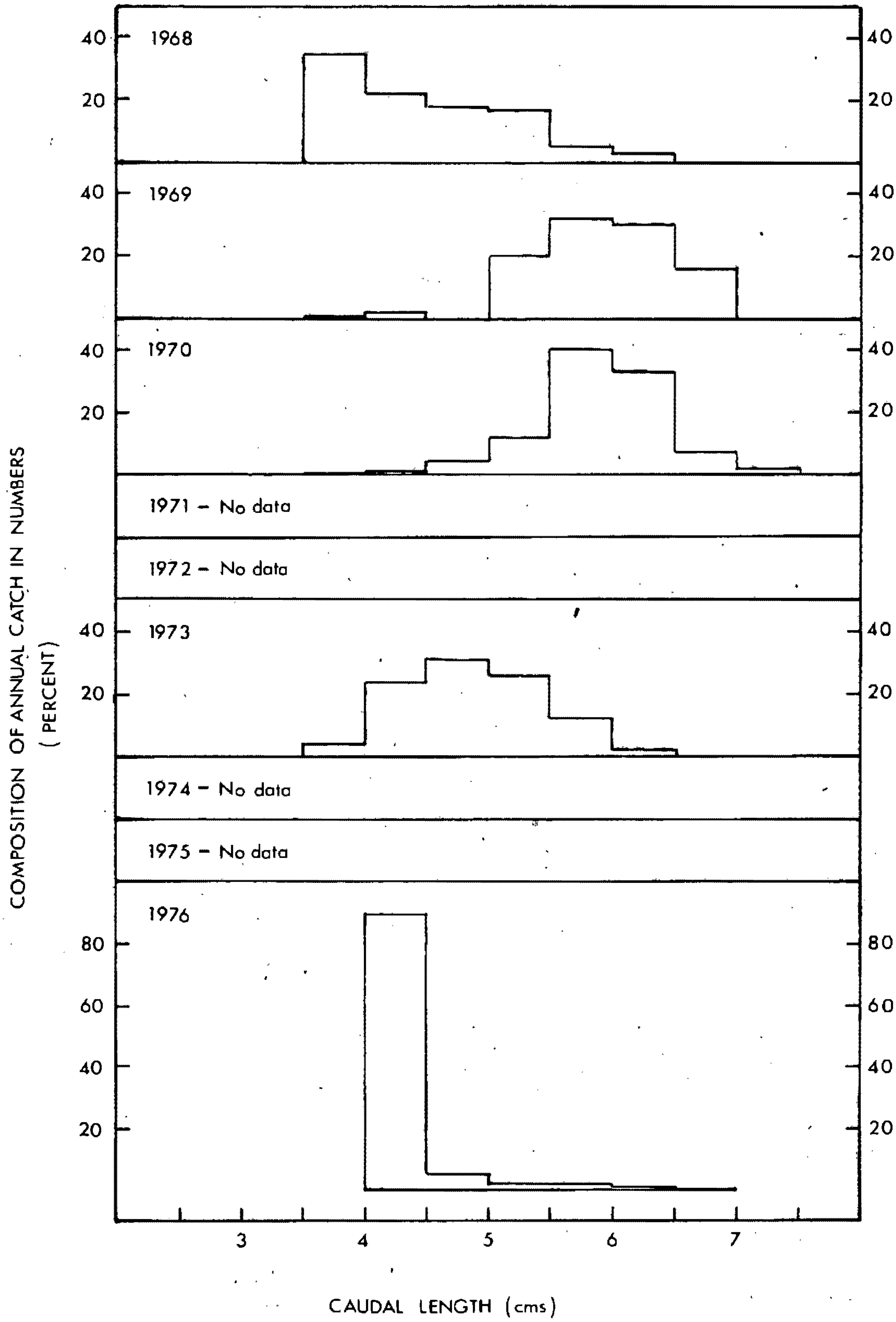

Fig 36 Length composition of South African lantern-fish landings, 1968-1976

TABLE XXVII : GONAD ACTIVITY AT CAUDAL LENGTH IN LANTERN-FISH, 1968 TO 1976.

Caudal length (cm)	Stage of activity *				Total
	0	1	2	3	
3,0	-	2	-	-	2
3,5	-	16	-	-	16
4,0	-	76	-	-	76
4,5	-	124	-	2	126
5,0	2	136	-	-	138
5,5	2	171	-	1	174
6,0	23	109	-	-	132
6,5	23	42	-	-	65
7,0	1	7	-	-	8
Total	51	683	-	3	737

* Classification according to Davies (1956a).

fish are known to undertake (Centurier-Harris 1974). A similar region exists south-west of Cape Point but the effort expended on these grounds is considerably less (chapter 4).

Bang and Andrews (1974) describe a pronounced sub-surface, north-flowing jet associated with and drawing its energy from a frontal feature situated some 40 miles west of Cape Town. They postulate that its intensity may be a function of the local south-east wind stress and that, should this remain favourable for prolonged periods, the front would move seawards until reaching the edge of the shelf. The jet would then expand downwards. The Cape Canyon comes to a head off Cape Columbine (Fig. 33) and in this vicinity a sub-surface current may be expected to be diverted upwards. This could have a marked bearing on the vertical positioning of lantern-fish in the water column, either directly or through influencing the location of its food. The effect would be especially pronounced from late spring to early autumn when south-east winds are dominant and it is at this time that lantern-fish are most available to purse-seine boats (Fig. 34).

The Cape Columbine vicinity is also where adult mackerel migrate inshore to spawn during the winter months (Baird 1974). These fish often subsequently move in a southerly direction as far as Dassen Island, where they generally disappear (Baird 1978a). L. hectoris dominate their diet (Baird 1978b) and, although the availability of lantern-fish is minimal after April, adult mackerel have been netted while feeding on this species. Thus the preference of mackerel aged three and older for the northernmost fishing grounds (chapter 8) and for the Cape Columbine vicinity in particular may well be correlated with the presence of lantern-fish.

A relatively diffuse distribution in the water column has been cited as one of the factors hampering commercial exploitation of lantern-fish species (Ahlstrom et al. 1976). Myctophids, however, have been known to form extensive aggregations in slope waters (Backus et al. 1968). In view of this and the evidence above the Cape Columbine/Cape Canyon area would appear the obvious choice for exploratory midwater fishing of L. hectoris, for either research or commercial purposes, and any attempts to estimate population size by acoustic or other surveys should be initiated in this region.

CHAPTER 11. SEASONALITY IN SOUTH AFRICA'S WESTERN CAPE PURSE-SEINE FISHERY.

pp. 181 - 196.

CHAPTER 11. SEASONABILITY IN SOUTH AFRICA'S WESTERN CAPE PURSE-SEINE FISHERY

Distinct seasonality characterises South Africa's Western Cape purse-seine fishery. Well-defined trends, generally age-specific, are evident in the availability and distribution of all six contributors to the commercial landings: pilchard *Sardinops ocellata*, anchovy *Engraulis capensis*, horse mackerel *Trachurus trachurus*, mackerel *Scomber japonicus*, round herring *Etrumeus teres* and lantern-fish *Lampanyctodes hectoris*. They result from the climatic conditions of the region and, in turn, influence the deployment of effort on the fishing grounds (chapter 4). The purpose of this paper is to summarise these patterns so that an overall perspective may be established for management. However, the multi-species nature of the resource, the many age components involved, the differential mortality rates and the wide variety of processed products of different values combine to necessitate the use of modelling before strategies may be compared in a quantitative manner. Knowledge of availability and distribution also provides a basis for future studies that may deal with the seasonal biology of predators. The more important of these include the Cape fur seal *Arctocephalus pusillus* (Rand 1959a), Cape gannet *Sula capensis*, jackass penguin *Spheniscus demersus* and Cape cormorant *Phalacrocorax capensis* (Davies 1955, 1956c, Rand 1959b, 1960a, 1960b, Matthews 1961), the snoek *Thyrsites atun* (Nepgen 1979), various tuna species (De Jager *et al.* 1963, Nepgen 1970) and the yellowtail *Seriola lalandi* (Crawford *et al.* in prep.).

THE OCEANOGRAPHIC ENVIRONMENT

Summer conditions are dominated by prevailing southerly to easterly winds, which result in powerful upwelling to the west of Cape Point (Fig. 1). At certain localities this is enhanced by the bathymetry and the land topography and plumes of cool, low-salinity water extend northwards and offshore for up to 100 km, separated from oceanic waters by sharp gradients of temperature and salinity (Crawford *et al.* in press). Strong equatorward jet currents are often associated with these frontal systems (Bang and Andrews 1974). East of Cape Point the influence of the Agulhas Current causes water temperatures to increase. From Cape Point to Quoin Point dense plankton occurs in the surface waters for a brief period each year (Tromp *et al.* in prep.) but between Quoin Point and Port Elizabeth growth of phytoplankton is restricted to occasional upwelling events and, when sufficient light is available, to the region of the thermocline (Crawford *et al.* in press).

During winter northerly to westerly winds drive warm, clear oceanic water inshore on the west coast. However, storm-induced mixing maintains a narrow strip of cooler, plankton-rich water between this and the mainland. The shallow area north of Cape Columbine is less subject to the warm water intrusions than areas further south and consequently exhibits less variability in plankton standing stock, although a distinct seasonal cycle is apparent (De Decker 1973).

All the fish processing factories are situated between Lambert's Bay and Gans Bay, though vessels have been known to operate as far north as the Orange River or eastwards to Cape Infanta. The overall area has been divided into six fishing grounds-the Namaqua, St Helena Bay, Saldanha Bay, Gans Bay and Agulhas ones (Fig. 1) - chosen to conform with the major environmental regions (Crawford et al. in press).

AVAILABILITY AND DISTRIBUTION

From January to August or September catch rates recorded between 1964 and 1976 have been used to determine quantitative, monthly indices of availability and of the relative abundance of fish occuring on each ground for the various components of the six stocks (chapters 5 - 10). Because of closed seasons, data for the latter part of the year were unfortunately too few to warrant manipulation and values for the relevant months can only be assumed on the basis of interpolation. Nevertheless definite behavioural trends are apparent and these are briefly outlined below.

Pilchard

Surface plankton tows conducted between 1951 and 1967 have demonstrated that most pilchard spawning takes place between September and February. Eggs were initially especially abundant offshore of St Helena Bay (Fig. 37) but the intensity of spawning in this region later declined and yields during the final two years of the survey (1966 - 1967) were negligible. Large concentrations were also encountered between Cape Point and St Sebastian Bay though here, unlike the northern area, there was no apparent decrease in productivity.

Recruitment of nought-year-old fish occurs along the entire west coast from May onwards, availability reaching a peak during September. In winter catch rates are highest on the northern grounds but at the onset of spring these juveniles exhibit a tendency to move south. One-groupers also favour the west coast areas, certain of them approaching sexual maturity towards the end of the year.

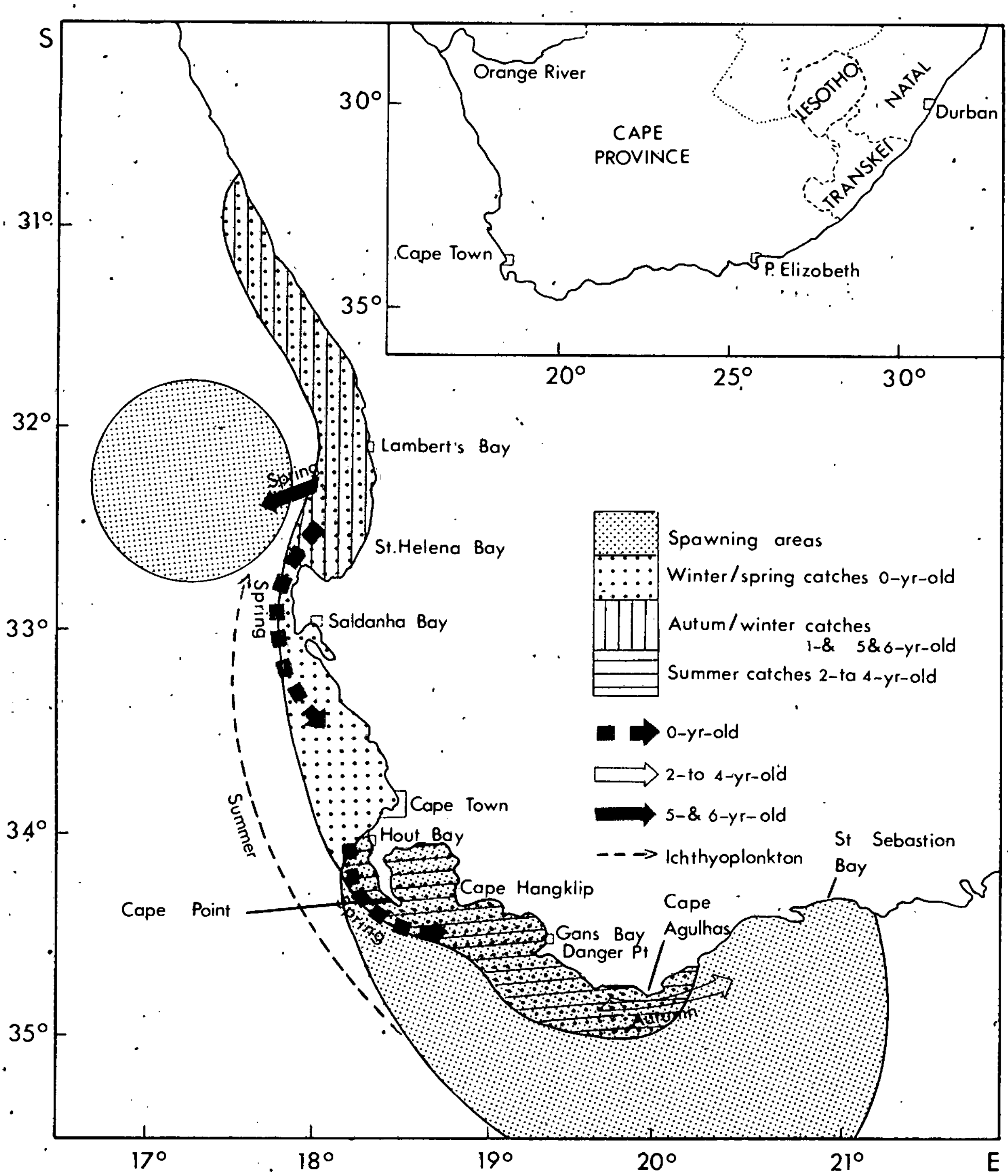

Fig 37 Main spawning areas and catch locations for different age components of the South African pilchard population.

Of all two-year-olds 50 per cent are reproductively active and, together with three's and four's, they occur on the southern spawning region during spring and summer. With the advent of autumn they regularly migrate in a south-easterly direction past Cape Agulhas, being infrequently caught after April or May. Two-year-olds seldom contribute large quantities to the commercial purse-seine landings in the Western Cape but often dominate the well-known winter "sardine run" off the Transkei and Natal coasts (Baird 1971). The centre of their distribution may therefore be to the east of the main fishing grounds.

Five- and six-group pilchard were traditionally encountered in the St Helena Bay region from February to May or June and are believed to have been responsible for the summer spawning further offshore. It is noteworthy that the greatly reduced egg yields from this area coincided with the virtual elimination of this section of the pilchard population as reflected by the age composition of the commercial catches (Crawford *et al.* 1978).

Anchovy

Anchovy spawning is largely confined to the period October to January and to the waters east of Cape Point (Fig. 38). Nought-year-olds recruit to the fishery on the west coast in steadily increasing numbers after February. Availability reaches its highest level in June, six months after the peak in egg production, and from then until September juveniles are caught in large quantities. As with young pilchard there is a definite movement from the northern grounds towards the south at the conclusion of winter.

Of one-year-old fish 50 per cent and of two-groupers virtually all are sexually mature. During late summer the adult shoals are distributed throughout the fishing region but thereafter frequently undertake a migration to the south and east, similar to that evidenced by pilchard aged between two and four. They are usually positioned slightly to the west of the pilchard shoals.

Horse mackerel

It is generally recognised (De Villiers 1977, chapter 7) that two separate stocks of horse mackerel exist in South African waters. Only one of these, that of the Western Cape, has in the past contributed to the purse-seine landings. The second is located off Port Elizabeth beyond the range of catcher vessels. Neither season nor area of spawning has yet been delimited though the initial results of a recent plankton survey (Shelton pers. comm.) suggest that most egg production by the Western Cape stock occurs between Saldanha Bay and Cape Hangklip in fairly deep water offshore in spring and early summer (Fig. 39).

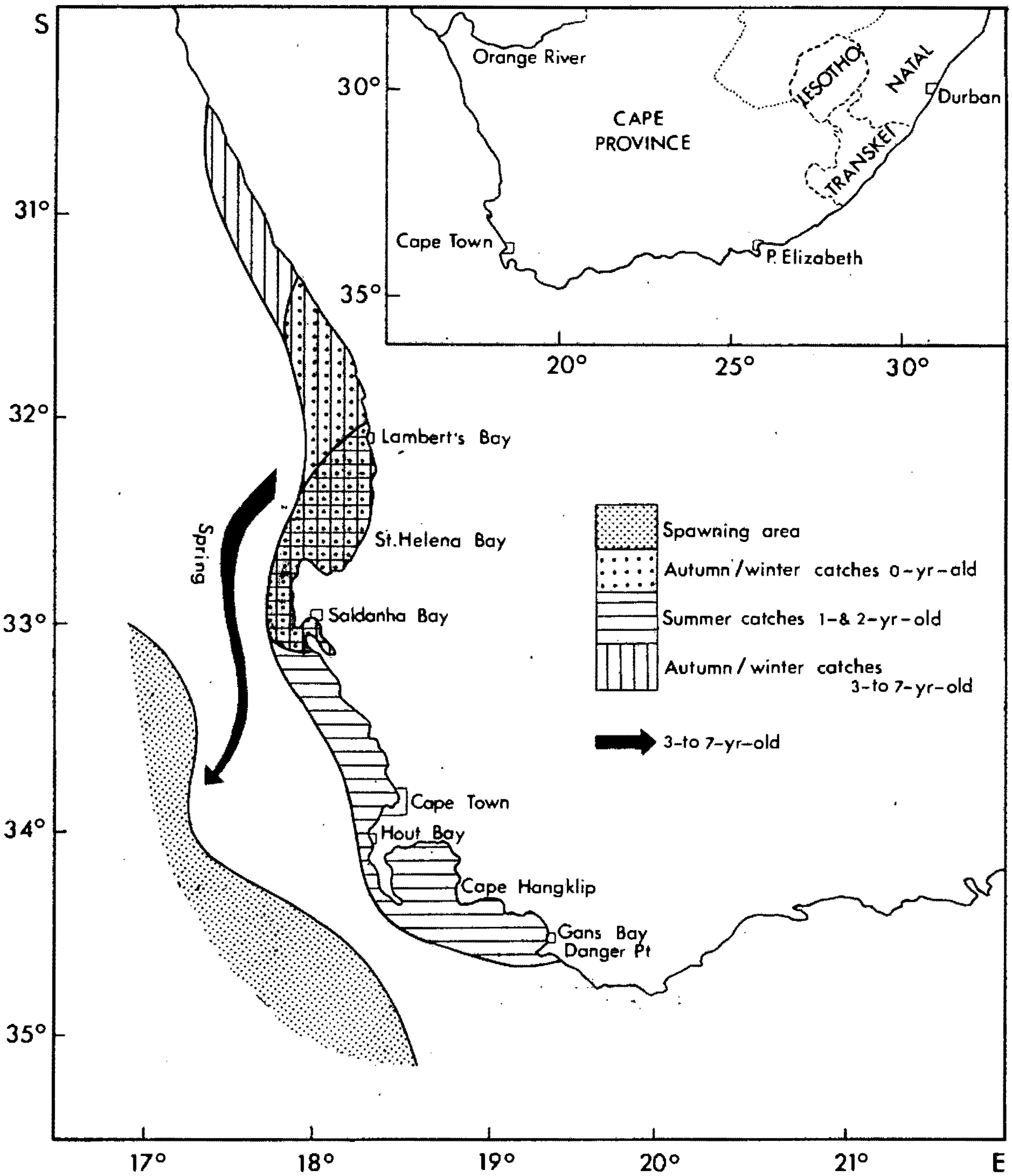

Fig 39 Main spawning area and catch locations for different age components of South Africa's Western Cape horse mackerel population.

Recruitment of nought-year-olds takes place during May and June, the bulk of these fish being caught in the St Helena Bay area. By contrast, one- and two-groupers, which appear to shoal together and are distributed over the four central fishing grounds, are most available at the beginning of each year with only low catch rates recorded after March.

Sexual maturity in horse mackerel elsewhere is initiated at about two years of age, though the majority of fish do not become reproductively active until they are three or older (Ja Lipskaja 1972, Macer 1974). A similar pattern probably applies to the Western Cape stock, where the older age classes (three to seven) are caught in their largest numbers from late summer through winter, primarily in the northern fishing regions, and their relative absence during other seasons is probably linked to spawning behaviour.

Mackerel

Baird (1977) defines the spawning season of mackerel as June - September. In 1973 the highest concentrations of eggs during these months were encountered between Lambert's Bay and Dassen Island (Fig. 40) (Baird 1975).

At the start of the customary fishing season in January, nought-year-olds are fully recruited and their availability remains at a moderately high level until May. Over this period there is a southward shift in distribution from north of Cape Columbine to the St Helena Bay, Hout Bay and Gans Bay grounds. Catch rates are subsequently poor. One- and two-groupers exhibit similar trends though the displacement from the north is not as pronounced.

Onset of reproductive activity takes place when mackerel are in their third year of life and all individuals are mature before they turn four (Baird 1977). Coincident with an offshore/inshore migration of such fish in the vicinity of Cape Columbine, which Baird (1978a) relates to spawning, there is marked increase in their availability to the purse-seine fleet from late summer through mid-winter. Only negligible quantities are caught in other months.

Round herring

On the basis of a recent plankton survey, Shelton (pers. comm.) is of the opinion that a distinct spring/summer spawning season may be distinguished for round herring. Though the area has not yet been accurately delimited it appears to be extensive and offshore (Fig. 41).

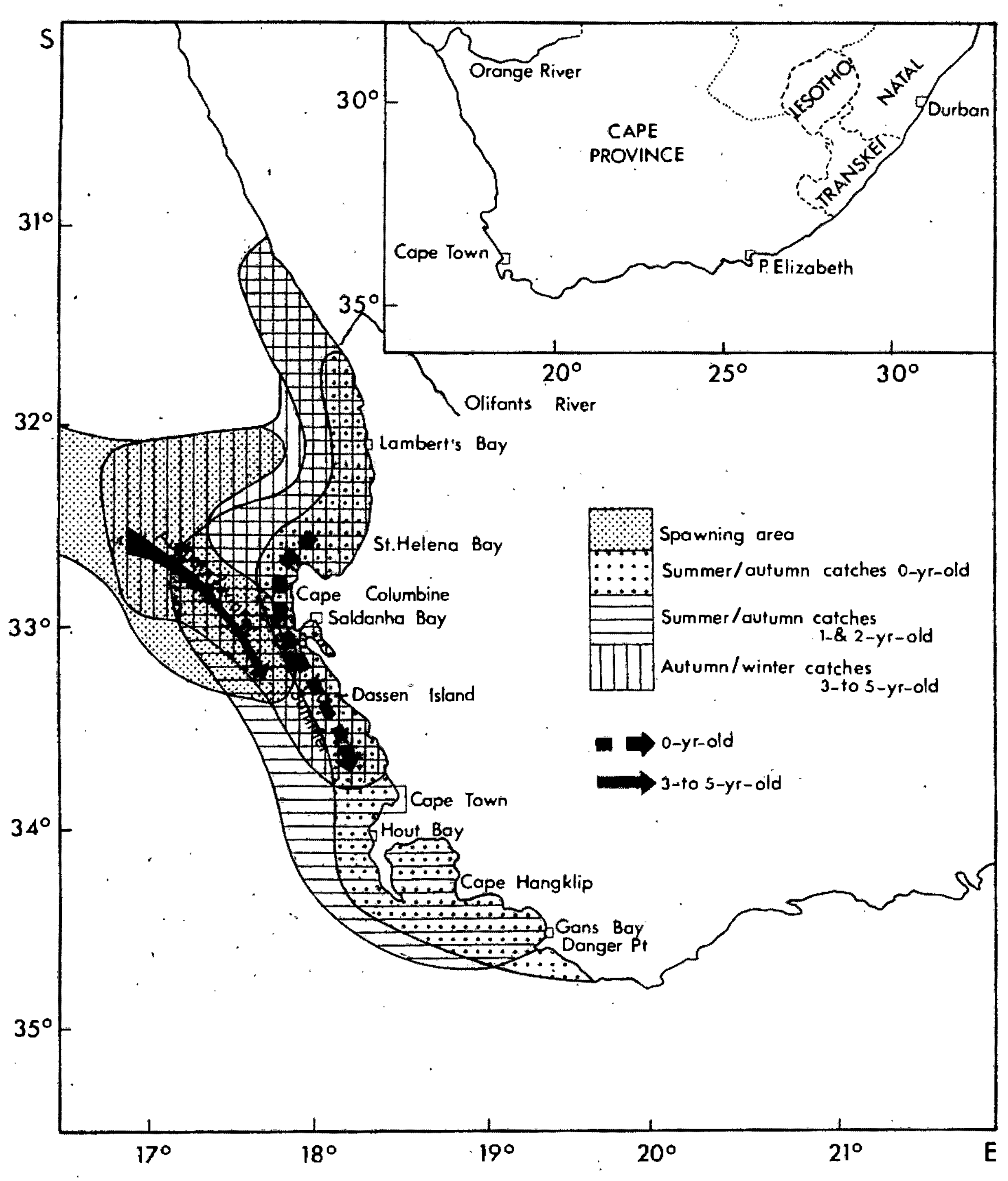

Fig 40 Main spawning area and catch locations for different age components of the South African mackerel population.

Recruitment of nought-year-olds takes place along the west coast from April to September, these young individuals tending to move towards the southern regions at the conclusion of winter. Fish aged one, which are most abundant in the catches during autumn, occur on the four central fishing grounds.

Spawning may be initiated at age one but generally not before round herring are two or three years old. Catch rates for adult age classes (two or older) are highest from mid-summer through autumn, availability deteriorating rapidly thereafter. These fish are distributed between Cape Columbine and Quoin Point and frequently co-occur with nought-year-old mackerel in mixed shoals (Baird 1978a, Geldenhuys 1978).

Lantern-fish

Landings of lantern-fish occur sporadically and to a large extent comprise immature females. The best catches are made from mid-summer to early autumn between the Olifants River and Dassen Island, especially in the vicinity of Cape Columbine (Fig. 42). Spawning off South West Africa appears to reach its zenith during late winter (Ahlstrom *et al*. 1976).

INFLUENCE OF THE ENVIRONMENT

The dominant species may be separated into two broad categories - spring or summer spawners, including pilchard, anchovy, horse mackerel and round herring, and winter spawners, to which belongs the mackerel - and it is convenient to treat each of these categories separately.

Of the former group it is apparent that pilchard aged between two and four and also all adult anchovy tend to spawn in the region to the east of Cape Point, where water temperatures increase due to the incluence of the Agulhas Current. Laboratory observations (King 1977a, King *et al*. 1978) indicate that the lower lethal temperature limits for the eggs of these two species are 13 and 14°C respectively and that their rates of development increase exponentially with temperature. The cool upwelled water of the west coast is thus avoided.

Five- and six-group pilchard, prior to a substantial decline in their abundance, were regular spawners in an offshore part of the St Helena Bay ground, and analysis of isotherms indicates that this was outside the oceanic front in warm water. Between 1964 and 1967, when measurements ceased, surface temperatures never dropped below 13°C in the spawning season. Values of 14°C, or slightly lower, were observed and may explain the rarity of anchovy eggs.

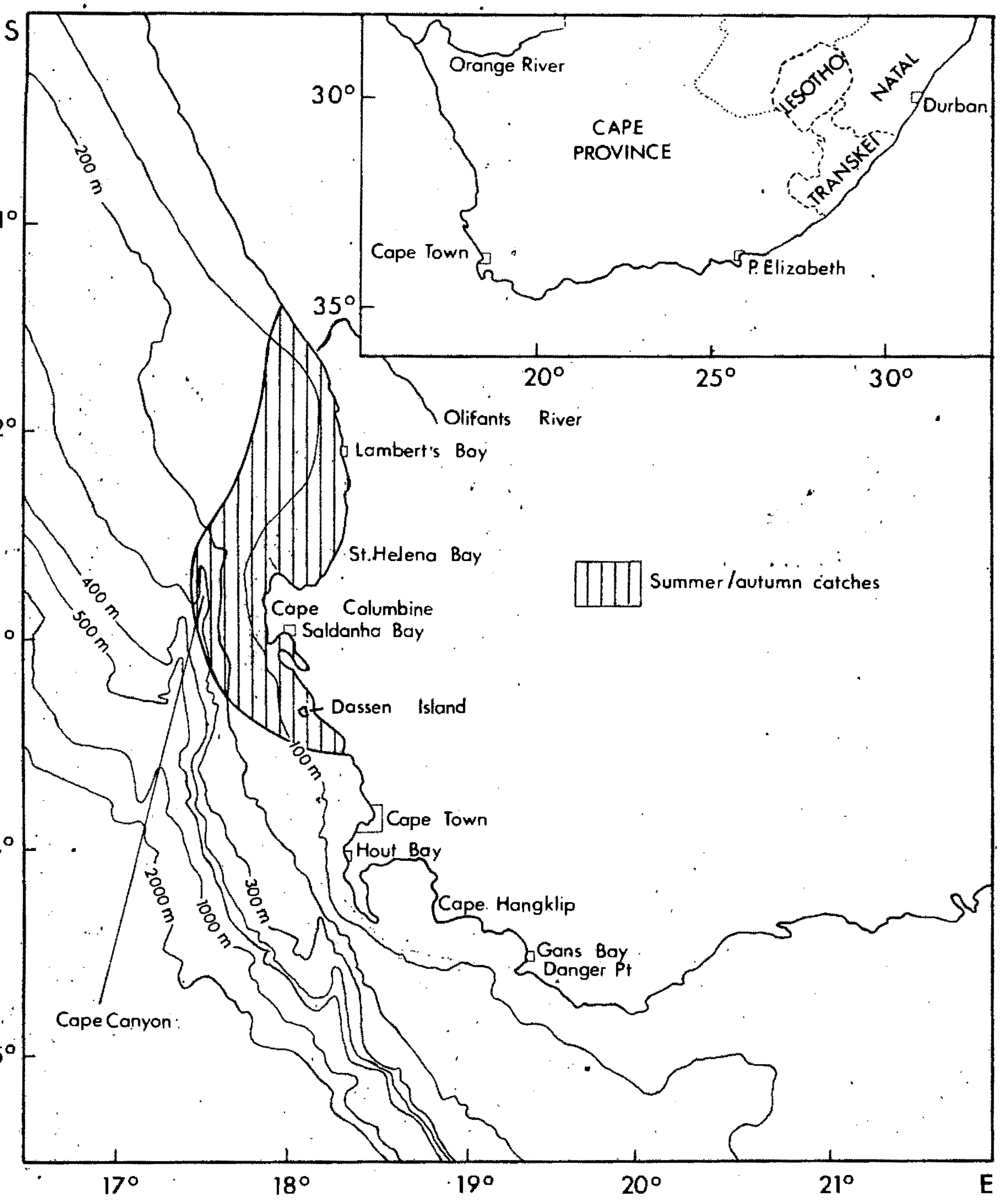

Fig 42 Main location of catches of lantern-fish off South Africa and bottom topography of the fishing area, indicating the Cape Canyon.

Horse mackerel and round herring eggs can tolerate temperatures at least as low as 12,6 and 11,0°C respectively (King et al. 1977, O'Toole and King 1974), though development is again more rapid in warmer water. Horse mackerel spawn well offshore in oceanic water and, although the round herring spawning region includes an area between Cape Columbine and Cape Point which is subject to invasion by cool upwelling plumes, eggs of this species are well adapted to survive in such conditions.

Recruitment of nought-year-olds of all four spring/summer spawners takes place along the west coast from mid-autumn onwards. These young fish occur initially in their heaviest concentrations on the northern grounds, where they frequently shoal together, but at the onset of spring there is a definite tendency for them to move south into regions of newly initiated upwelling. This pattern is true even when there is negligible pilchard spawning activity off St Helena Bay. It is therefore apparent that much of the ichthyoplankton originates from the southern areas and must subsequently be carried in a northerly direction. Shelton and Hutchings (1979) have demonstrated the importance of the Good Hope Jet (Bang and Andrews 1974) in the northward transportation of anchovy eggs and larvae. Other species may utilise the same mechanism. Ichthyoplankton spawned east of Cape Point may drift towards the jet in surface currents set in motion by the prevailing south-easterly winds of spring and summer (Duncan and Nell 1969).

In winter the highest plankton concentrations along the west coast are found in a narrow strip inshore with maximum standing stocks in the north (Crawford et al. in press). Nought-year-old pilchard and anchovy feed predominantly on zooplankton (King and Macleod 1976) and their initial preference for the Namaqua and particularly the St Helena Bay grounds may result from these being the regions of highest food abundance. They are occasionally congregated near the mouths of the larger rivers, notably the Olifants and the Berg Rivers (Fig. 1). The greater part of the rainfall in the catchment areas of these rivers takes place in winter and their outflow is consequently especially strong in this season. River discharge has been shown to be related to marine environmental factors (Sutcliffe et al. 1976) and fish catch (Sutcliffe 1972, 1973) off eastern Canada but the mechanism whereby biological production is influenced by physical parameters is believed to be complex. The contribution of the South African rivers to the overall system warrants further investigation. The sharp increase in the availability of all four species may be caused by the initiation of shoaling behaviour or alternatively growth to a size at which they are fully selected by the fishing gear.

One-year-old pilchard and round herring and also one- and two-group horse mackerel are generally not reproductively active. Significant quantities of these age classes remain in the upwelling areas of the west coast. By contrast many anchovy mature at the end of their first year and adults of this species, as well as pilchard aged two to four, spawn to the east of Cape Point. Then, in autumn, these shoals move in an easterly direction. The migration is especially regular for pilchard and takes them well past Cape Agulhas. Anchovy, though always following the same direction, sometimes initiate their migration from further north, and thus do not always round Cape Agulhas. In such instances good autumn and winter catches may be recorded (chapter 6).

Pilchard and anchovy are infrequently observed between Cape Agulhas and the Transkei coast where the winter "sardine run" is generally initiated. They are however preyed on extensively by hake in this area during May and June (Hect 1976). Conversely, they have not been found to contribute to the diet of hake caught in the Benguela Current region (Chłapowski 1977). East of Cape Agulhas, therefore, they probably occur below the surface. In these waters growth of phytoplankton is frequently restricted to the region of the thermocline (Crawford et al. in press). When about one year old, both species develop a fine filtering mechanism (King and Macleod 1976), which enables them to feed on phytoplankton as well as zooplankton. Their vertical position in the water column may thus be determined by food availability.

Catch rates of five- and six-group pilchard and adult (three- to seven-year-old) horse mackerel are highest from late summer through winter. During this period they are caught on the northern fishing grounds, as are the latest recruits, but on account of their ability to make maximum use of the phytoplankton resources the adult pilchard need not necessarily be in direct competition with juveniles for food. Availability of five- and six-year-old pilchard and adult horse mackerel is low in spring and early summer when they move offshore to spawn. Adult (two- to five-year-old) round herring exhibit a similar trend though it appears that their offshore migration is initiated earlier. They occur most frequently on the Saldanha Bay, Hout Bay and Gans Bay grounds.

The second category includes only mackerel. Their winter spawning takes place between Lambert's Bay and Dassen Island where onshore currents, set in motion by north-westerly winds, bring relatively warm (14 - 15°C) water nearer to the coast (Shannon 1976). Nought-year-olds are fully recruited at the start of the year, considerably earlier than those of the spring/ summer spawners. They are caught in much the same regions as adult round herring, with which they frequently co-occur, and exhibit a similar trend in availability. Thus it is possible that they too move away from the coast in winter. The behaviour of one- and two-year-old mackerel is much the same. Zooplankton continues to form an important component of their diet (Baird 1978b), which probably accounts for their presence in the major upwelling regions during summer and early autumn. However, these ages also start to eat more lantern-fish, which could influence their movement away from the coast, or to deeper water, in winter.

Adult mackerel (three to five year old) migrate inshore to spawn in the vicinity of Cape Columbine (Baird 1978a). They are not available to the purse-seine fleet during the remainder of the year. By this stage lantern-fish dominate their diet (Baird 1978b) and they are therefore likely to spend most of their time in deeper, offshore water. It is noteworthy that Cape Columbine is also the region where the bulk of the lantern-fish catch is recorded. However this species, which is typically mid-water (Centurier-Harris 1974), is generally caught only during summer or early autumn. The Cape Canyon comes to a head off Cape Columbine and north-flowing, sub-surface currents moving up the canyon, which are strongest during southerly to easterly wind conditions, may force lantern-fish towards the surface in this vicinity, either directly or through influencing the location of their food in the water column.

DEPLOYMENT OF FISHING EFFORT

Seasonal trends in the availability and distribution of the different age components of the six contributors to the South African purse-seine fishery are summarised in Fig. 43. Information for spring is based on September only. The trends may be expected to have a considerable influence on the deployment of effort throughout the fishing region, which in fact they do. This topic has been discussed in chapter 4 for the period 1964 - 1976.

Fishing activity on the Namaqua and St Helena Bay grounds is at its highest from mid-autumn to late winter, when species components available to the boats include the latest pilchard, anchovy, horse mackerel and round herring recruits, five- and six-year-old pilchard, adult horse mackerel and adult mackerel. Effort off Saldanha Bay and Hout Bay is also at a peak in autumn and winter, being directed once more at the recruits of the year and, additionally, at all sectors of the mackerel and round herring populations. By contrast purse-seining east of Cape Point is predominantly a summer or early autumn operation when the bulk of the catches comprise two- to four-year-old pilchard and adult anchovy.

After a severe depletion of pilchard aged five and six, horse mackerel and mackerel there was a noticeable increase of effort on the southern regions in 1974. Fishermen sought to maintain their yields by exploiting the shoals of adult pilchard and anchovy occuring to the east of Cape Point and, as a result, all the age classes of these two species are currently subject to intensive exploitation.

DISCUSSION

The seasonality of the fishery provides legislators with the opportunity to direct fishing at particular species or age classes through regulating the open season or closing certain areas. After the introduction of a small-meshed (12,7 mm) net in the mid - 1960's the average age of fish caught was reduced (Crawford et al. 1978) and factories now convert most of the raw material to fish oil and fish meal. A larger size of fish is required for processing for direct human consumption, as for example in the manufacture of canned products, but since such commodities are considerably more profitable it would appear advantageous to reduce fishing pressure on the younger age classes of especially pilchard, horse mackerel, mackerel and round herring. This could be accomplished by a prohibition on late autumn and winter fishing at least in the areas west of Cape Point. However, it is uncertain whether under such circumstances gains from growth would offset losses due to natural mortality for the important anchovy resource and suitable models will be required to analyse the situation in sufficient detail.

Conversely, legislating authorities may consider it more important to attempt to maintain parent stocks above specified biomass levels. They would then aim to reduce, for example, summer fishing for pilchard and anchovy and winter exploitation of the older mackerel age groups.

Trends described in this paper represent the usual patterns and, although these are generally observed (chapter 5 - 10), abnormal situations do occur. Thus there was an exceptionally large catch of mainly one-year-old mackerel in March 1967 and in 1974 high availability of anchovy resulted in record catches of this species, whereas those of pilchard and round herring were extremely poor. Such unpredictable events and also large fluctuations in recruitment and in the species composition of the combined landings (Newman and Crawford in press) will complicate the implementation of management goals. Nevertheless short-term perturbations should not deter the authorities from pursuing their longer-term objectives.

CHAPTER 12. SOME BIOLOGICAL PARAMETERS FOR SIX CONTRIBUTORS TO SOUTH AFRICA'S WESTERN CAPE PURSE-SEINE FISHERY.

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CHAPTER 12. BIOLOGICAL PARAMETERS FOR SIX CONTRIBUTORS TO SOUTH AFRICA'S WESTERN CAPE PURSE-SEINE FISHERY.

Since 1960 annual yeilds of between 324 000 and 509 000 metric tons have been harvested from South Africa's Western Cape purse-seine fishery. During this period six species contributed to the landings: pilchard *Sardinops ocellata*, anchovy *Engraulis capensis*, horse mackerel *Trachurus trachurus*, mackerel *Scomber japonicus*, round herring *Etrumeus teres* and lantern-fish *Lampanyctodes hectoris*. Information on basic biological parameters is available and is summarised in this report because of its usefulness for assessments of the resource. Additionally catchability coefficients are derived for all species except lantern-fish for the period 1964-1976.

VON BERTALANFFY GROWTH EQUATIONS

von Bertalanffy growth equations have been calculated for five of the six species and are as follows:

Pilchard (Baird 1970)

$$Lt_t = 30{,}60\ (1 - e^{-0{,}225\ (t\ +\ 1{,}505)})$$

Anchovy (Pollock 1970)

$$Lc_t = 14{,}75\ (1 - e^{-0{,}450\ (t\ +\ 0{,}717)})$$

Horse mackerel (Geldenhuys 1973)

$$Lt_t = 54{,}29\ (1 - e^{-0{,}1267\ (t\ +\ 0{,}3062)})$$

Mackerel (Baird 1977)

$$Lc_t = 68{,}01\ (1 - e^{-0{,}2070\ (t\ +\ 0{,}9845)})$$

Round herring (Geldenhuys 1978)

$$Lc_t = 26{,}19\ (1 - e^{-0{,}3334\ (t\ +\ 0{,}1664)})$$

In the above

Lt = total length (cm)

Lc = caudal length (cm)

t = age (years)

e = base of Naperian logarithms = 2,71828.

LENGTH CONVERSIONS

The following relationships for conversion from one form of length to another have been computed:

Pilchard (Newman 1970a)

$$Lc = 0,8357\ Lt + 0,0970$$

Anchovy (Robinson 1966)

$$Lt = 1,1174\ Lc + 0,6017 \quad (n = 7\ 145)$$

Horse mackerel (Geldenhuys 1973)

$$Lt = 1,171\ Lc + 0,087$$

Mackerel (Baird 1977)

$$Lt = 1,1925\ Lc + 0,8807 \quad (n = 565)$$

$$Lcf = 1,0650\ Lc + 0,2113 \quad (n = 621)$$

Round herring (Geldenhuys 1978)

$$Lt = 1,1966\ Lc + 0,1199$$

Lantern-fish (chapter 10)

$$Lt = 1,1549\ Lc + 0,4724 \quad (r = 0,99;\ p < 0,01;\ n = 800)$$

In the above Lcf = fork length (cm), the length from the tip of the snout to a line running perpendicularly through the fork of the caudal fin.

MASS AT LENGTH

Formulae for determining the total mass of fish at any given length are as follows:

Pilchard (Baird 1971)

$$Wt = 0,0096\ Lc^{3,075}$$

Anchovy (Robinson 1966)

$$Wt = 0,0034\ Lt^{3,250}$$

Horse mackerel (Geldenhuys 1973)

$$Wt = 0,0124\ Lt^{2,9028}$$

Mackerel (Baird 1977)

$$Wt = 0{,}0049\ Lc^{3{,}3112}$$

Round herring (Geldenhuys 1978)

$$Wt = 0{,}0092\ Lc^{3{,}0381}$$

Lantern-fish (chapter 10)

$$Wt = 0{,}0242\ Lc^{2{,}6838} \qquad (r = 0{,}96;\ p < 0{,}01;\ n = 800)$$

In the above Wt = total mass (g).

MASS CONVERSIONS

Only parts of individual fish may be utilised during the manufacture of certain products, for example in some forms of canning or in the freezing of fish for human consumption. On such occasions unsuitable material is generally reduced to meal and oil. In order to estimate the relative mass of fish assigned to these various processes samples were collected at random from the holds of boats. Each fish was weighed whole and after the removal of its head, viscera and caudal fin. The following relationships were derived from linear regression:

Pilchard

$$Wh = 0{,}8767\ Wt - 4{,}2600 \quad (r = 0{,}99;\ p < 0{,}01;\ n = 677)$$

$$Whv = 0{,}7038\ Wt - 0{,}4962 \quad (r = 0{,}98;\ p < 0{,}01;\ n = 677)$$

$$Whvc = 0{,}6926\ Wt - 0{,}2475 \quad (r = 0{,}99;\ p < 0{,}01;\ n = 677)$$

Anchovy

$$Wh = 0{,}8401\ Wt - 0{,}1803 \quad (r = 0{,}99;\ p < 0{,}01;\ n = 336)$$

$$Whv = 0{,}6439\ Wt - 0{,}2858 \quad (r = 0{,}98;\ p < 0{,}01;\ n = 336)$$

$$Whvc = 0{,}6330\ Wt - 0{,}5633 \quad (r = 0{,}98;\ p < 0{,}01;\ n = 336)$$

Horse mackerel

$$Wh = 0{,}7174\ Wt - 0{,}1044 \quad (r = 0{,}99;\ p < 0{,}01;\ n = 182)$$

$$Whv = 0{,}6293\ Wt + 0{,}1168 \quad (r = 1{,}00;\ p < 0{,}01;\ n = 182)$$

$$Whvc = 0{,}6182\ Wt + 0{,}1343 \quad (r = 1{,}00;\ p < 0{,}01;\ n = 182)$$

Mackerel

$$Wh = 0{,}8331\ Wt - 4{,}1116 \quad (r = 0{,}99;\ p < 0{,}01;\ n = 94)$$

$$Whv = 0{,}7257\ Wt - 2{,}7359 \quad (r = 0{,}98;\ p < 0{,}01;\ n = 94)$$

$$Whvc = 0{,}7168\ Wt - 1{,}7364 \quad (r = 0{,}98;\ p < 0{,}01;\ n = 94)$$

Round herring

$$Wh = 0{,}8491\ Wt - 2{,}0763 \quad (r = 1{,}00;\ p < 0{,}01;\ n = 283)$$

$$Whv = 0{,}7257\ Wt - 0{,}0397 \quad (r = 1{,}00;\ p < 0{,}01;\ n = 283)$$

$$Whvc = 0{,}7112\ Wt - 0{,}0085 \quad (r = 1{,}00;\ p < 0{,}01;\ n = 283)$$

Lantern-fish

$$Wh = 0{,}7282\ Wt + 0{,}0417 \quad (r = 0{,}98;\ p < 0{,}01;\ n = 60)$$

$$Whv = 0{,}6338\ Wt + 0{,}0707 \quad (r = 0{,}96;\ p < 0{,}01;\ n = 60)$$

$$Whvc = 0{,}6220\ Wt + 0{,}0897 \quad (r = 0{,}96;\ p < 0{,}01;\ n = 60)$$

In the above

Wh = mass after removal of head (g)

Whv = mass after removal of head and viscera (g)

Whvc = mass after removal of head, viscera and caudal fin (g).

NATURAL MORTALITY

Pilchard

Newman (1970a) suggested from tagging studies that 0,59 could be taken as an upper limit for the natural mortality rate of pilchard off South West Africa and, based on this, Centurier-Harris (1977) adopted a value of 0,5 for use in virtual population analysis of the South African stock. Variations in the parameter with age or between seasons have not yet been investigated. Minimal quantities of nought- and one-year-old fish were landed in 1964, the year in which fishing with the small-meshed (12,7 mm) net was first sanctioned (Crawford *et al*. 1978). Since recruitment was not greatly dissimilar during 1964 and 1965 (Newman and Crawford in press), a total mortality coefficient of 0,59 derived from the numbers of these two age groups occuring in the commercial catches of 1965, may be taken as a first approximation of the natural mortality for nought-year-olds. Similarly pilchard aged three and younger were not caught in any large amounts prior to 1958 (Crawford *et al*. 1978). This may be accounted for by fishing only being extended to the southern grounds, where the majority of two- and three-year-olds occur (chapter 5), in that year (Du Plessis 1959) and age composition records indicate a minimum natural mortality value of 0,50 for the three-year group. Recruitment was increasing from 1954 to 1955 (Newman and Crawford in press) and the estimate should be treated with caution. However, it agrees with that calculated for nought-year-olds, thereby suggesting that natural mortality does not differ greatly with age. It also confirms the value of 0,5 chosen by Centurier-Harris (1977).

Crawford and Shelton (1978) have demonstrated that breeding populations of seabird predators decline almost simultaneously with decreases in fish stock abundance. Mortality inflicted by seabirds can thus be expected to remain relatively constant. That due to seals Arctocephalus pusillus and other predators may show greater fluctuations though the multi-species nature of the resource could provide a buffering effect.

Anchovy

A natural mortality value of 0,8 has been computed for the South African anchovy population from the age composition of the relatively unfished stock in 1965 (Centurier-Harris et al. 1977) and in the absence of other estimates must be accepted. It is lower than coefficients of 1,10, 1,63, 1,70, 1,42 and 1,80 calculated for Engraulis ringens (Schaefer 1967), E. japonicus (Asami 1962), E. mordax, E. anchoita and E. encrasicholus (Bayliff 1967) respectively, which may account for the small biomass/catch ratios recorded by Newman and Crawford (in press).

Horse mackerel

From a graph of total mortality on effort Draganik (1977) concluded that the natural mortality rate for horse mackerel in the South East Atlantic is unlikely to exceed 0,25. This value was adopted for virtual population analysis by Centurier-Harris et al. (1977).

Mackerel

The assumed age composition of the mackerel catch in 1954 (Crawford et al. 1978), the first year in which the stock was exploited, suggests a natural mortality of 0,43. Values calculated for the North West Atlantic mackerel Scomber scombrus have ranged between 0,20 and 0,60 (Anderson and Paciorkowski 1978), whereas from tagging results Hamre (1978) arrived at a best estimate of 0,13 for the North East Atlantic mackerel S. scombrus. The value hitherto adopted for the South African fishery has been 0,25 (Centurier-Harris et al. 1977) and appears to remain a suitable compromise.

Round herring

No reliable estimate of natural mortality exists for round herring in South African waters. The coefficient has been assumed to be the same as that of the pilchard population (0,5) (Centurier-Harris et al. 1977). Although a similar species, pilchards live longer than round herring (Crawford et al. 1978) and the true value may lie between 0,5 and the estimate of 0,8 calculated for anchovy.

AVAILABILITY

Age-specific availability coefficients have been derived for pilchard, anchovy, horse mackerel, mackerel and round herring from catch-per-unit-effort information (chapters 5 - 9). These estimates applied to biomass of fish rather than to numbers present. In order to allow for their incorporation in dynamic pool models they have here been transformed to a numerical form by modifying all values, relative to those for January, to allow for growth and mortality. Fishing mortality was assumed to occur only during the first nine months of the year (the normal fishing season) but natural mortality to be constant through the year. When no data were available coefficients were obtained by interpolating between the nearest points. Revised indices, expressed as proportions of the maxima, are presented in Tables XXVIII - XXXII.

CATCHABILITY

Catchability coefficients were computed for the pilchard, anchovy, horse mackerel, mackerel and round herring populations for the period 1964 - 1976 by substitution of all other parameters in the equation:

$$\bar{F}_s = q_s \cdot \sum_{g=1}^{20} \sum_{m=1}^{12} f_{gm} \cdot (Y_{sgm} / \sum_{s} Y_{sgm})$$

where $\bar{F}_s$ = weighted fishing mortality for species s,

q_s = catchability coefficient for species s,

f_{gm} = total effort (standard boat days) expended on ground g in month m,

Y_{sgm} = total catch (metric tons) of species s on ground g in month m.

TABLE XXVIII : NUMERICAL AVAILABILITY COEFFICIENTS (r) FOR THE WESTERN CAPE PILCHARD STOCK, BASED ON CATCHES MADE BETWEEN 1964 AND 1976.

Month	Age (years)						
	0	1	2	3	4	5	6
January	0,00	0,42	0,54	0,54	0,95	0,08	0,08
February	0,00	0,22	0,56	0,56	1,00	0,15	0,15
March	0,00	0,71	0,52	0,52	0,92	0,24	0,24
April	0,00	1,00	0,51	0,51	0,90	0,32	0,32
May	0,80	0,69	0,26	0,26	0,47	0,45	0,45
June	0,75	0,43	0,17	0,17	0,30	0,41	0,41
July	0,52	0,29	0,05	0,05	0,09	0,29	0,29
August	0,84	0,32	0,05	0,05	0,10	0,43	0,43
September	1,00	0,22	0,02	0,02	0,04	0,46	0,46
October	0,86	0,44	0,34	0,34	0,33	0,74	0,74
November	0,69	0,64	0,66	0,66	0,67	0,86	0,86
December	0,53	0,84	1,00	1,00	0,98	1,00	1,00

TABLE XXIX : NUMERICAL AVAILABILITY COEFFICIENTS (r) FOR THE WESTERN CAPE ANCHOVY STOCK, BASED ON CATCHES MADE BETWEEN 1965 AND 1976.

Month	Age (years)		
	0	1	2
January	0,00	0,44	0,44
February	0,00	0,73	0,73
March	0,00	0,39	0,39
April	0,62	0,56	0,56
May	0,90	0,58	0,58
June	1,00	0,39	0,39
July	0,81	0,23	0,23
August	0,82	0,67	0,67
September	0,75	0,58	0,58
October	0,74	0,75	0,75
November	0,68	0,86	0,86
December	0,60	1,00	1,00

TABLE XXX : NUMERICAL AVAILABILITY COEFFICIENTS (r) FOR THE WESTERN CAPE HORSE MACKEREL STOCK, BASED ON CATCHES MADE BETWEEN 1964 AND 1974.

Month	Age (years)							
	0	1	2	3	4	5	6	7
January	0,00	1,00	1,00	0,08	0,08	0,08	0,08	0,08
February	0,00	0,79	0,79	0,18	0,18	0,18	0,18	0,18
March	0,00	0,63	0,63	0,16	0,16	0,16	0,16	0,16
April	0,00	0,32	0,32	0,22	0,22	0,22	0,22	0,22
May	1,00	0,31	0,31	0,32	0,32	0,32	0,32	0,32
June	0,86	0,16	0,16	0,24	0,24	0,24	0,24	0,24
July	0,14	0,23	0,23	0,32	0,32	0,32	0,32	0,32
August	0,14	0,20	0,20	0,13	0,13	0,13	0,13	0,13
September	0,18	0,09	0,09	0,87	0,87	0,87	0,87	0,87
October	0,29	0,31	0,21	1,00	1,00	1,00	1,00	1,00
November	0,32	0,51	0,30	0,89	0,89	0,89	0,89	0,89
December	0,36	0,67	0,38	0,76	0,76	0,76	0,76	0,76

TABLE XXXI : NUMERICAL AVAILABILITY COEFFICIENTS (r) FOR THE WESTERN CAPE MACKEREL STOCK, BASED ON CATCHES MADE BETWEEN 1964 AND 1976.

Month	Age (years)					
	0	1	2	3	4	5
January	1,00	0,62	0,62	0,22	0,22	0,22
February	0,38	0,61	0,61	0,25	0,25	0,25
March	0,30	1,00	1,00	0,27	0,27	0,27
April	0,47	0,70	0,70	0,30	0,30	0,30
May	0,25	0,43	0,43	0,19	0,19	0,19
June	0,09	0,14	0,14	0,19	0,19	0,19
July	0,02	0,27	0,27	1,00	1,00	1,00
August	0,01	0,30	0,30	0,16	0,16	0,16
September	0,00	0,35	0,35	0,00	0,00	0,00
October	0,05	0,49	0,40	0,11	0,11	0,11
November	0,09	0,59	0,49	0,23	0,23	0,23
December	0,13	0,68	0,40	0,32	0,32	0,32

TABLE XXXII : NUMERICAL AVAILABILITY COEFFICIENTS (r) FOR THE WESTERN CAPE ROUND HERRING STOCK, BASED ON CATCHES MADE BETWEEN 1964 AND 1976.

Month	Age (years) 0	1	2	3	4	5
January	0,00	0,59	0,49	0,49	0,49	0,49
February	0,00	0,48	1,00	1,00	1,00	1,00
March	0,00	0,81	0,71	0,71	0,71	0,71
April	1,00	0,84	0,86	0,86	0,86	0,86
May	0,85	1,00	0,62	0,62	0,62	0,62
June	0,71	0,52	0,06	0,06	0,06	0,06
July	0,29	0,22	0,19	0,19	0,19	0,19
August	0,57	0,28	0,06	0,06	0,06	0,06
September	0,57	0,16	0,00	0,00	0,00	0,00
October	0,43	0,25	0,27	0,27	0,27	0,27
November	0,29	0,33	0,56	0,56	0,56	0,56
December	0,29	0,39	0,82	0,82	0,82	0,82

TABLE XXXIII : CATCHABILITY COEFFICIENTS (q) FOR THE WESTERN CAPE PILCHARD, ANCHOVY, HORSE MACKEREL, MACKEREL AND ROUND HERRING STOCKS, 1964 - 1976 (VALUES HAVE BEEN MULTIPLIED BY 10^3).

Year	Pilchard	Anchovy	Horse mackerel	Mackerel	Round herring
1964	0,13	0,15	0,30	2,02	0,57
1965	0,11	0,19	0,13	0,13	0,25
1966	0,18	0,17	3,94	0,31	0,64
1967	0,29	0,15	Poor data	0,42	0,66
1968	0,20	0,12	No data	0,17	1,09
1969	0,24	0,13	0,97	0,21	1,08
1970	0,22	0,13	Poor data	0,32	0,96
1971	0,29	0,11	Poor data	0,17	0,58
1972	0,20	0,11	Poor data	0,21	0,31
1973	0,34	0,09	Poor data	0,28	1,56
1974	0,02	0,12	Poor data	0,35	1,29
1975	0,08	0,14	No data	0,31	0,65
1976	0,09	0,14	No data	Poor data	2,87
Mean	0,19	0,13	1,33	0,41	0,96
Standard deviation	0,09	0,03	1,77	0,52	0,67

For pilchard, anchovy, mackerel and round herring the weighted fishing mortality values employed were those of Centurier-Harris et al. (1977). Indices for horse mackerel were derived in a similar manner. Estimates of the monthly level of effort expended and species catch recorded at each of twenty discrete fishing areas were available (chapter 4, Crawford et al. 1978). Allocation of effort to species according to their contribution to the combined catch, as in the above equation has certain drawbacks, especially for the less dominant species. However, in a distinctly seasonal multi-species fishery, such as the one under consideration, the benefits appear to outweigh the disadvantages. This topic has been discussed in greater detail in chapter 4.

The catchability coefficients are listed in Table XXXlll, together with means and standard deviations. Values considered to be unrealistic were discarded; these are the coefficients for horse mackerel in 1967 and from 1970 - 1974 and for mackerel in 1976. They were based on catches of less than 10 000 metric tons, which could have resulted in biases in both the calculation of fishing mortalities and the allocation of effort.

Estimates for the pilchard and anchovy populations are similar, being more stable and lower than those for the other species. This may be an artifact arising from treatment of the data. Alternatively the stability may be due to the dominance of pilchard and anchovy in the catches of most years between 1964 and 1976 resulting in an accurate allocation of effort to these two species (chapter 4). It is also noteworthy that the catchability coefficient for pilchard in 1974 is exceptionally low, in agreement with observations made during that season (Crawford et al. in press).

CHAPTER 13. A SIMULATION MODEL FOR SOUTH AFRICA'S WESTERN CAPE PURSE-SEINE FISHERY. I. POPULATION DYNAMICS AND FISH CATCH.

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CHAPTER 13. A SIMULATION MODEL FOR SOUTH AFRICA'S WESTERN CAPE PURSE-SEINE FISHERY. I: POPULATION DYNAMICS AND FISH CATCH.

The South African purse-seine fishery is situated off the country's western seaboard in the highly productive waters of the southern Benguela Current system. Six species contribute to the landings, which from 1960 to 1978 fluctuated between 324 000 and 510 000 metric tons (Crawford et al. 1978), with a mean of 413 000 tons. All are characterised by distinct seasonal patterns of distribution and availability (chapter 11) and several have exhibited spectacular fluctuations in recruitment (Geldenhuys 1973, Centurier-Harris 1977, Crawford and Shelton 1978, Newman and Crawford in press). Pilchard *Sardinops ocellata*, anchovy *Engraulis capensis* and round herring *Etrumeus teres* are at present the most important, though in the past horse mackerel *Trachurus trachurus* and mackerel *Scomber japonicus* have also provided annual yields in excess of 100 000 tons. Catches of lantern-fish *Lampanyctodes hectoris* have only started recently and have been sporadic and of less significance.

In 1978 ten fish-processing plants were operative, being situated between Lambert's Bay and Gans Bay (Fig. 5). Along this strip of coastline the fishing intensity is highest, though under conditions of reduced availability boats have been known to operate as far north as the Orange River or eastwards to Cape Infanta (chapter 4). Each factory has its own set of purse-seiners and the entire fleet comprises approximately 100 vessels, having an average length of 22 m and a combined hold capacity of 11 000 metric tons. Vessels are equipped with echo sounders and sonar and are frequently assisted by a spotter aircraft.

Effort is currently oversubscribed (Newman et al. 1978) and since 1974 has been mostly directed at shoals of adult pilchard and anchovy in summer and early autumn and at juveniles of these two species during the remainder of the season (chapter 4). Thus both are subjected to intensive fishing pressure at all ages. Recruitment failure of anchovy in particular may be expected to have severe repercussions for the industry and it is pertinent to examine the implications that could then result from increased exploitation of other species.

Management also requires sound guidelines to take best advantage of the exceptional recruit-year-classes which occur sporadically (Geldenhuys 1973, Centurier-Harris 1977, Newman and Crawford in press). On the one hand it will be necessary to ensure that these are not prematurely exploited, and on the other that they are not wasted by delaying catching for too long.

This paper describes a simulation model of the population dynamics and fishing operations to investigate these and other factors. To provide for the geographical location of fish shoals and the discrete locations of the processing plants, fishing mortalities have not been input directly but have been calculated from catchability coefficients and estimates of effort. The model takes into account the fishing power of boats associated with each plant. The validity of simulated results is examined by comparison with historical observations.

DESCRIPTION OF THE MODEL

To limit the size of the model the number of species incorporated has been restricted to five and the number of age groups for any one species to seven, that is nought- to six-year-old fish. It was considered realistic to exclude lantern-fish as this is primarily a mid-water species (Centurier-Harris 1974) that has been caught only sporadically. The contribution of fish aged seven or older has been minimal since the introduction of the small-meshed (12,7 mm) net over the period 1963 - 1965 (Crawford et al. 1978). Provision has been made for the inclusion of ten factories (those that were operative in 1978), each of which may employ a maximum of 20 boats (a number greater than the largest fleet of 1978), and for eight fishing grounds. At present only six of the latter - Namaqua, St Helena Bay, Saldanha Bay, Hout Bay, Gans Bay and Agulhas (Fig. 1) - are utilised, but allowance has been made for a possible expansion of the fishing region. The model operates with incrementation on a monthly basis and it may be run for any specified number of years.

Population numbers

Estimates of the number of fish alive at each age at the start of the initial month are required as input data. Fishing mortality and natural mortality are taken into account when calculating the appropriate values for subsequent months. At the end of each year all ages are increased by one.

Recruitment

No definite parent stock - recruitment relationship has yet been established for any of the component species. Centurier-Harris (1977) investigated the possibility of such relationships existing for the pilchard and anchovy populations and concluded that both these stocks could be imperfectly described by either the Beverton-Holt or Ricker functions. However, goodness of fit was poor and neither could be used for realistic predictions. Environmental factors are believed to play a major role in determining year-class strength (Shelton and Hutchings 1979) and the controlled input to the model of previously established values was therefore preferred. This has the advantage of facilitating a model investigation of implications for the fishery of good, bad or fluctuating recruitment. Should any stock-recruitment relationships be demonstrated in the future the model may be readily adapted to incorporate these.

Distribution and availability

In the model fish surviving at the start of each month are assigned to specific fishing grounds in the accordance with the known pattern of distribution. Thus the number of fish of species s at age t occuring on ground g at the initiation of month m is calculated as:

$$N_{stgm} = N_{stm} \cdot d_{stgm} \quad \ldots\ldots (1)$$

where N = number of fish alive,
d_{stgm} = distribution coefficient (i.e. the proportion of species s at age t occuring on ground g in month m).

For each s, t and m : $\sum_{g=1}^{8} d_{stgm} = 1{,}00.$

Not all these fish need necessarily be available to the purse-seiners and the biomass of species s on ground g that is available at the start of month m is therefore computed by the expression:

$$B_{sgm} = \sum_{t} N_{stgm} \cdot r_{stm} \cdot w_{stm} \quad \ldots\ldots (2)$$

where B = biomass (metric tons),
N = number of fish alive,
r = availability coefficient,
w = mean mass per fish (metric tons).

For each s, t and m : $0{,}00 \leq r_{stm} \leq 1{,}00.$

Processor fishing strategy

In each month it is necessary to ascertain which species the boats belonging to each processor will catch and on which ground(s) they will operate. The technique for modelling this is illustrated in Fig. 44. To ensure flexibility provision has been made for a moratorium to be placed on the exploitation of specified species during any months. Similarly a maximum of four of the eight grounds may be closed to fishing. It is also possible for each processor to direct its boats to catch a preferred species or to proceed to a chosen ground.

In the absence of specific instructions fishing grounds are ranked in order of preference for each processor. These sequences were determined after consultation with the factory managers and in all instances the nearest grounds are selected first and those more distant later. Two forms of decision variable are also

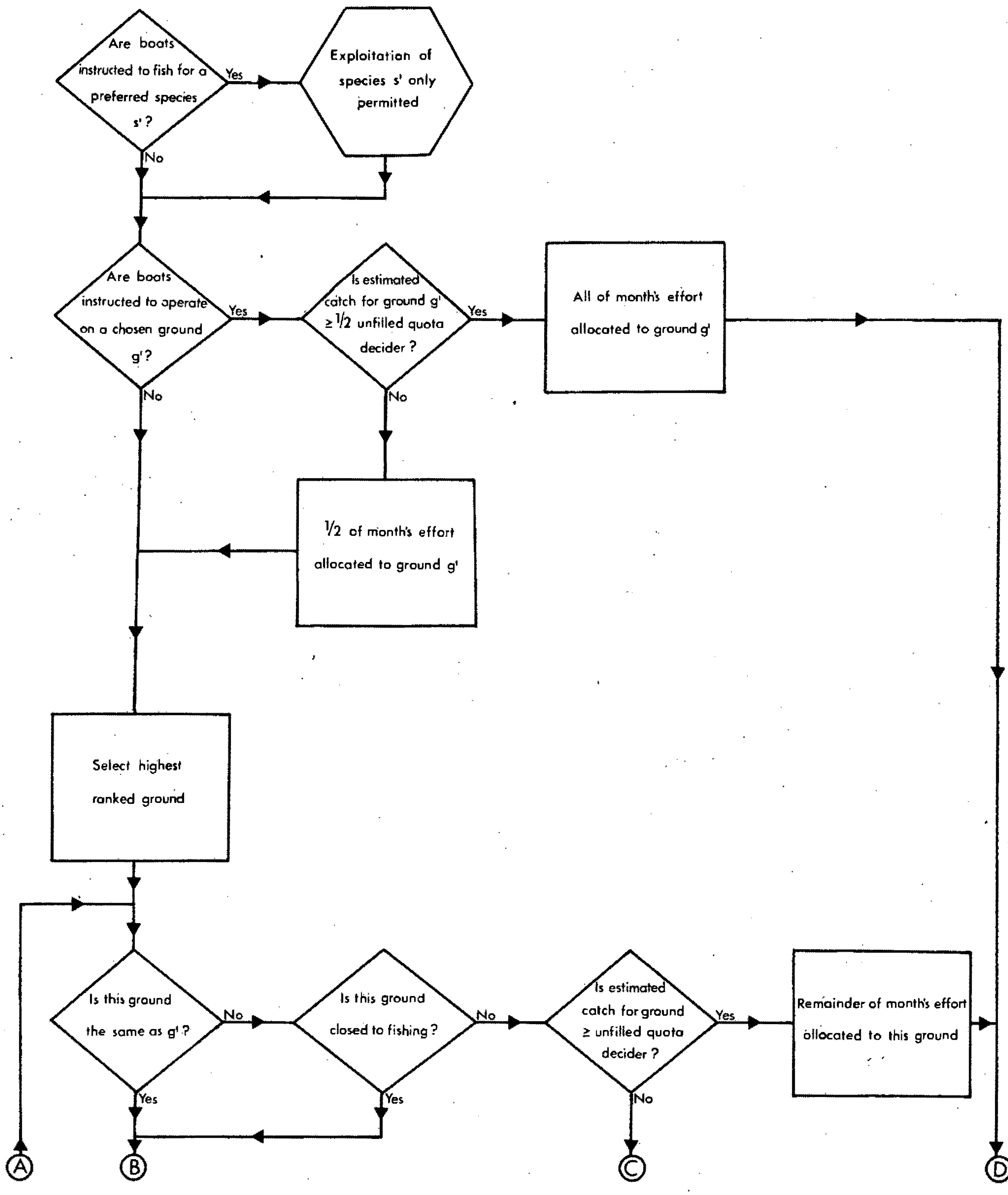

Fig 44 Diagramatic representation of procedure used to compute fishing strategy of each processor in each month (continued overleaf)

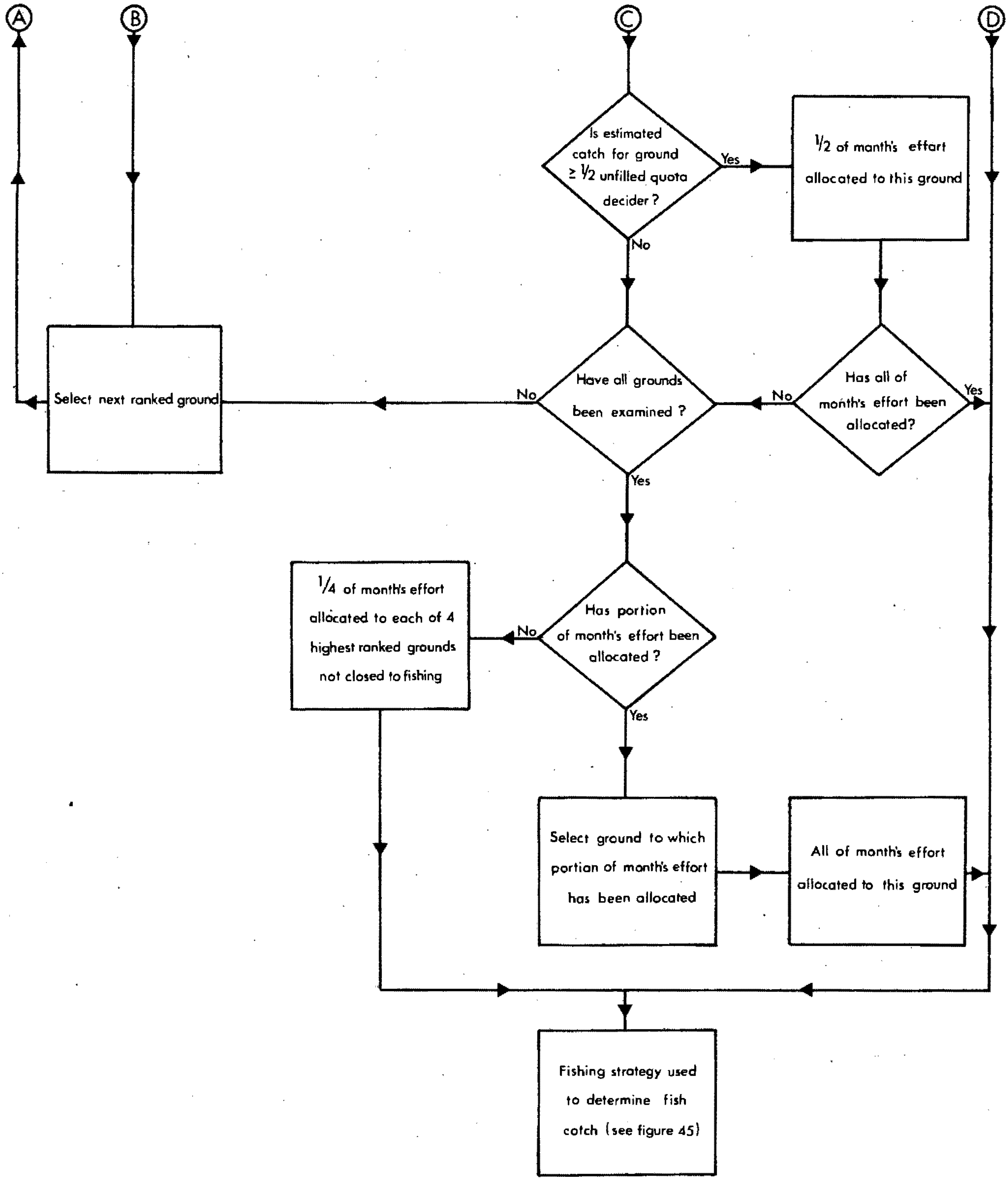

Fig 44 cont. Diagramatic representation of procedure used to compute fishing strategy of each processor in each month.

computed. The first estimates the total catch that would accrue for processor p from ground g in month m, were all its boats $\{b\}$ to operate exclusively on that ground, as follows:

$$\hat{Y}_{gmp} = \sum_{s} \sum_{t} B_{stgm} \left[1 - e^{-(q_s \cdot \sum_{\{b\}} p_b \cdot DF_{gmp} \cdot (B_{stgm} / \sum_{s} B_{sgm}))}\right] \quad \ldots (3)$$

where $\hat{Y}$ = estimated catch (metric tons),
B = biomass (metric tons),
e = base of Naperian logarithms = 2,71828 ,
q = catchability coefficient,
p = boat fishing power (standard boat units),
DF = number of days spent fishing.

The summations over species apply only to those for which exploitation is not prohibited or, in the event of fishing being directed at one particular species, to that species alone. Problems associated with the allocation of effort to individual species have been discussed in chapter 4. The number of days spent fishing is calculated from the expression:

$$DF_{gmp} = (DM_m - DNFP_p).FTR_{gp} \quad \ldots\ldots (4)$$

where DF = number of days spent fishing,
DM = number of days in the month,
$DNFP$ = number of days on which there is no fishing by the processor. This allows for policy decisions by the processor such as the customary one to close over weekends.
FTR_{gp} = fishing-travelling ratio, i.e. the ratio of time spent fishing to the total of time spent fishing and travelling between ground g and processor p.

Equation (3) is of necessity only a first approximation to the possible catch. Exploitation by other processors cannot be considered at this stage and neither is natural mortality. However it does provide a useful working index of the amount of fish that might be caught, taking into account both fish abundance and the distance of the ground from the processor.

The second decision variable, which may conveniently be called the "unfilled quota decider", compares the outstanding portion of a processor's catch quota with what remains of the fishing season and is determined for any month m' as follows:

$$UNFQD_{m'p} = (Q_p - \sum_{m=1}^{m'-1} Y_{mp})/(S - \sum_{m=1}^{m'-1} x_m - m'+1) \quad \ldots\ldots (5)$$

where $UNFQD$ = unfilled quota decider,
Q = catch quota for processor p (metric tons),

Y_{mp} = total catch (metric tons) of processor p in month m,
S = duration of fishing season (months),
x_m = 0 if month m closed to fishing,
= 1 if month m open to fishing.

The model tests whether the estimated catch on any ground (equation 3) is greater than or equal to the unfilled quota decider (equation 5) or, if not, half of this value. In the first instance all the non-assigned effort for the month is allocated to the ground and, in the latter, half of the month's effort. Grounds are tested in order of their ranking; those which are closed to fishing are obviously ignored, and the procedure is terminated after all effort has been accounted for. The underlying rationale is that, with the ten processors being well distributed over the four centre grounds (Fig. 5) and maintaining constant communication with each other, and with the availability of a twin-engine aircraft for fish spotting, any factory manager is likely to become rapidly aware of the nearest grounds that would provide satisfactory fishing. In view of the region's unpredictable weather, processors are expected to attempt to schedule fishing operations to at least pace their quotas. Equation 5 may readily be modified to enable them to hold one or more months in reserve. However, there is the balancing consideration that fish caught close to the home port involve considerably less capital expenditure than those obtained from distant waters and are more likely to arrive in a cannable condition.

Should only a fraction of the effort remain unassigned once all the grounds have been examined, it is allocated to the ground that has already attracted some fishing. This ground would then have been established as the only one that could ensure even moderately successful operations. There is one further possibility - that for all open grounds the estimated catch is less than half the unfilled quota decider. In this event effort is shared equally between the four most favoured grounds not closed to fishing. Under conditions of fish scarcity it is reasonable to assume that boats would be relatively far flung in an attempt to locate rewarding shoals.

When a factory manager decides to direct his boats to a specific ground the model assumes that at least half of the month's effort is expended on that ground. Should the estimated catch exceed or equal half the unfilled quota decider, or should the equivalent estimates for all other grounds fail to satisfy this condition, the model allocates all of the effort to the selected ground. If fish availability on the ground is particularly poor, whereas that on at least one other ground is satisfactory, the experiment is terminated at the middle of the month and deployment of the remaining effort is determined by the general method.

Fish catch

Once the proportion of processor p's total fishing effort for month m that is to be expended on ground g (fP_{gmp}) has been ascertained the number of days spent fishing is calculated from the expression:

$$DF_{gmp} = (DM_m - DNFP_p - DNFW_{gmp}) \cdot FTR_{gp} \cdot fP_{gmp} \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

where DF = number of days spent fishing,
DM = number of days in the month,
DNFP = number of days on which there is no fishing by the processor,
DNFW = number of days on which there is no fishing on account of bad weather,
FTR = fishing travelling ratio.

$$DNFW_{gmp} = DAW_{gm} - DNFP_p \quad \text{if } DNFP_p \leq DAW_{gm} \ldots\ldots\ldots\ldots\ldots\ldots (7a)$$

where DAW = number of days on which adverse weather occurs.

$$DNFW_{gmp} = 0 \quad \text{if } DNFP_p > DAW_{gm} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (7b)$$

Processors are thus enabled to offset poor weather conditions to some extent by operating on days when they would normally lay up boats (e.g. over weekends).

The actual level of effort is computed as:

$$f_{gmp} = \sum_{\{b\}} p_b \cdot DF_{gmp} \cdot BNOP_{mb} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (8)$$

where f = fishing effort (standard boat days),
p = boat fishing power (standard boat units),
DF = number of days spent fishing,
$BNOP_{mb}$ = proportion of month m that boat b is not operative.

The summation is over all boats $\{b\}$ linked to processor p. When a factory directs effort at a particular species the entire effort is assigned to that species. In other instances the proportion of effort directed at each species is calculated by the equation:

$$f_{sgmp} = f_{gmp} \cdot (B_{sgm} / \sum_s B_{sgm}) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (9)$$

where f = fishing effort (standard boat days),
B = biomass (metric tons).

Those species for which exploitation is prohibited are excluded from the summation.

On account of the need to provide for the implementation of species' quotas the number of fish of species s at age t caught on ground g in month m by processor p is derived in an iterative manner (Fig. 45). The first estimate is obtained from the expression:

$$C_{stgmp} = (F_{stgmp} / Z_{stgm}) \cdot N_{stgm} \cdot r_{stm} \cdot (1 - e^{-Z_{stgm}}) \text{.........(10)}$$

where C = number of fish caught,
F = fishing mortality coefficient,
Z = total mortality coefficient,
N = number of fish alive,
r = availability coefficient,
e = base of Naperian logarithms = 2,71828.

Fishing mortality is calculated as:

$$F_{stgmp} = q_s \cdot f_{sgmp} \text{..(11)}$$

where q = catchability coefficient,
f = fishing effort (standard boat days).

Total mortality is derived as:

$$Z_{stgm} = (M_{st} / 12) + \sum_{p=1}^{10} F_{stgmp} \text{................................(12)}$$

where M = annual natural mortality coefficient.

Transformation of catch numbers to mass is as follows:

$$Y_{stgmp} = C_{stgmp} \cdot w_{stm} \cdot K_{stm} \text{....................................(13)}$$

where Y = catch mass (metric tons),
C = number of fish caught,
w = mean mass per fish (metric tons),
K = condition factor.

It is possible that a processor's catch by mass may be greater than its monthly intake capacity ($CAPAC_p$). In such instances it is reduced to parity with this capacity. Thus effort, catch in numbers and catch in mass are adjusted downwards for all species, ages and grounds through multiplication by the same factor:

$CAPAC_p / Y_{mp}$.

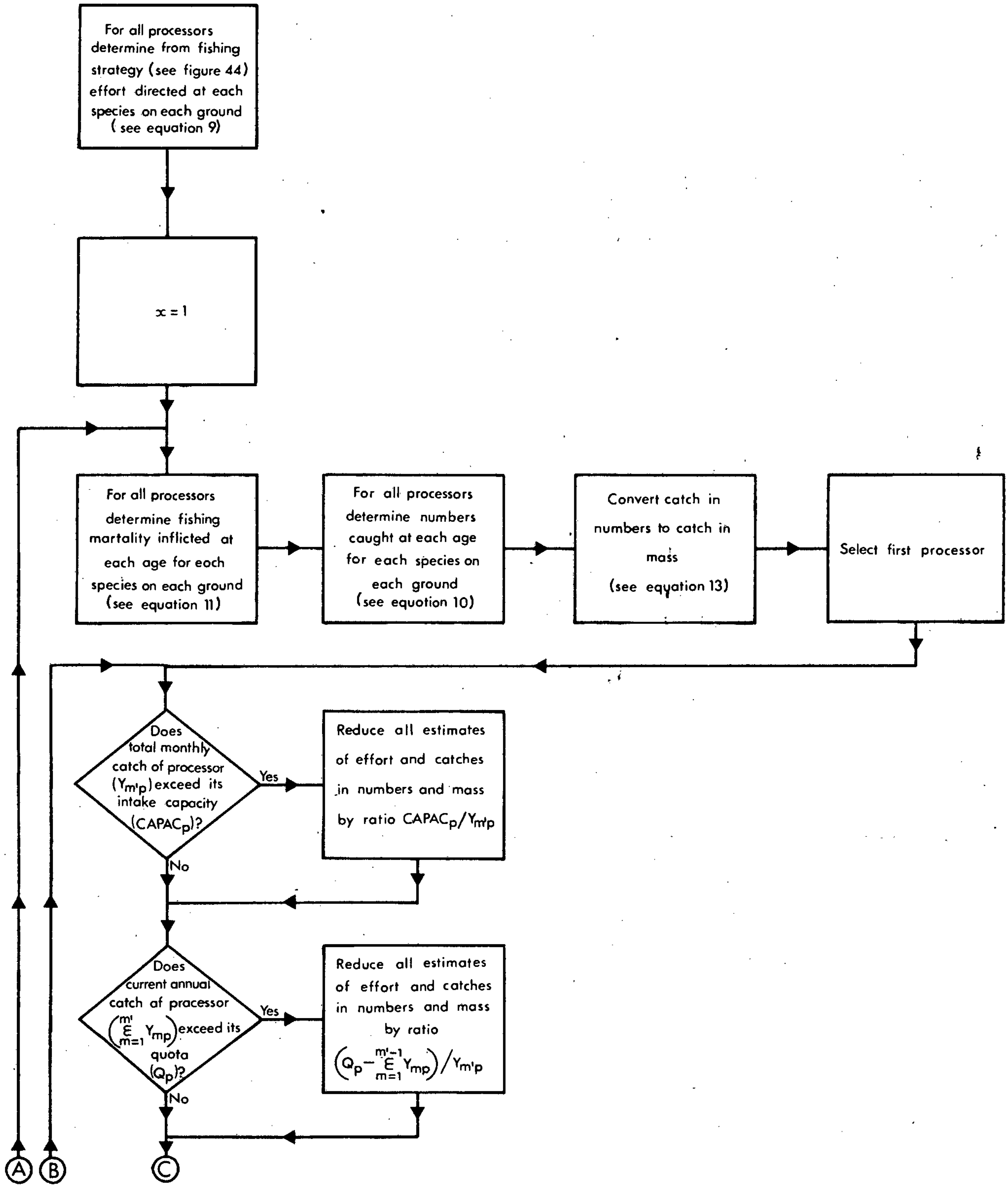

Fig 45 Diagramatic representation of procedure used to compute fish catch in month m' (continued overleaf)

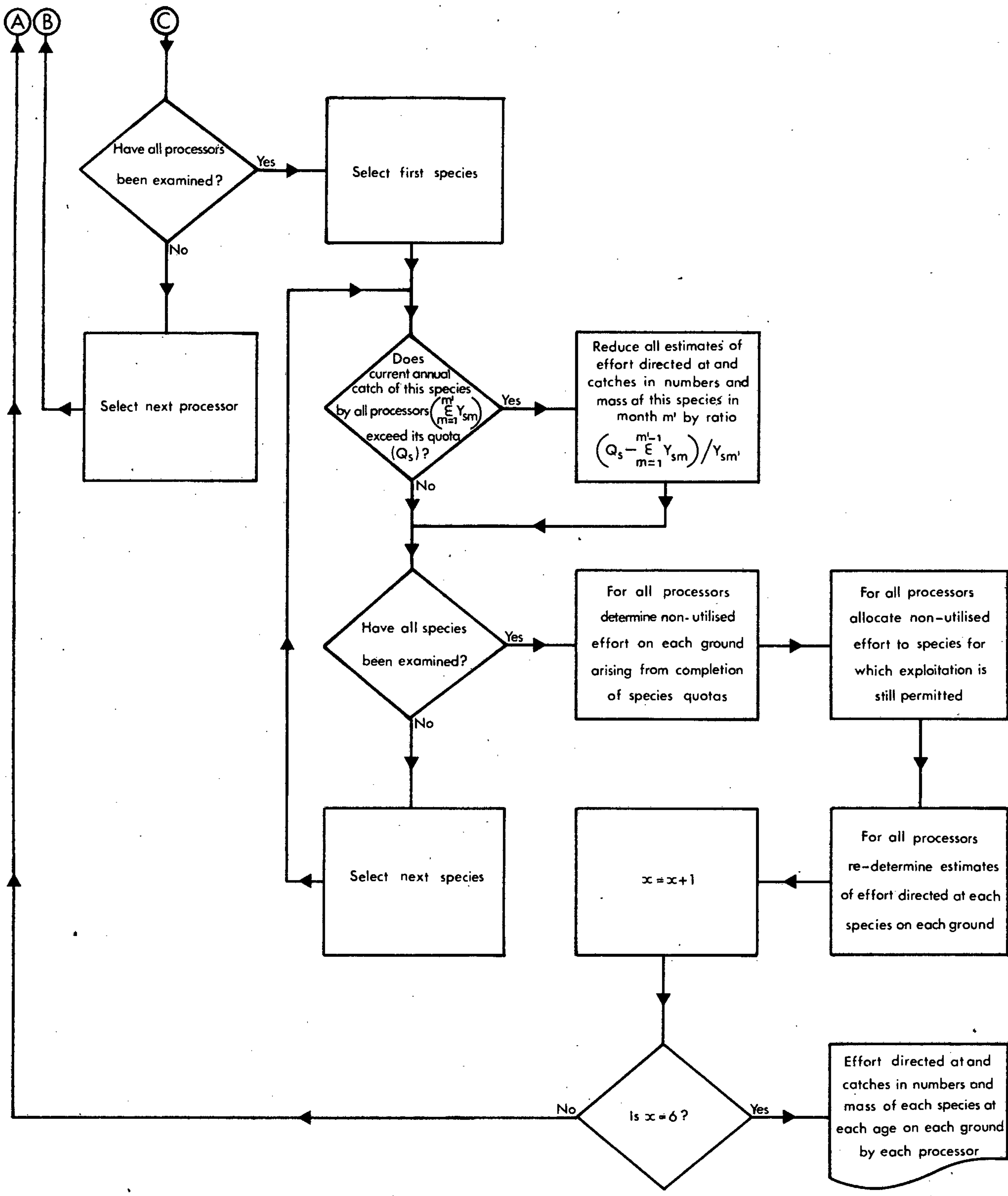

Fig 45 cont. Diagramatic representation of procedure used to compute fish catch in month m'.

A similar technique has been employed by Tillman and Stadelman (1976). The processor's quota (Q_p) may also be exceeded, say in month m', necessitating similar manipulation. In this case the ratio is:

$$(Q_p - \sum_{m=1}^{m'-1} Y_{mp}) / Y_{m'p}.$$

Finally, should an overall quota for a given species s (Q_s) be in force, corrections may again be required on account of the fact that incrementation of the model is on a monthly basis. In the event of overfishing during month m', effort, catch in numbers and catch in mass for that particular species are reduced for all ages, grounds and processors by the factor:

$$(Q_s - \sum_{m=1}^{m'-1} Y_{sm}) / Y_{sm'}.$$

This last adjustment gives rise to some non-utilised effort and may result in processor catches falling below their intake capacities or quotas. The spare effort is thus reallocated to species still open to exploitation and the entire procedure is repeated in an iterative manner until all necessary refinements have been incorporated.

The non-available fraction of the population is decreased only by natural mortality in computing the number of fish alive at the start of the following month.

ADOPTION OF PARAMETERS

The model was initially run for four years - 1966, 1967, 1970 and 1974 - for which observed information was available. 1967 was selected since the mackerel catch attained a peak in this season and the other years as being evenly spaced through the period (1964 - 1976) used to derive availability and catchability coefficients (chapter 12). During 1964 and 1965 only the anchovy population was allowed to be caught with the small-meshed (12,7 mm) net. 1975 and 1976 were not chosen because estimates of recruitment from virtual population analysis (VPA) are sensitive to the choice of terminal fishing mortalities required to start the analysis (Newman and Crawford in press).

Initial populations used in the model (Table XXXIV) were those calculated by VPA (Centurier-Harris _et al_. 1977). Natural mortality coefficients are discussed in chapter 12. This parameter was not varied with age and the values adopted were the same as those used in VPA, namely 0,50 for pilchard; 0,80 for anchovy; 0,25 for horse mackerel; 0,25 for mackerel; and 0,50 for round herring.

TABLE XXXIV : INITIAL POPULATIONS (N) USED IN THE SIMULATION MODEL FOR 1966, 1967, 1970 AND 1974 (VALUES HAVE BEEN MULTIPLIED BY 10^{-10}) *

Species	Age	1966	1967	1970	1974
Pilchard	0	0,520	1,030	0,614	0,702
	1	0,179	0,287	0,186	0,316
	2	0,107	0,103	0,158	0,078
	3	0,074	0,061	0,084	0,032
	4	0,050	0,015	0,015	0,013
	5	0,016	0,002	0,001	0,002
	6	0,003	0,000	-	0,001
Anchovy	0	5,660	6,800	6,100	7,330
	1	1,090	1,440	1,350	2,640
	2	0,304	0,256	0,353	0,356
	3	0,071	0,081	0,052	0,043
	4	0,004	0,015	0,004	0,001
Horse mackerel	0	0,025	0,006	0,075	0,325
	1	0,046	0,005	0,017	0,061
	2	0,005	0,029	0,002	0,001
	3	0,002	0,002	-	-
	4	0,009	0,000	-	-
Mackerel	0	0,089	0,052	0,012	0,017
	1	0,007	0,047	0,004	0,004
	2	0,002	0,007	0,001	0,008
	3	0,003	0,002	0,002	0,001
	4	0,000	0,001	0,002	0,000
	5	0,000	0,000	0,001	-
	6	0,000	-	0,000	-
Round herring	0	0,204	0,316	0,531	0,061
	1	0,090	0,102	0,192	0,027
	2	0,047	0,035	0,054	0,038
	3	0,017	0,025	0,010	0,011
	4	0,004	0,008	0,001	0,001
	5	0,000	0,002	0,004	0,000

* Calculated by VPA (Centurier-Harris _et al_. 1977)

Monthly distribution indices, assigning fish of a given age to specific grounds, were calculated on a pro rata basis from the mean levels of catch per unit effort recorded on the various grounds between 1964 and 1976 (chapter 4). The availability coefficients used were those listed in chapter 12.

The catchability coefficients initially adopted were the mean values derived for the period 1964 - 1976 (chapter 12). These are not independent of the availability indices but it was necessary to include both, the latter to simulate seasonal changes in the availability of fish and catchability coefficients to compute fishing mortality. Catchability coefficients were therefore varied until the numbers of fish caught as estimated by the model approximated the observed information for all years. Values decided upon in this manner appear in Table XXXV. For all species except anchovy they decrease after the initial year before rising again later. This could be due to a change in shoaling behaviour as fish approach sexual maturity. The minimum value for pilchard occurs at the age of two as expected. These fish are often distributed to the east of the main fishing grounds (chapter 5). Horse mackerel catches were low during the four years examined and the high values obtained may therefore be inaccurate.

Fish mass was calculated at the mid-point of each month from von Bertalanffy growth equations, length conversions and mass-length relationships (chapter 12). The von Bertalanffy equation may provide poor estimates during the early months of growth, especially when these fall outside the range of observations used to derive the equation. Theoretical values were therefore compared with sampled weights for nought-year-old fish of all species and the condition factor was used to incorporate the necessary modifications in the model. Similar comparisons were made for older age groups because the weight of fish during summer and early autumn (when upwelling results in high primary productivity) is often greater than the theoretical value. All condition factors used in the model that differed from unity are listed in Table XXXVI.

Processor intake capacities and their 1976 catch quotas appear in Table XXXVII. The estimated intake capacities were based on the normal operating schedule but factories could accept more fish if working hours were extended. During 1966, 1967 and 1970 landings were not limited by quotas and in 1974 an overall catch restriction applied to all processors. In all these years each factory's catch was therefore limited in the model to the product of its intake capacity and the duration of the season in months. This has the effect of increasing the unfilled quota decider and thus of spreading effort to more distant waters in an attempt to maximise catch, which was the general trend in years prior to the introduction of individual processor quotas. Between 1964 and 1976 no species quota was in force and this option was therefore not employed in the model.

TABLE XXXV : CATCHABILITY COEFFICIENTS (q) ADOPTED FOR USE IN THE SIMULATION MODEL (VALUES HAVE BEEN MULTIPLIED BY 10^2).

Age	Pilchard	Anchovy	Horse mackerel	Mackerel	Round herring
0	0,19	0,14	40,00	0,39	1,16
1	0,12	0,20	4,00	0,26	0,50
2	0,10	0,20	2,00	0,31	0,30
3	0,48	0,34	4,00	0,36	0,35
4	0,48	0,34	4,00	1,05	0,35
5	2,00	-	-	1,05	0,48
6	2,00	-	-	1,05	-

TABLE XXXVI : CONDITION FACTORS (K) DIFFERING FROM UNITY THAT WERE USED IN THE SIMULATION MODEL.

Age	Month	Pilchard	Anchovy	Horse mackerel	Round herring
0	January	-	$4,1^{+}$	$2,2^{+}$	$5,6^{+}$
	February	-	$4,1^{+}$	$2,2^{+}$	$5,6^{+}$
	March	-	$4,1^{+}$	$2,2^{+}$	$5,6^{+}$
	April	-	4,1	2,2	$5,6^{+}$
	May	-	3,9	2,2	5,6
	June	-	3,1	2,2	4,4
	July	-	2,3	2,2	1,7
	August	-	1,8	2,2	1,3
	September	-	1,9	2,2	1,3
	October	-	$2,0^{*}$	$2,2^{*}$	$1,3^{*}$
	November	-	$2,1^{*}$	$2,1^{*}$	$1,4^{*}$
	December	-	$2,2^{*}$	$2,0^{*}$	$1,4^{*}$
1	January	-	2,2	2,0	1,4
	February	-	2,0	2,3	-
	March	-	1,9	-	-
	April	-	1,7	-	-
	May	-	1,7	-	-
	June	-	1,4	-	-

Continued....

TABLE XXXVI : CONDITION FACTORS (K) DIFFERING FROM UNITY THAT WERE USED IN THE SIMULATION MODEL CONTD.

Age	Month	Pilchard	Anchovy	Horse mackerel	Round herring
1	July	-	1,3	-	-
	August	-	1,2	-	-
	September	-	1,3	-	-
	October	-	1,4*	-	-
	November	-	1,5*	-	-
	December	-	1,6*	-	-
2	January	1,3	1,6	-	1,3
	February	1,3	-	-	1,3
	March	1,3	1,1	-	1,3
	April	-	1,1	-	1,3
3	January	1,3	-	-	1,3
	February	1,3	-	-	1,3
	March	1,3	-	-	1,3
	April	-	-	-	1,3
4	January	1,3	-	-	1,3
	February	1,3	-	-	1,3
	March	1,3	-	-	1,3
	April	-	-	-	1,3
5	January	-	-	-	1,3
	February	-	-	-	1,3
	March	-	-	-	1,3
	April	-	-	-	1,3

+ Values selected to equal nearest observation.

* Values adopted on the basis of interpolation.

TABLE XXXVII : MONTHLY INTAKE CAPACITIES (CAPAC) AND 1976 CATCH QUOTAS (Q) FOR THE TEN WESTERN CAPE PELAGIC FISH PROCESSING PLANTS.

Processing plant	Monthly intake capacity (metric tons)*	1976 catch quota (metric tons)
1	10 080	45 920
2	8 820	36 880
3	8 820	43 230
4	15 120	80 320
5	6 300	32 440
6	8 820	41 100
7	5 544	30 800
8	4 488	26 450
9	15 120	40 240
10	6 300	30 000
Total	89 412	407 380

* Estimated as hourly intake capacity x 12 (operating hours) x 21 (operating days).

Each factory's ranking of the fishing grounds is indicated in Table XXXVIII. The number of boats associated with different processors was available from records maintained at the Sea Fisheries Branch and computation of vessel fishing power has been discussed in chapter 4.

Fishing-travelling ratios (Table XXXIX) were derived by estimating the time required to journey from a factory to the mid-point of each ground, assuming a speed of 10 knots and a minimum of six hours fishing on each trip. The open season used in the model was chosen to correspond with the year under consideration. The number of non-fishing days due to processor policy was taken as nine per month to allow for closure over weekends and public holidays.

During the period 1966 - 1972 information was available for between 10 and 13 boats on the number of days fishing was prevented by adverse weather conditions (Table XL) or bright moonlight and also on the number of days each vessel was inoperative for other reasons (Table XLI). Mean values were used in the model, moonlight being incorporated with bad weather.

TESTING THE MODEL

The model was tested by comparing simulated results with observed information or estimates obtained from VPA for four years: 1966, 1967, 1970 and 1974. Annual catches of each species and levels of effort are contrasted in Table XLII, numbers of fish caught at age in Fig. 46, monthly landings of all species combined in Fig. 47 and numbers of fish of each age surviving to the end of the year in Fig. 48.

When the years are considered in chronological sequence the total annual catches calculated by the model represent 91, 96, 116 and 105 per cent of the observed amounts respectively (Table XLII). The relatively high value for 1970 results mainly from the simulated catch of anchovy being substantially greater than the actual tally. However, the catch numbers of this species as estimated by the model and by field sampling approximate each other closely (Fig. 46b). This could be explained by individual anchovy having a lower average weight than normal in 1970.

In both 1966 and 1974 the model overestimates the catch numbers of the younger age groups of pilchard, horse mackerel and round herring (Fig. 46a,c,e). 1966 was the first year in which the capture of all species with the small-meshed (12,7 mm) net was permitted and, although the majority of vessels were equipped with this net (Newman et al. 1978), a large number also retained their 32 mm nets. It appears that skippers to some extent still avoided catching juvenile pilchard, horse mackerel and round

TABLE XXXVIII : RANKING OF FISHING GROUNDS BY THE TEN WESTERN CAPE PELAGIC FISH PROCESSING PLANTS.

Fishing ground	Processing plant 1	2-6	7-8	9	10
N. of Orange River	7	7	7	8	8
Namaqua	2	3	5	6	6
St Helena Bay	1	1	2	5	5
Saldanha Bay	3	2	1	3	4
Hout Bay	4	4	3	1	3
Gans Bay	5	5	4	2	1
Agulhas	6	6	6	4	2
E. of Cape Infanta	8	8	8	7	7

TABLE XXXIX : FISHING-TRAVELLING RATIOS (FTR)* APPLICABLE TO THE DIFFERENT GROUNDS FOR THE TEN WESTERN CAPE PELAGIC FISH PROCESSING PLANTS.

Fishing ground	Processing plant 1	2-6	7-8	9	10
N. of Orange River	0,2	0,2	0,2	0,2	0,2
Namaqua	0,4	0,4	0,4	0,2	0,2
St Helena Bay	1,0	1,0	0,8	0,4	0,2
Saldanha Bay	0,8	1,0	1,0	0,8	0,4
Hout Bay	0,4	0,6	0,8	1,0	0,8
Gans Bay	0,4	0,4	0,4	0,8	1,0
Agulhas	0,4	0,4	0,4	0,4	0,8
E. of Cape Infanta	0,2	0,2	0,2	0,2	0,2

* Time spent fishing to total of time spent fishing and time spent travelling.

TABLE XL : NO. DAYS PER MONTH ON WHICH FISHING WAS PREVENTED BY BAD WEATHER CONDITIONS, 1966 TO 1972.

Month	1966	1967	1968	1969	1970	1971	1972	Mean 1966-1972
January	0	14	5	0	0	4	0	3,3
February	5	3	5	9	4	5	5	5,1
March	5	5	4	4	1	1	0	2,9
April	1	9	5	4	1	1	0	3,0
May	1	12	23	3	14	1	8	8,9
June	12	22	12	9	22	9	20	15,1
July	17	3	14	4	12	14	10	10,6
August	10	14	12	9	15	23	3	13,0
September	5	3	0	-	-	-	-	2,7
October	-	-	-	-	-	-	-	2,9*
November	-	-	-	-	-	-	-	3,0*
December	-	-	-	-	-	-	-	3,2*

* Values adopted on the basis of interpolation.

TABLE XLI : MEAN NO. DAYS PER VESSEL-MONTH ON WHICH THERE WAS NO FISHING ON ACCOUNT OF BRIGHT MOONLIGHT OR FACTORS CAUSING A BOAT TO BECOME INOPERATIVE, 1966 TO 1972.

Year	No. vessel-months for which data available	Bright moonlight	Boat inoperative
1966	108	6,56	2,62
1967	81	0,79	2,83
1968	90	2,43	1,82
1969	88	4,60	2,39
1970	88	1,57	1,83
1971	80	4,98	1,80
1972	88	0,91	3,25
1966-1972	623	3,23	2,37

TABLE XLII : ACTUAL AND SIMULATED SPECIES CATCHES (THOUSANDS OF METRIC TONS) AND TOTAL EFFORT (STANDARD BOAT DAYS) FOR 1966, 1967, 1970 AND 1974.

Year	1966	1967	1970	1974
Actual catch of:				
Anchovy	143,9	270,6	169,3	349,8
Pilchard	118,0	69,7	61,8	16,0
Horse mackerel	26,3	8,8	7,9	2,5
Mackerel	53,4	128,2	77,9	30,7
Round herring	15,4	32,0	23,7	1,3
Lantern-fish	-	-	18,2	0,3
All species	357,1	509,3	358,9	400,5
Simulated catch of:				
Anchovy	179,9	268,8	252,2	318,7
Pilchard	79,6	83,2	71,8	49,8
Horse mackerel	16,1	6,2	2,5	12,7
Mackerel	34,7	108,3	57,0	30,4
Round herring	13,9	21,9	32,4	7,8
Lantern-fish	-	-	-	-
All species	324,3	488,4	415,8	419,3
Actual total effort	8 099	12 099	11 052	8 270
Simulated total effort	7 555	11 261	11 018	9 741

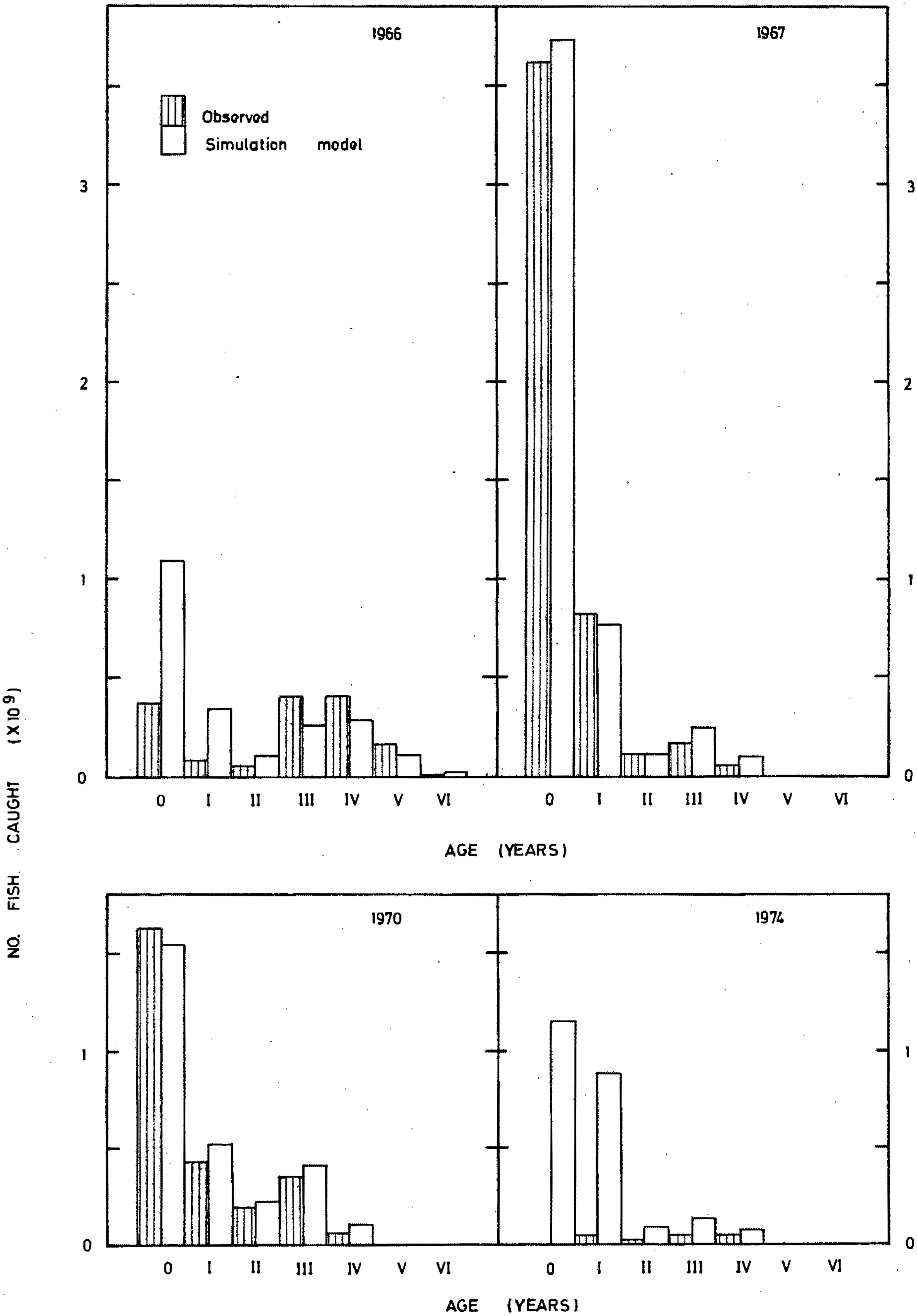

Fig 46a Actual and simulated catch numbers per age for pilchard in 1966, 1967, 1970 and 1974.

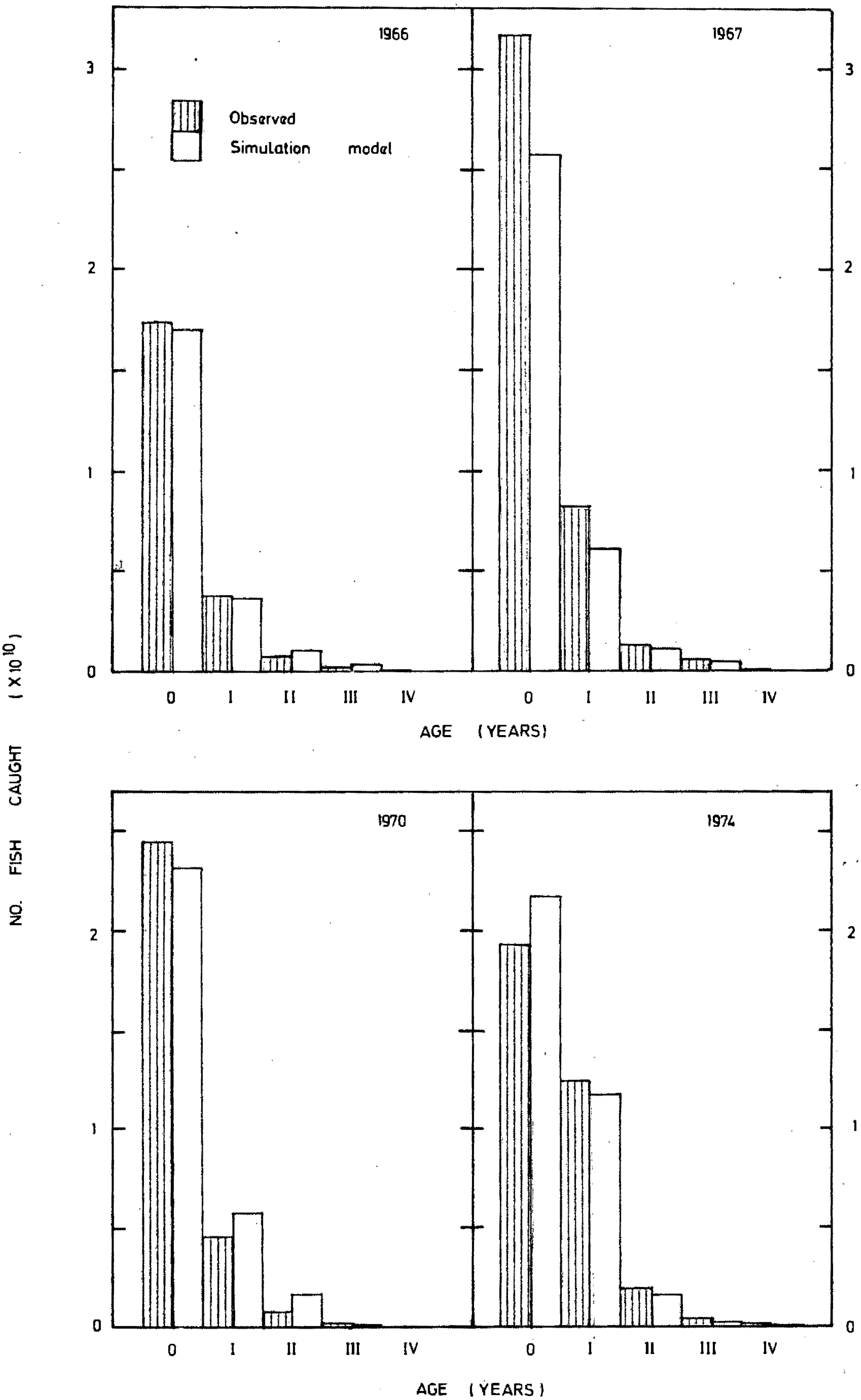

Fig 46b Actual and simulated catch numbers per age for anchovy in 1966, 1967, 1970 and 1974.

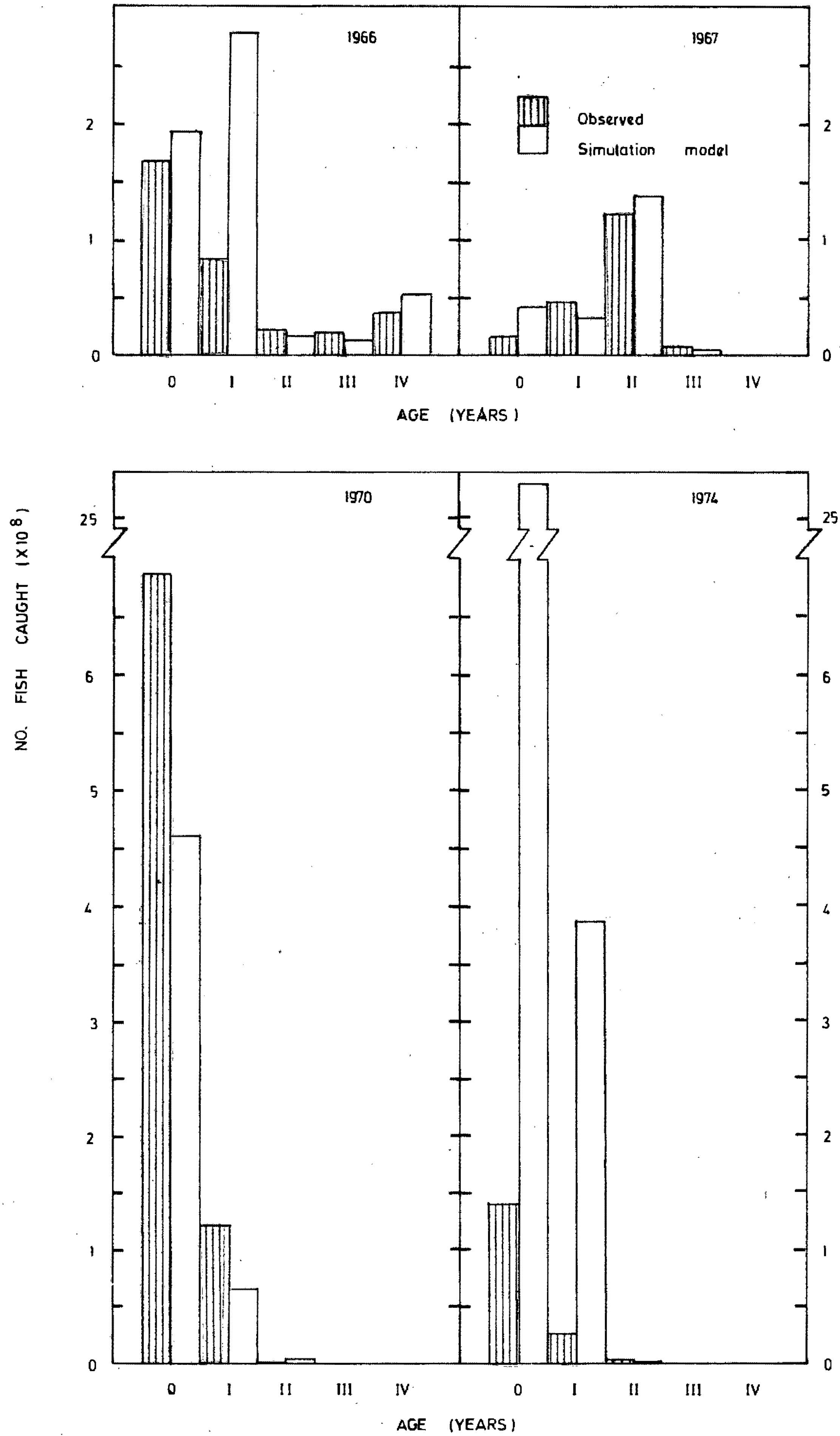

Fig 46c Actual and simulated catch numbers per age for horse mackerel in 1966, 1967, 1970 and 1974.

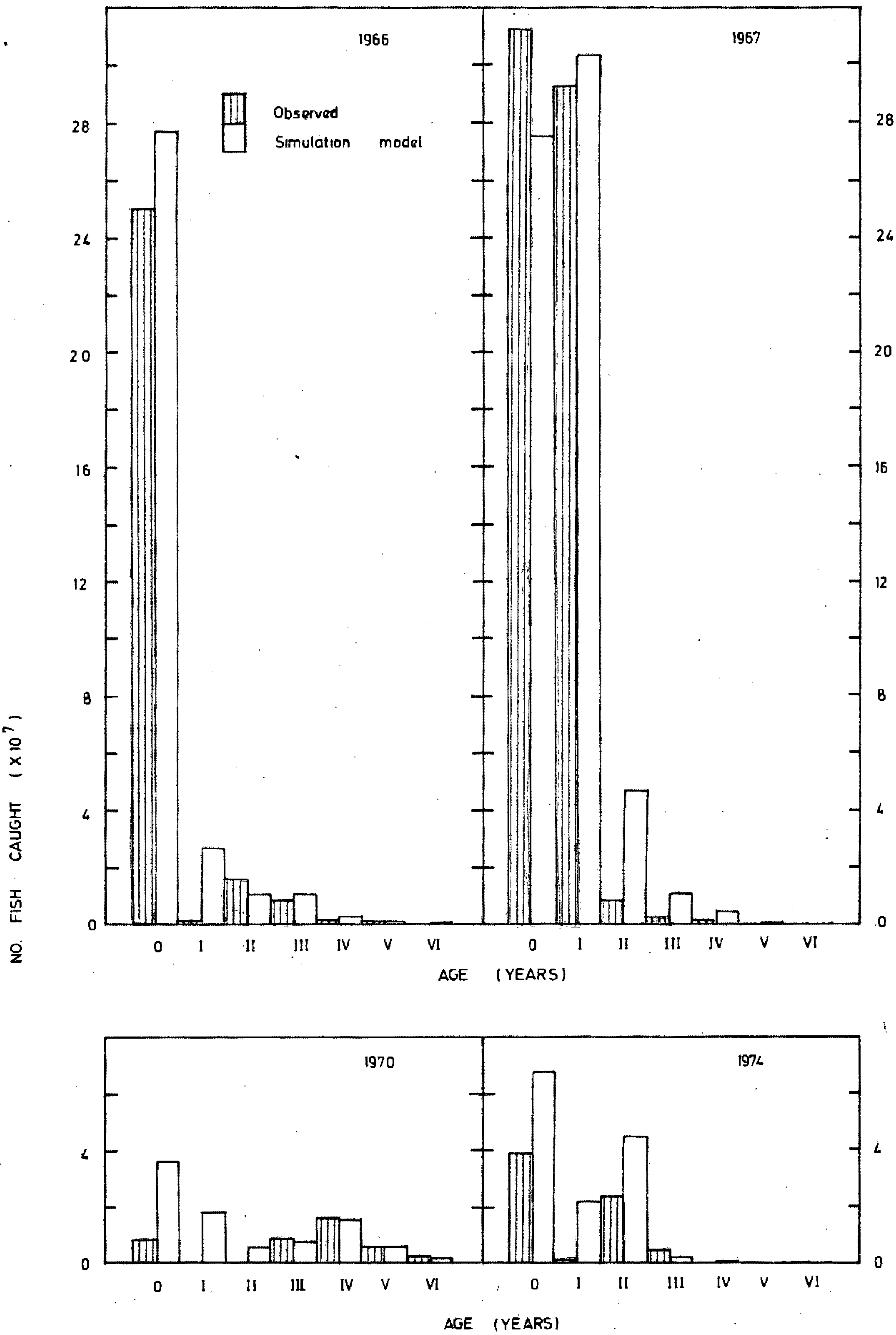

Fig 46d Actual and simulated catch numbers per age for mackerel in 1966, 1967, 1970 and 1974.

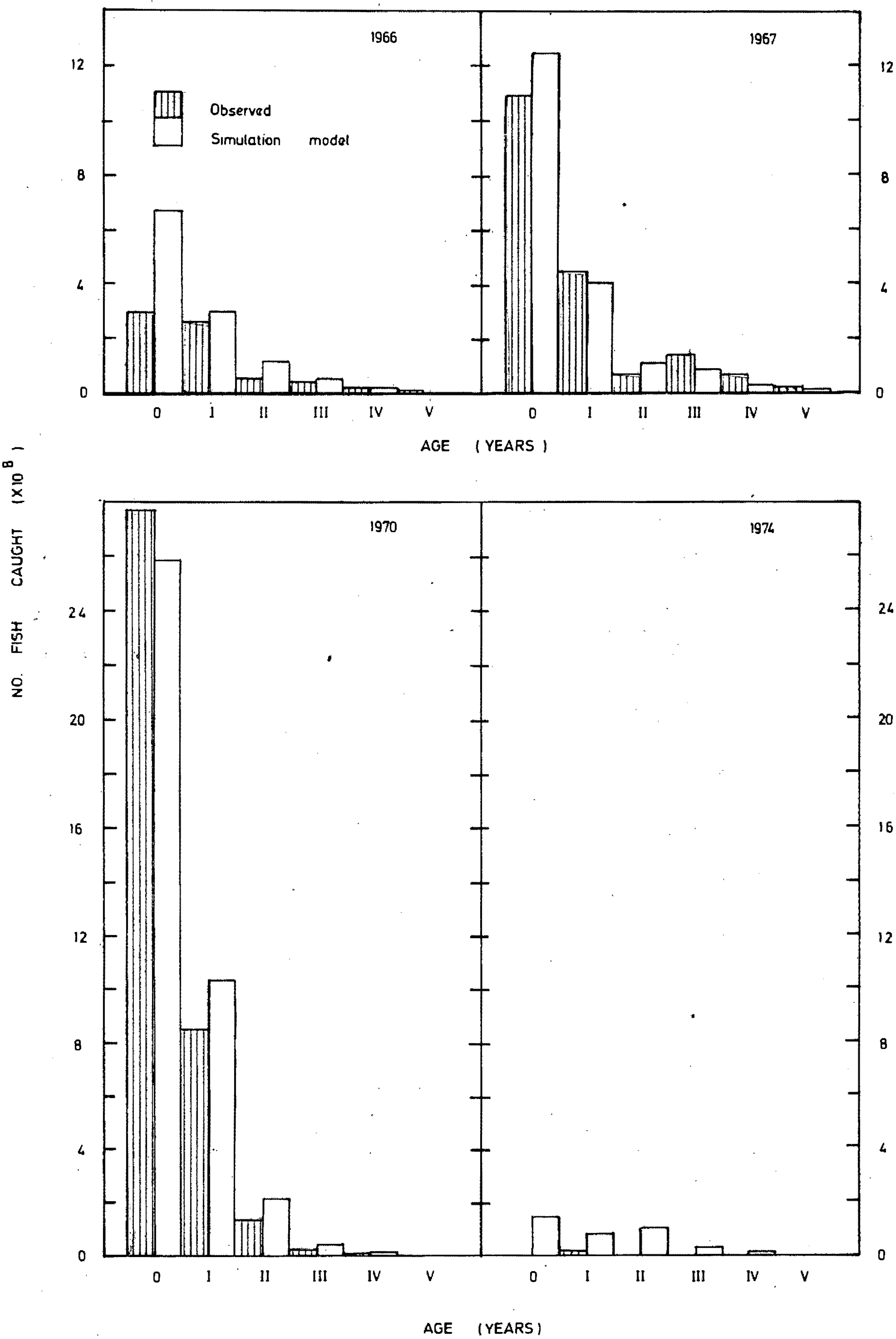

Fig 46e Actual and simulated catch numbers per age for round herring in 1966, 1967, 1970 and 1974.

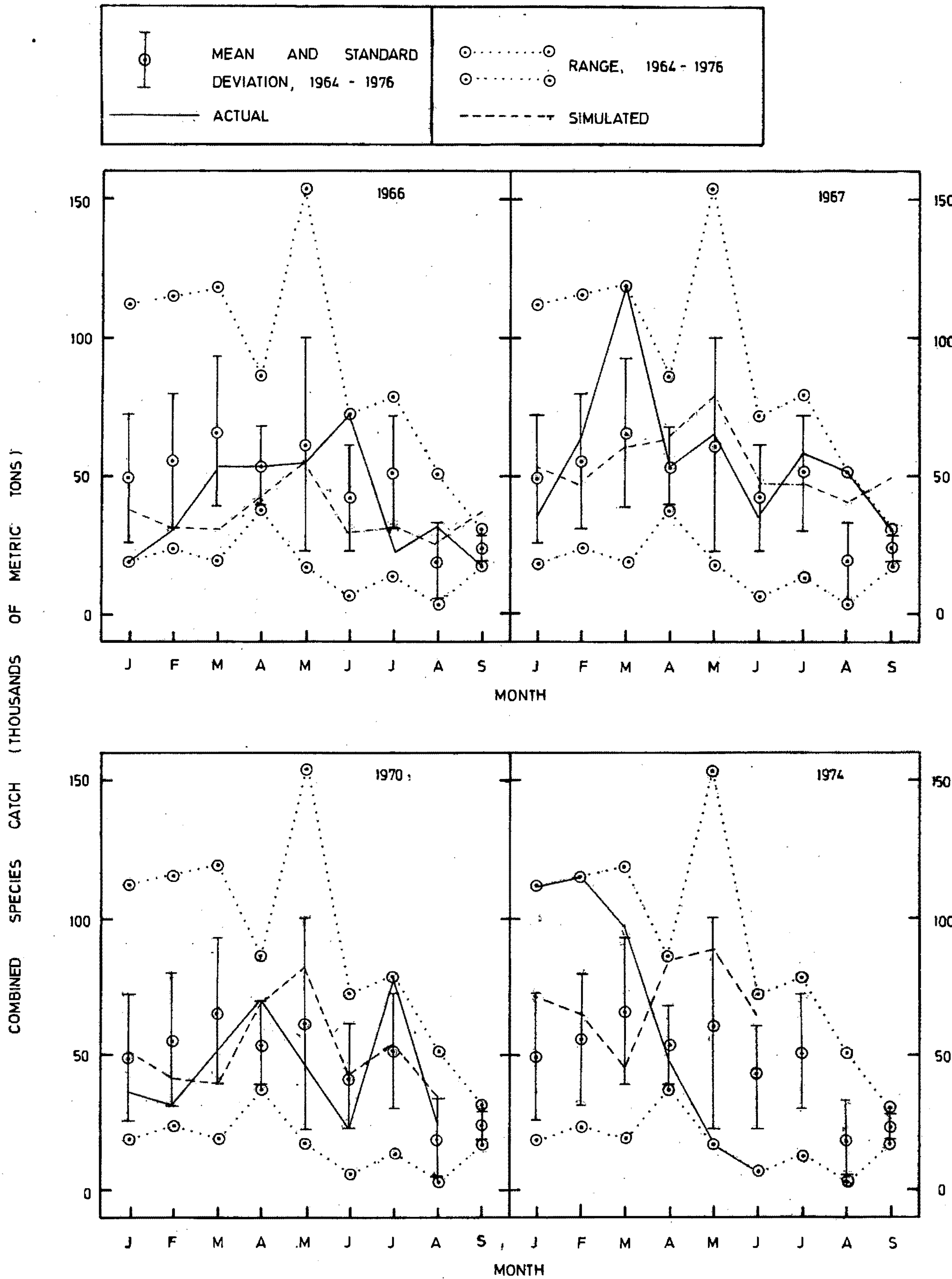

Fig 47 Actual and simulated combined species catch per month in 1966, 1967, 1970 and 1974 indicating mean, standard deviation and range of observed values for the period 1964 - 1976.

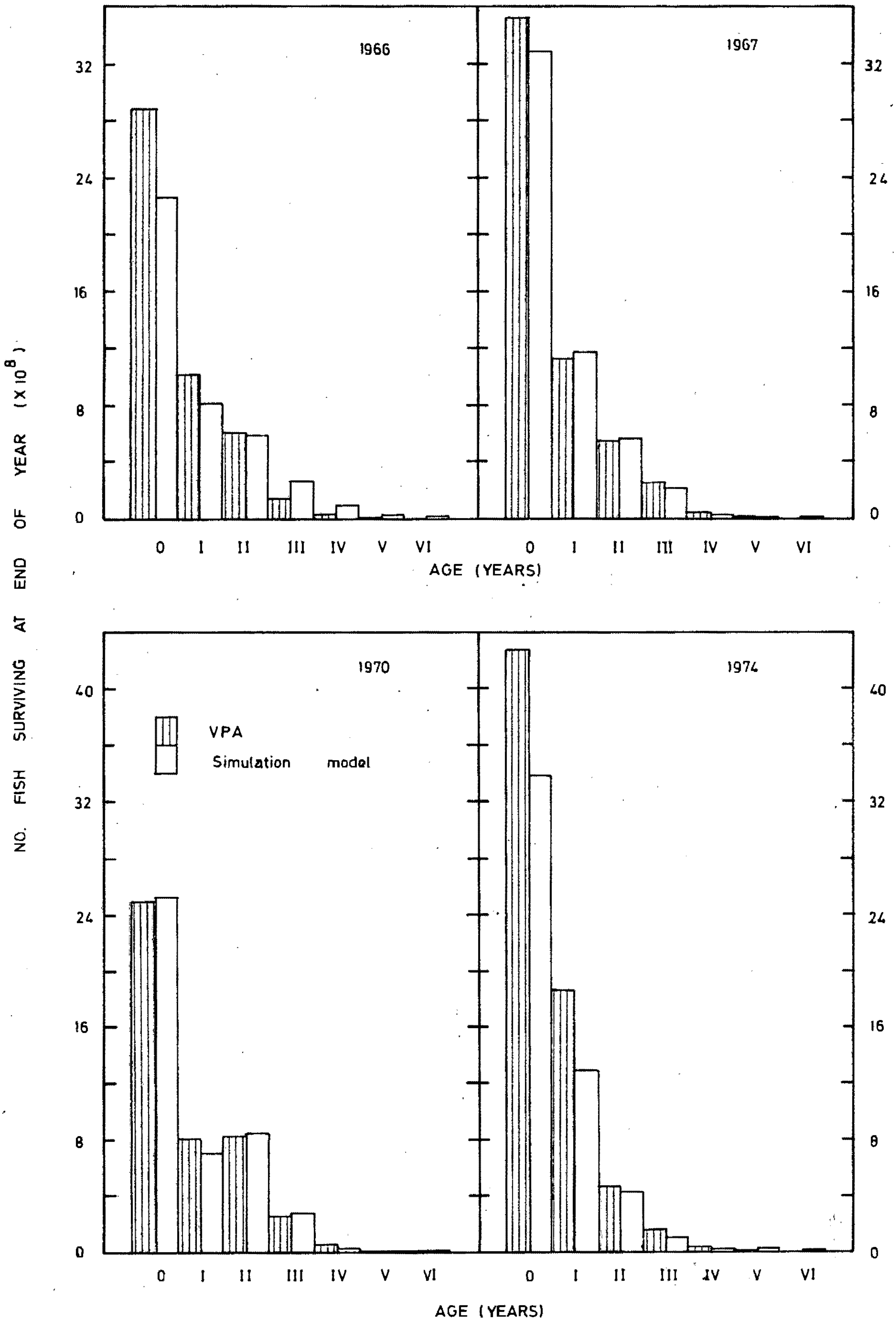

Fig 48a VPA and simulation model estimates of numbers of pilchard at each age surviving at end of year in 1966, 1967, 1970 and 1974.

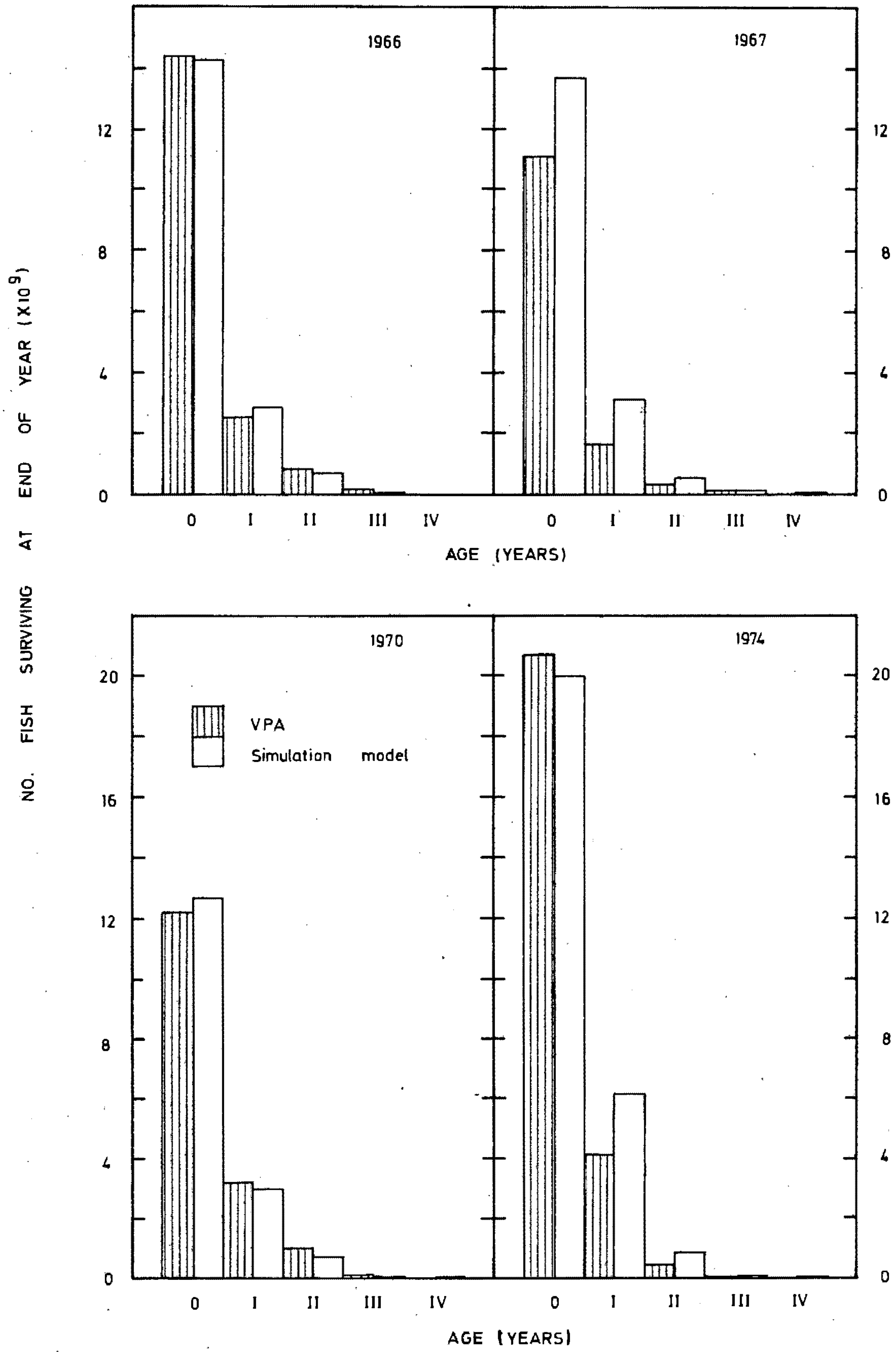

Fig 48b VPA and simulation model estimates of numbers of anchovy at each age surviving at end of year in 1966, 1967, 1970 and 1974.

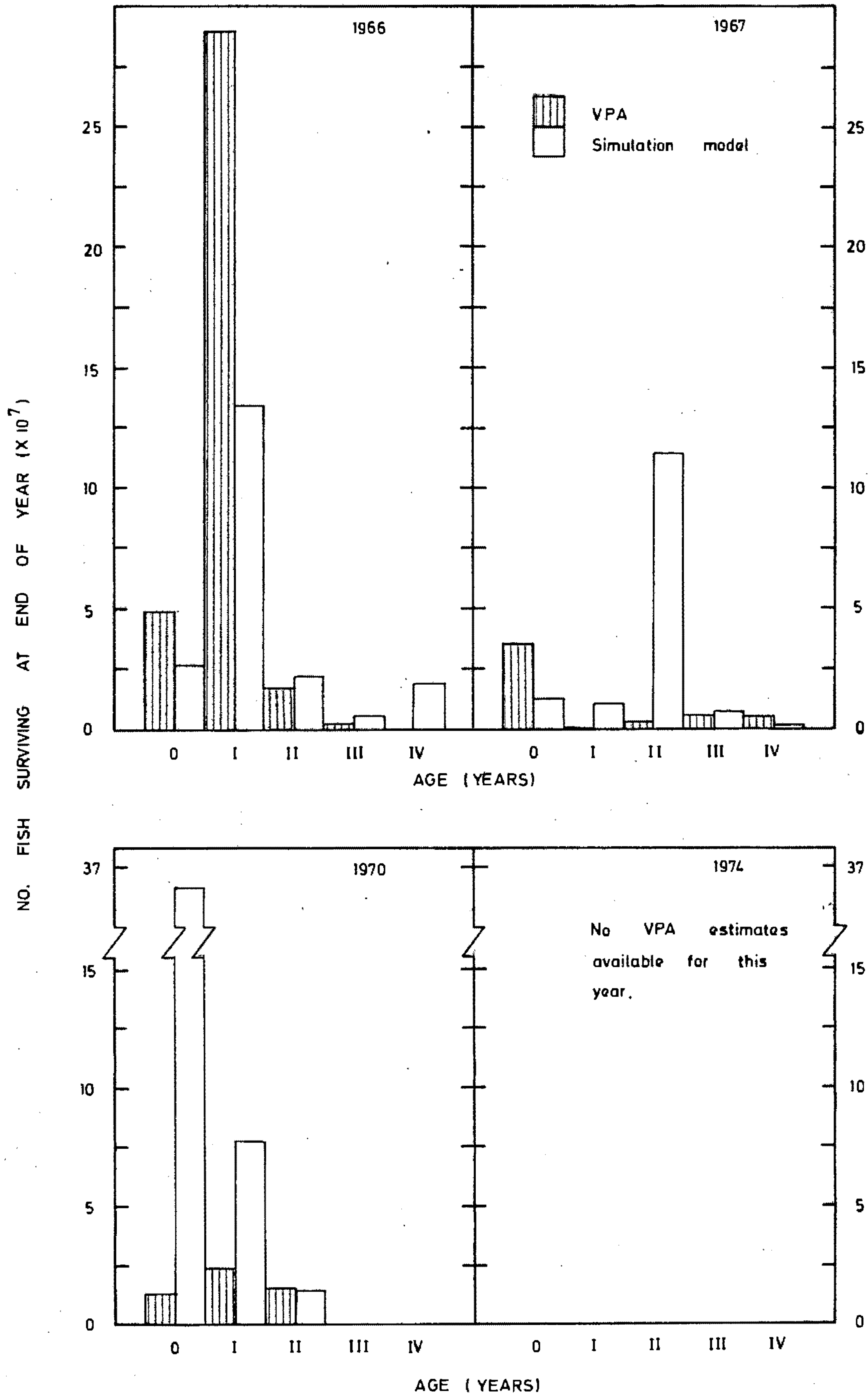

Fig 48c VPA and simulation model estimates of numbers of horse mackerel at each age surviving at end of year in 1966, 1967 and 1970.

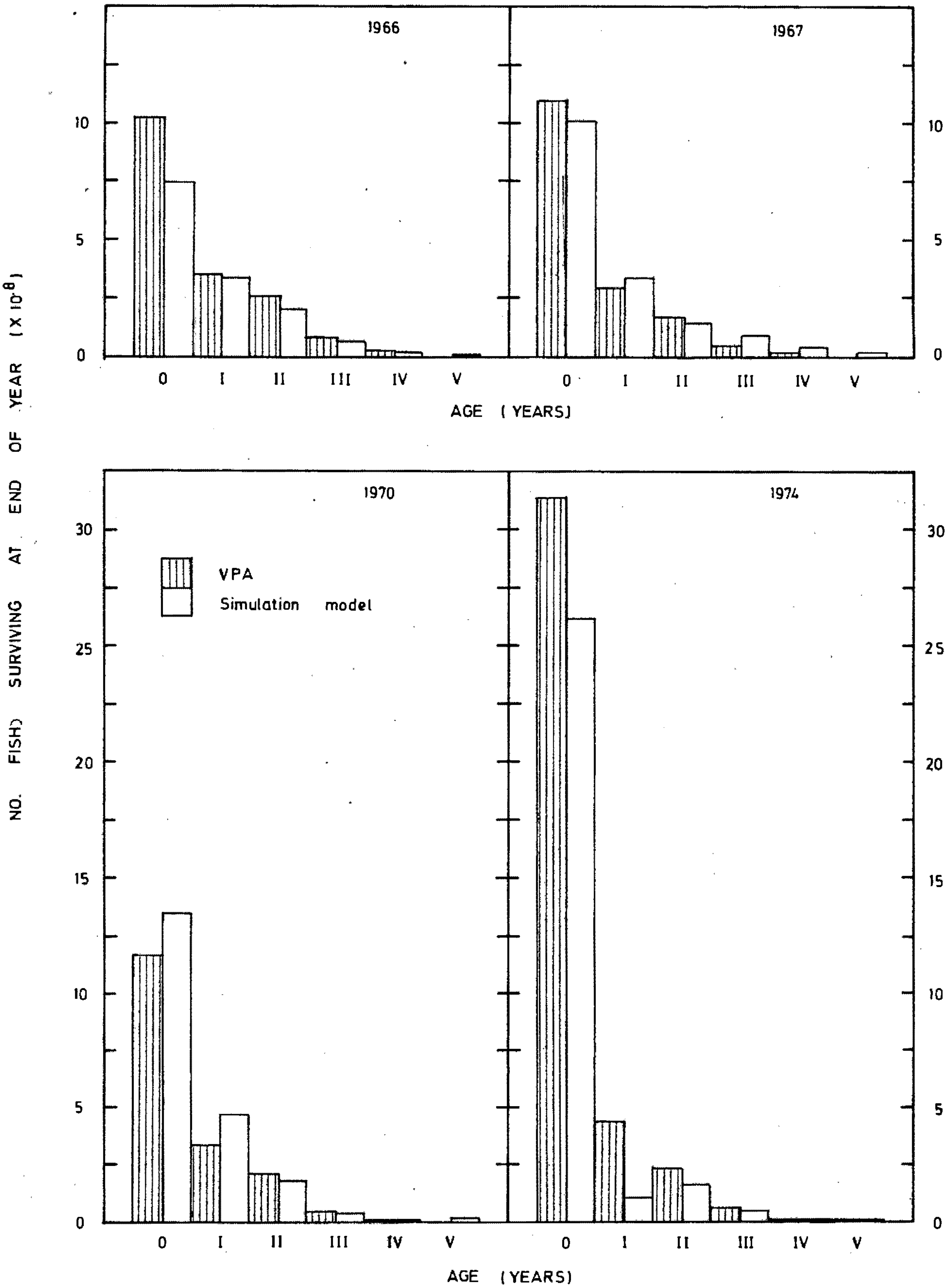

Fig 48e VPA and simulation model estimates of numbers of round herring at each age surviving at end of year in 1966, 1967, 1970 and 1974.

herring. In 1974 a ready availability of adult anchovy in summer and early autumn resulted in a record catch of this species (chapter 6) and led to an early closure of the fishing season. By contrast the pilchard catch was the lowest ever, that of horse mackerel only some 2 500 metric tons and that of round herring the smallest since the introduction of the 12,7 mm net. The actual catches in 1974 were especially high during the first three months of the season, whereas those of May and June were the lowest for the period 1964 - 1976 (Fig. 47). Simulated results do not follow this trend but reach a peak in May. Thus the model does not account for the unusually good availability of anchovy but estimates that a greater proportion of the catch was from months during which nought-year-old fish of summer spawning species recruit to the fishery (chapter 11).

As expected the model's estimates of the numbers of fish surviving at the end of the year are generally smaller than those calculated by VPA when simulated catch numbers are greater than observed values and vice versa. This is again noticeable for the younger pilchard and round herring age groups in 1966 and 1974 and for those of horse mackerel in 1966 (Fig. 48a,c,e). For the latter species no VPA estimates are available for 1974 and inadequate sample information during 1968 (chapter 7) may have influenced those for 1967.

The simulated monthly catches exhibit less fluctuation through each season than observed trends (Fig. 47). This again may be expected as the model employs average values of availability and distribution. Only during September do predicted results fall outside the observed range for the period 1964 - 1976 and in the majority of cases the calculated catches lie within one standard deviation obtained for the same period.

Levels of effort calculated by the model represent 93 per cent of the actual value for both 1966 and 1967, 100 per cent for 1970 and 118 per cent for 1974 (Table XLII). This partially explains the fact that the simulated catches for the former two years were slightly lower than those observed. The good availability of anchovy in 1974 resulted in improved catch rates in that year (chapter 4) but this was not accounted for by the model.

The model thus appears to simulate the normal situation adequately but makes no allowance for unusual events as, for example, the ready availability of anchovy in 1974, the poor catches of juvenile pilchard, horse mackerel and round herring in the same year, the virtual absence of one- and two-year-old mackerel from the landings of 1970 and the large mackerel catch in March 1967. In view of the high degree of variability associated with the fishery the model will have only limited value as a predictor of particular events. It's usefulness is likely to lie in examining general trends.

SENSITIVITY ANALYSIS

Sensitivity of the model to availability, catchability and natural mortality coefficients was examined by using the input data for 1970. These three parameters were considered the most important and the least exact and each was varied separately, at the 75, 90, 110 and 125 per cent levels, while holding all others constant. Data for 1970 were chosen because of the representative fishing pattern in that year.

The results are illustrated in Figs. 49 - 51, from which it may be seen that availability exerted the greatest influence and natural mortality the least. 25 per cent increases in availability and catchability and an equivalent decrease in natural mortality improved the predicted catch of all species combined by 14, 10 and 5 per cent respectively (Fig. 49). A 10 per cent rise in availability increased the yield by 6 per cent and thus had a greater impact than a 25 per cent decrease in natural mortality. Catches of individual species were all influenced to a similar degree.

Levels of effort were less sensitive to the variations (Fig. 49). 25 per cent changes in availability and catchability altered the annual effort by only 3 per cent, whereas 25 per cent changes in natural mortality affected effort by 1per cent. The model is therefore robust in its estimation of this parameter, probably on account of the stringent requirements which must be satisfied before a processor's total effort is allocated to any one ground (Fig. 44). Catch rates were affected to a greater extent. Availability of fish may be expected to exert a considerable influence on catch per unit effort and in the model a 25 per cent increase in availability produced an 18 per cent rise in the overall catch rate for 1970. When 75 per cent levels of availability were employed catch per unit effort fell by 20 per cent. A 25 per cent increase in catchability and a similar decrease in natural mortality improved catch rates by 13 and 6 per cent respectively.

Numbers of fish caught and numbers surviving were not greatly affected by variations in the three parameters. For clarity only results obtained with the adopted values and with these increased or decreased by 25 per cent have been illustrated in Figs. 50 and 51. The estimated catch numbers were most sensitive to changes in availability (Fig. 50) and at the 75 per cent level were reduced by between 14 and 25 per cent, the largest discrepancies being obtained for nought- and one-year-old pilchard. As expected natural mortality proved more important in computing the numbers of fish surviving at the end of the year (Fig. 51). The differing influences obtained for species and age groups may be partially attributed to the fact that these are not independent of each other (equations 3 and 9).

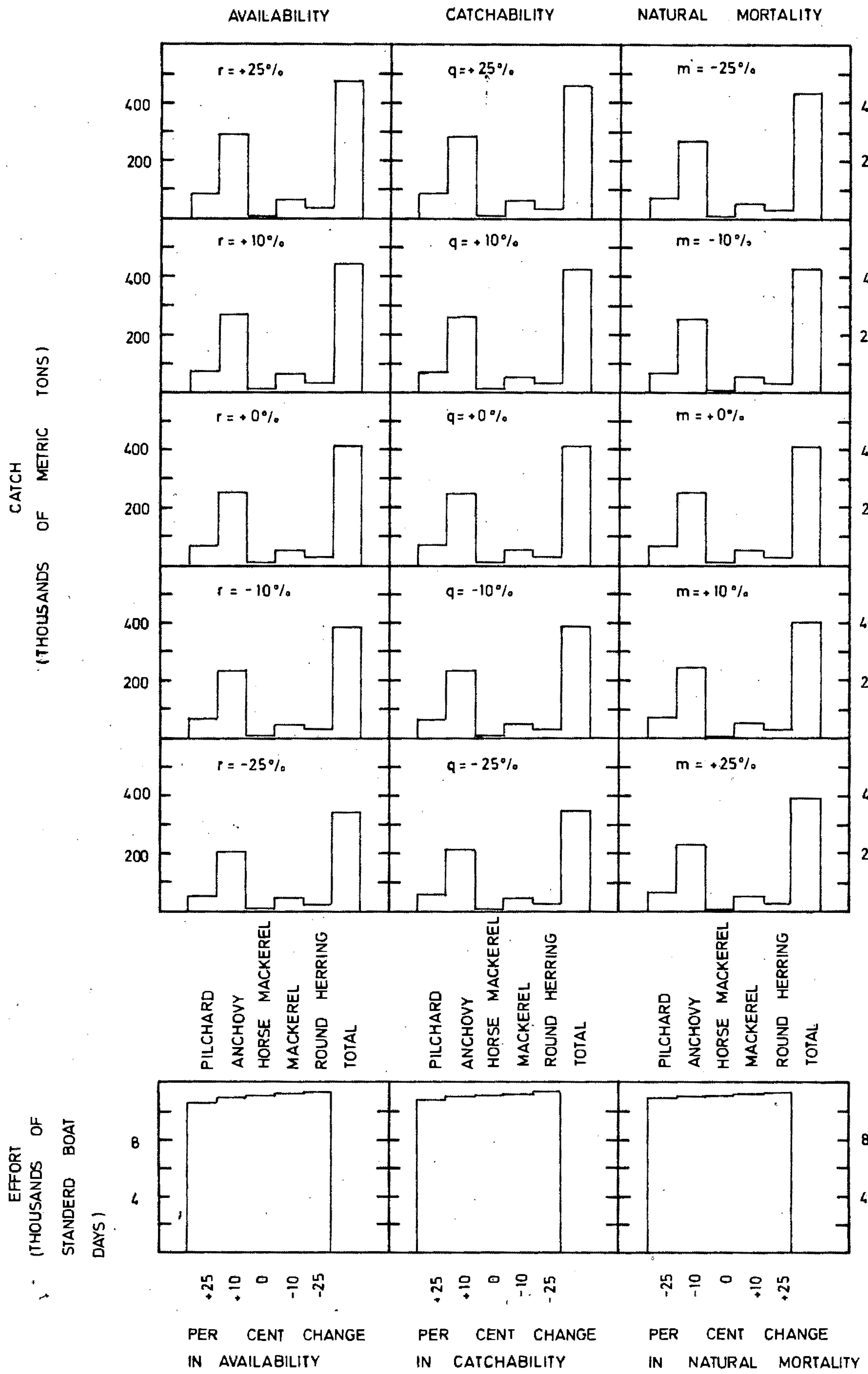

Fig 49 Results of sensitivity analysis indicating model estimates of species and total catch and effort expended in 1970. Per cent changes in the best model estimates of availability (r), catchability (q) and natural mortality (m) coefficients are indicated. In all instances these parameters were altered for every species and age.

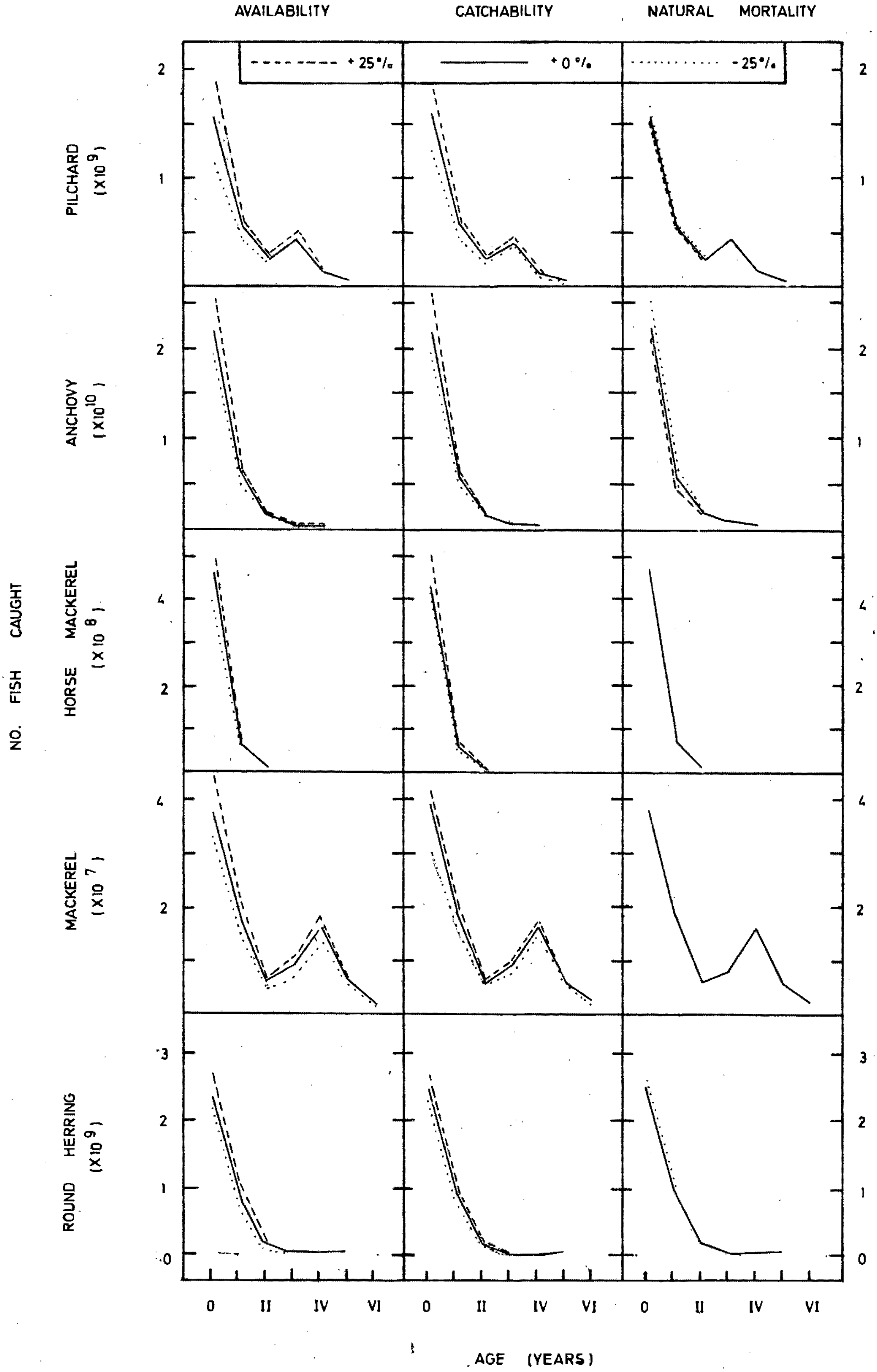

Fig 50 Results of sensitivity analysis indicating model estimates of numbers of fish caught at age per species in 1970. Per cent changes in the best model estimates of availability, catchability and natural mortality coefficients are indicated. In all instances these parameters were altered for every species and age.

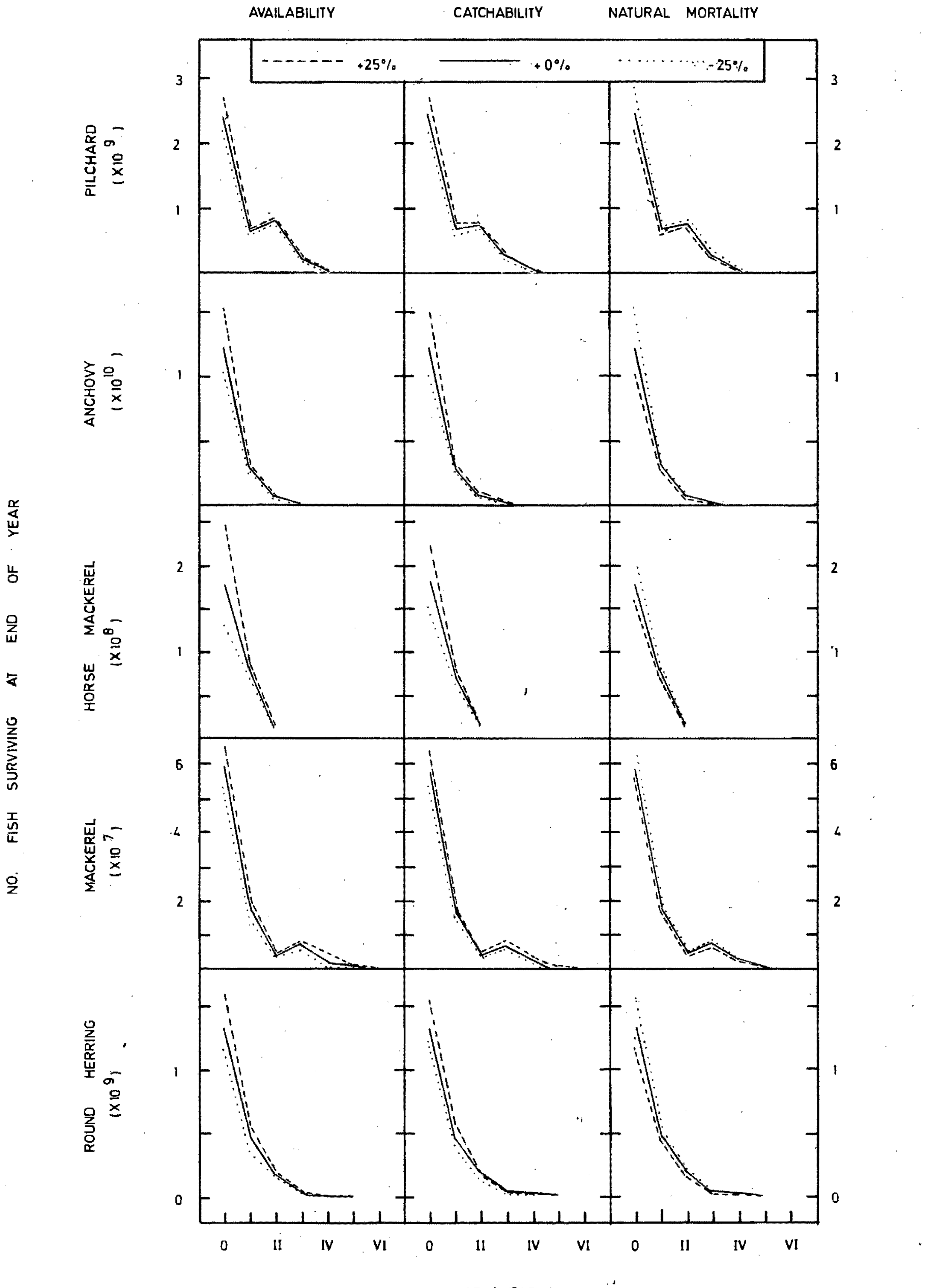

Fig 51 Results of sensitivity analysis indicating model estimates of numbers of fish at each age surviving at end of 1970 per species. Per cent changes in the best model estimates of availability, catchability and natural mortality coefficients are indicated. In all instances these parameters were altered for every species and age.

The model was also run for 1970 using 75 per cent levels of availability and catchability and 125 per cent levels of natural mortality to examine the combined influence of these parameters. The total catch fell by 36 per cent to 264 508 metric tons and catch rates by 39 per cent to 23,0 metric tons per standard boat day. Again all species were affected to a similar degree.

IMPLICATIONS OF RECRUITMENT VARIATIONS

Large fluctuations in year-class strength have been exhibited by several contributors to South Africa's purse-seine landings (Geldenhuys 1973, Centurier-Harris 1977, Crawford and Shelton 1978, Newman and Crawford in press). In order to examine their implications for management of the resource the model was run for eight series of eleven consecutive years, recruitment being varied on each occasion. 1974 was chosen as the starting year and the runs were therefore hypothetically terminated at the end of 1984. The input data for 1974 were the same as described earlier. From 1975 the open season was extended to include July and August and thereby to conform with current restrictions. Apart from the number of nought-year-olds entering the fishery each year, all other parameters remained constant throughout. These included the number of boats associated with each processor and their fishing powers. The catching potential of the fleet was therefore unaltered. Additionally no effective quota restraints were placed on the catch so that the impact of fluctuations in recruitment would not be masked.

Average recruitment

In the first run the mean values of recruitment observed between 1964 and 1976 were used for all species for the entire period 1975 - 1984. 1964 is the first year for which information is available for the anchovy and round herring populations (Newman and Crawford in press) and 1976 the last for which VPA estimates are considered even moderately accurate. The purpose of examining this average situation was to provide a yardstick against which the impact of fluctuations in year-class strength might be gauged and not to predict the future performance of the fishery. By 1978 the valuable horse mackerel and mackerel stocks had ceased to contribute significantly to the catches and it would be unrealistic to anticipate average levels of recruitment for these two species.

Together with the recruitment levels adopted, model estimates of parent stock biomass at the beginning of the year and of annual catch are illustrated for each species in Fig. 52. The combined species catch, total effort expended and overall catch per standard boat day are also shown. The parent stocks were assumed to be anchovy aged one or older, pilchard and round herring aged two or older and horse mackerel and mackerel aged three or older (chapter 11).

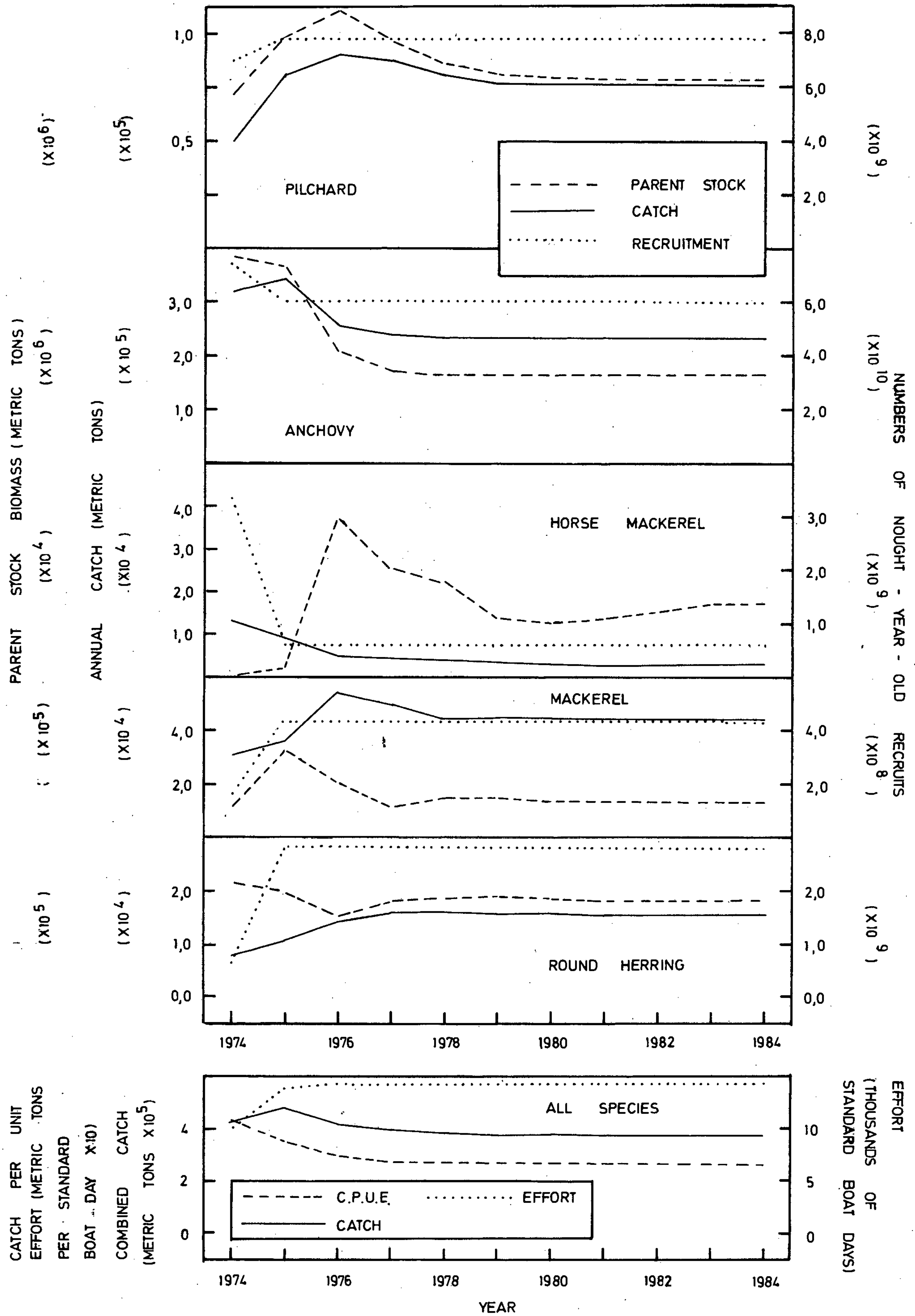

Fig 52 Model estimates of catch, effort, catch per unit effort and parent stock biomasses 1974 - 1984, using for 1975 - 1984 the average recruitment observed between 1964 and 1976 for all species.

The catches of all species rapidly attained an equilibrium, pilchard at about 76 000 metric tons, anchovy at 235 000 tons, horse mackerel at 3 000 tons, mackerel at 44 000 tons and round herring at 16 000 tons. The adult populations, too, stabilised after the first six years: those of pilchard, mackerel and round herring at approximately the same levels and that of anchovy at 50 per cent of the value estimated for 1974. In 1974 the VPA estimate of total population size for anchovy was substantially greater than that for any other year (Newman and Crawford in press). The parent stock of horse mackerel was assumed to be zero in 1974 on the basis of the initial population used in the model. It subsequently reached an equilibrium of about 17 000 tons.

As a result of the extension of the fishing season from the end of June to the end of August the effort expended in 1975 was 40 per cent higher than that in 1974. Thereafter it remained constant. The combined species catch also increased between 1974 and 1975, from 419 000 to 479 000 tons. It then fell, as did catch rates, and from 1979 - 1984 fluctuated only between 373 000 and 379 000 tons.

Moderate failure of anchovy recruitment

Implications of a continuing moderate failure of anchovy recruitment were investigated by using 50 per cent of the mean value observed between 1964 and 1976 throughout the period 1975 - 1984. For all other species the average values were employed.

It was preferred to maintain recruitment at a constant level after reducing it, rather than to subsequently increase it. In the absence of well-defined parent stock - recruitment relationships it is difficult to gauge the full implications of a few poor year classes. However, it was ascertained that reduced recruitment fairly rapidly decreased the spawning population and this could result in a continuity of recruitment failure, although the initial liklihood of such an event may be low.

The results (Fig. 53) indicate that an equilibrium was again rapidly attained. When compared with the situation in which mean recruitment was used for all five species, the predicted steady state catches of pilchard, horse mackerel, mackerel and round herring were only slightly lower. Parent stocks were affected to a greater degree, being reduced to 74, 64, 70 and 76 per cent respectively. The equilibrium anchovy catch fell by 52 per cent and the adult population by 40 per cent. The combined species catch stabilised at 240 000 tons as compared to 375 000 tons and catch rates at 16,5 in place of 26,1 tons per standard boat day.

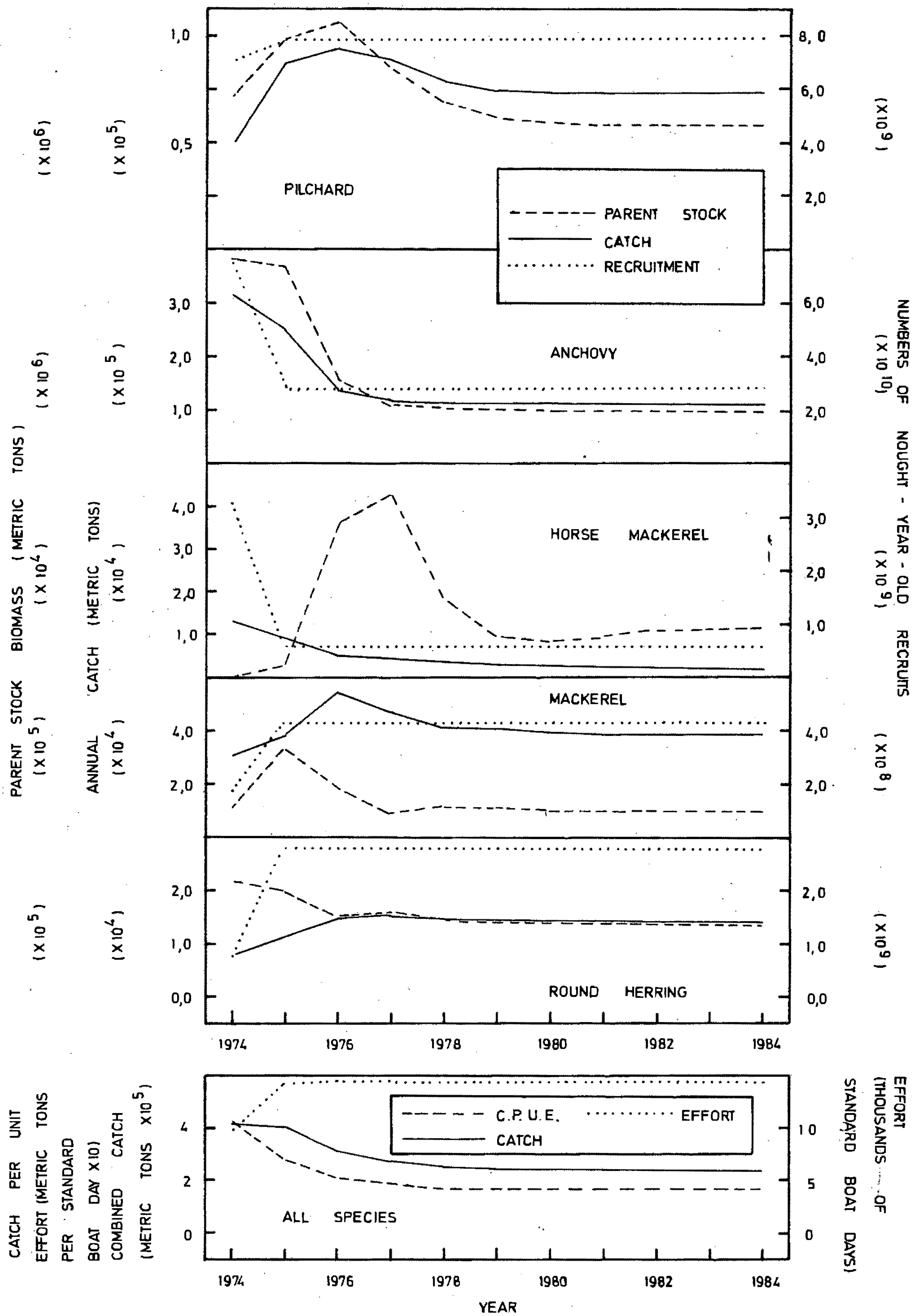

Fig 53 Model estimates of catch, effort, catch per unit effort and parent stock biomasses 1974 - 1984, using for 1975 - 1984 50 per cent for anchovy and 100 per cent for other species of the average recruitment observed between 1964 and 1976.

The lower catches and spawning populations of species other than anchovy result from their attracting a greater proportion of the fishing effort on account of a reduced anchovy biomass. The decreased parent stock sizes of these species could reduce their recruitment and so further aggravate the adverse trends.

Severe failure of anchovy recruitment

The consequences of a severe failure of anchovy recruitment were examined by using only 10 per cent of the mean value observed between 1964 and 1976 for the ten year period 1975 - 1984. Levels employed for all other species were the same as in the previous two runs.

The model results are illustrated in Fig. 54. When compared with the situation in which average recruitment was used for all species, the equilibrium catch of anchovy was decreased by 92 per cent and those of the other contributors by between 12 and 26 per cent. Steady state parent stock biomasses declined by 80 per cent for anchovy and by 48 - 60 per cent for each of the other species. The combined catch stabilised at 133 000 tons, at which level the predicted catch rate was 9,1 tons per standard boat day. In all instances the reductions were greater than those obtained when the recruitment failure of anchovy was less drastic.

Moderate failure of pilchard recruitment

To investigate the effect on the fishery of a moderate failure of the pilchard resource the model was run using 50 per cent of the average recruitment level observed between 1964 and 1976 for the entire period 1975 - 1984. For all other species the mean values were employed.

The results (Fig. 55) were less severe than those predicted for a similar decline in anchovy recruitment. The combined species catch stabilised at 340 000 tons. The most important trends were again the decreased equilibrium parent stock sizes. That of pilchard was reduced to 69 per cent of the steady state obtained when using mean recruitment levels for all species and those of the other contributors to between 77 and 85 per cent.

Severe failure of pilchard recruitment

A more severe collapse of the pilchard stock was examined by using 10, instead of 50, per cent of the average recruitment level observed between 1964 and 1976. Except for 1974 the mean values were again used for all other species. In this instance the combined species catch stabilised at 311 000 tons (Fig. 56). The equilibrium population of mature pilchard declined to

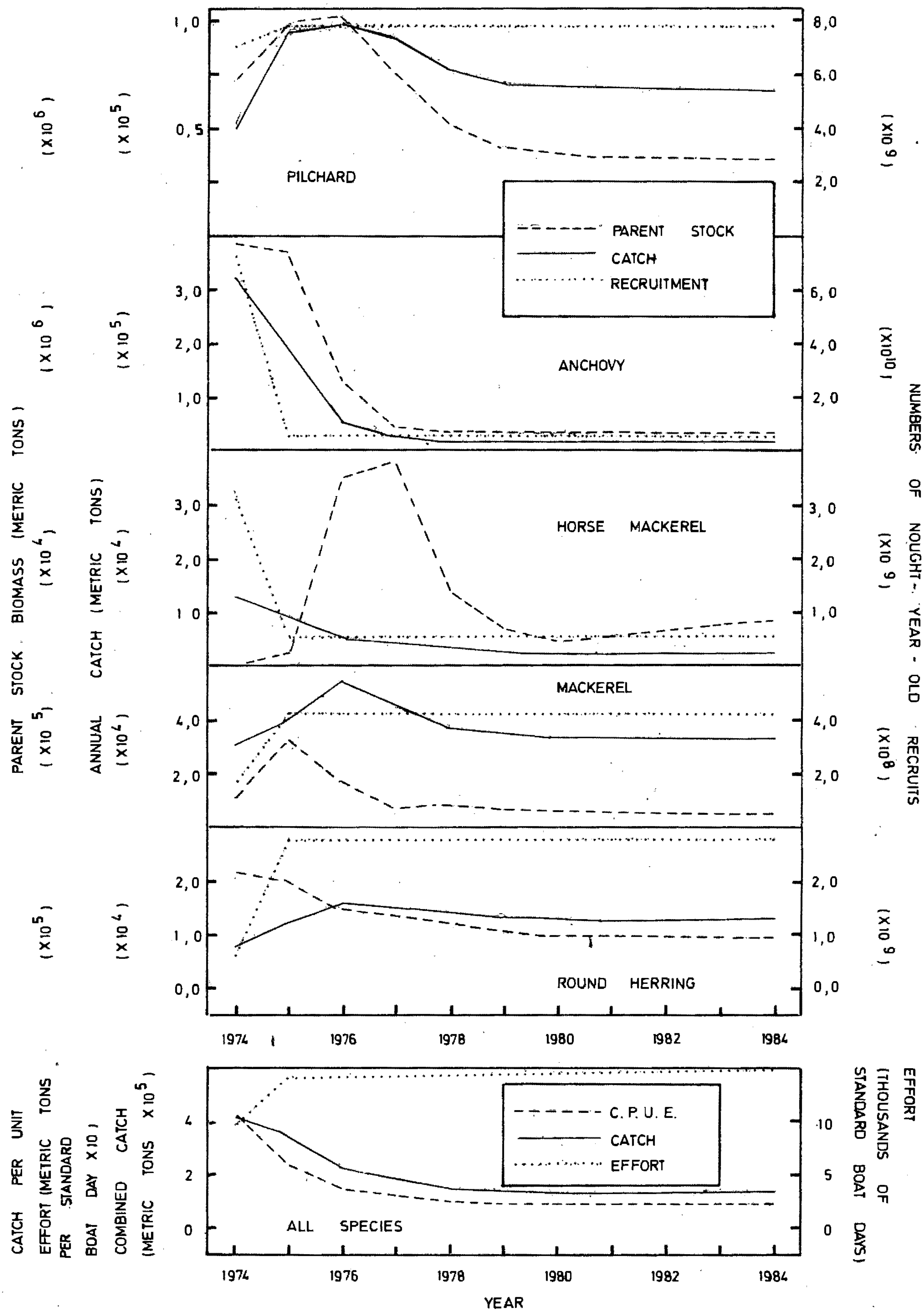

Fig 54 Model estimates of catch, effort, catch per unit effort and parent stock biomasses 1974 - 1984, using for 1975 1984 10 per cent for anchovy and 100 per cent for other species of the average recruitment observed between 1964 and 1976.

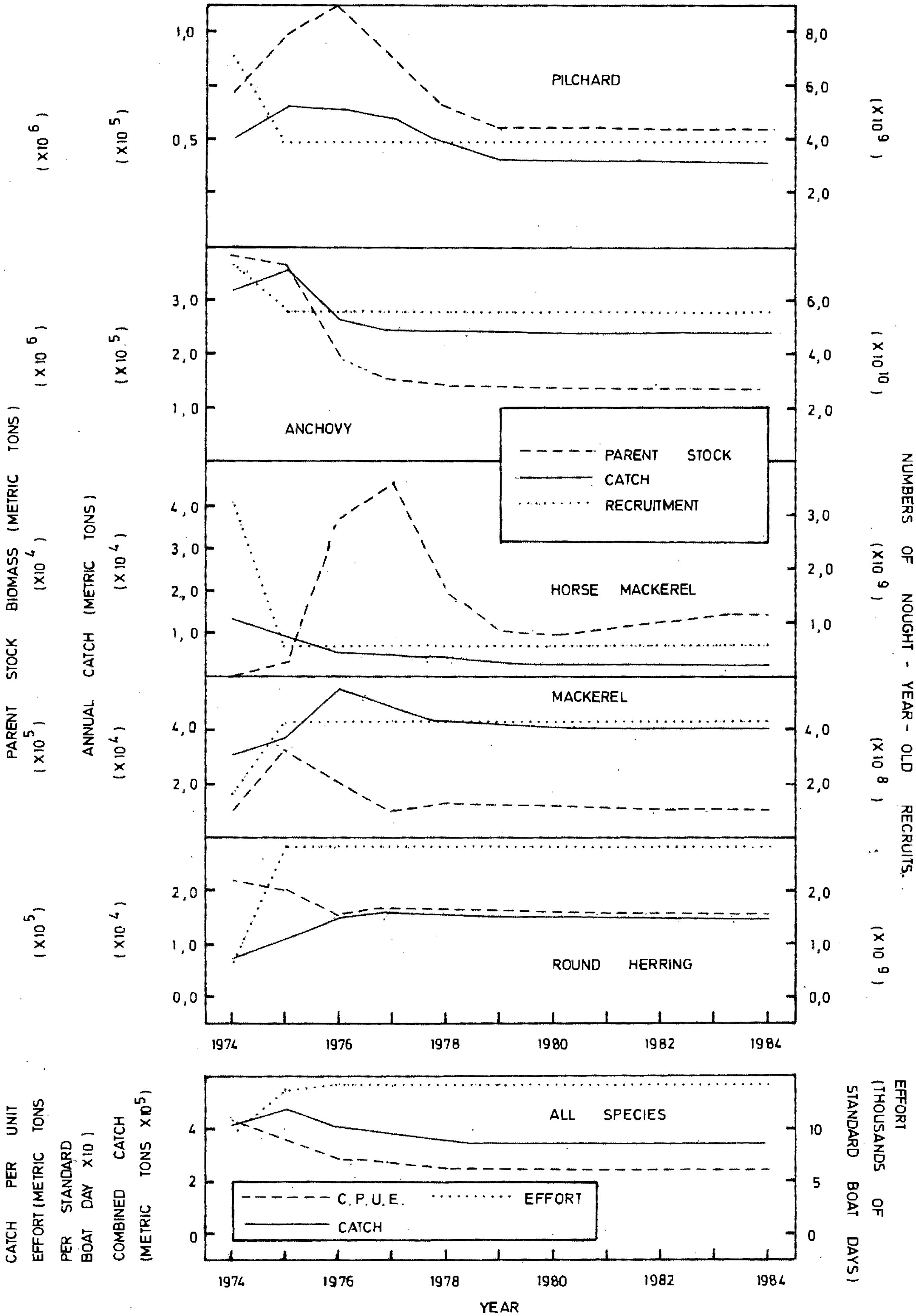

Fig 55 Model estimates of catch, effort, catch per unit effort and parent stock biomasses 1974 - 1984, using for 1975 - 1984 50 per cent for pilchard and 100 per cent for other species of the average recruitment observed between 1964 and 1976.

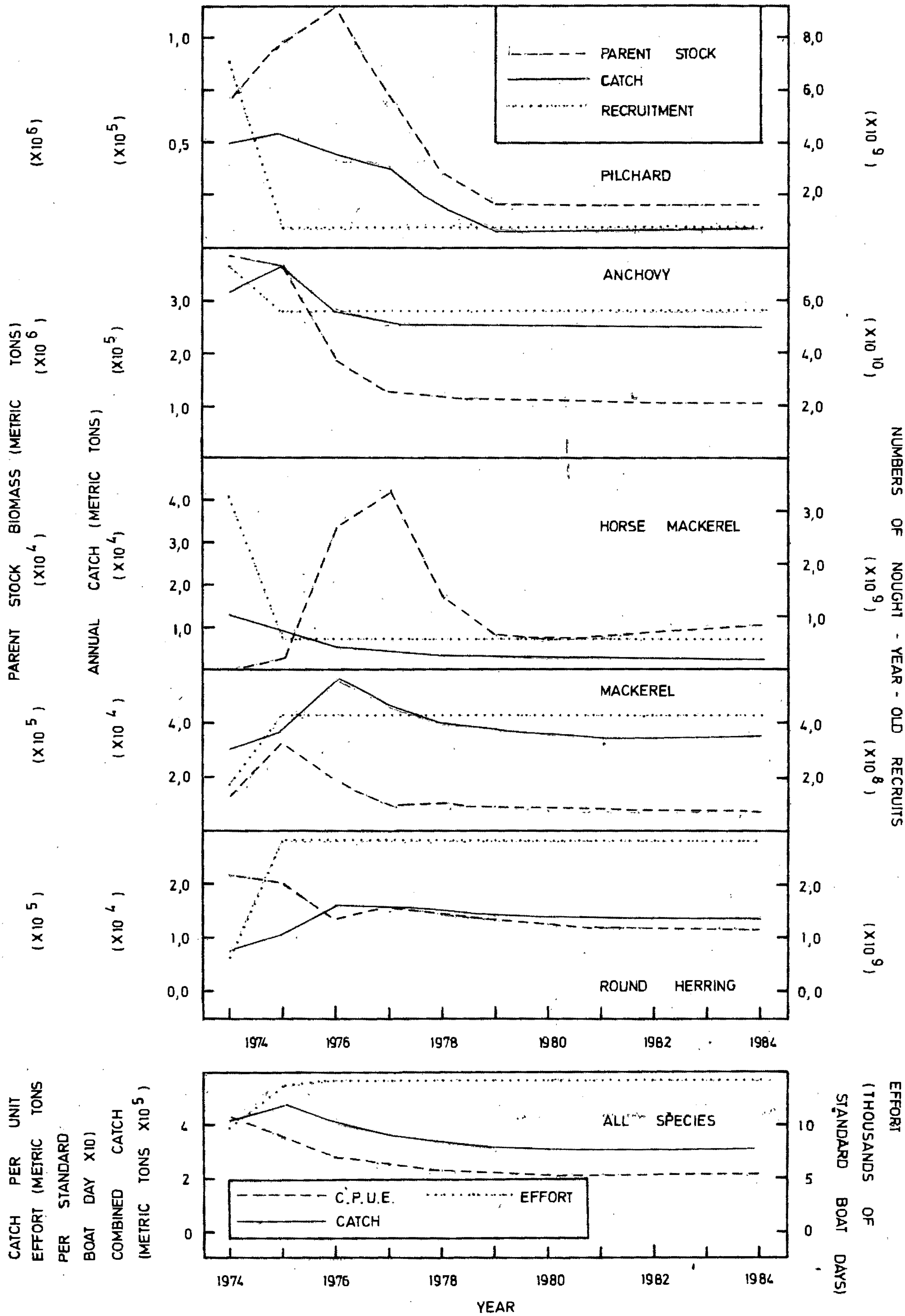

Fig 56 Model estimates of catch, effort, catch per unit effort and parent stock biomasses 1974 - 1984, using for 1975 - 1984 10 per cent for pilchard and 100 per cent for other species of the average recruitment observed between 1964 and 1976.

26 per cent of that obtained when using average recruitment for all species. Those of the other contributors fell by between 34 and 51 per cent. The 36 per cent decrease for anchovy might be expected to be especially disadvantageous for the fishery.

Strong pilchard year classes

To investigate the impact that a series of strong pilchard year classes, similar to those occuring during the mid-1950's, would have on the fishery now that a small-meshed (12,7 mm) net has been introduced the model was run using for 1975 and 1984 the mean value of pilchard recruitment calculated for the period 1950 - 1954, and from 1976 - 1983 an equivalent time series to that observed between 1955 and 1962. For all other species the average values occuring between 1964 and 1976 were again employed for the entire period 1975 - 1984.

The results are illustrated in Fig. 57 and indicate that the pilchard catch would attain a peak of 308 000 tons in 1978. This summit coincided with the year of highest recruitment. In the real situation when a 32 mm-meshed net was in use, the youngest age classes were not exploited and the largest pilchard catch (410 000 tons in 1962) was recorded five years after the initiation of the exceptionally powerful 1967 cohort.

Between 1955 and 1964 the observed pilchard catch was 2,5 million tons and the combined landings of all species amounted to 3,4 million tons. The pilchard catch predicted by the model for the period 1975 - 1984 was 2,0 million tons and the total yield 5,0 million tons. The lower pilchard catch can be attributed to a high fishing mortality on the young age groups preventing growth to the optimum size. The higher combined landings resulted mainly from exploitation of the anchovy resource, the predicted catch of which was 2,3 million tons for the period 1975 - 1984.

The good pilchard recruitment had a favourable influence on all parent stocks, biomasses of which attained higher levels than the equilibria predicted when using average recruitment for all species. The model therefore suggests that an increased abundance of pilchard would lessen fishing pressure on other species.

Strong pilchard year classes when using a 32 mm-meshed net

The previous run was repeated with catchability coefficients that it was thought would apply to the use of a 32 mm-meshed net. On the basis of the age compositions of the commercial catches immediately before and after the replacement of the 32 mm net by one having a mesh size of 12,7 mm (Crawford et al. 1978), the catchability coefficients for all anchovy ages and

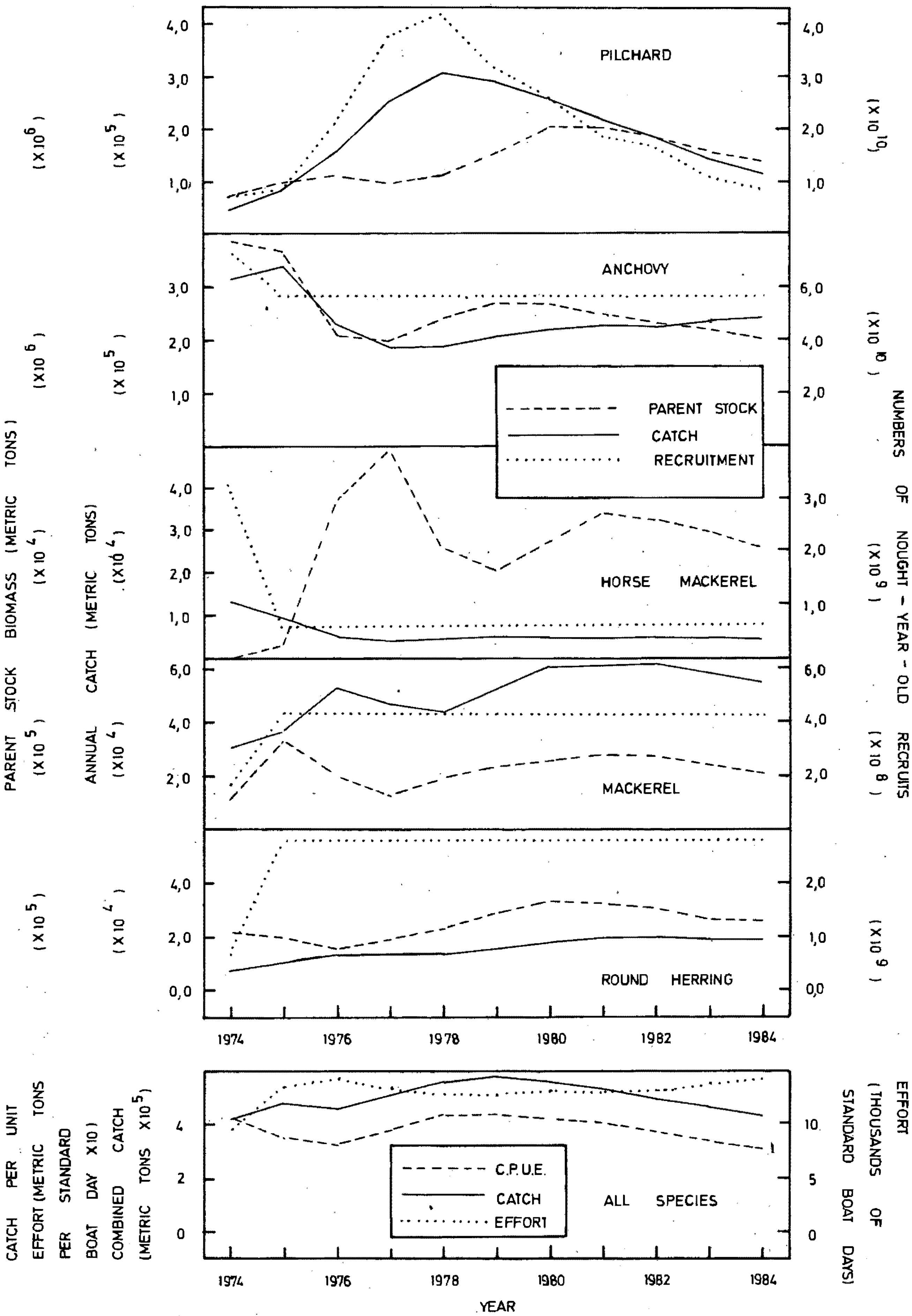

Fig 57 Model estimates of catch, effort, catch per unit effort and parent stock biomasses 1974 - 1984, using for 1975 - 1984 a time series of pilchard recruitment similar to that observed between 1955 and 1964 and for other species the average values observed between 1964 and 1976. Catchability coefficients used were those applicable to a 12,7 mm-meshed net.

for nought- and one-year-old pilchard, horse mackerel and round herring were equated to zero. Those for two-year-old horse mackerel and nought-year-old mackerel were set at half the values calculated for the 12,7 mm net but for all other age groups were left unchanged.

Results are illustrated in Fig. 58. The pilchard and combined species catches for the ten year period 1975 - 1984 were calculated as 2,4 and 3,8 million tons respectively, which may be compared with the observed totals of 2,5 and 3,4 million tons during the period 1955 - 1964. The overall yield is considerably smaller than the 5,0 million tons predicted for the use of a 12,7 mm net but the catches of all species except anchovy were improved, pilchard by 19 per cent, horse mackerel by 398 per cent, mackerel by 72 per cent and round herring by 22 per cent, emphasising the undesirability of exploiting these populations in their early stages. The parent stocks of all species also increased considerably. Catch rates were initially poor relative to those predicted for the use of a 12,7 mm net (11,4 as opposed to 35,3 tons per standard boat day in 1975) but from 1979 were superior.

Strong mackerel year classes

To investigate the effect of a peak in mackerel recruitment the model was run using for 1976 and 1977 estimated values of the strong 1966 and 1967 year classes. The average values observed during the period 1964 - 1976 were employed for other years and for all other species from 1975 - 1984. The catchability coefficients adopted were those applicable to the 12,7 mm-meshed net.

The results (Fig. 59) were similar to those predicted when using average recruitment throughout. As expected both the mackerel and total catches were improved between 1976 and 1978. There was a beneficial influcence on the adult populations of of other species in years immediately following the good recruitment, which can be attributed to effort being directed away from these sectors of the fishery and toward the strong mackerel cohorts. The parent stock of mackerel was 15 - 20 per cent higher in 1979 and 1980, as a result of the good year classes attaining maturity, but thereafter was almost identical to that predicted for the average run. Thus a disappointing feature was the limited duration of the favourable impact, as had been the case with the actual catches recorded during the late 1960's (chapter 8). This suggests that if good mackerel recruitment were to occur in future years the present fishing power of the fleet would result in fishing pressure on the younger age groups being higher than optimum unless quota restrictions were employed to limit the catch.

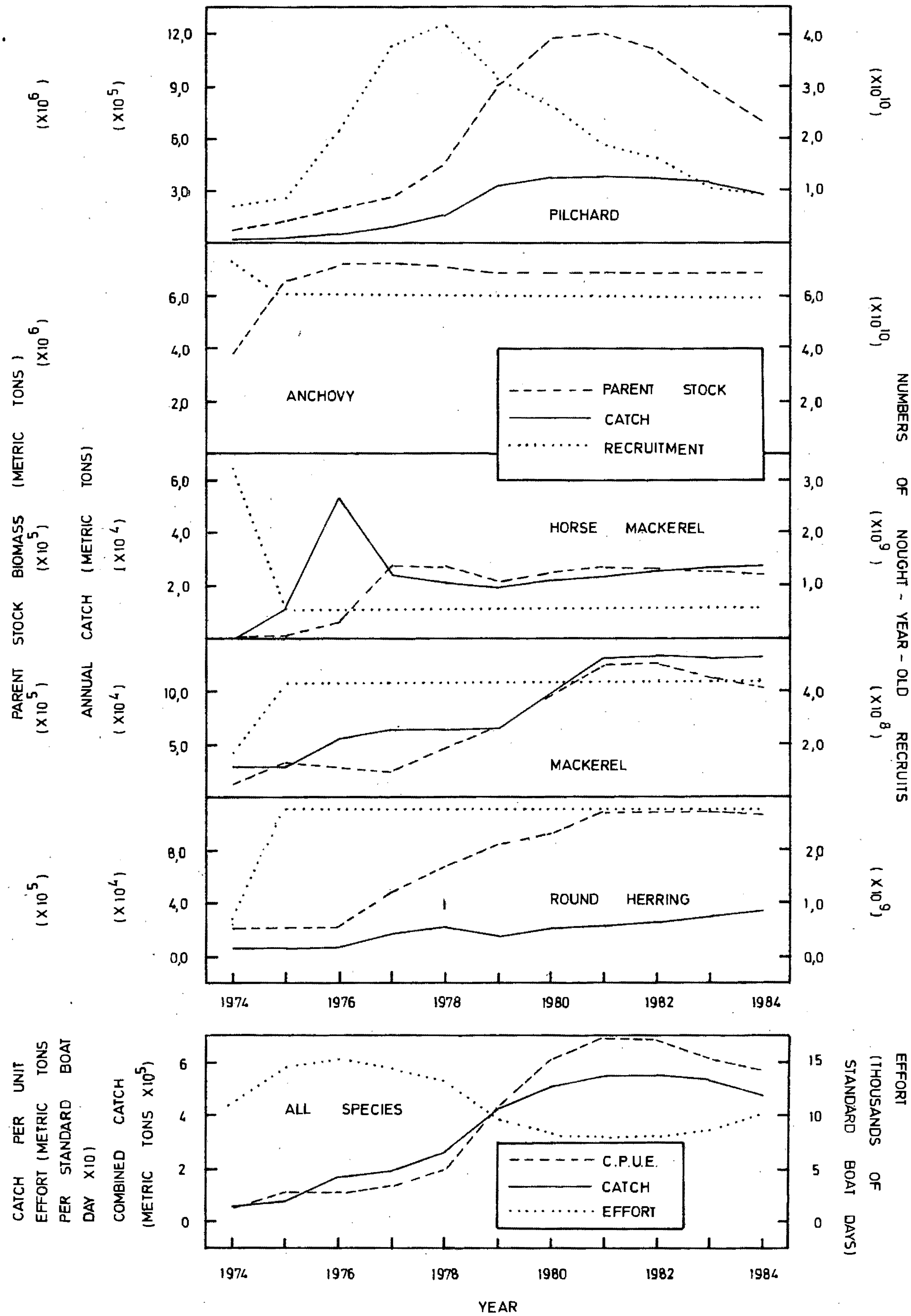

Fig 58 Model estimates of catch, effort, catch per unit effort and parent stock biomasses 1974 - 1984, using for 1975 - 1984 a time series of pilchard recruitment similar to that observed between 1955 and 1964 and for other species the average values observed between [illegible] and [illegible]. Catchability coefficients used [illegible]

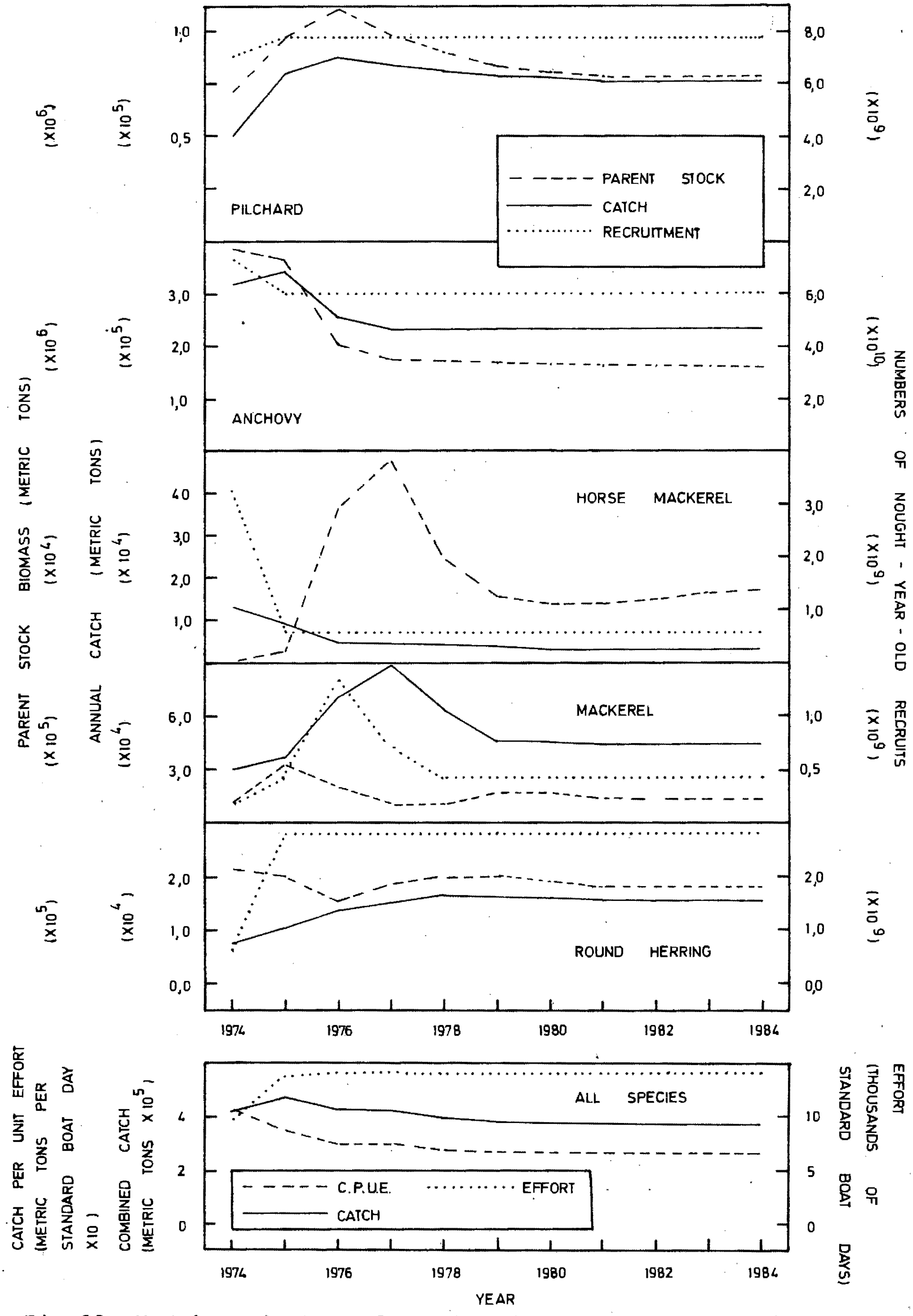

Fig 59 Model estimates of catch, effort, catch per unit effort and parent stock biomasses 1974 - 1984, using for 1975 - 1984 the average recruitment observed between 1964 and 1976 for all species except mackerel in 1976 and 1977. For these years the calculated values for 1966 and 1967 were used.

DISCUSSION

The high degree of variability associated with South Africa's Western Cape purse-seine fishery makes the construction of a model capable of predicting events in the short-term difficult and there are insufficient data to achieve this aim. However, average situations have been examined over a longer period and important principles emerge for future management of the resource.

A continuing failure of the anchovy population could reduce the annual catch to between 130 000 and 240 000 tons, depending on its severity. Although poor pilchard recruitment would have less impact it might be expected to decrease the yield to between 310 000 and 340 000 tons. In each instance the parent stocks of all populations would be adversely influenced and this could in turn lead to further bad recruitment. As all ages of both the pilchard and anchovy populations are currently subject to intensive fishing pressure (chapter 4) there is obvious cause for conern. It would be expedient, therefore, to alleviate some of this pressure by lowering the catch quota, which from 1977 - 1979 was set at 380 000 tons. The simulation model predicts that if the mean levels of recruitment observed between 1964 and 1976 were maintained for all species the combined catch would stabilise at about 375 000 tons. In recent years horse mackerel and mackerel have contributed insignificant catches and average recruitment cannot be reasonably expected from either in the immediate future. On the basis of predicted yields for the other three species the overall quota should be reduced to 325 000 tons.

The estimated catches of pilchard, horse mackerel, mackerel and round herring were increased considerably when catchability coefficients thought to be applicable to a 32 mm-meshed net were used in the model. This result emphasises the desirability of progressing towards a directed fishery that avoids the capture of these species in their younger stages. The discrepancies between observed and simulated catch numbers in 1966, the first year in which fishing for all species with the 12,7 mm net was permitted and when skippers are thought to have avoided catching juvenile pilchard, horse mackerel and round herring, suggests that more can be done than at present to achieve this aim. It would be appropriate for representatives from industry and government to discuss measures that might improve the situation. Penalising skippers who offload juveniles of species other than anchovy is a possible solution but may encourage dumping. This could perhaps be monitored through aerial surveillance, with the estimated quantity of dumped fish being deducted from the overall quota as a deterrent.

The model predicts that increases in availability and catch-ability would improve both landings and catch rates. Temporary increases in these factors, therefore, need not necessarily reflect a healthier resource and should not cause controlling authorities to deviate from their longer-term objectives.

CHAPTER 14. A SIMULATION MODEL FOR SOUTH AFRICA'S WESTERN CAPE PURSE-SEINE FISHERY. II. FACTORY TREATMENT OF THE FISH CATCH.

Ten pelagic fish processing plants are situated off South Africa's west coast between Lambert's Bay and Gans Bay (Fig. 5). Some of these factories are equipped with canning plants and all are capable of reducing fish to meal and oil. Recently the production of other commodities, such as frozen products or fish paste, has also received attention. However, the bulk of the raw material, although having a high protein content, is still not optimally utilised. In 1978 only 0,13 per cent was processed for direct human consumption in spite of the fact that such end-products are considerably more profitable. There are two main reasons for this, the first being the small average size of fish which results from the small mesh size (12,7 mm) of nets and a high fishing intensity on the younger age groups, and the second that catches of larger fish are frequently offloaded in a poor condition after being transported considerable distances from the fishing grounds.

Increased operating costs, especially large rises in fuel prices, necessitate a review of the situation. In particular uncertainty exists as to whether the present <u>modus</u> <u>operandi</u> is the best. Current regulations are that the season is closed from 1st September - 31st December and boats are allowed to operate over the greater part of the fishing grounds. Postponing the capture of the younger age groups, for example, would allow for increased growth but would also result in a higher natural mortality. Assessment is complicated by the mixed-species nature of the fishery and for this reason a model has been developed to simulate each factory's treatment of its fish catch. The model is described here.

Canned fish is packed in a variety of forms but, apart from distinguishing species, the model differentiates only between the two major types, <u>viz.</u> cutlets or fillets and minced fish. Provision is also made for the production of fish paste, fish frozen for human consumption or for bait, oil, meal and roll mops, though the latter have not yet been manufactured on a commercial scale.

DESCRIPTION OF THE MODEL

For all months and processors the model examines separately the species catch (in mass) at age from each ground. Another model is already available to simulate these catches (chapter 13) and is used to provide the input information. Each catch is considered for processing to the various products, it being ascertained whether the processor has facilities for the manufacture of a specified commodity, whether any portion of the catch would be suitable for it and whether the processor's monthly intake capacity for that item has been filled. In the event of either of the former two conditions being negative or the capacity being filled the model proceeds to investigate whether the catch could be used for another product (Fig. 60). Consultation with factory managers suggested that fish are invariably processed to the most valuable commodity and the following profitability rating was adopted for the model: canned cutlets or fillets, canned mince, fish paste, fish frozen for human consumption, fish frozen for bait, roll mops, oil and meal. However, an option enabling factories to decide not to produce any given item has also been included.

A single intake capacity is assumed to apply for canning of cutlets or fillets and mince; similarly for fish frozen for human consumption and bait. The limiting factors are the combined mass of fish which may be used for canning and the total refrigerated storage space. No restriction is placed on the quantity of raw material that may be reduced to oil and meal. This factor was accounted for when determining the monthly catch of each factory (chapter 13). As the possibility exists that the amount of fish suitable for processing to any product may exceed the intake capacity for that product and as certain fish types are favoured more than others, the model considers species according to the hierarchy: pilchard Sardinops ocellata, mackerel Scomber japonicus, horse mackerel Trachurus trachurus, round herring Etrumeus teres and anchovy Engraulis capensis. If required it may be expanded to include additional species such as lantern-fish Lampanyctodes hectoris.

Once a particular catch is to be considered for conversion to a chosen product, the proportion of the catch that would be suitable is established and then whether or not it may all be processed without exceeding the capacity for the commodity. If so the entire proportion is allocated for processing to that commodity. Alternatively only the amount required to complete the maximum intake is utilised. In both instances the remaining fraction is passed to the next item and the procedure repeated. All fish arriving at the final oil and meal stage is reduced to these components. The large size of fishing grounds (Fig. 1) often results in only a proportion of the catch being suitable for particular processes. Fish caught on the near reaches of a ground may be offloaded in a much better condition than those caught in more distant waters.

Sometimes not all the catch assigned for processing to a commodity is employed for this purpose. In canning or freezing, for example, fish arriving in a satisfactory condition may be damaged during offloading. Furthermore the heads, viscera and caudal fins are often removed. Allowance is thus made for a further reduction of the catch and the direct transfer of all reject fish and offal to the oil and meal intake (Fig. 60).

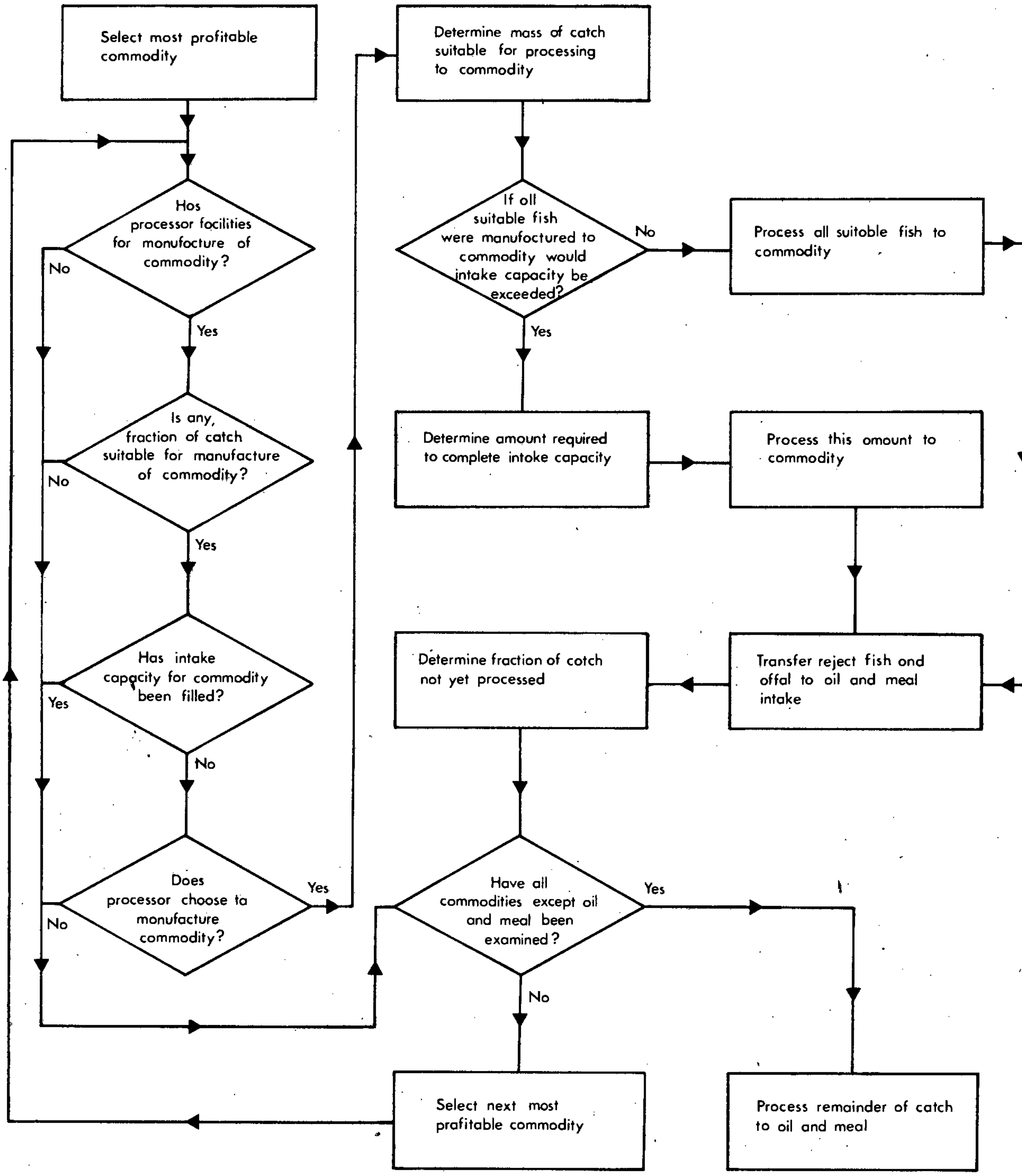

Fig 60 Diagramatic representation of procedure used to allocate mass of each catch for processing to the various end products.

The final production of each commodity is calculated through multiplication of the total mass of fish allocated to the commodity by an appropriate constant. This may be unity, as in the case of frozen fish; greater than one should other foods be added, as during canning operations; or less than one should, for example, water be extracted, as in the reduction of fish to meal and oil.

Three fish derivatives are used in the manufacture of fish paste: bloaters (smoked herring Clupea harengus), a base material and flavouring. The former are currently imported but could in the future be replaced by salted pilchard or round herring. Only these two species are considered to be suitable at the fish paste stage in the above allocation process. The base material most frequently employed is canned mackerel and the required amount may be deducted from the final inventory for this product. When this is insufficient it is generally purchased from the demersal trawling industry or imported. Cured anchovy is used to provide the flavouring and in the model the necessary quantities are deducted from raw material that is transferred to the oil and meal plant as part of the canning operation for this species.

ADOPTION OF PARAMETERS

Factory intake capacities for the various products were ascertained from plant managers and are listed in Table XLIII. Values for frozen products are dependant on refrigerated storage facilities and are thus to some extent determined by the rate of turnover. Facilities introduced in 1979 were not considered in this study.

Species, size of fish and distance of capture from the factory all have a bearing on the suitability of a catch for use in different commodities. All five species were considered suitable for both types of canning and for packs of fish frozen for human consumption, though technology for the canning of anchovy as cutlets or fillets has not yet been fully developed. Anchovy are also not used for bait. Fish that are to be minced for canning must have a minimum total length of about 10,0 cm, which means that pilchard, anchovy and round herring aged one or older, horse mackerel aged two or older and all mackerel may be processed in this manner. A similar size of anchovy may be canned as fillets, though the minimum requirement for cutlets of pilchard, horse mackerel and round herring is 18,5 cm (three-year-olds) and of mackerel 28,0 cm (one-year-olds). A total length greater than 12,5 cm is necessary for fish frozen for human consumption (one-year-old pilchard; two-year-old anchovy, horse mackerel and round herring; nought-year-old mackerel) and greater than 20,0 cm for that packed for bait (three-year-old pilchard and round herring; four-year-old horse mackerel, one-year-old mackerel).

TABLE XLIII : MONTHLY INTAKE CAPACITIES FOR DIFFERENT COMMODITIES FOR THE TEN WESTERN CAPE PELAGIC FISH PROCESSING PLANTS (METRIC TONS)*

Processing plant	Commodity: Canned products	Frozen products
1	-	868
2	4 340	350
3	2 170	-
4	-	1 000+
5	-	400
6	3 255	350
7	2 170	-
8	2 170	350
9	-	-
10	1 056+	-
Total		

* Values for fish paste are confidential and are therefore not indicated.
\+ Facilities available from 1979 only.

The condition of fish arriving at a processing plant is dependant upon a number of factors other than distance travelled, of which the more important are perhaps condition at capture and air and water temperatures. Thus it is not possible to precisely define the distance fish may or may not be transported to be suitable for manufacture to given commodities. After consultation with factory managers average values were adopted and these are indicated in Table XLIV. The proportion of fish arriving at each processor that could be used for a commodity was decided by estimating the proportion of each ground falling within the stipulated distance. In instances when only a fraction of the catch was suitable the proportion of the ground falling within the stipulated distance was multiplied by this fraction.

Only 62,5 per cent of suitable mackerel can be canned because of damage during the offloading process. The figure for other species is less: 50,0 per cent when the end product is minced fish and 45,0 per cent if cutlets or fillets. Similarly for freezing only 45,0 per cent of the catch is employed for all species. Head, viscera and caudal fin are removed during the canning process or when fish is frozen for human consumption, but not from that to be sold as bait. The quantity of fish used in these instances had therefore to be reduced further. Mass conversions have been summarised in chapter 12 and of all fish suitable for given commodities the final proportion adopted for use in the model is indicated in Table XLV.

Cans of cutlets or fillets consist of 80,0 per cent fish for most species, though the value is nearer 82,5 per cent for mackerel. Fish content is higher when the product is minced: 96,5 per cent for anchovy, 100 per cent for mackerel and 95,7 per cent for other species. These modifications and similar ones for fish paste which are confidential, are taken into consideration by the model in determining the final quantities. None were necessary for packs of frozen fish which have no additives.

In the reduction plants production of meal per ton of raw material varies only slightly. Annual averages for the period 1964 - 1976 ranged between 0,220 and 0,251. The overall mean of 0,233 was adopted for use in the model. Oil yields show a greater fluctuation and depend on species caught and size of fish (Simmonds 1968). However, on account of insufficient data the only distinction drawn in this paper is between mackerel and the other species combined. Mean monthly values for the period 1964 - 1976 were employed in the model (Table XLVI). In instances when mackerel contributed more than 50 per cent of the landings catches were assumed to have been of mackerel and on other occasions of other species. A distinct annual cycle is apparent, the best oil yield for mackerel being in winter, when the catches comprise mainly older individuals (chapter 8), and for all other species at the conclusion of the spring-summer upwelling season.

TABLE XLIV : DISTANCES FROM PROCESSING PLANTS (HOURS STEAMED) AT WHICH SPECIFIED PROPORTIONS OF A FISH CATCH WERE CONSIDERED SUITABLE FOR MANUFACTURE TO VARIOUS COMMODITIES.

Commodities : Canned cutlets or fillets and fish frozen for human consumption.

Species	Percentage of catch suitable for processing to commodities				
	100	75	50	25	0
Pilchard	<3,5	3,5- 5,0	5,0- 6,5	6,5- 8,0	> 8,0
Anchovy	<2,0	2,0- 4,0	4,0- 6,0	6,0- 8,0	> 8,0
Horse mackerel	<6,5	6,5-10,0	10,0-14,0	14,0-18,0	>18,0
Mackerel	<6,5	6,5-10,0	10,0-14,0	14,0-18,0	>18,0
Round herring	<3,5	3,5- 5,0	5,0- 6,5	6,5- 8,0	> 8,0

Commodities : Canned mince, fish frozen for bait (pilchard, horse mackerel, mackerel and round herring only) and bloaters (pilchard and round herring only).

Species	Percentage of catch suitable for processing to commodities				
	100	75	50	25	0
Pilchard	<6,0	6,0- 6,7	6,7- 7,3	7,3- 8,0	> 8,0
Anchovy	<6,0	6,0- 6,7	6,7- 7,3	7,3- 8,0	> 8,0
Horse mackerel	<6,5	6,5-10,0	10,0-14,0	14,0-18,0	>18,0
Mackerel	<6,5	6,5-10,0	10,0-14,0	14,0-18,0	>18,0
Round herring	<6,0	6,0- 6,7	6,7- 7,3	7,3- 8,0	> 8,0

TABLE XLV : PROPORTIONS OF SUITABLE FISH MASS USED IN THE MANUFACTURE OF VARIOUS COMMODITIES.

Species	Commodity Canned cutlets or fillets and bloaters*	Canned mince	Fish frozen for human consumption	Fish frozen for bait
Pilchard	,31	,35	,31	,45
Anchovy	,28	,31	,28	-
Horse mackerel	,28	,31	,28	,45
Mackerel	,45	,45	,32	,45
Round herring	,32	,36	,32	,45

* Only pilchard and round herring used for bloaters.

TABLE XLVI : MEAN MONTHLY YIELDS OF OIL PER METRIC TON RAW FISH PROCESSED FOR MACKEREL AND OTHER SPECIES COMBINED DURING THE PERIOD 1964 TO 1976.

Month	Yield (metric tons) Mackerel	Other species
January	0,053+	0,046
February	0,053+	0,050
March	0,053	0,059
April	0,053+	0,047
May	0,053+	0,043
June	0,121*	0,043
July	0,121	0,034
August	0,121	0,024
September	0,121*	0,017
October	0,053+	0,032
November	0,053+	0,039
December	0,053+	0,038

\+ Assumed the same as March.
* Assumed the same as July and August.

TESTING THE MODEL

The model was tested by comparing observed and predicted results for the 1966, 1967, 1970 and 1974 seasons. The reasons for selecting these years have been discussed in chapter 13. After discrepancies between the actual and simulated quantities of fish landed had been taken into consideration, satisfactory values were obtained for the production of oil and meal. Model estimates of the amount of fish required to produce one ton of oil ranged between 21,79 and 23,43 tons and may be compared with the observed factors of 27,98 , 28,10 , 16,40 and 17,48 . Amongst other reasons the greater stability of the simulation model can be accounted for by its use of the mean monthly yields observed between 1964 and 1976 (Table XLVI). Similarly there was less variation in the simulated ratios for meal (4,25 - 4,29 as opposed to the actual range of 4,35 - 4,47).

Less realistic results were calculated for the production of canned fish, the simulated estimates being invariably too high. Thus either the information gained from factory manager was incorrect or inapplicable to previous years or the assumption that suitable fish is preferentially processed in this manner is invalid. However, the fact that the bias is always in the same direction means that the model may be used to compare trends until further data have been gathered to resolve these issues.

SEASON AND AREA RESTRICTIONS

All contributors to South Africa's Western Cape purse-seine fishery are characterised by seasonal patterns of distribution and availability (chapter 11). To examine implications of altering the open season and of closing specific grounds to fishing the model was run for six series of four consecutive years. Because of its representative fishing pattern 1970 was selected as the initial year on each occasion. The input data for this season have been listed in chapter 13. During the three succeeding years the recruitment values used were those estimated by virtual population analysis for the period 1971 - 1973 (Table XLVII). Other parameters were left unchanged.

For the first run the month/area restrictions were those which applied from 1975 - 1978. In the others closed seasons and grounds were manipulated in a manner which sought to achieve two objectives, reduced exploitation of the latest recruits and no fishing in the months and areas which account for most pilchard and anchovy spawning. The desirability of decreasing fishing pressure on young pilchard, horse mackerel, mackerel and round herring has been demonstrated in chapter 13. It was also shown that a failure of either the pilchard or anchovy populations would have a detrimental influence on the whole fishery and it would therefore not be advisable to risk

TABLE XLVII : VIRTUAL POPULATION ESTIMATES* OF NOS. OF NOUGHT-YEAR-OLD PILCHARD, ANCHOVY, HORSE MACKEREL, MACKEREL AND ROUND HERRING, 1971 TO 1973 (VALUES HAVE BEEN MULTIPLIED BY 10^{-10}).

Species	1971	1972	1973
Pilchard	0,892	0,381	0,895
Anchovy	4,550	4,320	9,930
Horse mackerel	0,007	0,002	0,118
Mackerel	0,039	0,025	0,009
Round herring	0,126	0,148	0,154

* Data from Centurier-Harris *et al.* 1977.

TABLE XLVIII : PERCENTAGE DIFFERENCES OVER A FOUR-YEAR PERIOD IN COMBINED-SPECIES CATCH, TOTAL EFFORT AND THE PRODUCTION OF FIVE MAIN COMMODITIES, AS ESTIMATED BY THE MODEL FOR CHANGES TO CURRENT SEASON AND AREA RESTRICTIONS.

Simulation run no.	2	3	4	5	6
Open season	Jan-Aug	Jan-Sept	Jan-Sept	Jan-Oct	Jan-Oct
Fishing prohibited west of Cape Point	May-June	May-June	May-July	May-Aug	May-Aug
Fishing prohibited south of Stompneus Point				Sept-Oct	Jan and Sept-Oct
Fishing prohibited east of Cape Point		Sept	Sept	Jan	
Combined species catch					
Year 1	-16	- 4	-14	-23	-26
Year 2	- 6	- 3	- 6	-10	-13
Year 3	- 5	- 4	- 5	- 2	- 5
Year 4	-10	- 4	-11	-15	-16
Total effort					
Year 1	-15	- 3	-13	-22	-31
Year 2	-16	- 4	-14	-24	-33
Year 3	-16	- 5	-16	-24	-32
Year 4	-13	+ 0	-12	-23	-30

Continued.....

TABLE XLVIII : PERCENTAGE DIFFERENCES OVER A FOUR-YEAR PERIOD IN COMBINED-SPECIES CATCH, TOTAL EFFORT AND THE PRODUCTION OF FIVE MAIN COMMODITIES, AS ESTIMATED BY THE MODEL FOR CHANGES TO CURRENT SEASON AND AREA RESTRICTIONS CONTD.

Simulation run no.	2	3	4	5	6
Fish oil					
Year 1	-16	- 7	-20	-25	-28
Year 2	- 8	- 8	-10	- 7	-11
Year 3	- 5	- 7	- 6	+ 1	- 1
Year 4	-11	- 9	-11	- 9	-10
Fish meal					
Year 1	-16	- 3	-13	-23	-26
Year 2	-10	- 3	- 6	- 9	-13
Year 3	- 5	- 4	- 5	- 3	- 5
Year 4	-11	- 5	-11	-16	-17
Canned cutlets or fillets of pilchard					
Year 1	-13	-10	-11	- 6	-44
Year 2	-16	-12	-14	+ 3	-28
Year 3	- 5	-11	-10	+14	-15
Year 4	+ 4	- 7	- 2	+57	+19
Canned cutlets or fillets of mackerel					
Year 1	- 6	- 5	-46	-49	-50
Year 2	-51	-31	-39	-45	-44
Year 3	+ 2	+ 5	- 4	- 8	- 4
Year 4	+12	+ 4	+ 6	+11	+17
Canned cutlets or fillets of round herring					
Year 1	- 8	- 8	- 9	-10	-15
Year 2	- 4	+ 3	- 1	- 5	- 5
Year 3	+ 3	- 2	- 3	-14	-13
Year 4	+30	+20	+28	+24	+21

disrupting spawning behaviour. Additionally there are insufficient data on distribution and availability to allow for confident modelling of fishing operations at the end of the year. The season-ground combinations used in the runs were as follows:

1. Closed season September - December inclusive. No closed grounds.

2. Closed season September - December inclusive. Namaqua, St Helena Bay, Saldanha Bay and Hout Bay grounds (Fig. 1) closed May and June. May and June are two of the earlier months for good recruitment of nought-year-olds of spring-summer spawning species (chapter 11). At this stage opportunity for growth has been limited and the strategy therefore prohibits fishing on the main nursery grounds.

3. Closed season October - December inclusive. Namaqua, St Helena Bay, Saldanha Bay and Hout Bay grounds closed May and June. Gans Bay and Agulhas grounds closed September. These restrictions are similar to the foregoing, though to the west of Cape Point the season has been extended to include September. Decreased fishing opportunity resulting from the closure of the same region in May and June is thus partially offset. No fishing is permitted to the east of Cape Point in September since it is one of the main pilchard spawning areas and pilchard egg production is generally high in this month (chapter 5).

4. Closed season October - December inclusive. Namaqua, St Helena Bay, Saldanha Bay and Hout Bay grounds closed May - July inclusive. Gans Bay and Agulhas grounds closed September. This strategy allows for the closure of nursery grounds for spring-summer spawners during three months of initial recruitment.

5. Closed season November and December. Namaqua, St Helena Bay, Saldanha Bay and Hout Bay grounds closed May - August inclusive. Saldanha Bay, Hout Bay, Gans Bay and Agulhas grounds closed September and October. Gans Bay and Agulhas grounds closed January. These restrictions would extend the season to include September and October but prohibit fishing on nursery grounds for spring-summer spawners during four of the best recruit months. The southern four grounds would be closed to fishing in September and October and the region east of Cape Point in January to protect spawning shoals of pilchard and anchovy.

6. Closed season November and December. Namaqua, St Helena Bay, Saldanha Bay and Hout Bay grounds closed May - August inclusive. Saldanha Bay, Hout Bay, Gans Bay and Agulhas grounds closed January, September and October. This strategy only differs from the previous one in that it prohibits fishing on the Saldanha Bay and Hout Bay grounds in January and thus affords additional protection for the adult pilchard and anchovy populations.

Percentage increases or decreases in combined species catch, total effort and the production of five main products, compared to those estimated by the first run (current restrictions) are indicated for runs 2-6 in Table XLVIII. The catch was reduced by averages of 4, 9, 9, 13 and 15 per cent for runs 3, 2, 4, 5 and 6 respectively. There was little difference between the various catches predicted for the third year when recruitment of pilchard, anchovy and horse mackerel was low, suggesting that the decreased yields in most other cases resulted from reduced exploitation of nought-year-olds of these species. This was confirmed by reference to model estimates of catch numbers at age. In the fourth year recruitment of pilchard, anchovy and horse mackerel was relatively good and yields were decreased by substantial percentages in all instances except for run 3, which permitted fishing to the west of Cape Point in three of the best recruit months for spring/summer spawners (July - September).

By contrast there was little year to year variation in the reduction of fishing effort predicted by any one run. Averages ranged from 3 per cent for run 3 to 32 per cent for run 6. In runs 5 and 6 the drop in effort was often large relative to that for catch, indicating that both these strategies should improve catch rates.

Decreases in the amount of meal produced were similar to those for catch. Oil was also closely linked to the quantity of fish offloaded, although when fishing west of Cape Point was prohibited in August there was a tendency for yields to improve and vice versa. This may be attributed to the low oil content observed in August for species other than mackerel (Table XLVI).

With regard to canned commodities the most important trend was the rapid reversal of initially large decreases in production. By the fourth year greater amounts were being manufactured from pilchard, mackerel and round herring than when current restrictions were employed, in all instances except runs 3 and 4 for pilchard. The gains were especially noticeable for round herring and for pilchard in run 5. Minimum quantities of canned horse mackerel were predicted for each year and differences are not shown on Table XLVIII.

For some commodities little or no commercial data are available and for others the necessary food technology has not yet been developed. Predicted differences between the various runs in the production of these items are shown in Table XLIX. It is apparent that in the majority of cases long-term benefits should accrue from changing the present season/area restrictions. A notable exception is the manufacture of canned cutlets or fillets of anchovy. The expected yield is decreased by the introduction of fishing strategies 5 or 6. This results from the northern location of the canning plants and the small distances over which anchovy may be transported to be suitable for such processing(Table XLIV).

DISCUSSION

Implementation of different closed season and area strategies would influence revenue accruing to the industry. To estimate the impact of such measures mean values for the annual production of oil, meal and canned pilchard, mackerel and round herring were calculated for the five year period 1974 - 1978.

It was then assumed that these quantities would remain constant for four years if current season and area restrictions were adhered to. Amounts that should result from different strategies were computed using the information presented in Table XLVIII. The approximate 1978 prices of R370, R291 and R1 800 paid per ton of fish oil, fish meal and canned fish respectively were used to estimate the value of the processed catch. Results are presented in Table L. Comparison with Table XLVIII indicates that for strategies 2, 4, 5 and 6 higher oil yields and increased production of canned fish had by the fourth year to some extent offset the reduced revenues caused by lower catches. However the value of canned fish was still small relative to that of oil and meal. Although production costs for the various commodities have not been taken into account, decreased operating costs could be expected to result from the lower levels of effort and the net loss to the industry could be smaller than the gross figures reflected in Table L.

On the assumptions that recruitment of pilchard, anchovy and round herring will be maintained at levels similar to those prevailing from 1964 - 1976, but that the horse mackerel and mackerel populations are currently depressed, it has been argued that the catch quota should be reduced by 14 per cent, from 380 000 to 325 000 tons (chapter 13). Such a measure would help safeguard against further deterioration of the mixed-species resource and if introduced would have an effect similar to the implementation of season/area strategies 5 or 6. As these latter ought to improve catch rates, profitability of the catch and the long-term quantity of fish canned, especially pilchard, it is recommended that one of the two be enacted concurrently with the decrease in catch quota. The model predicts

TABLE XLIX : PERCENTAGE DIFFERENCES OVER A FOUR-YEAR PERIOD IN THE PRODUCTION OF FIVE COMMODITIES NOT YET MANUFACTURED ON A LARGE SCALE COMMERCIALLY, AS ESTIMATED BY THE MODEL FOR CHANGES TO CURRENT SEASON AND AREA RESTRICTIONS.

Simulation run no.	2	3	4	5	6
Open season	Jan-Aug	Jan-Sept	Jan-Sept	Jan-Oct	Jan-Oct
Fishing prohibited west of Cape Point	May-June	May-June	May-July	May-Aug	May-Aug
Fishing prohibited south of Stompneus Point				Sept-Oct	Jan and Sept-Oct
Fishing prohibited east of Cape Point		Sept	Sept	Jan	
Canned cutlets or fillets of anchovy					
Year 1	-11	+19	+14	-20	-40
Year 2	- 1	+13	+21	+ 2	-22
Year 3	+ 6	+11	+20	-13	-36
Year 4	+14	+12	+27	- 7	-32
Fish canned as mince					
Year 1	-15	- 9	-12	-19	-28
Year 2	- 9	- 1	- 2	- 1	- 9
Year 3	+ 7	- 3	+ 0	+19	+ 6
Year 4	+ 4	+ 2	+ 3	+17	- 2
Fish paste					
Year 1	+ 0	+ 0	+ 0	+ 0	+ 0
Year 2	+ 0	+ 0	+ 0	+ 0	+ 0
Year 3	+ 0	+ 0	+ 0	+ 0	+ 0
Year 4	+ 0	+ 0	+ 0	+ 0	+ 0
Fish frozen for human consumption					
Year 1	-11	- 5	-28	-31	-34
Year 2	-23	-20	-22	-19	-19
Year 3	+ 2	- 5	- 5	+ 4	+ 9
Year 4	+11	- 1	+ 3	+18	+28
Fish frozen for bait					
Year 1	- 9	- 8	-26	-28	-36
Year 2	-34	-22	-26	-25	-33
Year 3	- 1	+ 0	- 7	+ 9	+12
Year 4	+ 8	+ 1	+ 3	+29	+16

TABLE L : PREDICTED VALUES (MILLIONS OF RAND) OF FIVE MAIN COMMODITIES OVER A FOUR-YEAR PERIOD (APPROXIMATE PRICES PAID PER TON IN 1978 HAVE BEEN USED). PRODUCTION FIGURES WERE ESTIMATED BY THE MODEL FOR VARIOUS CLOSED SEASON AND AREA STRATEGIES.

Simulation run no.	1	2	3	4	5	6
Open season	Jan-Aug	Jan-Aug	Jan-Sept	Jan-Sept	Jan-Oct	Jan-Oct
Fishing prohibited west of Cape Point		May-June	May-June	May-July	May-Aug	May-Aug
Fishing prohibited south of Stompneus Point					Sept-Oct	Jan and Sept-Oct
Fishing prohibited east of Cape Point			Sept	Sept	Jan	
Year 1						
Fish oil	7,0	5,9	6,5	5,6	5,2	5,0
Fish meal	27,5	23,1	26,6	23,9	21,2	20,3
Canned cutlets or fillets of pilchard	0,2	0,2	0,2	0,2	0,2	0,1
Canned cutlets or fillets of mackerel	2,7	2,6	2,6	1,5	1,4	1,4
Canned cutlets or fillets of round herring	0,4	0,4	0,4	0,4	0,4	0,3
Canned cutlets or fillets of all species	3,3	3,1	3,1	2,0	1,9	1,8
All products combined	37,8	32,0	36,3	31,5	28,3	27,2
Year 2						
Fish oil	7,0	6,4	6,4	6,3	6,5	6,2
Fish meal	27,5	24,7	26,6	25,8	25,0	23,9
Canned cutlets or fillets of pilchard	0,2	0,2	0,2	0,2	0,2	0,1
Canned cutlets or fillets of mackerel	2,7	1,3	1,9	1,7	1,5	1,5
Canned cutlets or fillets of round herring	0,4	0,4	0,4	0,4	0,4	0,4
Canned cutlets or fillets of all species	3,3	1,9	2,5	2,2	2,1	2,0
All products combined	37,8	33,0	35,5	34,3	33,6	32,2

continued......

TABLE L : PREDICTED VALUES (MILLIONS OF RAND) OF FIVE MAIN COMMODITIES OVER A FOUR-YEAR PERIOD (APPROXIMATE PRICES PAID PER TON IN 1978 HAVE BEEN USED). PRODUCTION FIGURES WERE ESTIMATED BY THE MODEL FOR VARIOUS CLOSED SEASON AND AREA STRATEGIES CONTD.

Simulation run no.	1	2	3	4	5	6
Year 3						
Fish oil	7,0	6,6	6,5	6,6	7,0	6,9
Fish meal	27,5	26,1	26,4	26,1	26,6	26,1
Canned cutlets or fillets of pilchard	0,2	0,2	0,2	0,2	0,2	0,2
Canned cutlets or fillets of mackerel	2,7	2,8	2,9	2,6	2,5	2,6
Canned cutlets or fillets of round herring	0,4	0,4	0,4	0,4	0,3	0,3
Canned cutlets or fillets of all species	3,3	3,4	3,4	3,2	3,1	3,1
All products combined	37,8	36,1	36,3	35,8	36,8	36,1
Year 4						
Fish oil	7,0	6,2	6,4	6,2	6,4	6,3
Fish meal	27,5	24,4	26,1	24,4	23,1	22,8
Canned cutlets or fillets of pilchard	0,2	0,2	0,2	0,2	0,3	0,2
Canned cutlets or fillets of mackerel	2,7	3,0	2,8	2,9	3,0	3,2
Canned cutlets or fillets of round herring	0,4	0,5	0,5	0,5	0,5	0,5
Canned cutlets or fillets of all species	3,3	3,8	3,5	3,6	3,8	3,9
All products combined	37,8	34,4	35,9	34,2	33,2	33,0

that this would also have the effect of decreasing the catch of nought-year-old pilchard by 50 per cent or more, which would be especially advantageous if strong pilchard recruitment, similar to that recorded during the late 1950's (Newman and Crawford in press), were to occur again.

If legislation governing closed seasons and areas is changed it may be necessary to accomodate individual factories. For example, should strategies 5 or 6 be implemented, fishing in the vicinity of Gans Bay would be reduced to only three months. Since the fleet based at this harbour is small it could be permitted to operate on the Gans Bay and Agulhas grounds in January without greatly influencing trends derived in this paper.

The recent construction of a canning plant at Gans Bay and cold storage facilities at St Helena Bay, as well as the endeavours of processors to develop markets for new products, will make it necessary to repeat the study in the near future to ensure continued applicability to a changing situation. In the interim attention should be given to the collection of additional data on distribution from September - December, the traditional closed season. Further modelling to take production costs into account would also be desirable.

CHAPTER 15. CONCLUSIONS.

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CHAPTER 15. CONCLUSIONS.

Two independant indicators of the state of South Africa's Western Cape purse-seine fishery, guano yields and catch rates, suggest that the overall abundance of the mixed-species resource has decreased considerably. Contributory reasons include an expansion of fishing effort when populations were declining, the sequential depletion of traditional stocks and younger age structures for most populations caused by the introduction of small-meshed (12,7 mm) nets. In particular five- and six-group pilchard, horse mackerel and mackerel no longer provide significant catches and this has resulted in increased fishing pressure on the remaining components. Seabird predators have been demonstrated to be influenced by food availability and have also decreased, emphasising the importance of sound fisheries management for the conservation of other ecosystem components.

From the inception of the fishery until the mid-1960's the landings were dominated by pilchard, and thereafter by anchovy. There is evidence to show that the pilchard population has declined, but not that the anchovy stock subsequently expanded. The increased importance of anchovy may rather be attributed to a change in the fishing gear. Adults of both these species currently form the basis of an intensive summer fishery to the east of Cape Point (Fig. 1), whereas juveniles are caught off the west coast in autumn and winter, and there is danger of over-exploitation.

The horse mackerel and mackerel populations are depressed and although fishermen have in the past generally avoided catching round herring, as their large scales frequently clog net meshes, recruitment indices do not suggest that greatly improved yields of this species can be expected in future years. Thus the combined harvest is unlikely to be increased or even maintained.

These factors, together with recent large rises in operating costs, have necessitated a reassessment of the fishery and simulation models have been constructed. Provision has been made in the models for age-specific, seasonal patterns of distribution and availability exhibited by the different species. In the past these were poorly understood but have now been demonstrated to be regular, on account of their being influenced by environmental factors, and to hold advantages for management of the fishery.

When average patterns of distribution and availability are used in the models, it can be expected that long-term trends will be adequately described. A high degree of variability associated with the fish stocks will limit the value of the models as predictors of particular events but they may be used to explore the short-term consequences of management action under specified conditions. For example, strategies to be implemented in the event of one or two bad year classes entering the fishery could be formulated in advance. The models could also be used to investigate the profitability of replacing existing vessels by boats that are equipped with refrigerated facilities to allow a greater proportion of the catches to be canned and of other investments.

Model results have indicated that recruitment failure of either pilchard or anchovy would decrease the parent stocks of all species. This would arise from increased effort directed at and a higher fishing mortality inflicted on the other populations and, if the spawning stocks were reduced to low levels at which they would largely determine recruitment,could precipitate further bad year classes.

To decrease the probability of such events it is recommended that the overall catch quota be lowered by about 14 per cent to 325 000 metric tons. Average recruitment values calculated by virtual population analysis for the period 1964 - 1976 were used in the model to derive this figure. If the quota is lowered, it is probable that the reduction in revenue for the industry could be offset to some extent by revision of legislation relating to closed seasons and areas. An extension of the fishing season to include September and October, combined with a prohibition on late autumn and winter fishing to the west of Cape Point (Fig. 1) and on the exploitation of adult pilchard and anvhovy during their spring-summer spawning season should improve both catch rates and profitability of the landings in the long-term. This would allow for increased growth of recruits and, although no rigorous parent stock-recruitment relationships have been demonstrated, the additional protection afforded the spawning populations of pilchard and anchovy would help to maintain these stocks at reasonable levels.

The models also suggest that yields of species other than anchovy are adversely influenced by exploitation of the younger age group and that measures could be implemented to avoid capture of these juveniles. The resulting gains would be especially large in the event of strong year classes, similar to those of pilchard in the late-1950's or mackerel in the mid-1960's,entering the fishery. Good mackerel recruitment should be noticed at an early stage because of the inshore distribution of juveniles. It may also be possible to detect powerful year classes of spring-and summer-spawning species (especially pilchard and anchovy) by monitoring the seabird colonies at Bird Island, Lambert's Bay (Fig.16), an important recruitment region.

The need to reduce the quota, combined with overinvestment of effort in the fishery, emphasises the desirability of diversification to exploit new resources. Unfortunately few, if any, pelagic shoaling species remain to be harvested. Lantern-fish have been caught sporadically and appear to be the most suitable alternative, but because of their importance in the diet of many pisciverous fish, notably hake and mackerel, it will first be necessary to assess the magnitude of this stock. An extensive ichthyoplankton survey, with stations extending well into the South Atlantic, could be used to ascertain what proportion the area of exploitation off Cape Columbine forms of the range of Lampanyctodes hectoris. If small it could be assumed that its occurrence in this vicinity in summer results from the oceanography and bottom topography of the region and that all available lantern-fish could be safely harvested. Exploitation could then be encouraged by the introduction of a separate quota for this species.

Certain distributional hypotheses have been formulated in this thesis. It has been postulated that adult pilchard and anchovy occur in sub-surface regions of high chlorophyll production after migrating east of Cape Agulhas (Fig. 22), and that five- and six-year-old pilchard, adult horse mackerel and adult round herring move away from the west coast to warm, oceanic water to spawn during spring and summer. As the models depend on an accurate understanding of fish distribution, future research should aim to verify these hypotheses by acoustic surveys that make adequate provision for target identification. Furthermore there is a need for improved knowledge of fish distribution and availability between September and December. The extension of the fishing season as recommended above would provide additional information. Data should also be forthcoming from examination of the stomach contents of predators. Cape gannets and Cape cormorants are easy to sample in these months. They return regularly to their young during their spring-summer breeding season and regurgitate on handling. Long-term sampling programs have already been initiated at Bird Island, Lambert's Bay, and Malagas Island (Fig. 16). Similar studies at Dyer Island and Bird Island, Algoa Bay, would be advantageous as adequate cover would then be available for the entire fishing area.

Sensitivity analysis points out a further area for future research priority, namely examining the influence of environmental factors on availability and catchability. The models predict that increases in these parameters would result in improved landings and catch rates. This could create the false impression of a healthy resource and may also result in catches being higher than optimal. It will be important to ascertain the real situation.

Finally a more rigorous assessment of economic implications of management decisions relating to closed seasons and areas is required. Modelling that accounts for processing costs and detailed information about which fish are suitable for the manufacture of various commodities will first be necessary.

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ACKNOWLEDGEMENTS

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APPENDIX

pp. 292 - 467.

APPENDIX

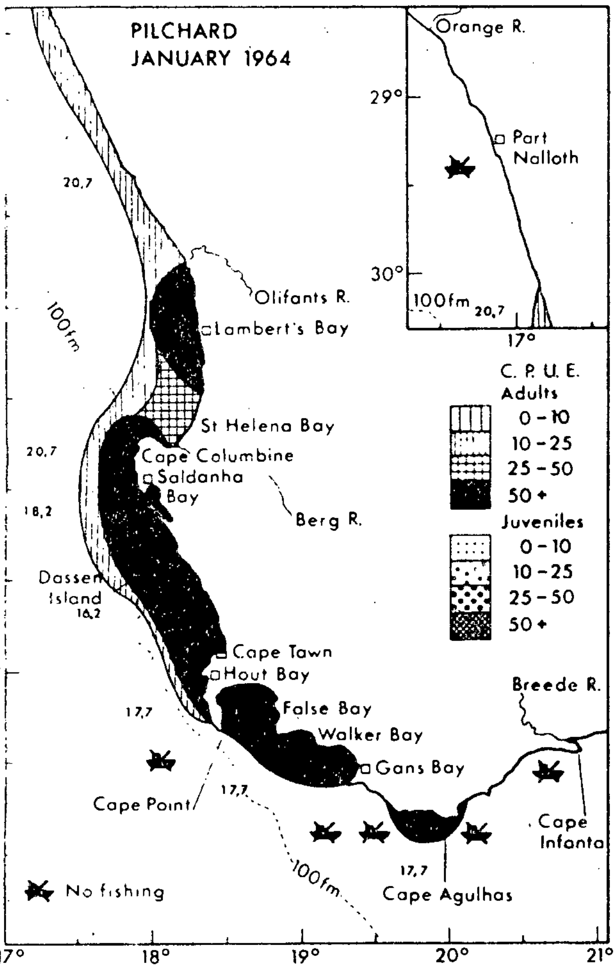
From 1969 - 1976 the closed season included the period September-December. No maps are shown therefore for these months, except for mackerel in 1971, when permission was granted for the exploitation of this species during September.

Levels of catch per unit effort (C.P.U.E.) are indicated in terms of metric tons per standard boat day. In all instances, except lantern-fish for which no age information is available, nought-year-old fish have been illustrated as juveniles and all older age groups as adults.

Modal caudal lengths (cm) of fish from different areas are shown adjacent to catch locations. Although growth varies between seasons, predicted lengths at age as calculated from the von Bertalanffy equations (chapter 12) are listed below to give some indication of the age of fish depicted as adults.

Age	Pilchard	Anchovy	Horse mackerel	Mackerel	Round herring
1	11,1	7,9	7,0	23,1	8,4
2	14,1	11,1	11,7	31,3	13,5
3	16,4	12,6	15,8	38,2	17,1
4	18,2	14,2	19,4	43,8	19,7
5	19,7		22,6	48,3	21,5
6	20,9		25,4	52,0	22,8
7	21,9		27,9	55,0	23,8
L_∞	25,7	14,8	46,3	68,0	26,2

Areas in which there was no fishing effort are indicated.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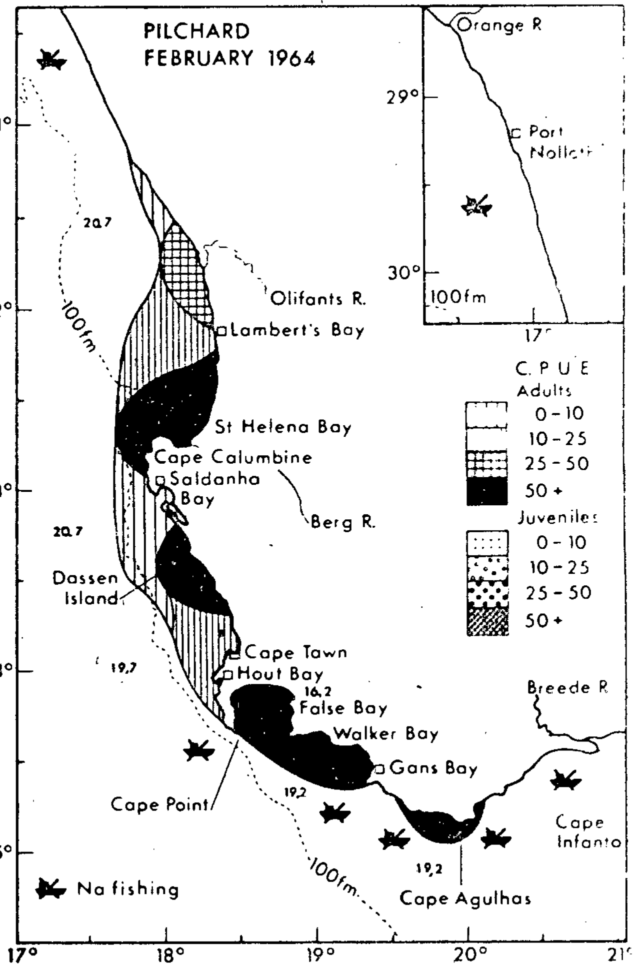
JANUARY 1964
Orange R.
29°
Port Nolloth
30°
100fm
20,7
17°
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
34°
35°
17°
18°
19°
20°
21°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FEBRUARY 1964
Orange R
29°
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100fm
C. P U E
Adults
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50 +
Juveniles
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Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
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Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
17°
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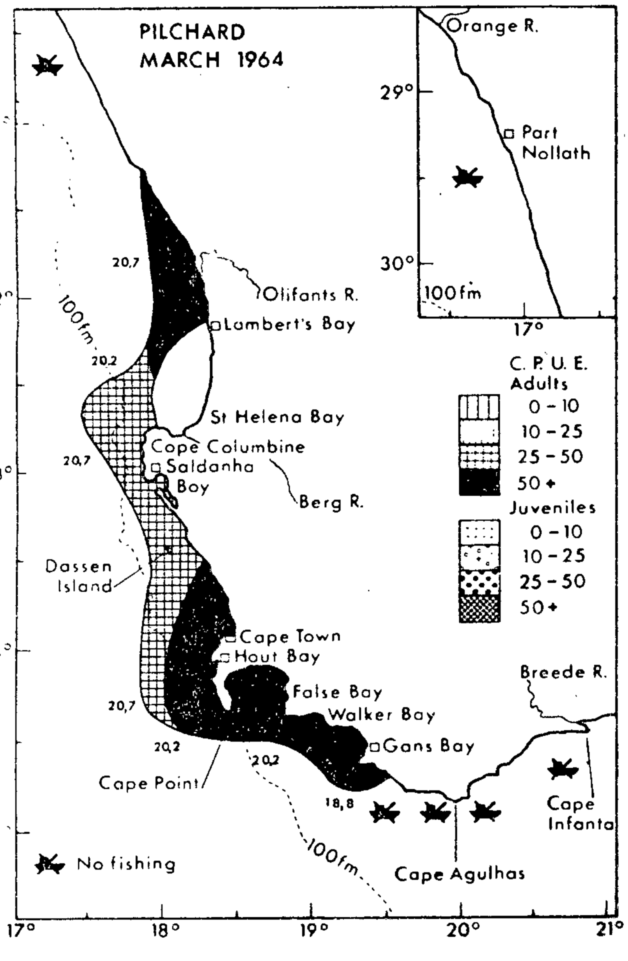
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MARCH 1964
Orange R.
29°
Port Nolloth
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100fm
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C. P. U. E.
Adults
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25 - 50
50 +
Juveniles
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32°
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Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
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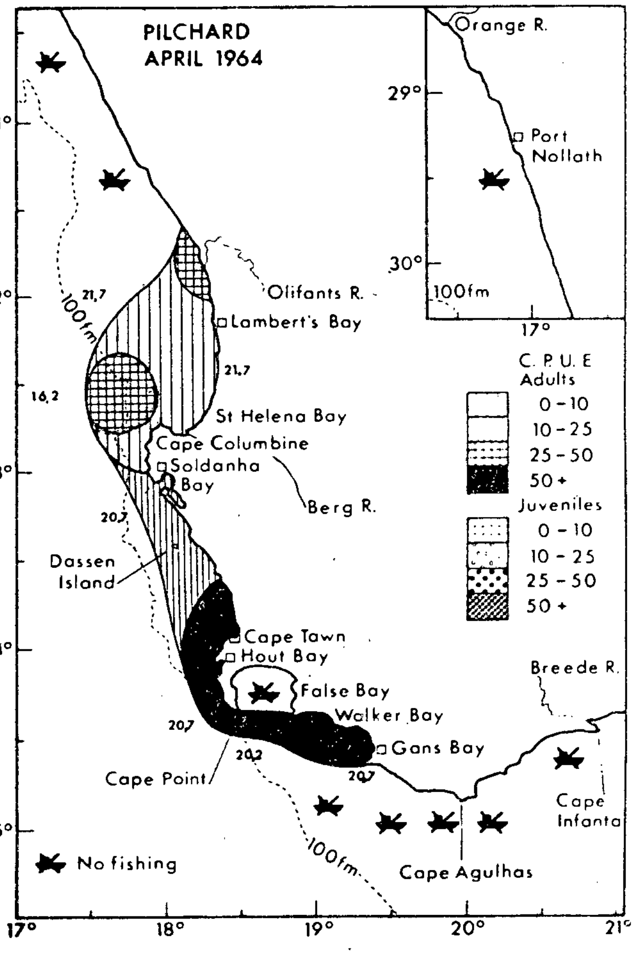
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Port Nolloth
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C. P. U. E
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Juveniles
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Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
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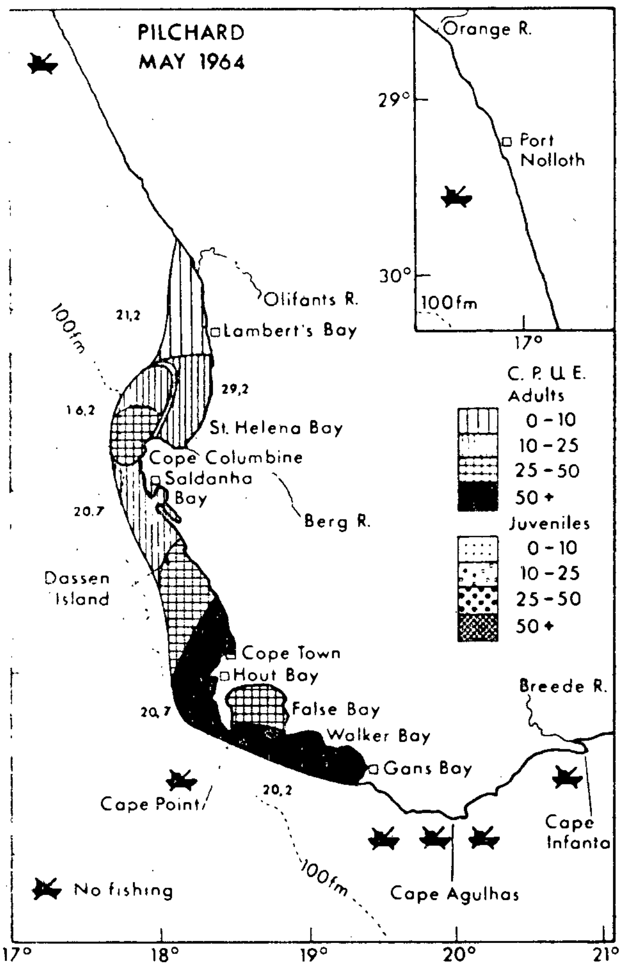
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Port Nolloth
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100fm
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Juveniles
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Olifants R.
Lambert's Bay
St. Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
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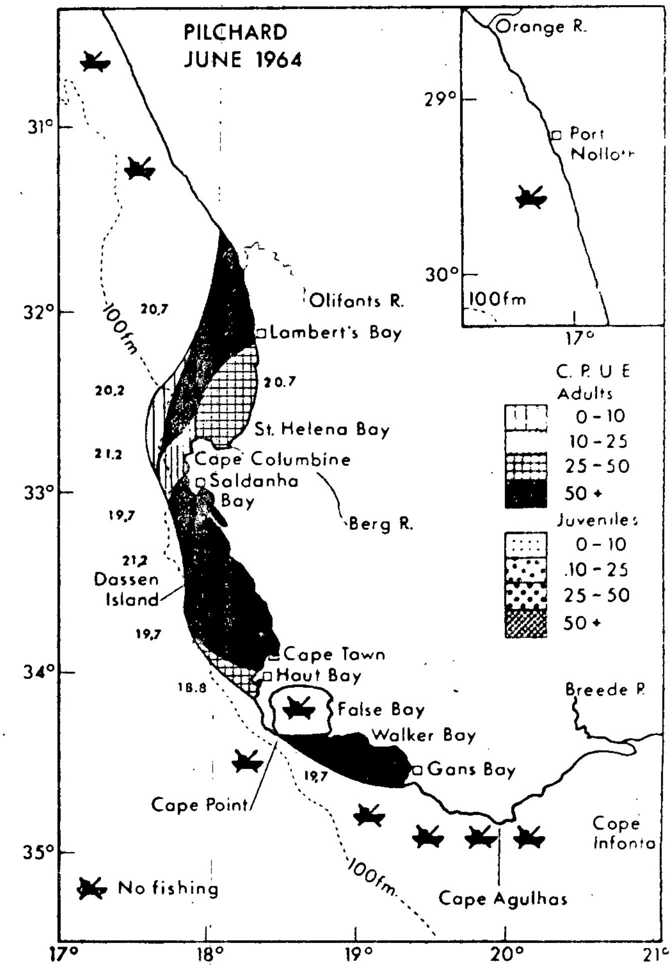
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Adults
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25 - 50
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Olifants R.
Lambert's Bay
St. Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
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Cape Infanta
Cape Agulhas
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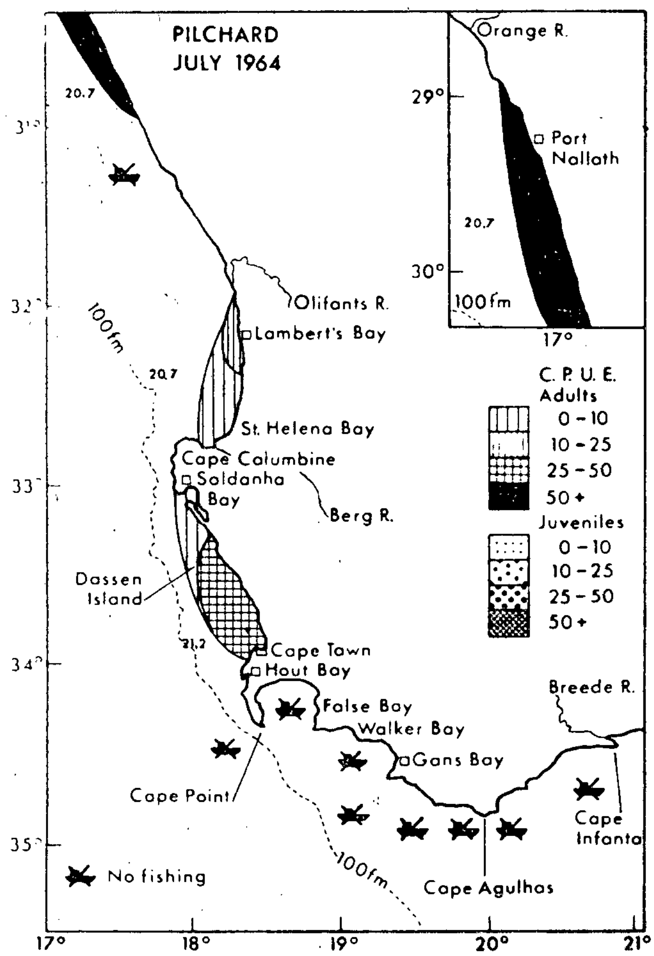
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Juveniles
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Olifants R.
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Walker Bay
Gans Bay
Breede R.
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Cape Agulhas
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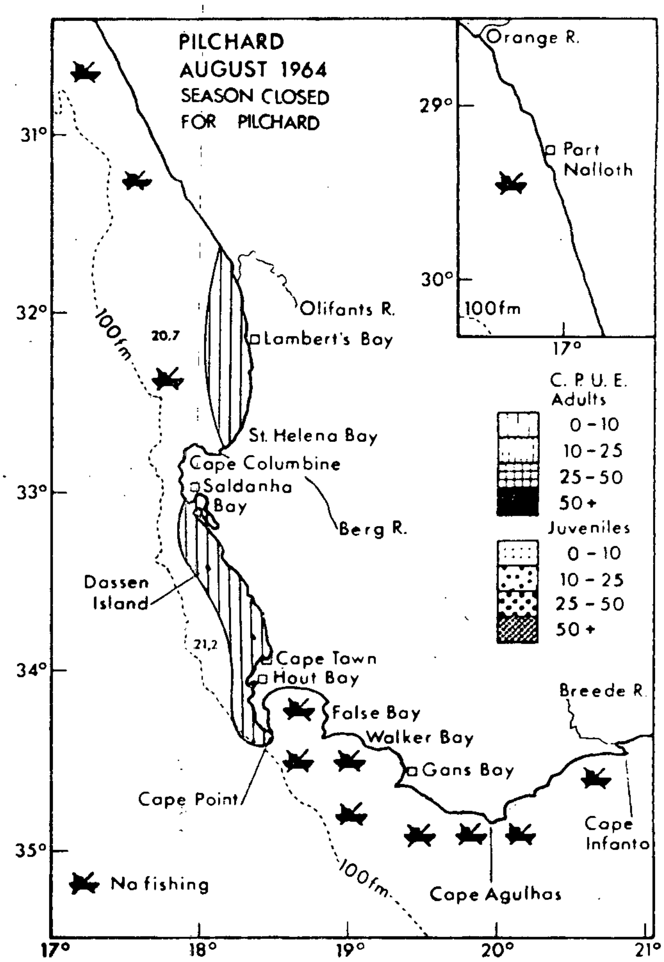
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C. P. U. E.
Adults
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Juveniles
0 - 10
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Olifants R.
Lambert's Bay
St. Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
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False Bay
Walker Bay
Gans Bay
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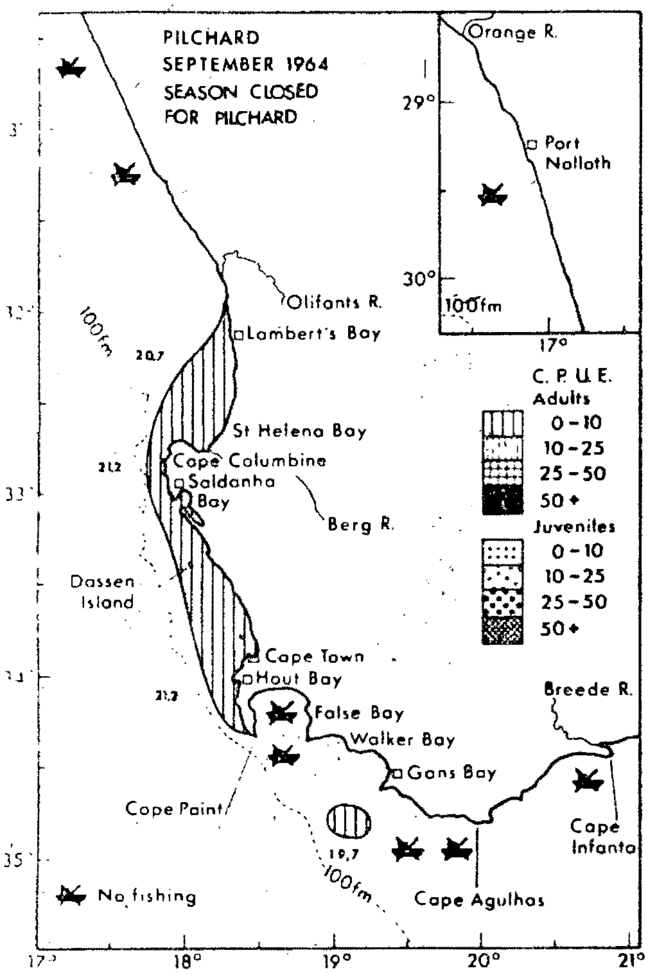
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Gans Bay
Breede R.
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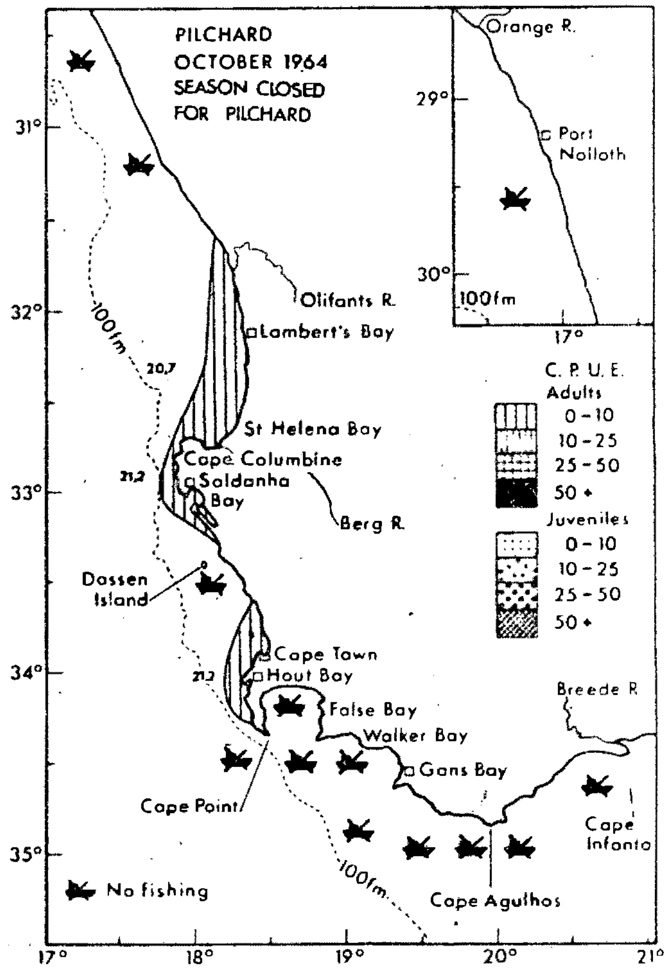
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Gans Bay
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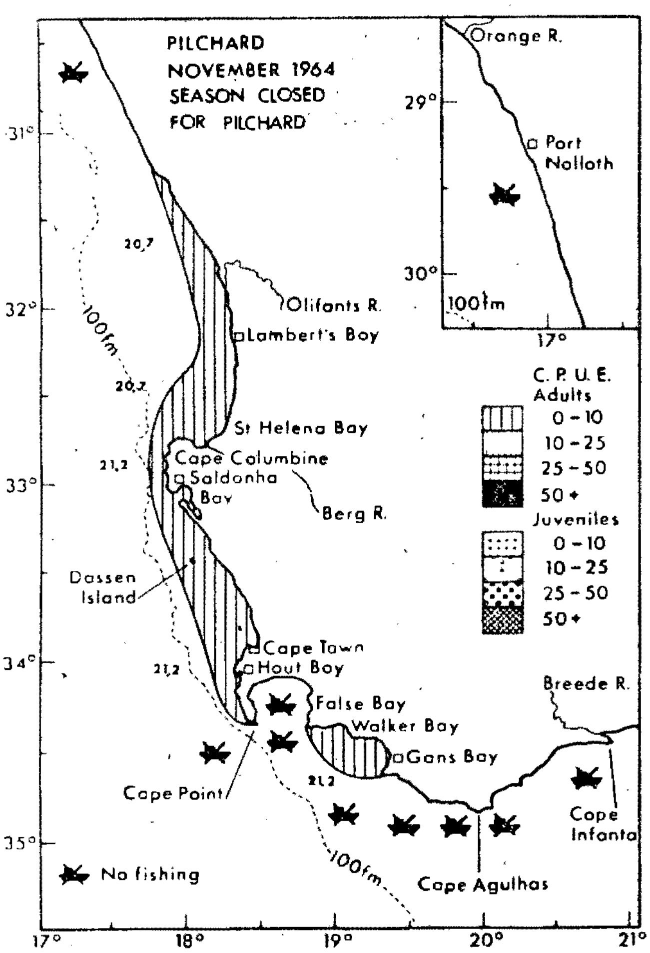
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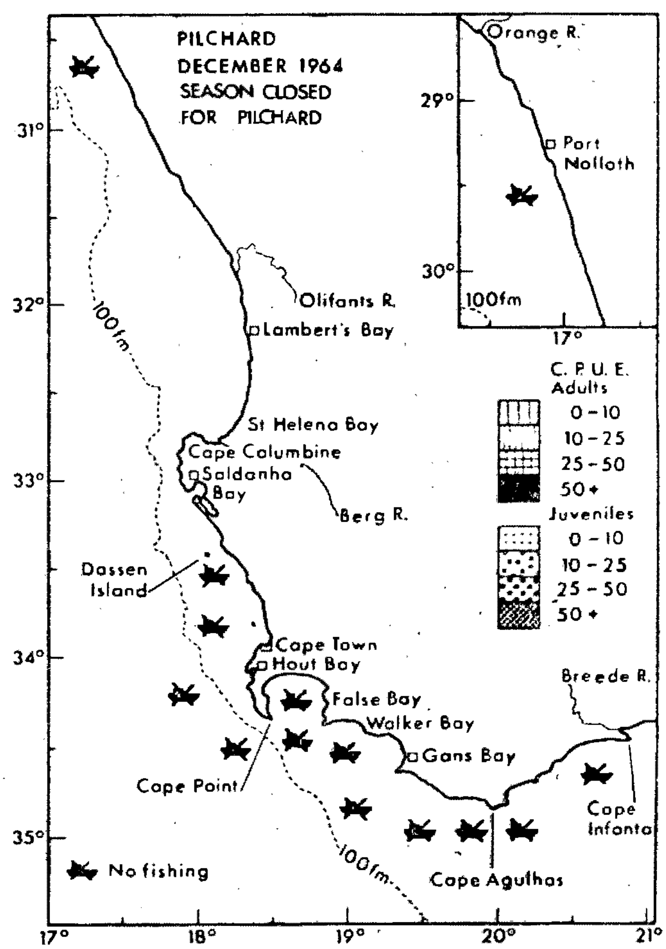
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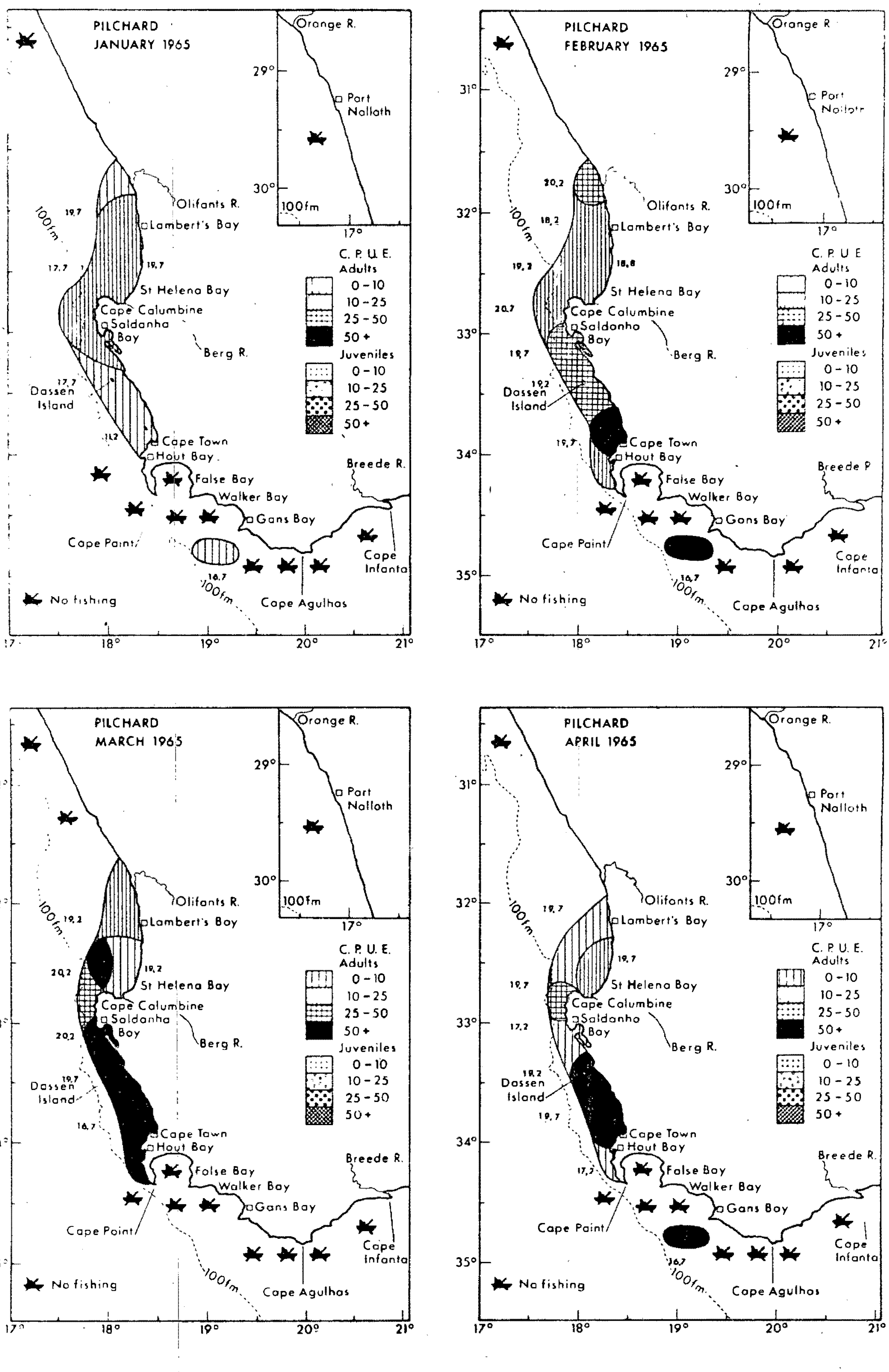
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No fishing
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Juveniles
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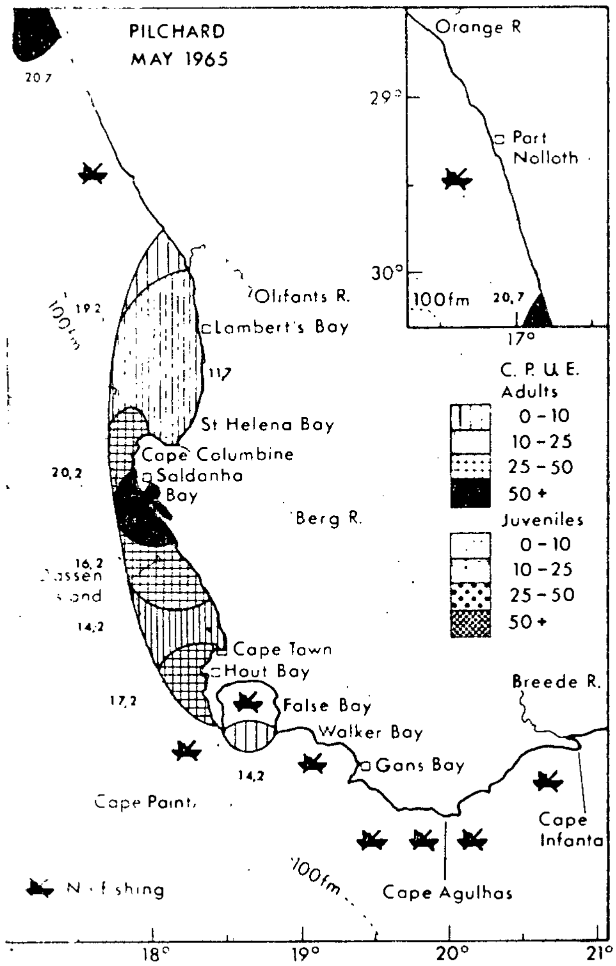
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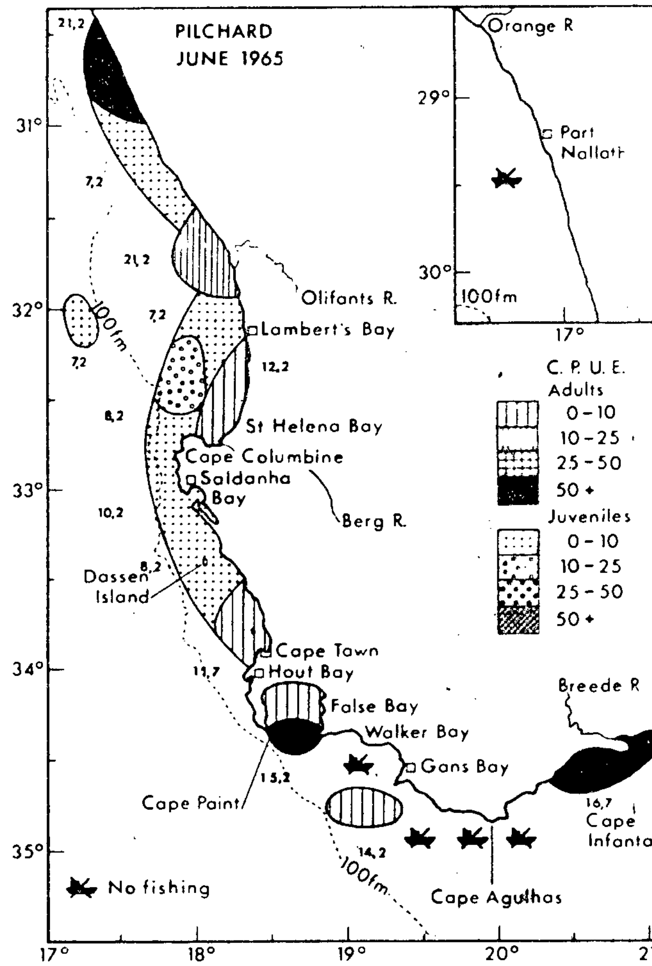
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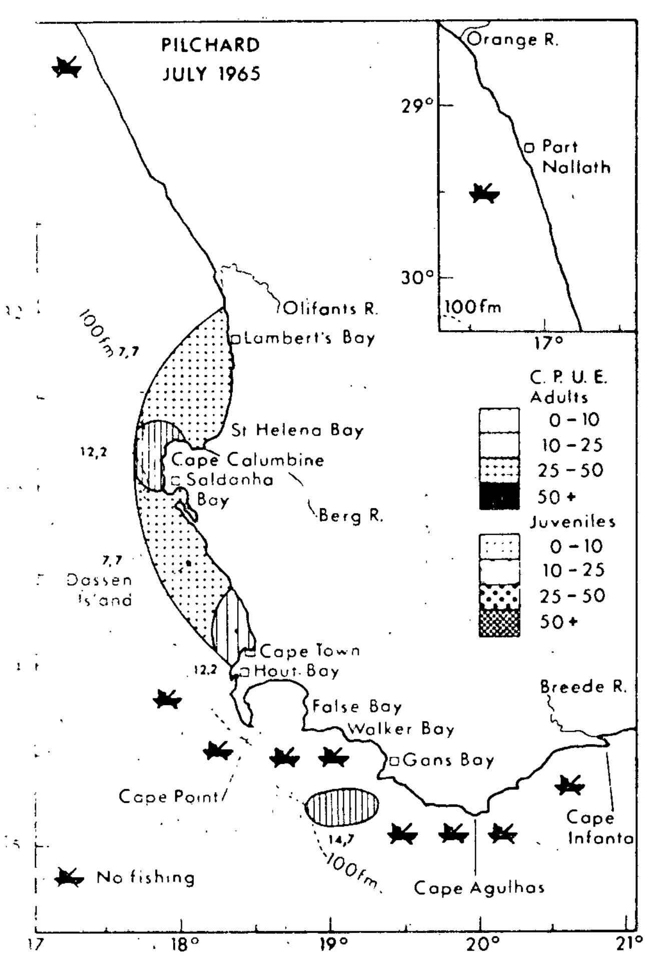
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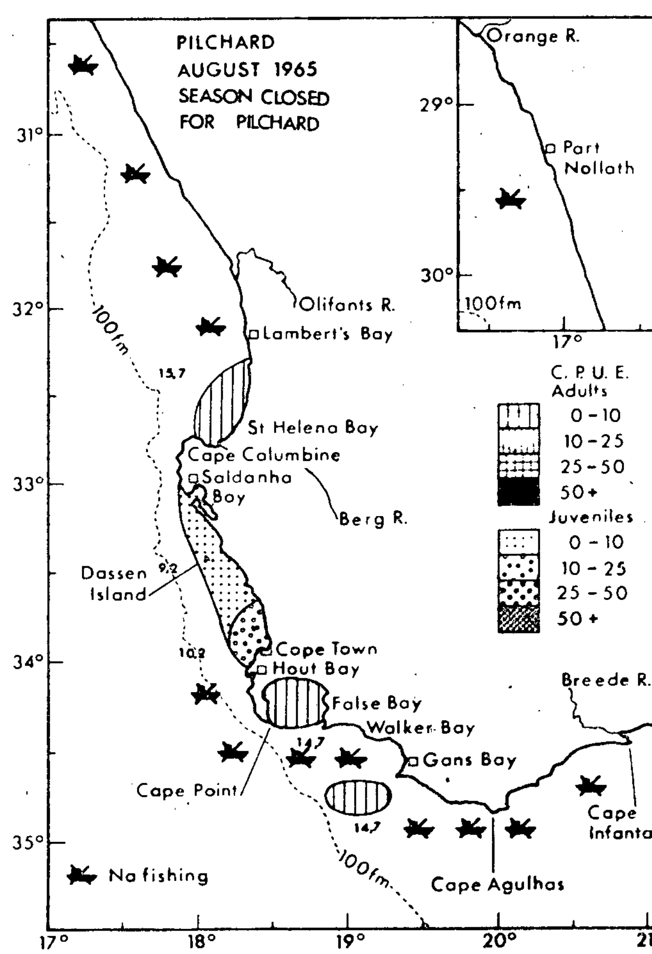
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Port Nolloth
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Juveniles
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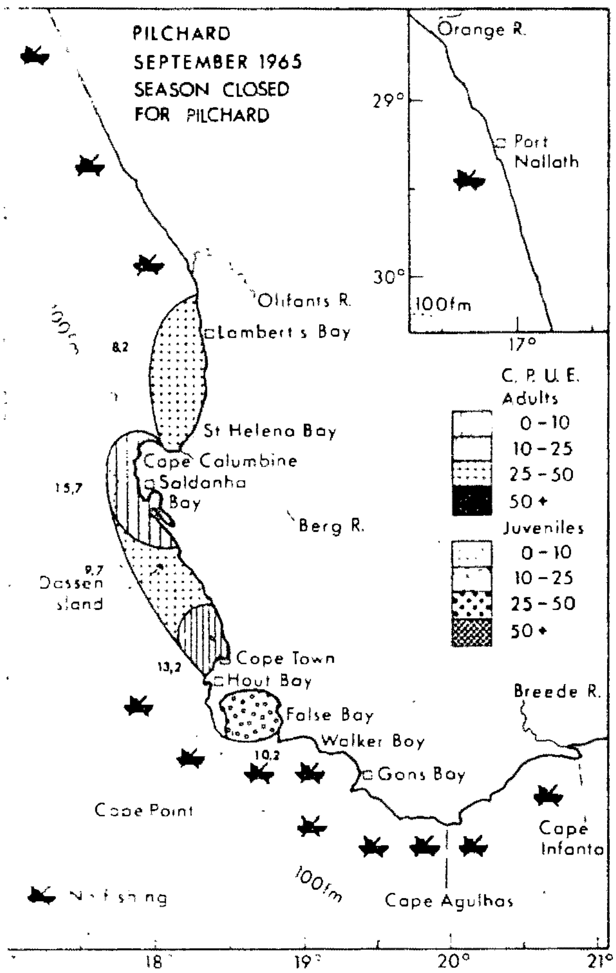
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False Bay
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Breede R.
Cape Point
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100fm
Cape Agulhas
C. P. U. E.
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50 +
Juveniles
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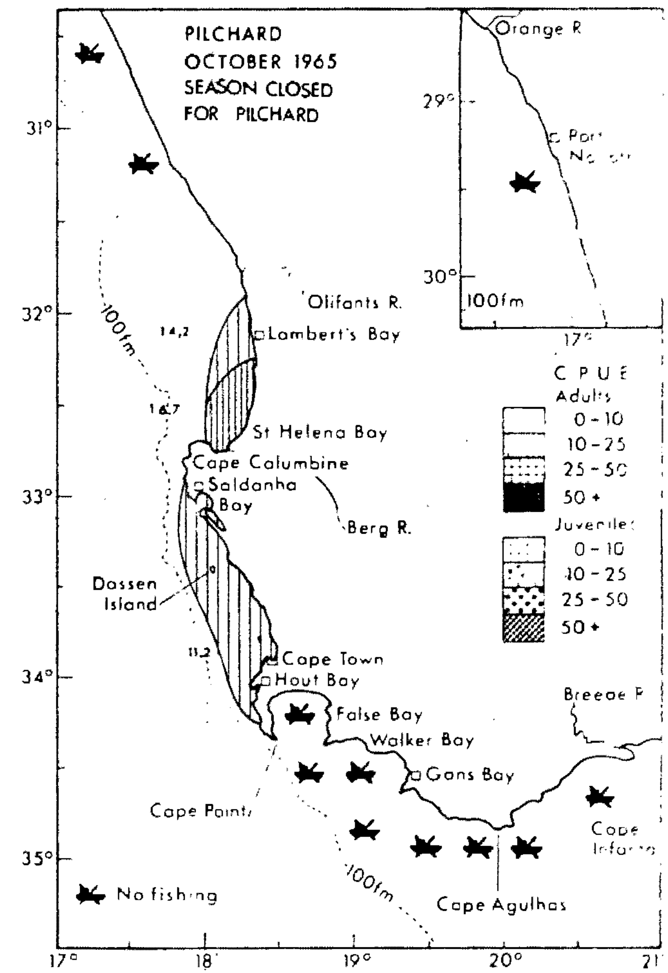
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Cape Columbine
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Berg R.
Dassen
Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Cape Point
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Cape Agulhas
No fishing
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Adults
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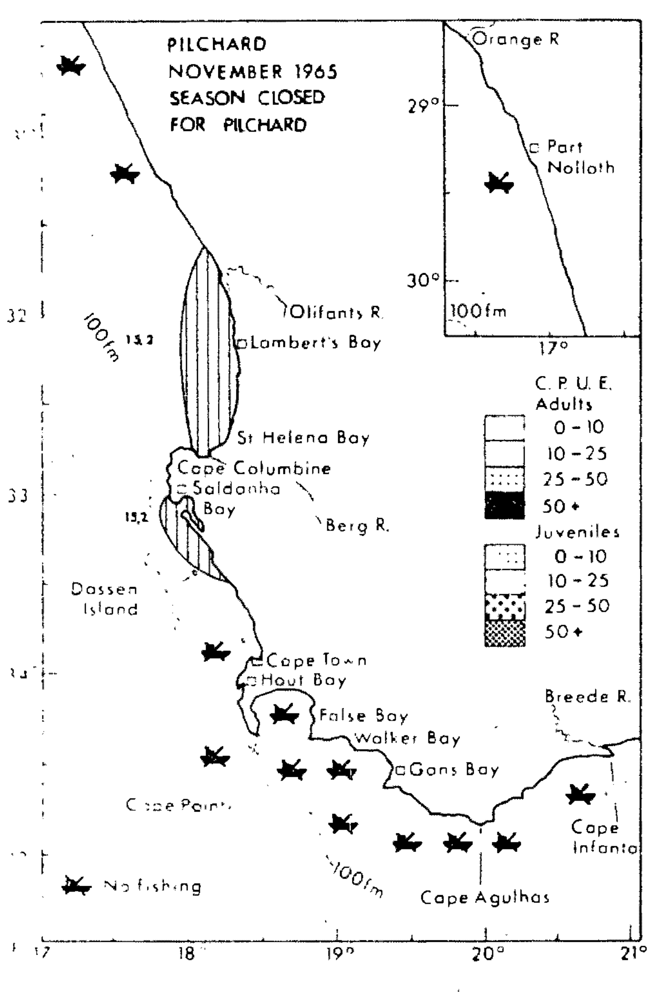
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Lambert's Bay
St Helena Bay
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Hout Bay
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Gans Bay
Breede R.
Cape
Infanta
100fm
Cape Agulhas
C. P. U. E.
Adults
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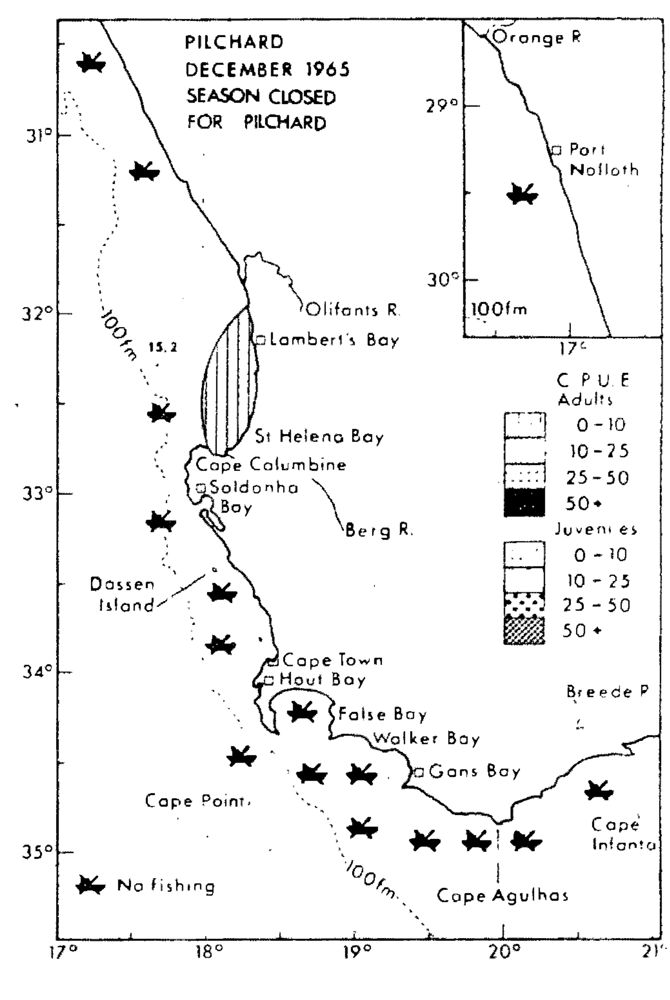
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False Bay
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Gans Bay
Cape Point.
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Infanta
100fm
Cape Agulhas
No fishing
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C P U E
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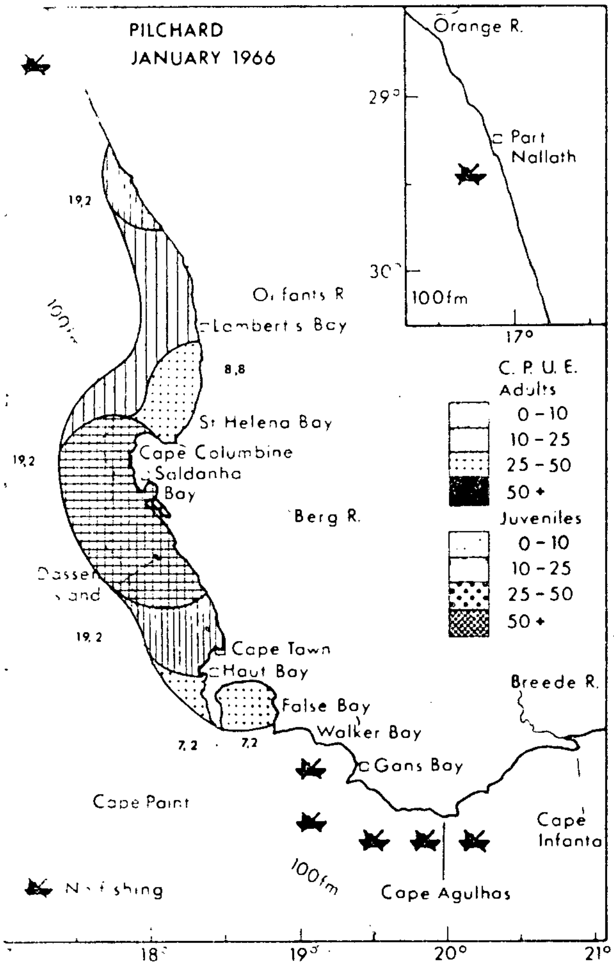
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Cape Columbine
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Cape Point
Cape
Infanta
Cape Agulhas
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
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Juveniles
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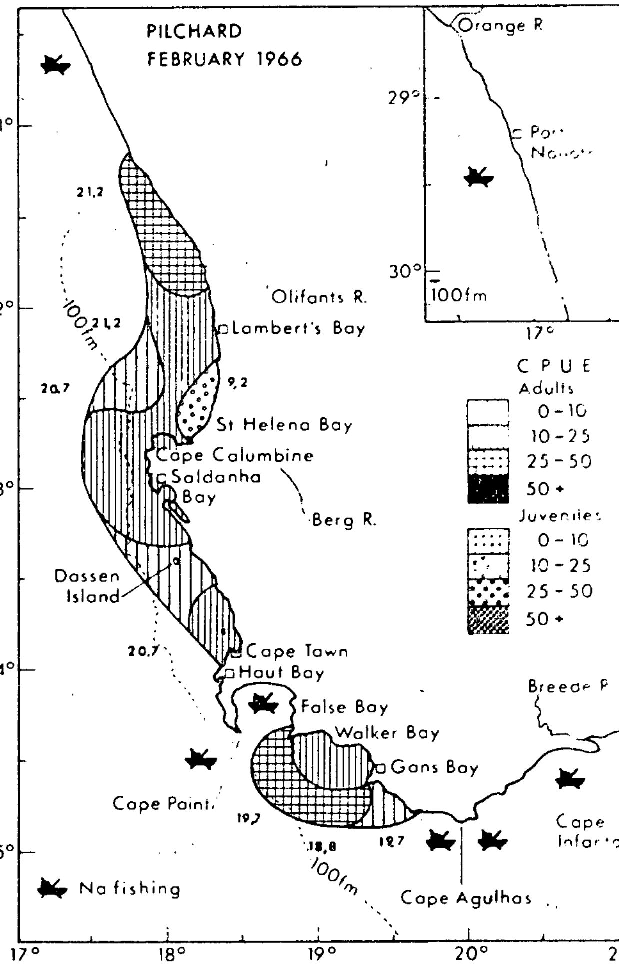
20°
21°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FEBRUARY 1966
Orange R
29°
30°
100fm
17°
31°
32°
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35°
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21,2
20,7
20,7
9,2
19,7
18,8
19,7
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha
Bay
Berg R.
Dassen
Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Cape Point
100fm
100fm
Cape Agulhas
No fishing
C P U E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
19°
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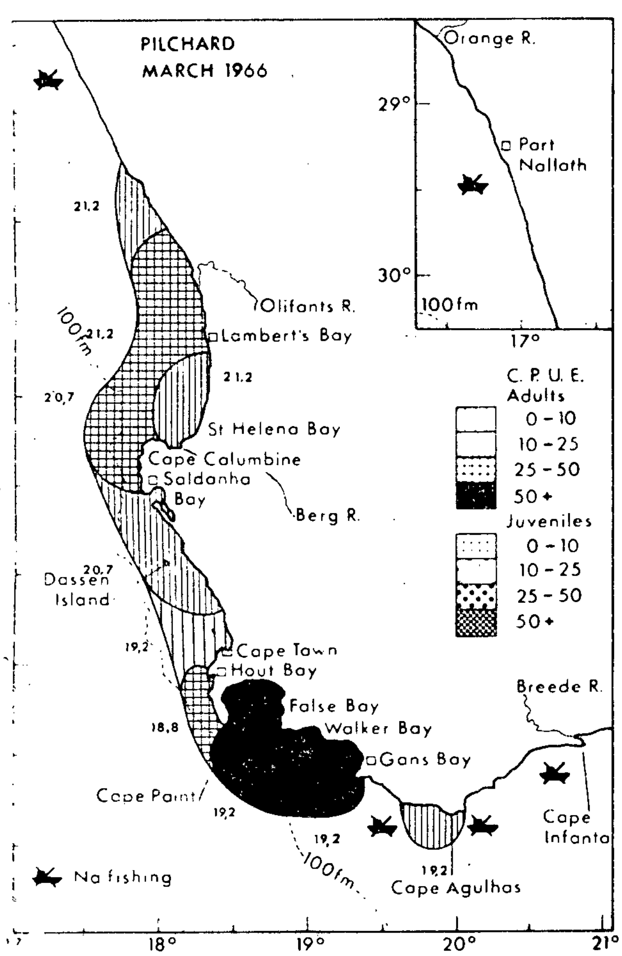
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MARCH 1966
Orange R.
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Port
Nallath
30°
100fm
17°
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20,7
19,2
18,8
19,2
19,2
19,2
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha
Bay
Berg R.
Dassen
Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape
Infanta
100fm
100fm
Cape Agulhas
No fishing
C. P. U. E.
Adults
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25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
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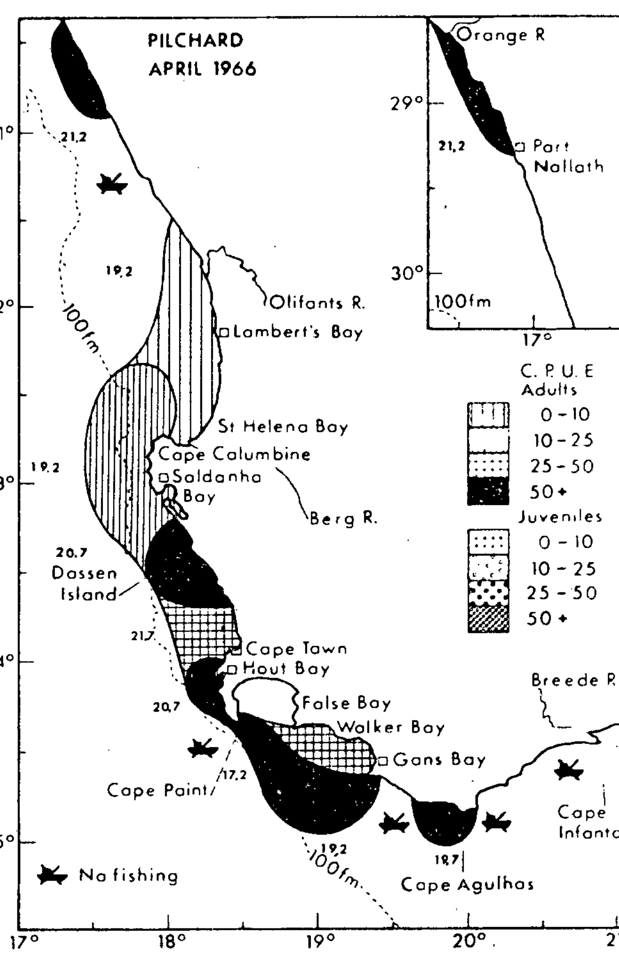
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Port
Nallath
30°
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34°
35°
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19,2
19,7
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha
Bay
Berg R.
Dassen
Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape
Infanta
100fm
Cape Agulhas
No fishing
C. P. U. E
Adults
0 - 10
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25 - 50
50 +
Juveniles
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25 - 50
50 +
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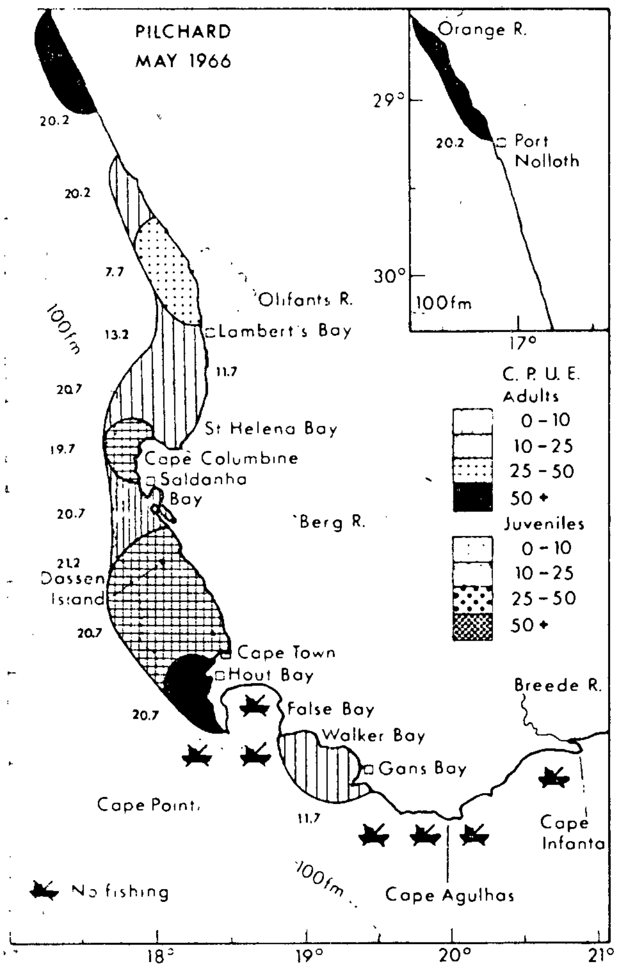
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Port Nolloth
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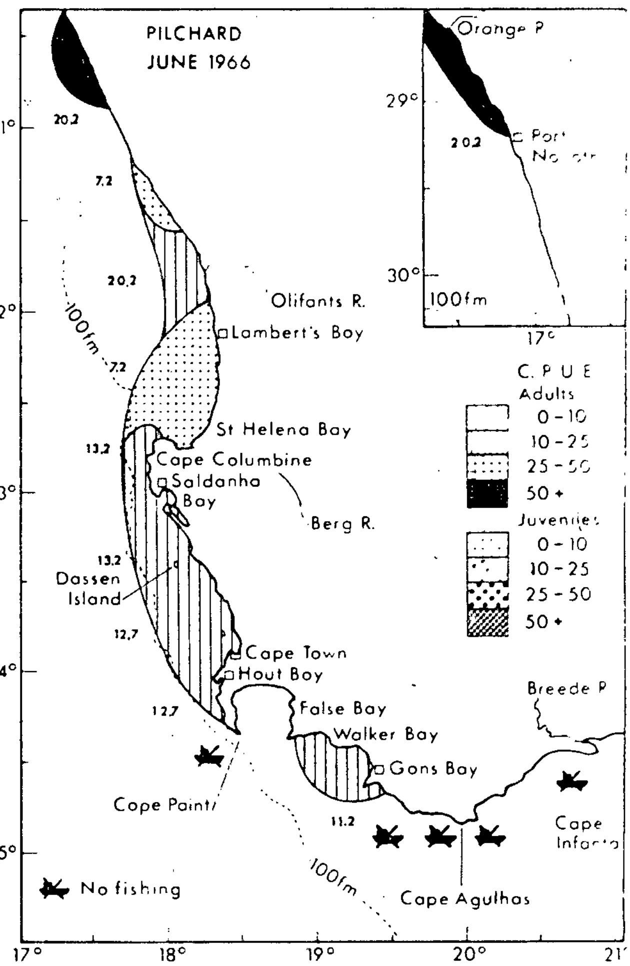
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
C. P. U. E.
Adults
0 – 10
10 – 25
25 – 50
50 +
Juveniles
0 – 10
10 – 25
25 – 50
50 +
No fishing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JUNE 1966
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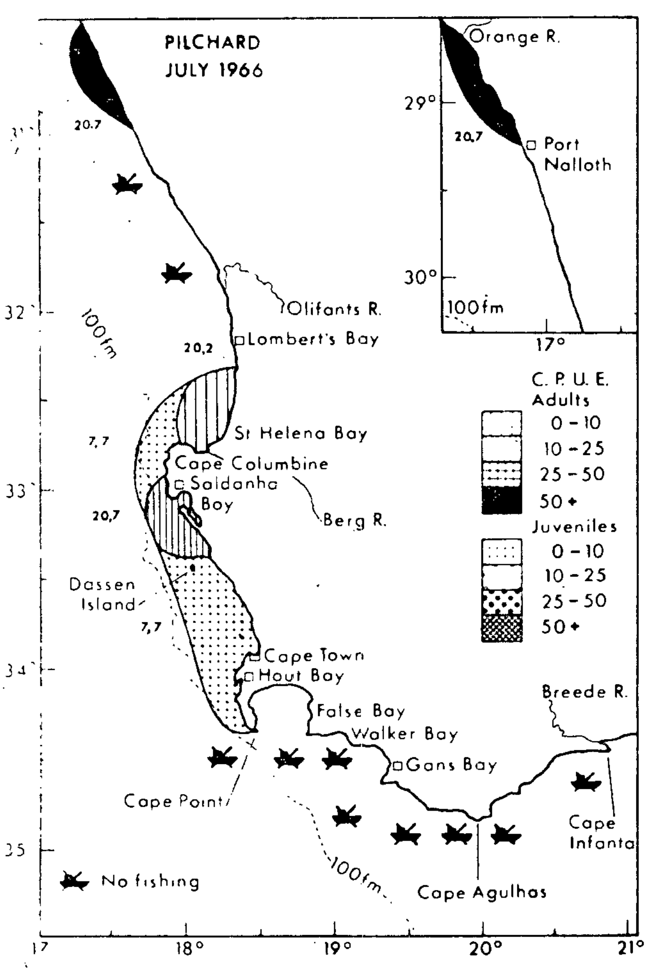
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Cape Point
Cape Agulhas
100fm
C. P. U. E.
Adults
0 – 10
10 – 25
25 – 50
50 +
Juveniles
0 – 10
10 – 25
25 – 50
50 +
No fishing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JULY 1966
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Port Nolloth
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Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
C. P. U. E.
Adults
0 – 10
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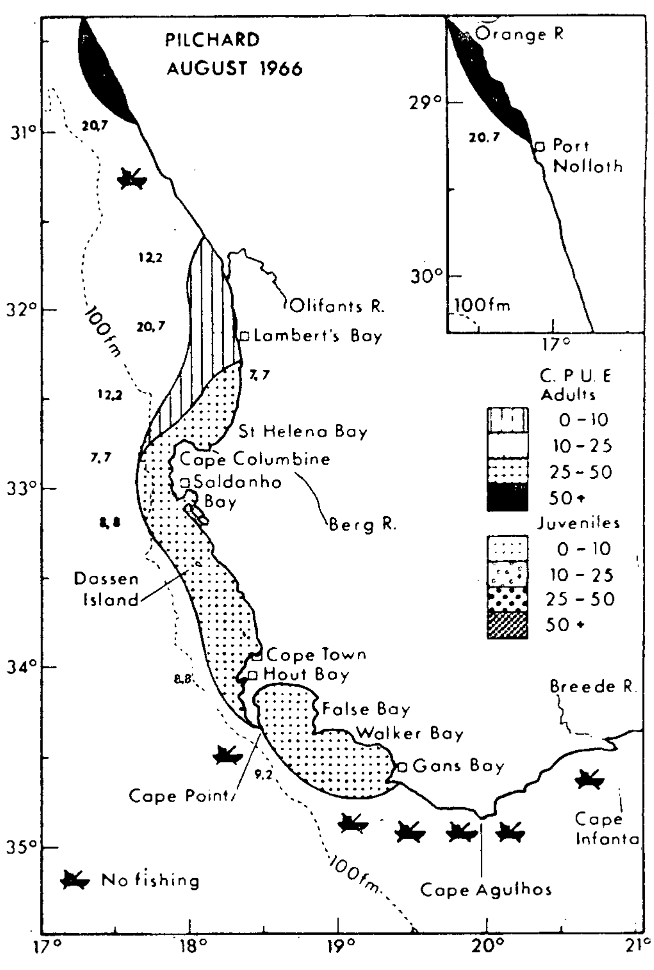
25 – 50
50 +
Juveniles
0 – 10
10 – 25
25 – 50
50 +
No fishing


PILCHARD
AUGUST 1966
Orange R
Port Nolloth
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanho Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
C. P. U. E
Adults
0 – 10
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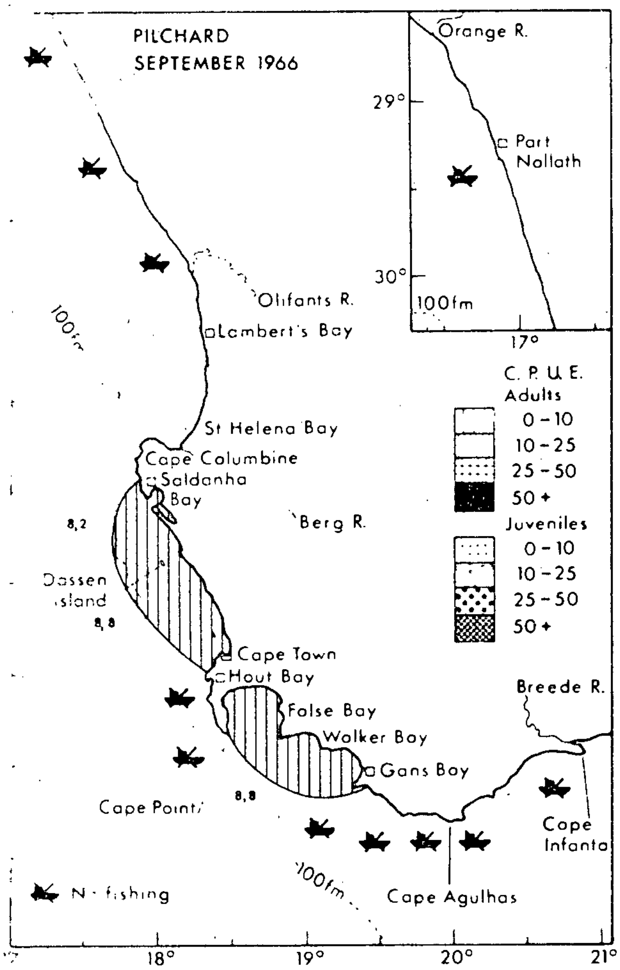
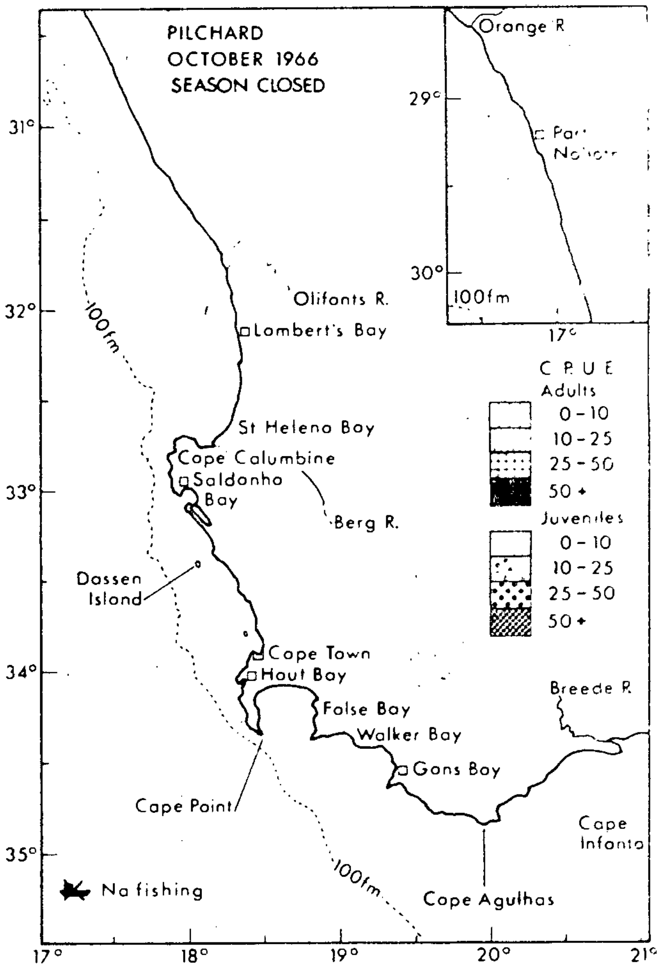
25 – 50
50 +
Juveniles
0 – 10
10 – 25
25 – 50
50 +
No fishing


PILCHARD
SEPTEMBER 1966
Orange R.
29°
Port Nollath
30°
100fm
17°
Olifants R.
Lambert's Bay
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
8,2
Dassen Island
8,8
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
8,8
Cape Point
Cape Infanta
100fm
Cape Agulhas
No fishing
18°
19°
20°
21°


PILCHARD
OCTOBER 1966
SEASON CLOSED
Orange R
29°
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100fm
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100fm
Olifants R.
Lambert's Bay
C. P. U. E.
Adults
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50 +
Juveniles
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50 +
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
100fm
Cape Agulhas
No fishing
17°
18°
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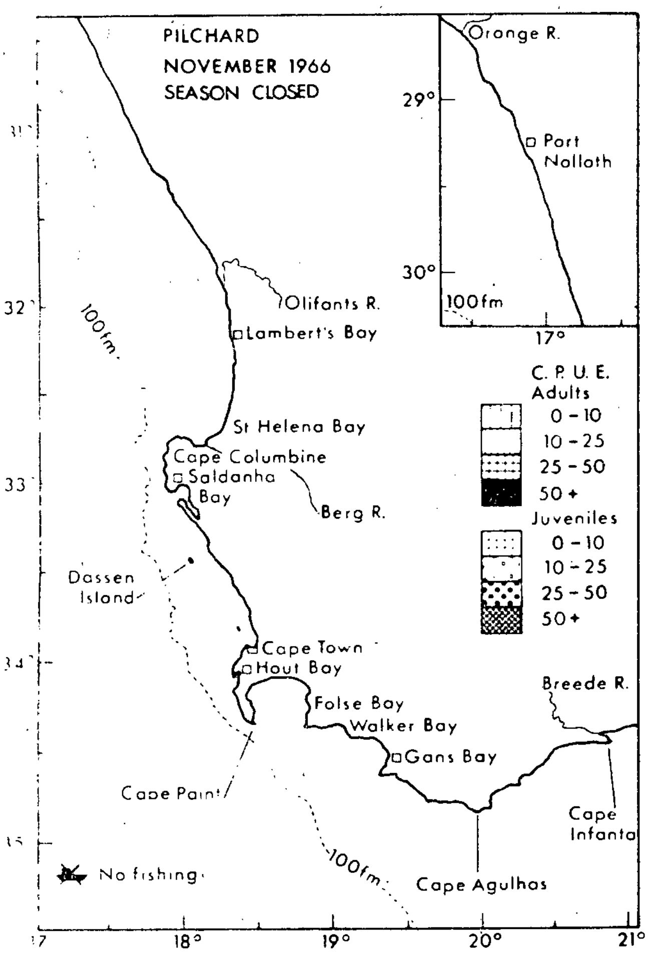
21°


PILCHARD
NOVEMBER 1966
SEASON CLOSED
Orange R.
29°
Port Nollath
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100fm
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Olifants R.
Lambert's Bay
C. P. U. E.
Adults
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10 - 25
25 - 50
50 +
Juveniles
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10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
100fm
Cape Agulhas
No fishing
18°
19°
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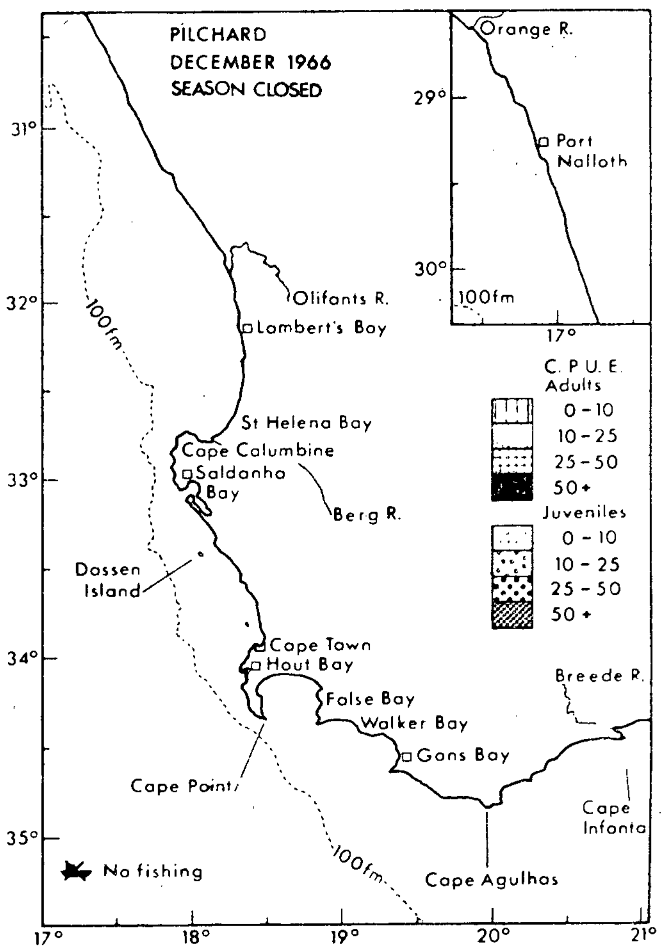
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DECEMBER 1966
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29°
Port Nolloth
30°
100fm
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Olifants R.
Lambert's Bay
C. P. U. E.
Adults
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50 +
Juveniles
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10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
100fm
Cape Agulhas
No fishing
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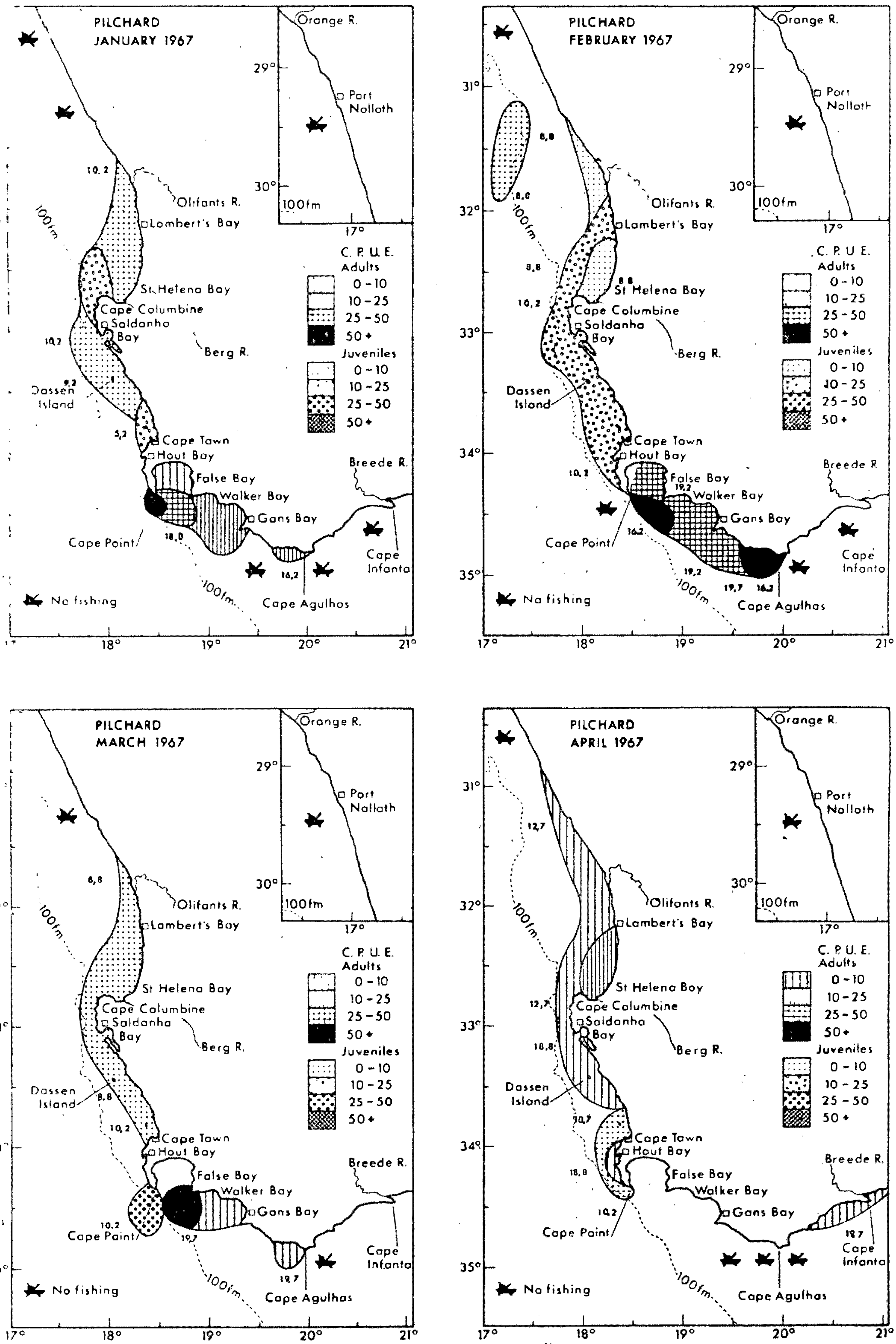
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Port Nolloth
100fm
Olifants R.
Lambert's Bay
St. Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
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False Bay
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Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
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Juveniles
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10,2
9,2
5,2
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16,2
PILCHARD
FEBRUARY 1967
8,8
10,2
19,2
16,2
19,7
PILCHARD
MARCH 1967
8,8
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19,7
PILCHARD
APRIL 1967
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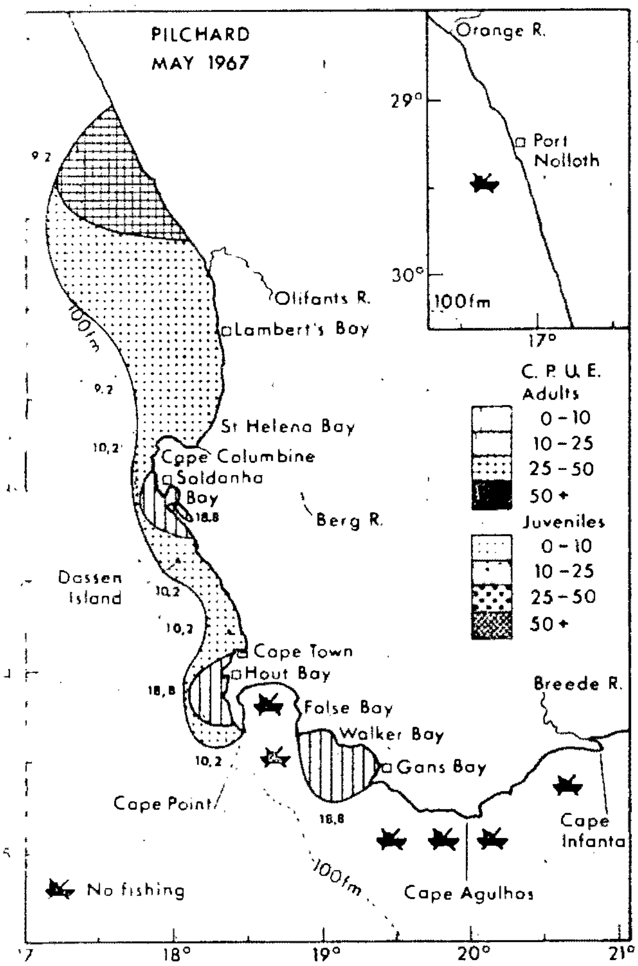
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MAY 1967
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Port Nolloth
100fm
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Lambert's Bay
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Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
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Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
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Juveniles
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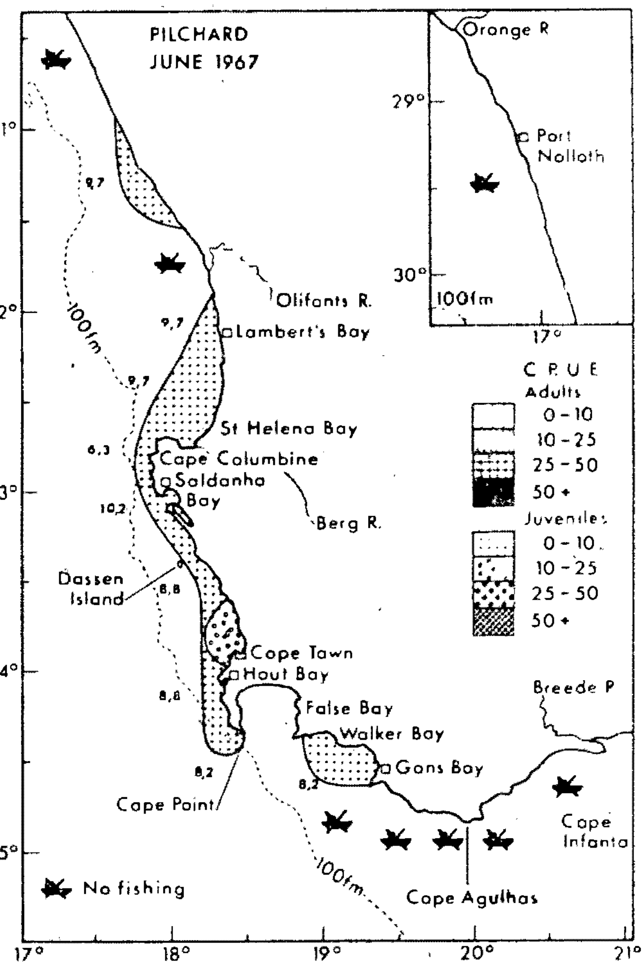
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Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C P U E
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Juveniles
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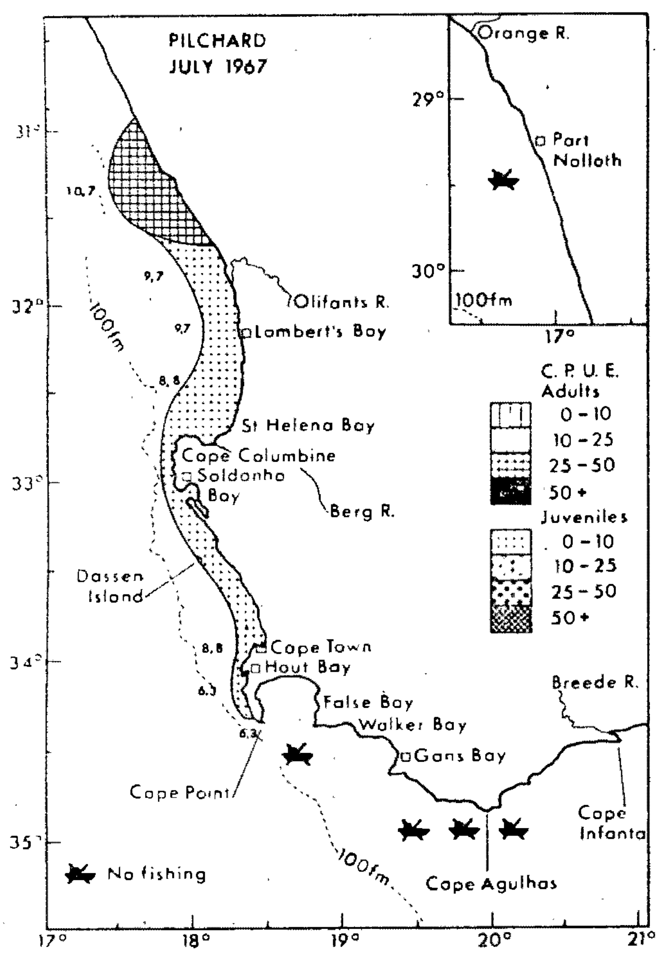
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Port Nolloth
100fm
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Lambert's Bay
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Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
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Juveniles
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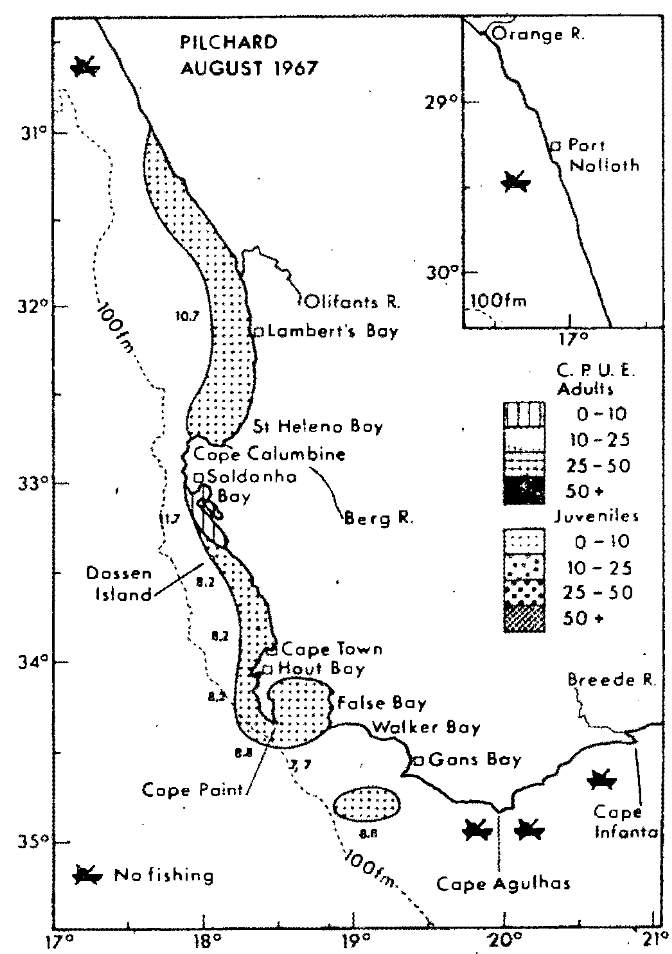
PILCHARD
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Port Nolloth
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Lambert's Bay
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Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
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Juveniles
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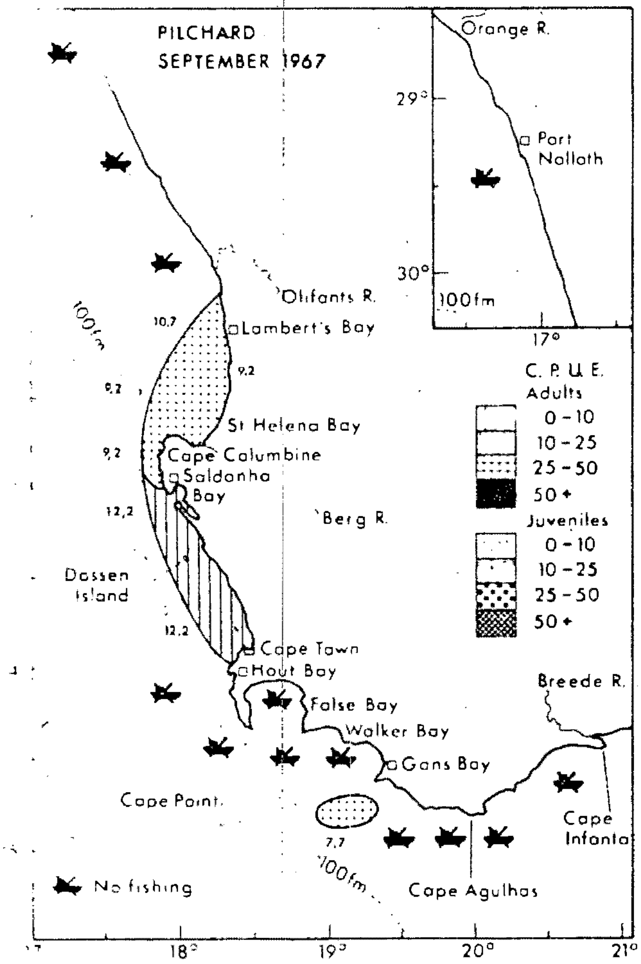
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Port Nolloth
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100fm
17°
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Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
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C. P. U. E.
Adults
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Juveniles
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50 +
No fishing
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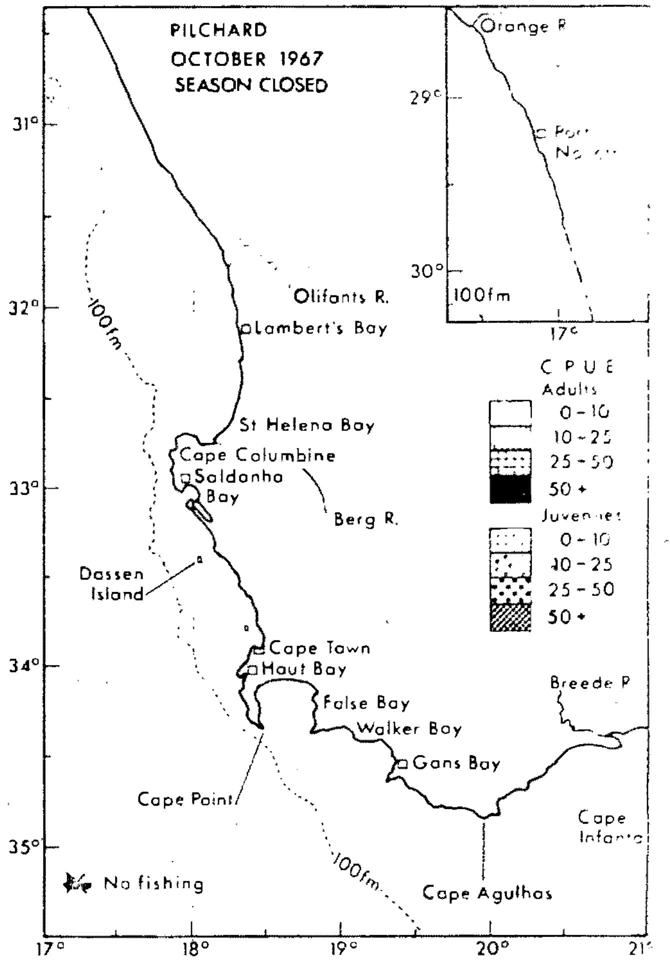
PILCHARD
OCTOBER 1967
SEASON CLOSED
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100fm
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Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
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Cape Town
Hout Bay
False Bay
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Gans Bay
Cape Point
Cape Agulhas
C P U E
Adults
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No fishing
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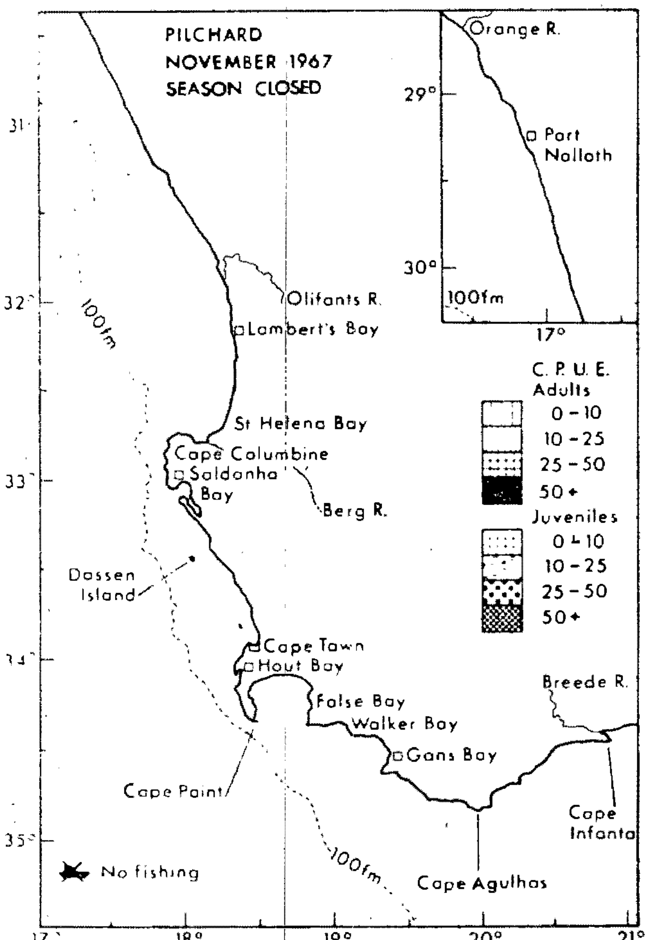
PILCHARD
NOVEMBER 1967
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Port Nolloth
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Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
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Cape Town
Hout Bay
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Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
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Adults
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Juveniles
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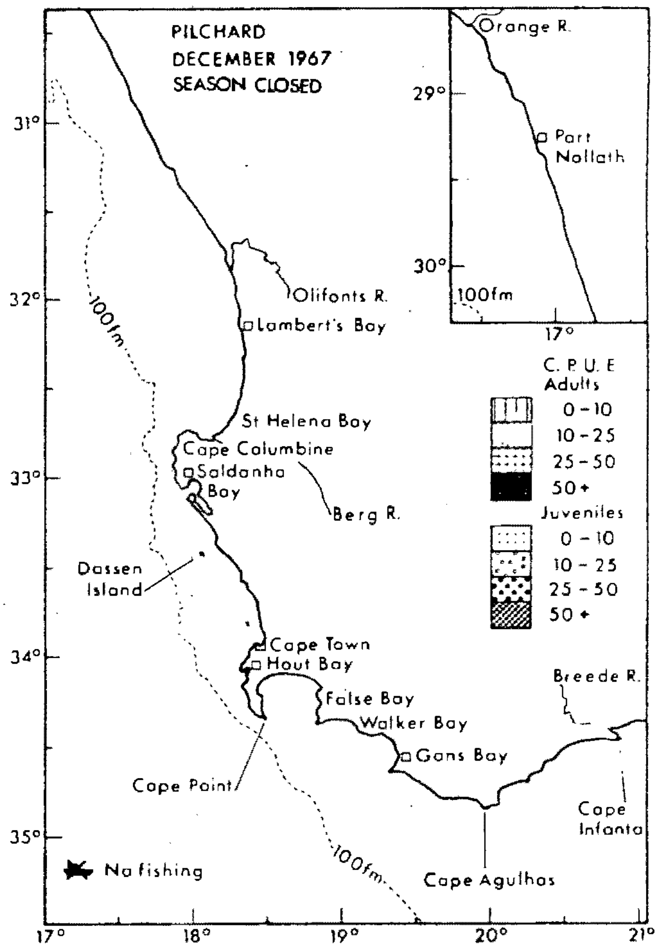
PILCHARD
DECEMBER 1967
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Port Nolloth
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Olifants R.
Lambert's Bay
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Cape Columbine
Saldanha Bay
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Cape Town
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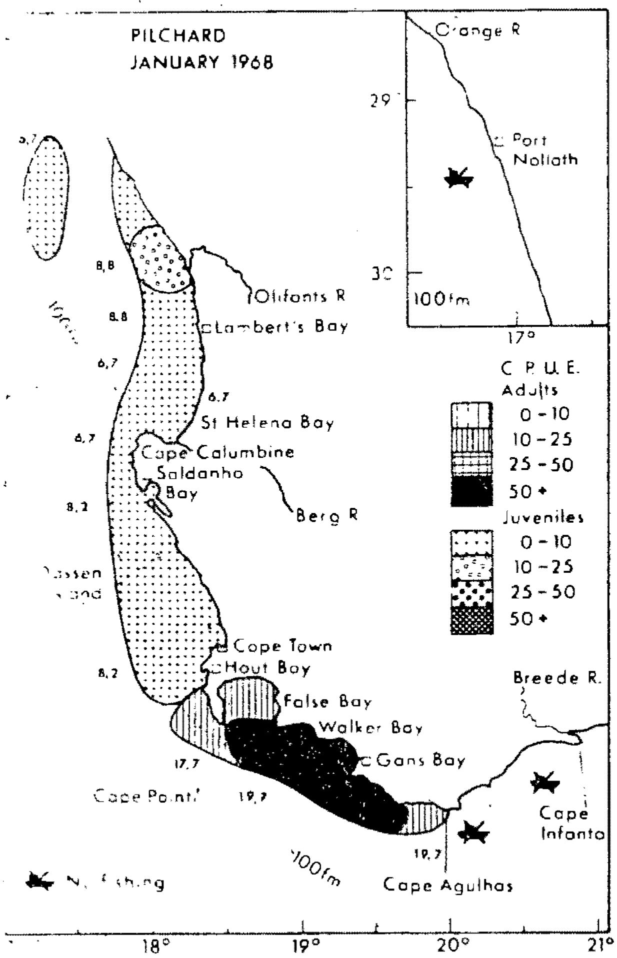
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JANUARY 1968
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Port Nolloth
100fm
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
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Cape Agulhas
C. P. U. E.
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Juveniles
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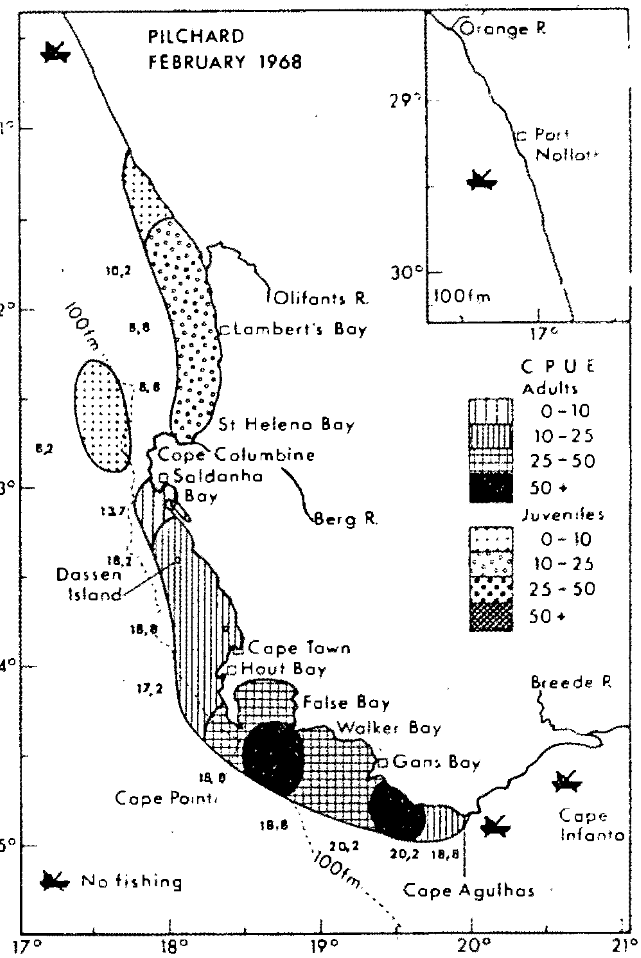
PILCHARD
FEBRUARY 1968
Orange R
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
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No fishing
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Adults
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Juveniles
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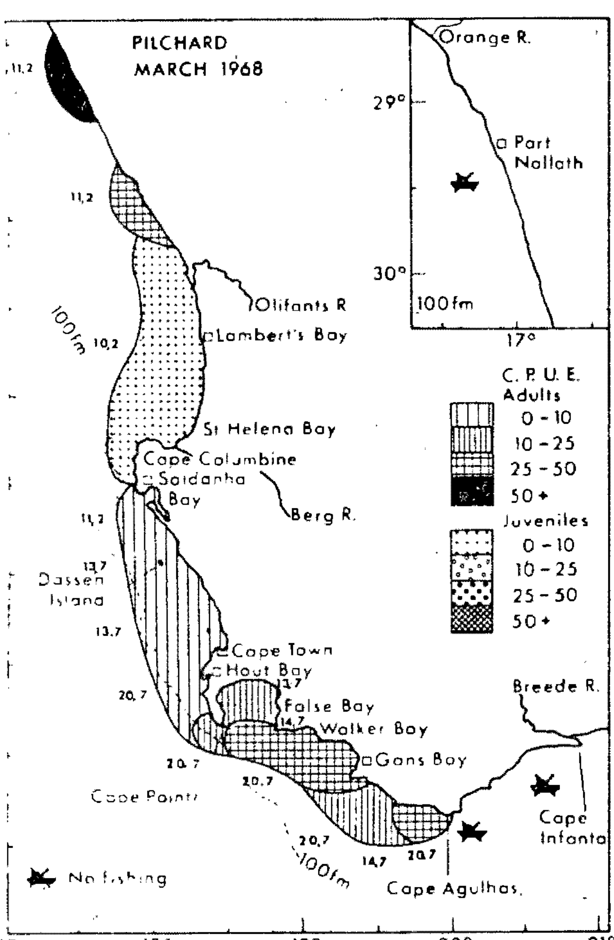
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MARCH 1968
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Port Nolloth
100fm
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Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
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Juveniles
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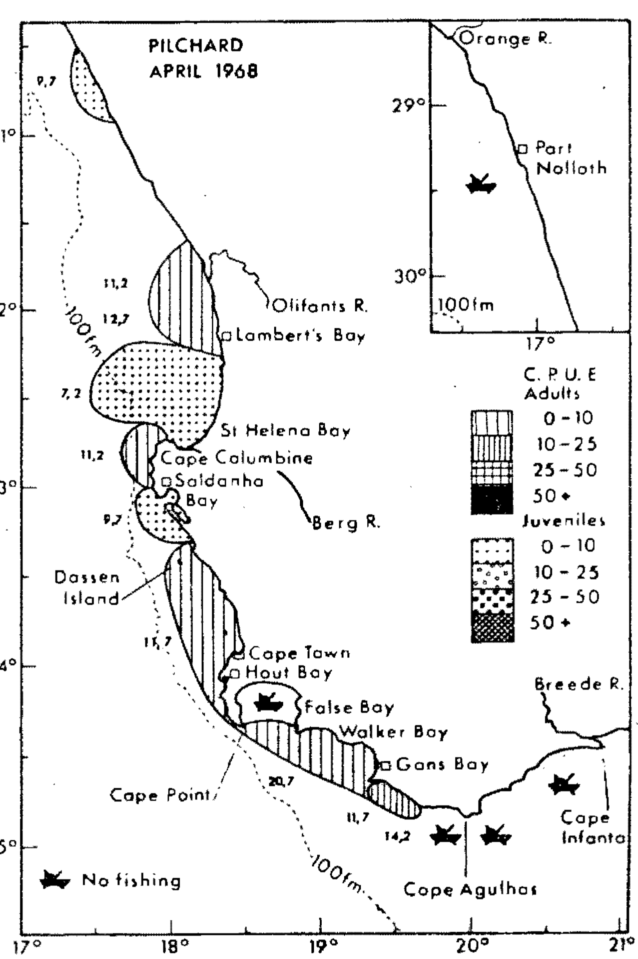
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APRIL 1968
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Port Nolloth
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Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
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No fishing
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Adults
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50 +
Juveniles
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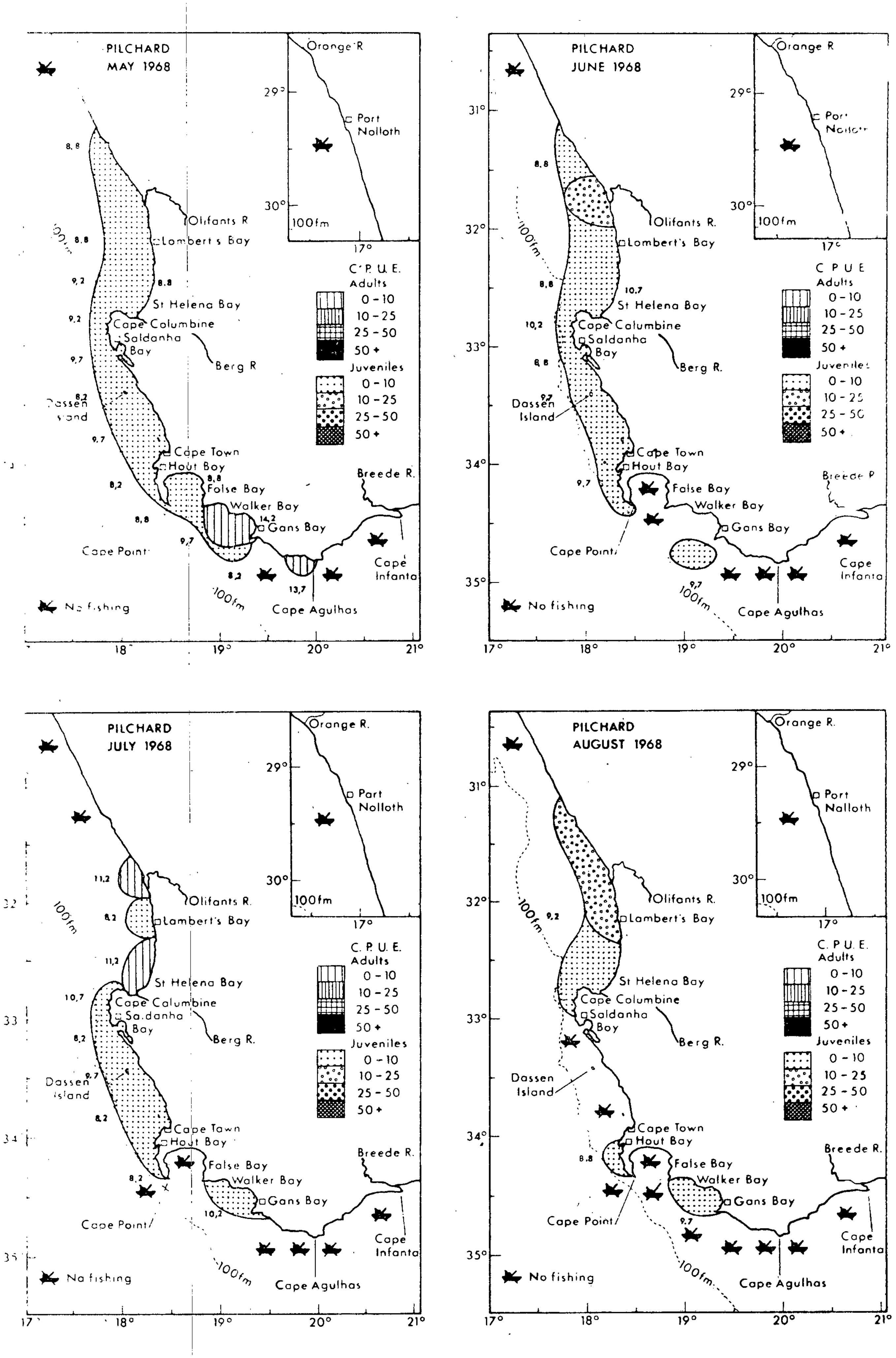
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MAY 1968
PILCHARD
JUNE 1968
PILCHARD
JULY 1968
PILCHARD
AUGUST 1968
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Port Nolloth
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Olifants R.
Lombert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
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Juveniles
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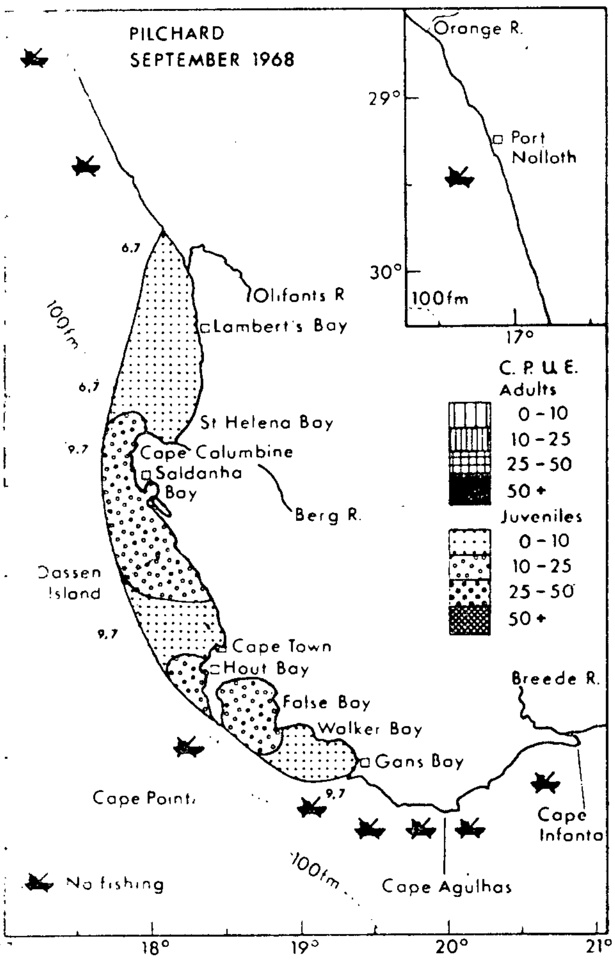
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SEPTEMBER 1968
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Port
Nolloth
30°
100fm
17°
6,7
Olifants R
Lambert's Bay
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
9,7
Cape Columbine
Saldanha
Bay
Berg R.
Dassen
Island
9,7
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
9,7
Cape
Infanta
100fm
Cape Agulhas
No fishing
18°
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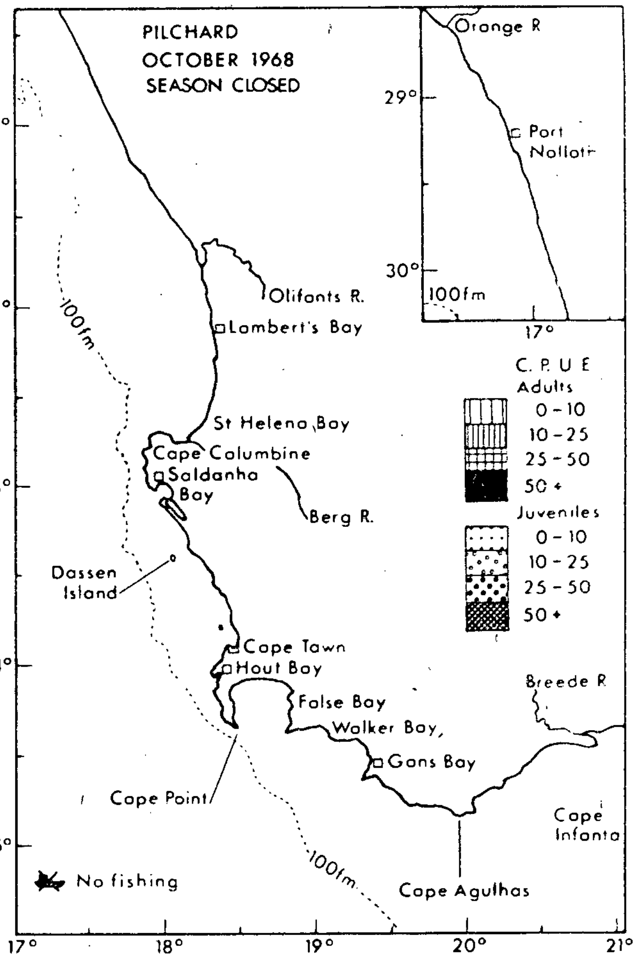
21°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Nolloth
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32°
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Olifants R.
Lambert's Bay
C. P. U. E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
33°
Saldanha
Bay
Berg R.
Dassen
Island
Cape Town
34°
Hout Bay
Breede R
False Bay
Walker Bay,
Gans Bay
Cape Point
Cape
Infanta
35°
100fm
No fishing
Cape Agulhas
17°
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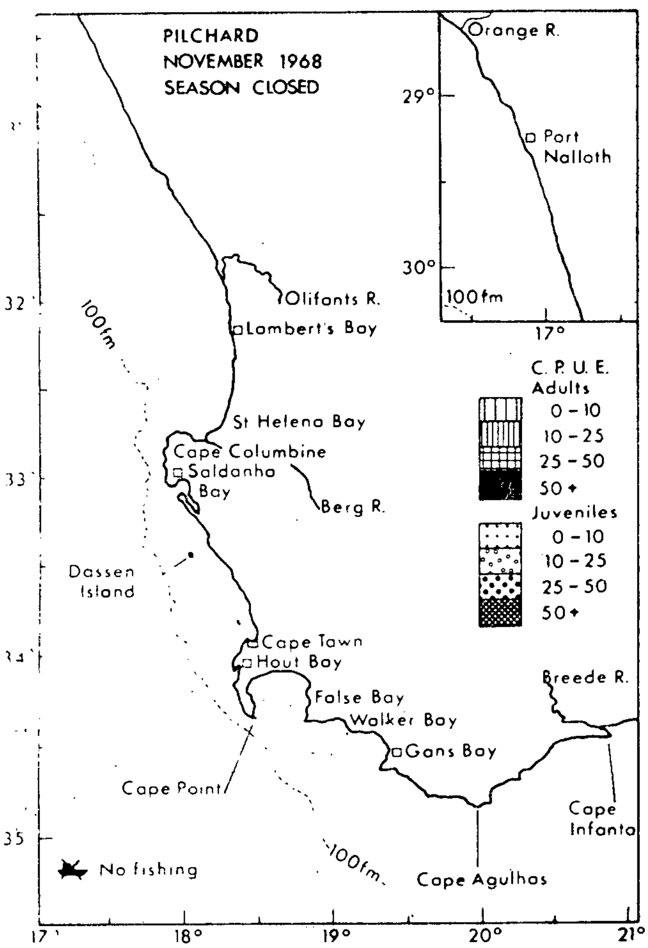
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17°
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Olifants R.
100fm
Lambert's Bay
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
33
Saldanha
Bay
Berg R.
Juveniles
0 - 10
10 - 25
25 - 50
50 +
Dassen
Island
Cape Town
Hout Bay
Breede R.
False Bay
Walker Bay
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Cape Point
Cape
Infanta
35
No fishing
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Cape Agulhas
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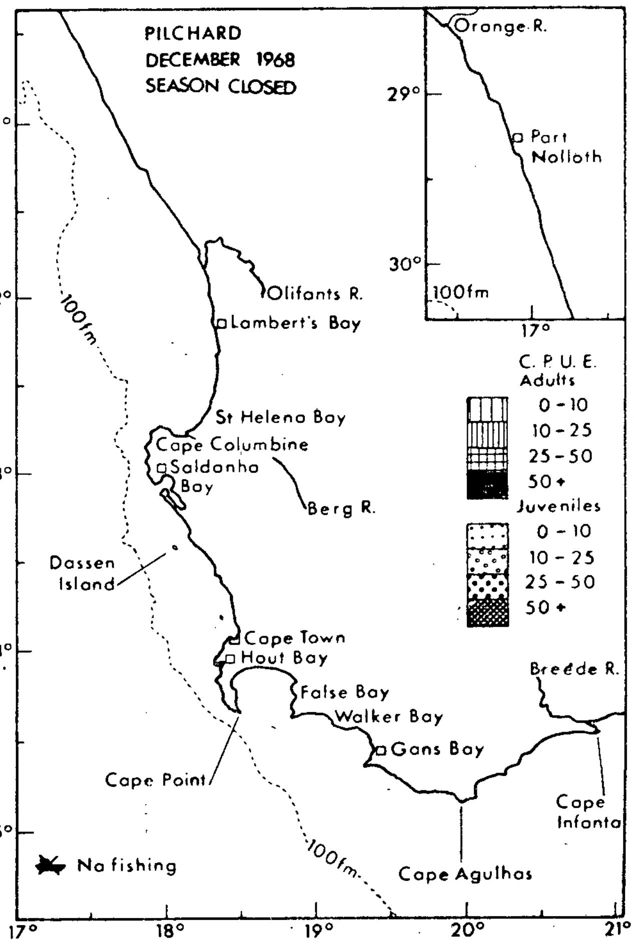
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Nolloth
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Olifants R.
100fm
Lambert's Bay
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
33°
Saldanha
Bay
Berg R.
Juveniles
0 - 10
10 - 25
25 - 50
50 +
Dassen
Island
Cape Town
34°
Hout Bay
Breede R.
False Bay
Walker Bay
Gans Bay
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Infanta
35°
100fm
No fishing
Cape Agulhas
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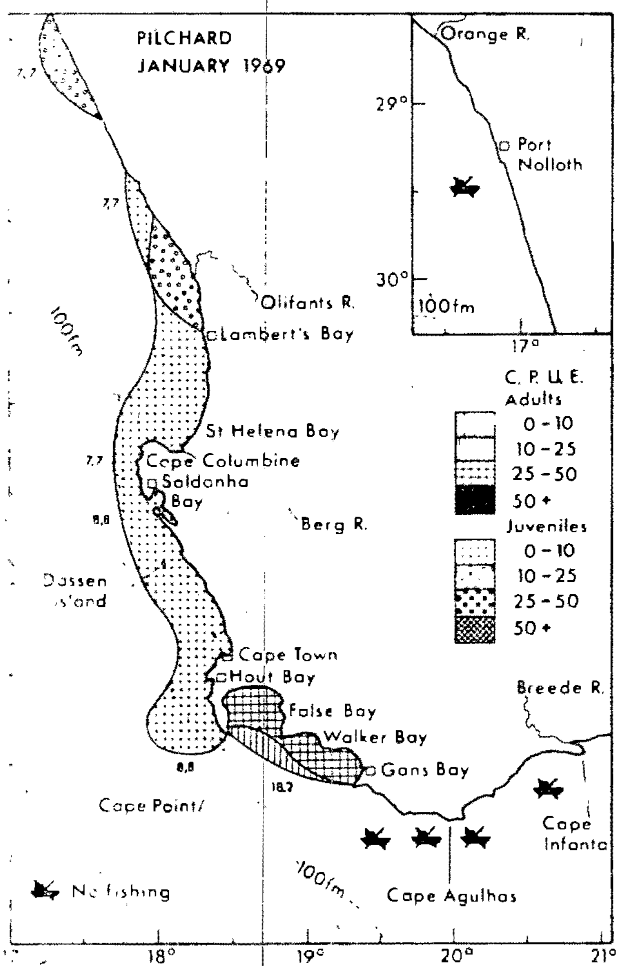
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Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
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Breede R.
Cape Point
Cape Agulhas
Cape Infanta
No fishing
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Juveniles
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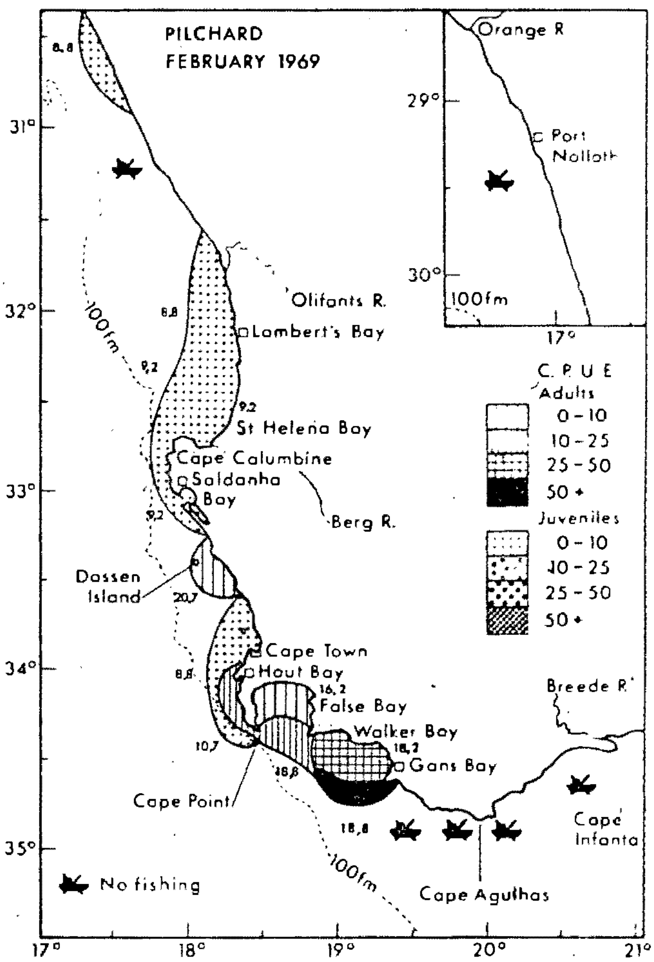
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Berg R.
Dassen Island
Cape Town
Hout Bay
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Breede R.
Cape Point
Cape Agulhas
Cape Infanta
No fishing
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Adults
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Juveniles
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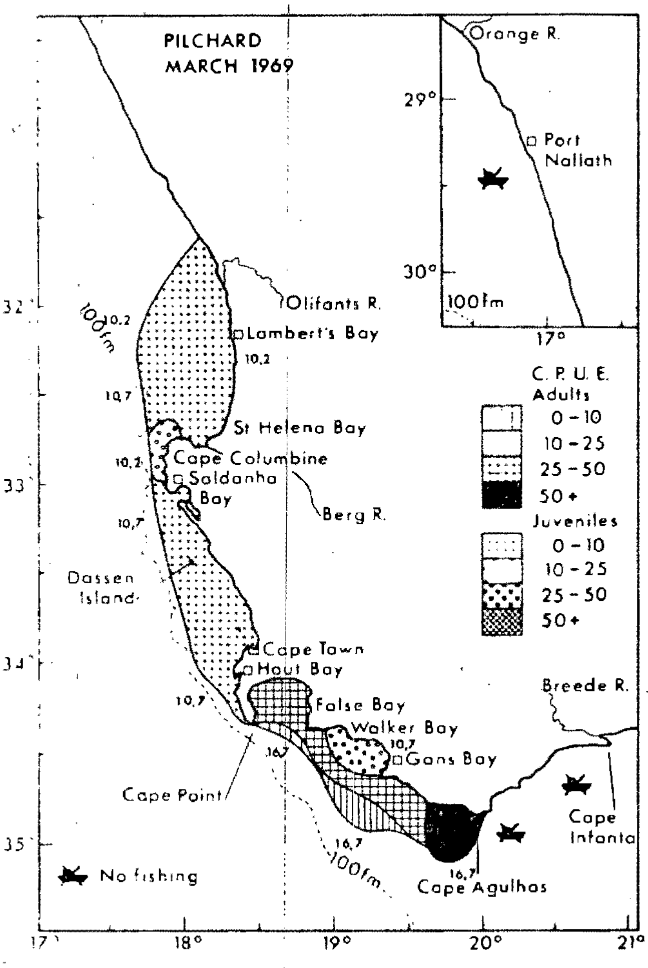
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Port Nallath
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Berg R.
Dassen Island
Cape Town
Hout Bay
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Cape Point
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Juveniles
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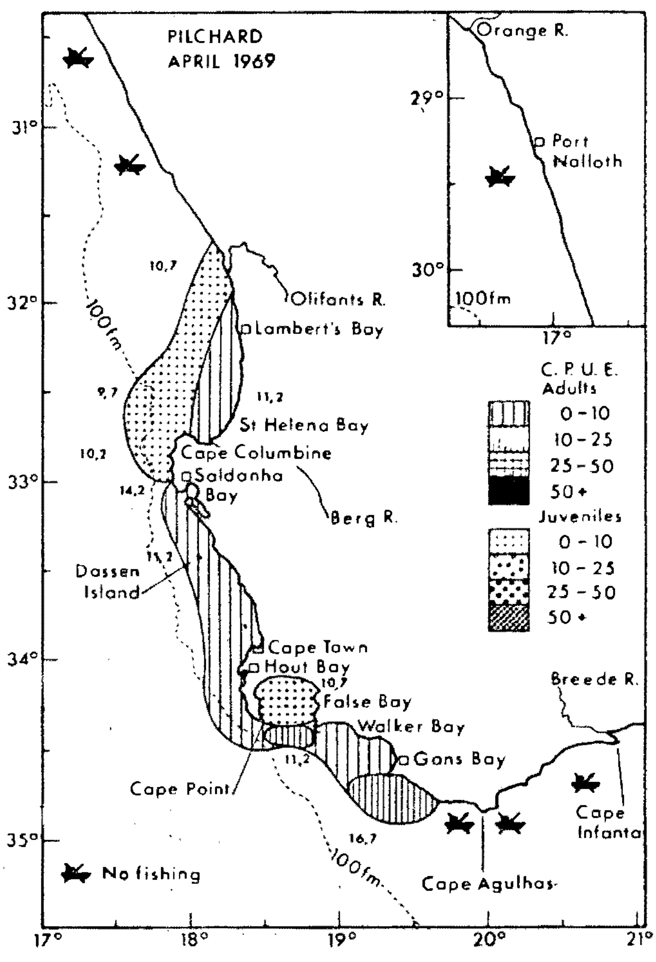
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Saldanha Bay
Berg R.
Dassen Island
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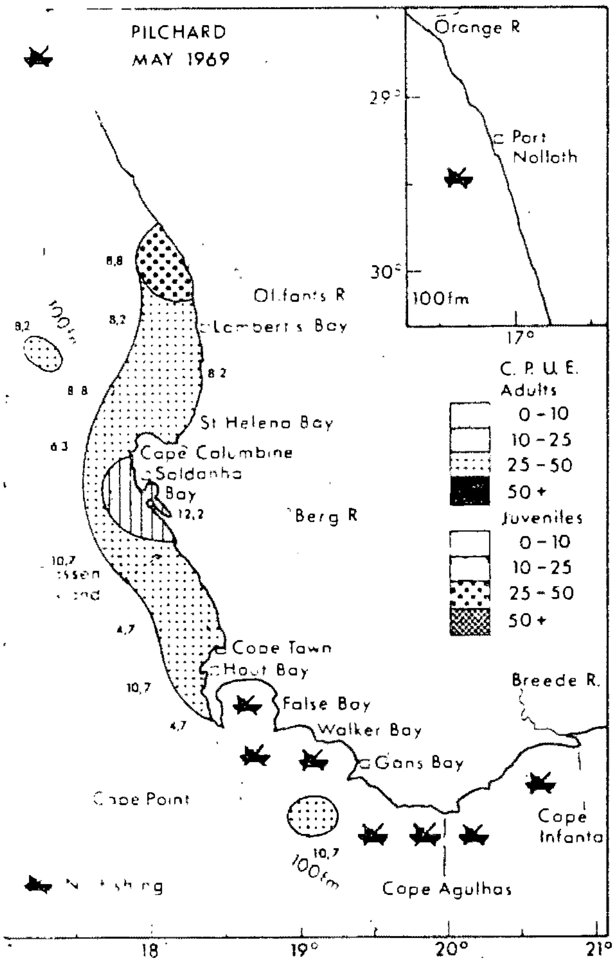
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Port Nolloth
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Cape Columbine
Saldanha Bay
Berg R
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
C. P. U. E.
Adults
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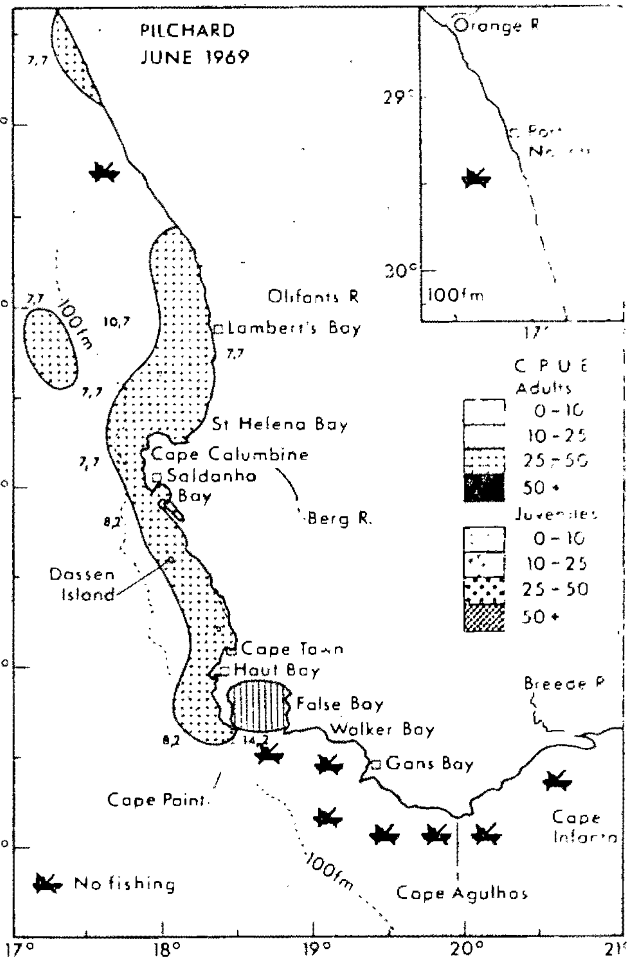
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Lambert's Bay
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Berg R.
Dassen Island
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Cape Agulhas
No fishing
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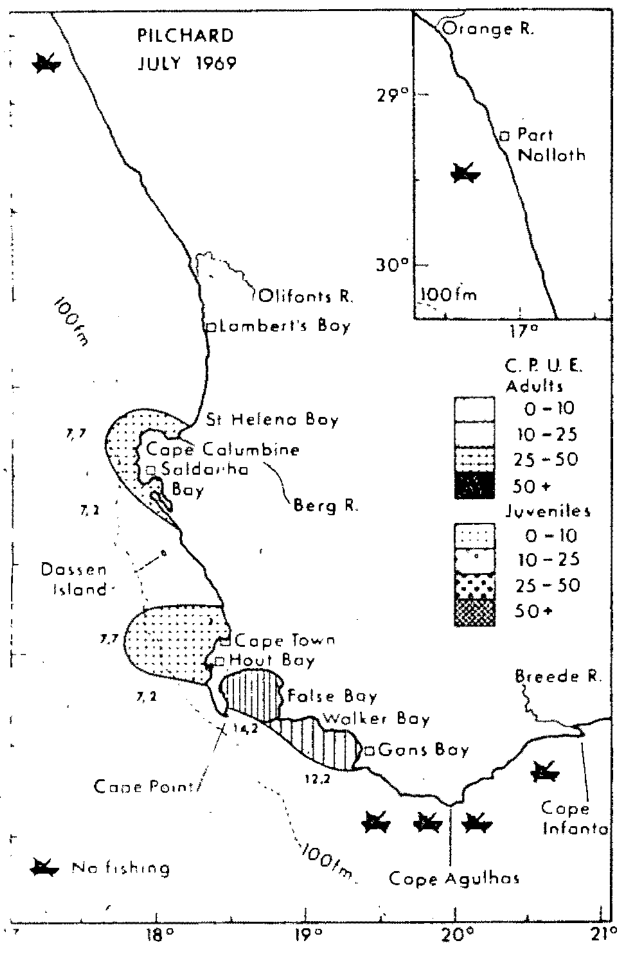
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Port Nolloth
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Lambert's Bay
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Cape Columbine
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Berg R.
Dassen Island
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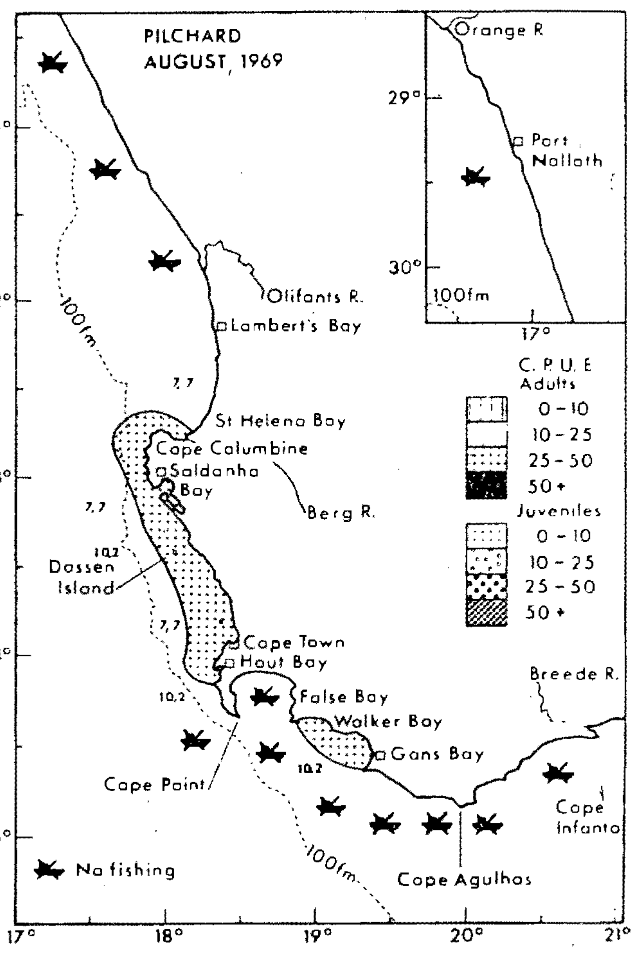
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AUGUST 1969
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Port Nolloth
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Lambert's Bay
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Dassen Island
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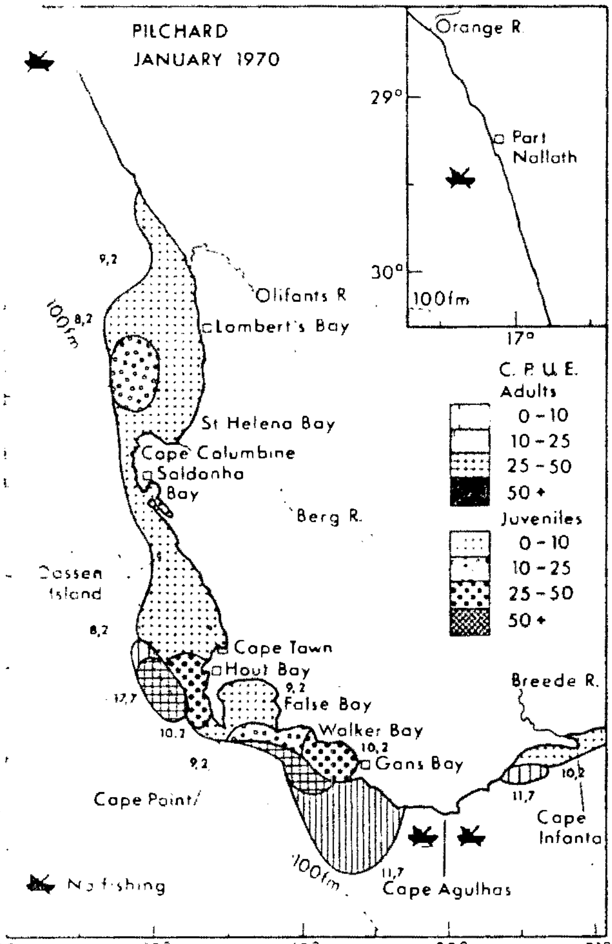
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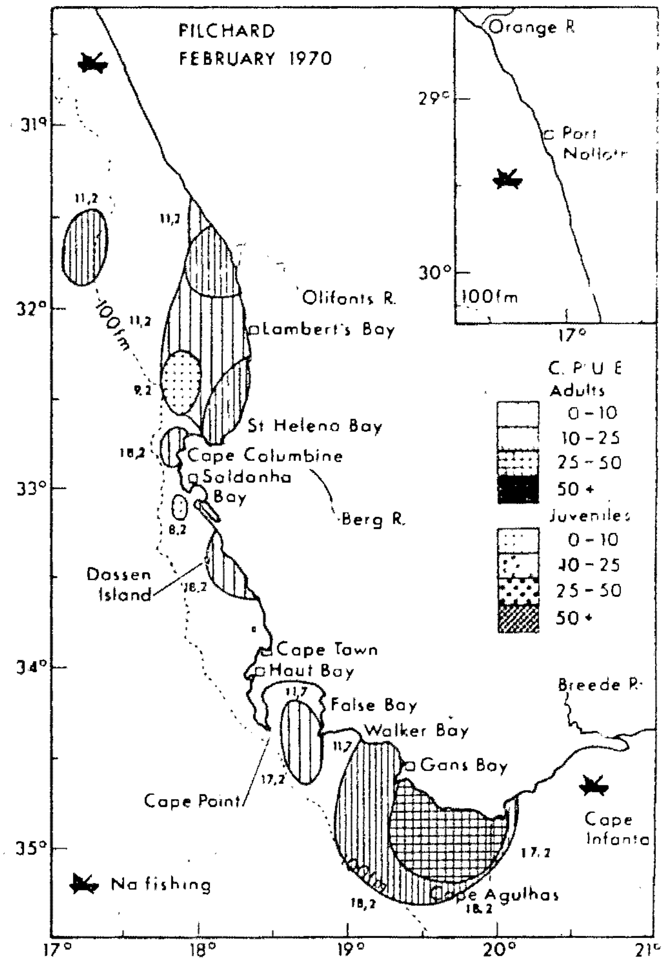
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Lambert's Bay
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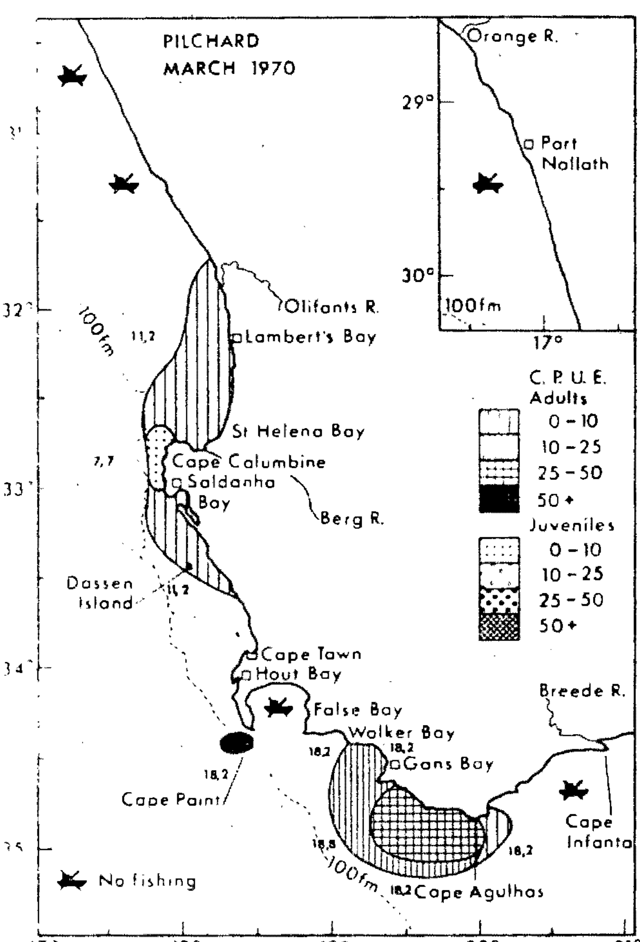
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St Helena Bay
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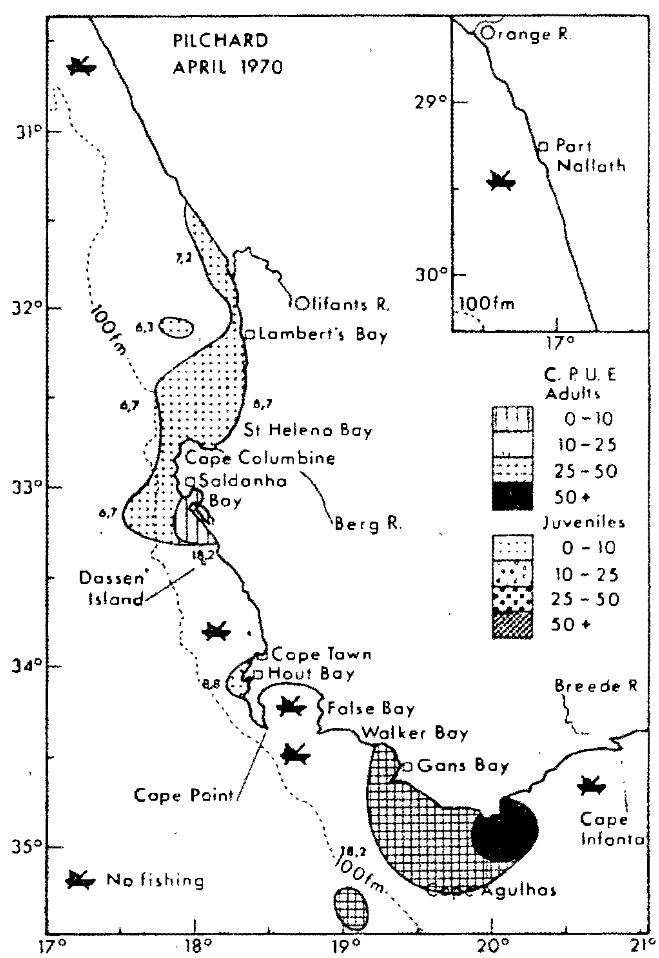
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St Helena Bay
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Dassen Island
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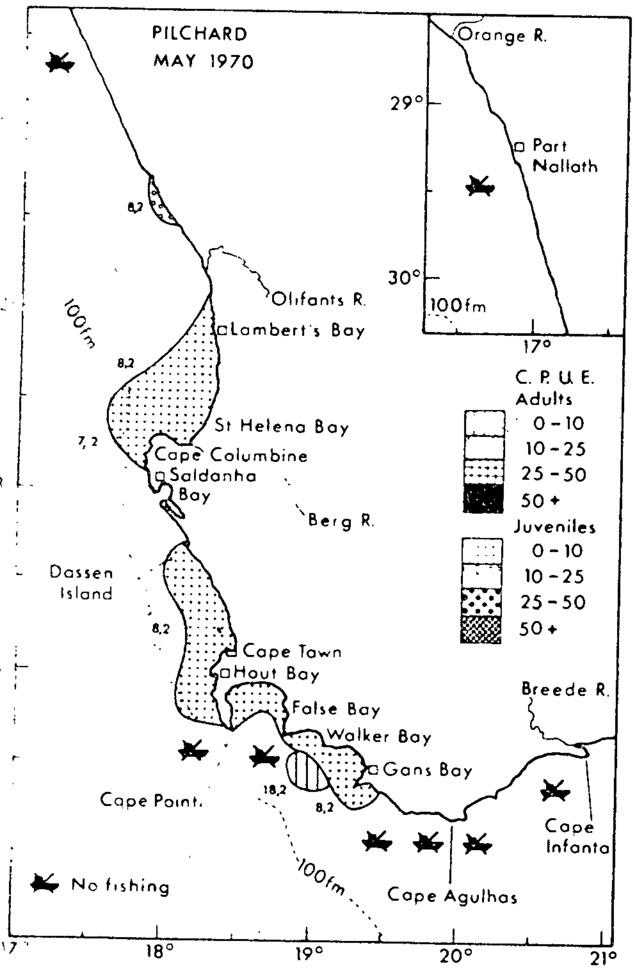
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Dassen Island
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Cape Infanta
Cape Agulhas
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Juveniles
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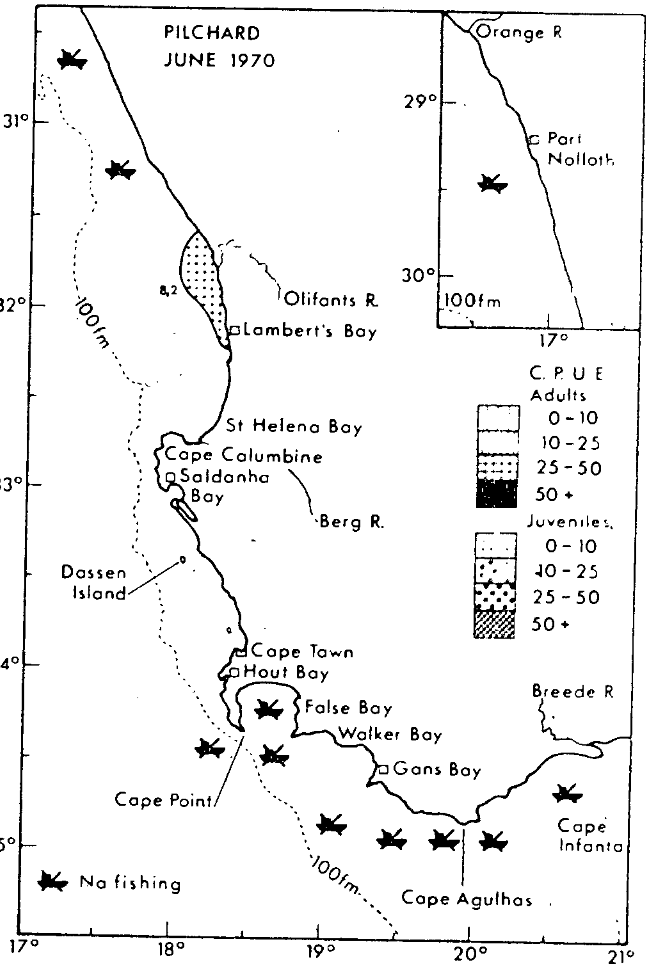
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Dassen Island
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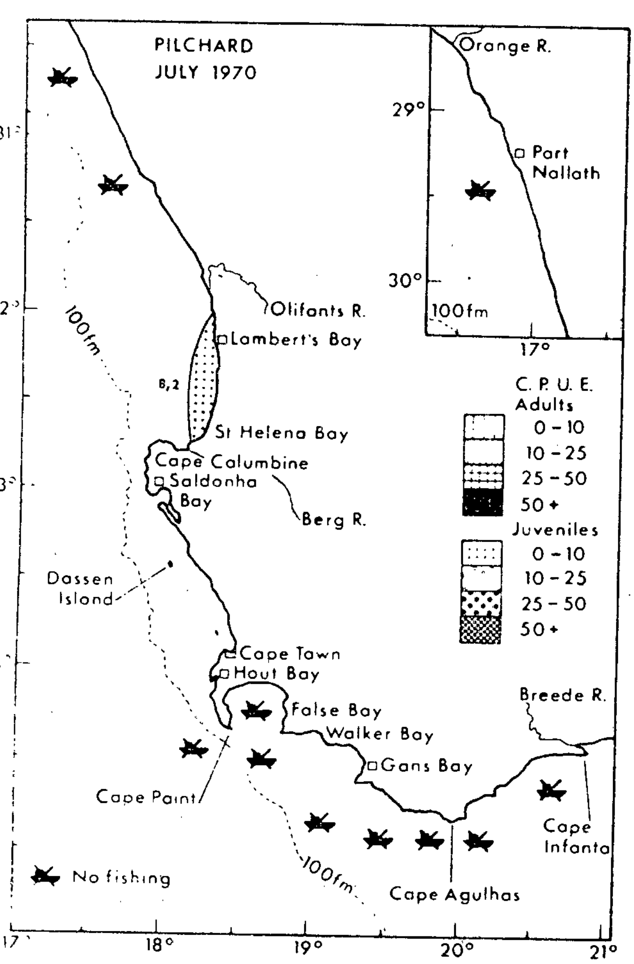
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Dassen Island
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Juveniles
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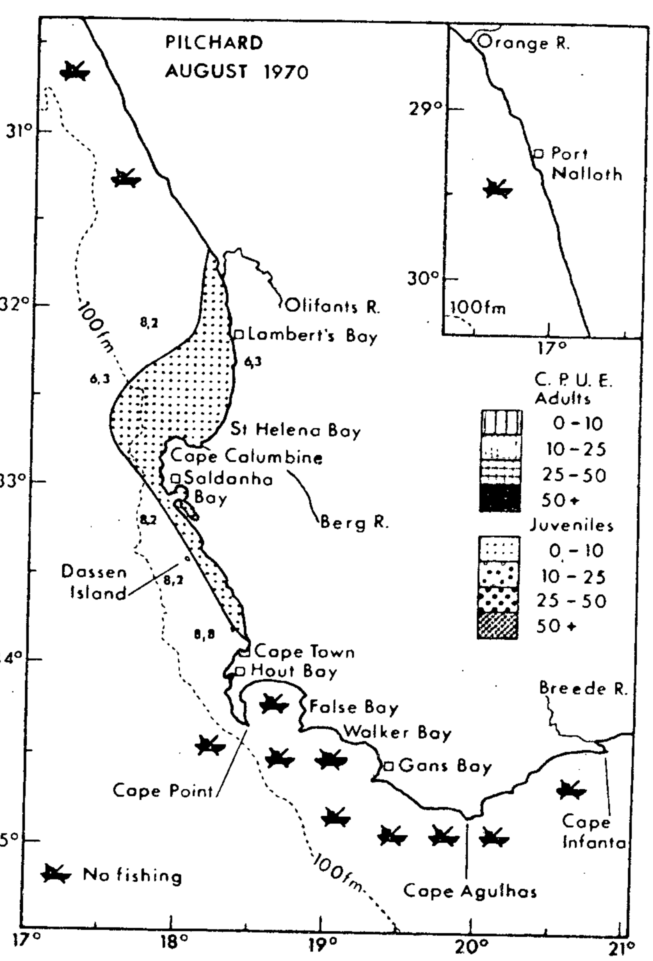
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Dassen Island
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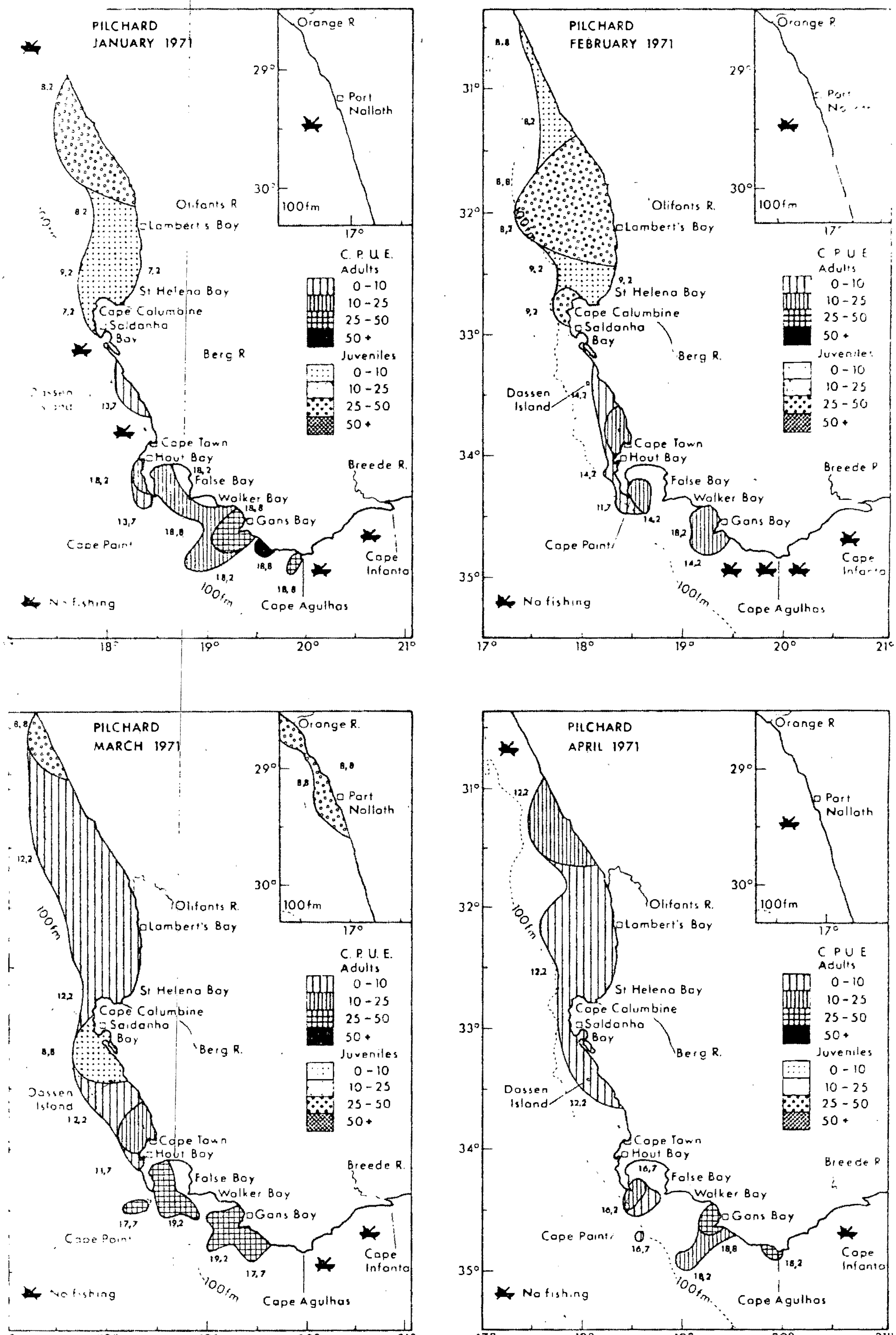
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Berg R.
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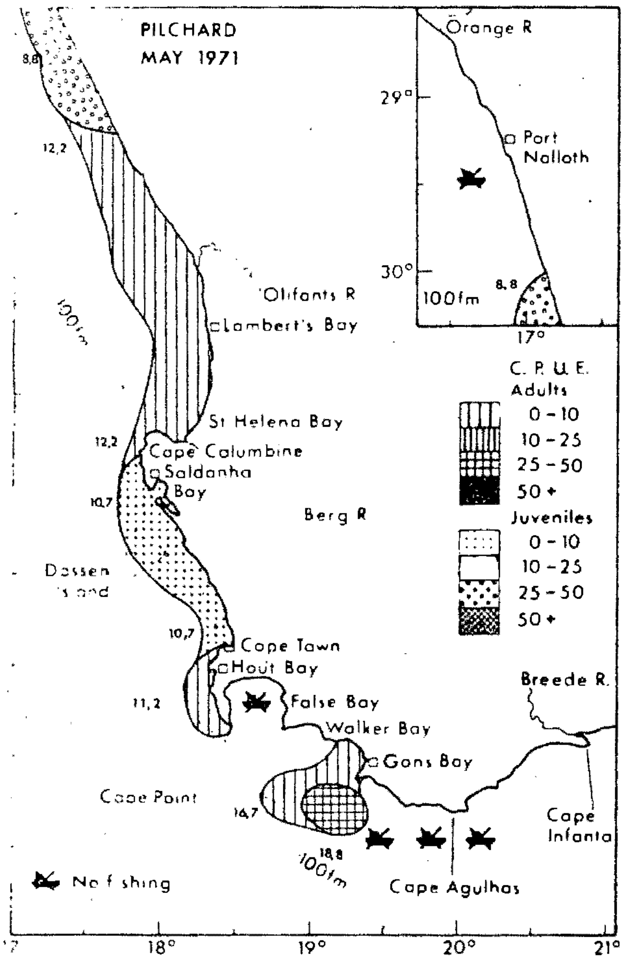
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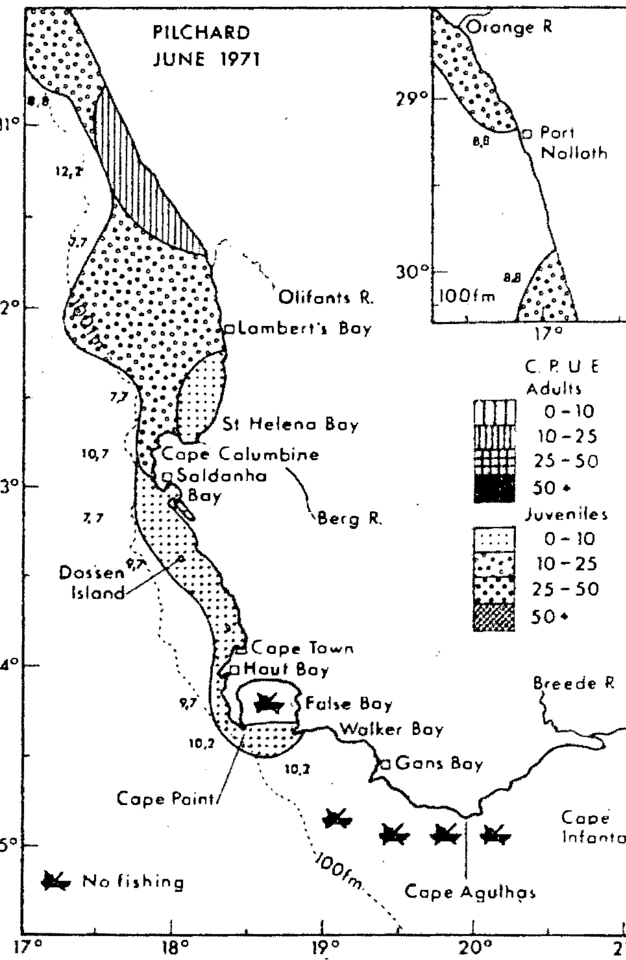
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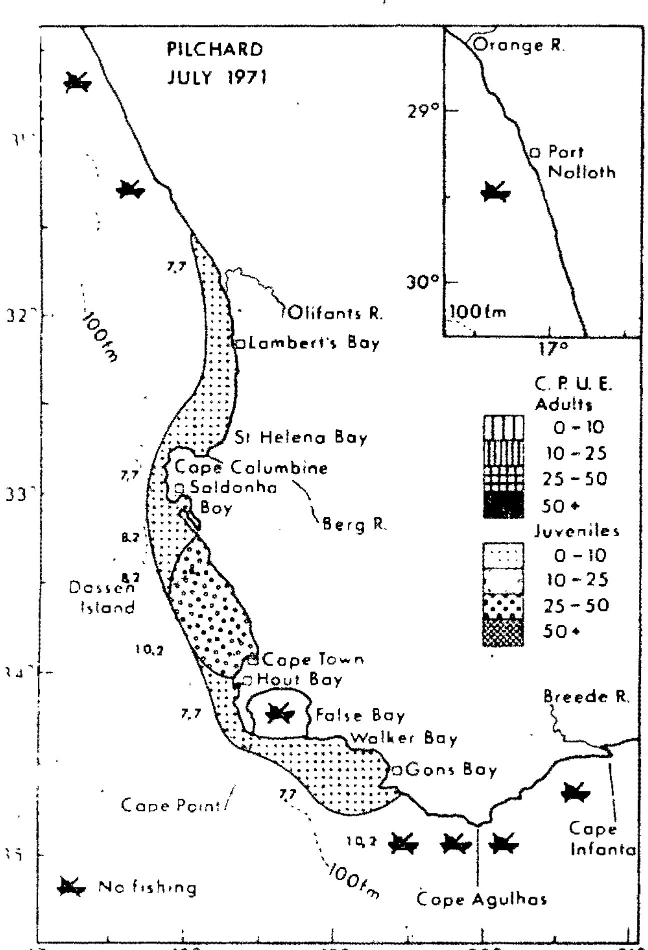
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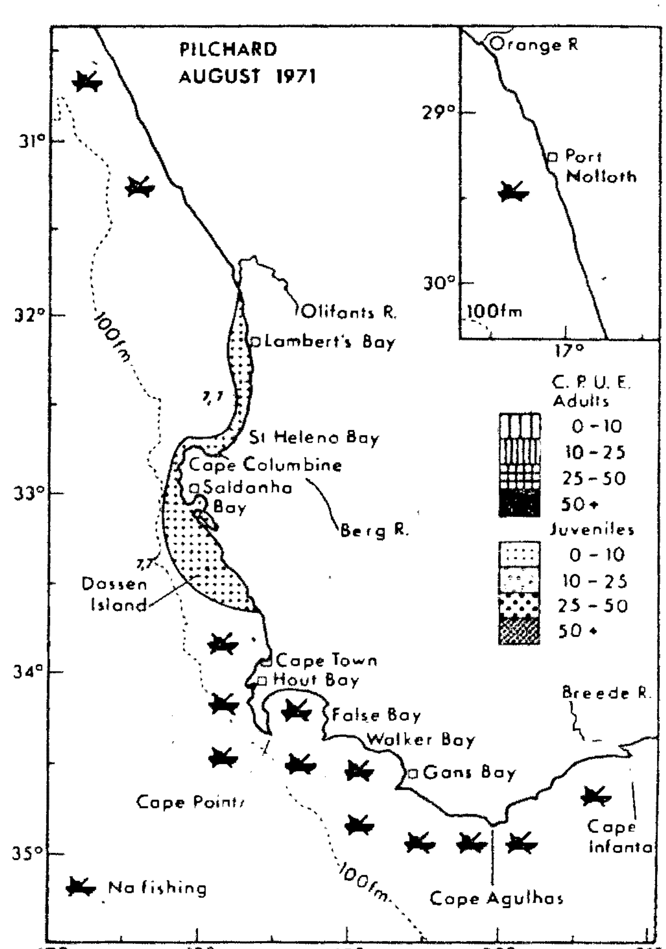
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AUGUST 1971
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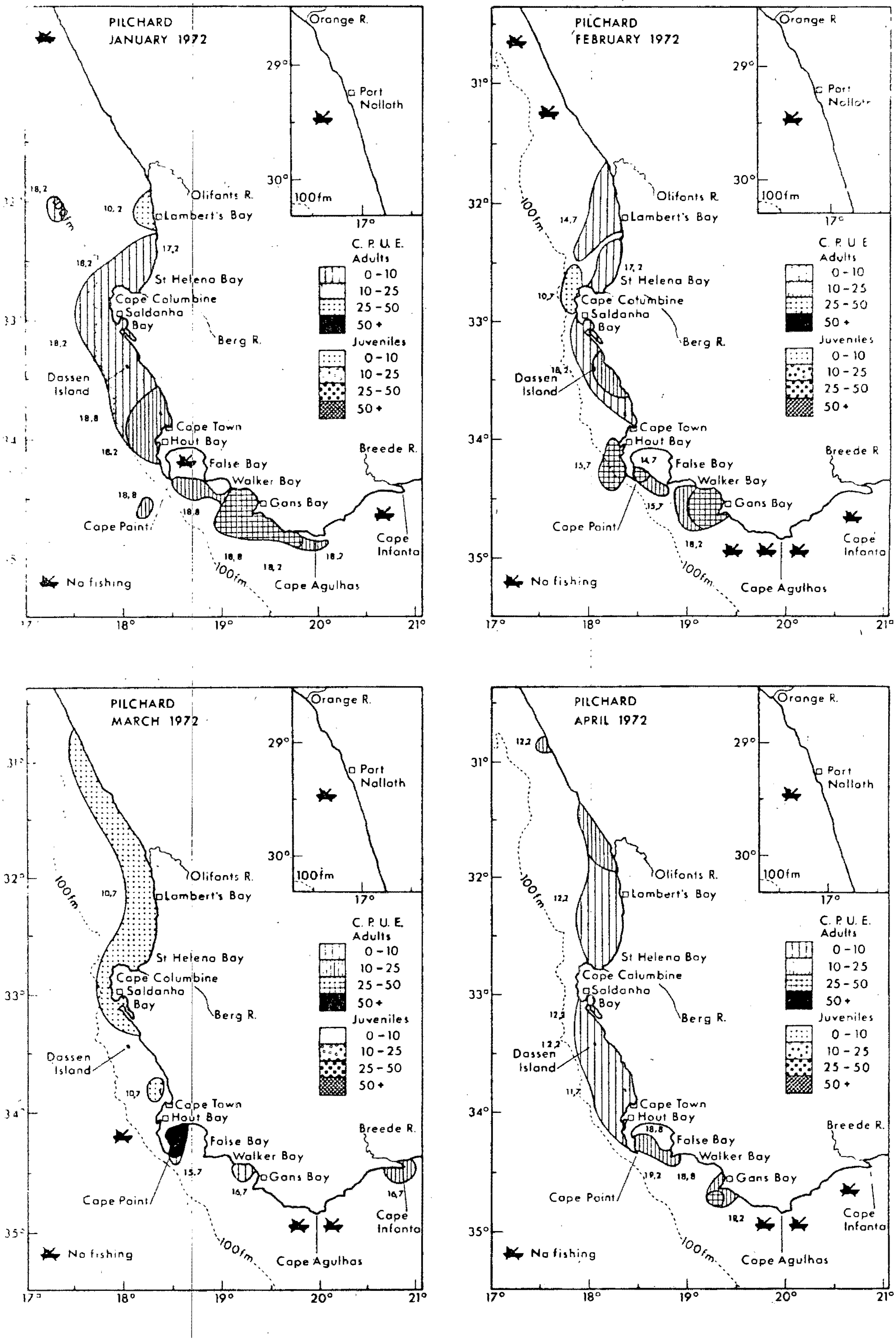
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MARCH 1972
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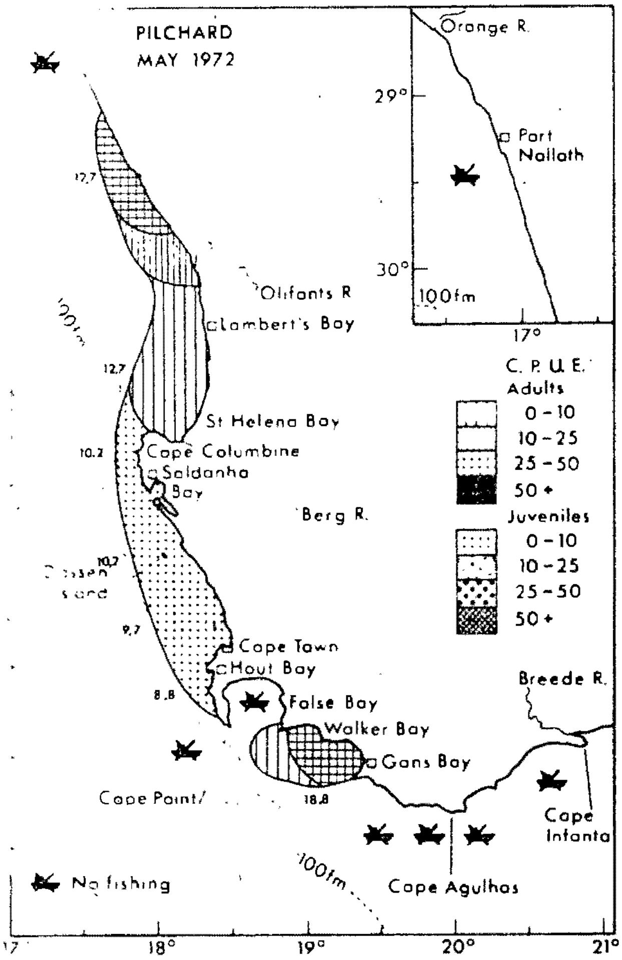
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Lambert's Bay
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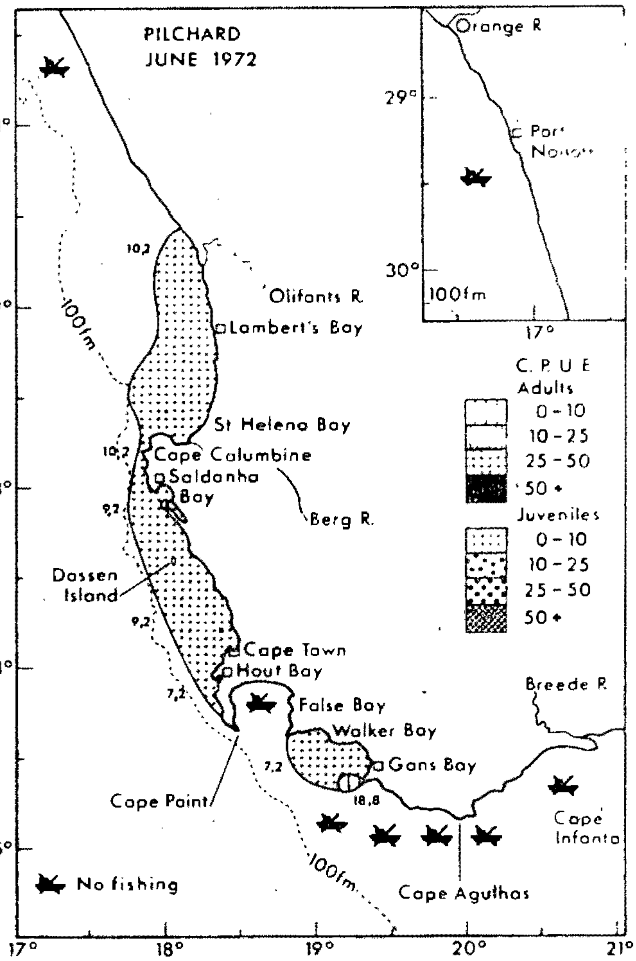
Juveniles
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha
Bay
Berg R.
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape
Infanta
No fishing
100fm
Cape Agulhas
17°
18°
19°
20°
21°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JUNE 1972
Orange R
29°
30°
100fm
17°
31°
32°
33°
34°
35°
100fm
Olifants R.
Lambert's Bay
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha
Bay
Berg R.
Dassen
Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape
Infanta
No fishing
100fm
Cape Agulhas
17°
18°
19°
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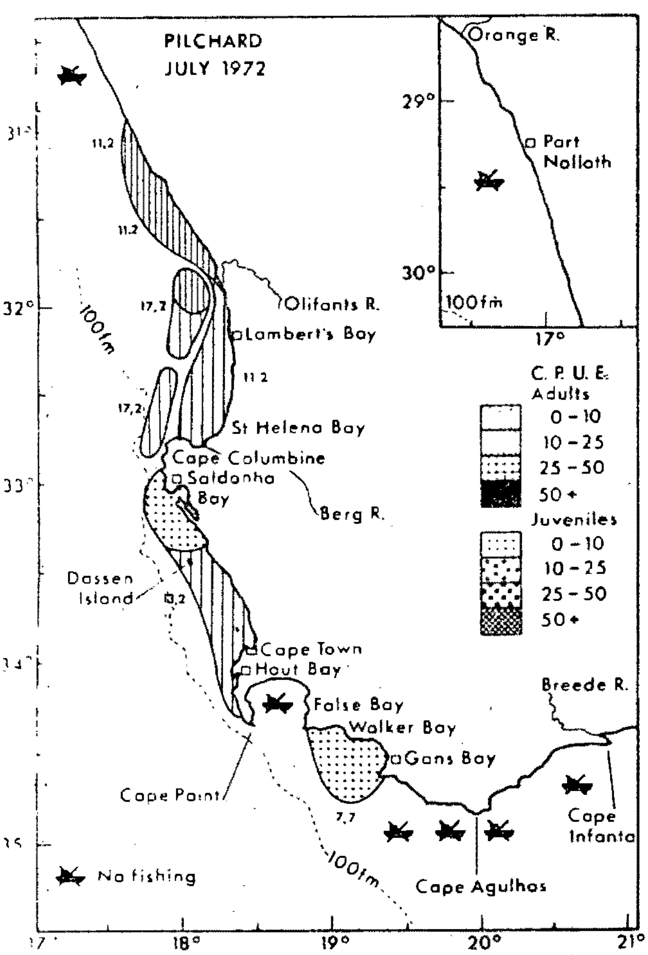
21°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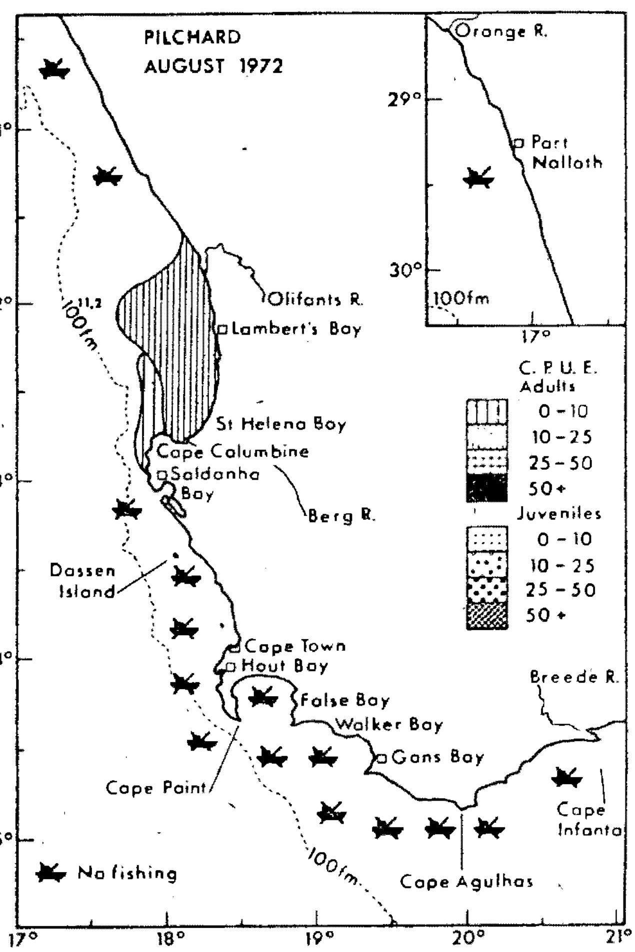
JULY 1972
Orange R.
29°
Port
Nolloth
30°
100fm
17°
32°
100fm
Olifants R.
Lambert's Bay
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha
Bay
Berg R.
Dassen
Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape
Infanta
No fishing
100fm
Cape Agulhas
18°
19°
20°
21°


PILCHARD
AUGUST 1972
Orange R.
29°
Port
Nolloth
30°
100fm
17°
31°
32°
33°
34°
35°
100fm
Olifants R.
Lambert's Bay
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha
Bay
Berg R.
Dassen
Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape
Infanta
No fishing
100fm
Cape Agulhas
17°
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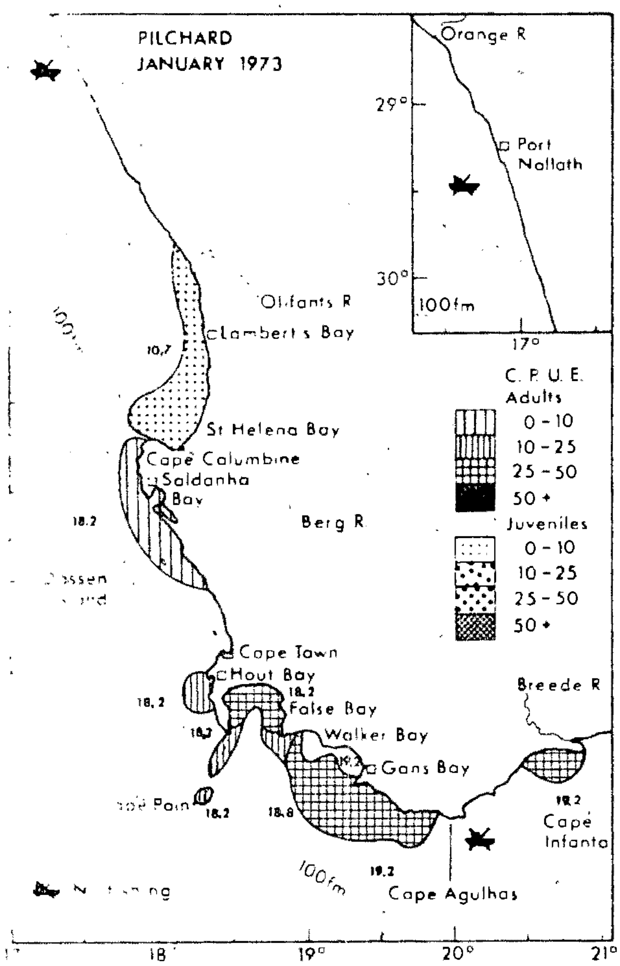
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Port Nolloth
100fm
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Infanta
Cape Agulhas
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
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25 - 50
50 +
18°
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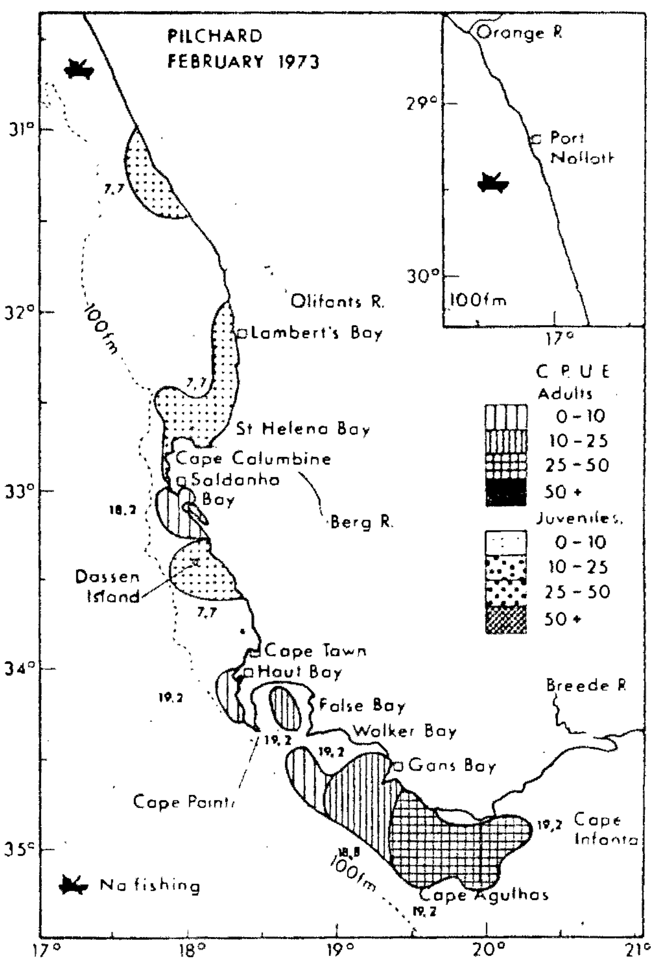
PILCHARD
FEBRUARY 1973
Orange R
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E
Adults
0 - 10
10 - 25
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50 +
Juveniles.
0 - 10
10 - 25
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50 +
17°
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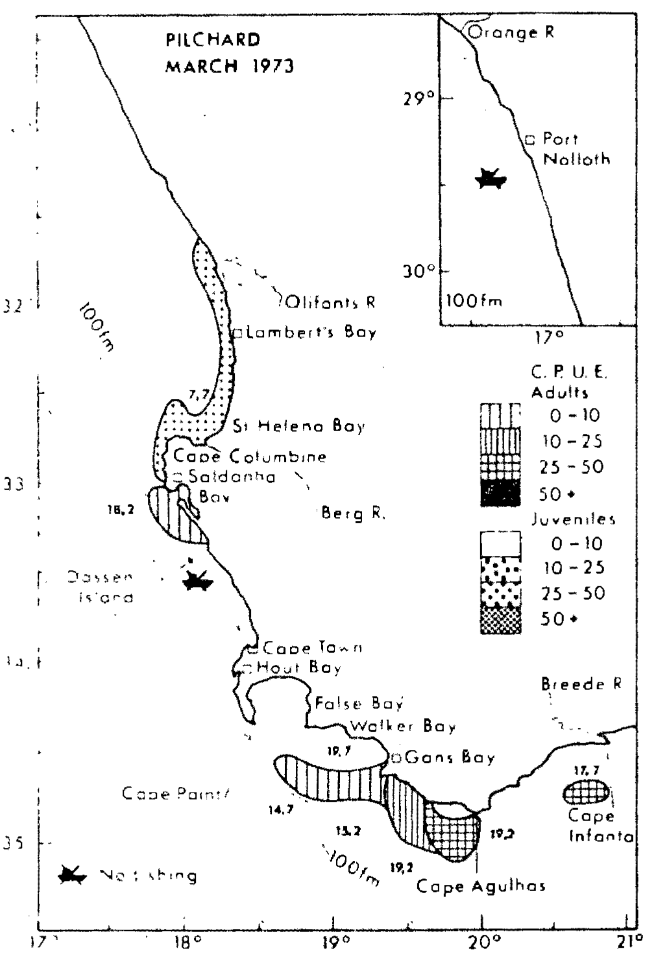
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Port Nolloth
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Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
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25 - 50
50 +
18°
19°
20°
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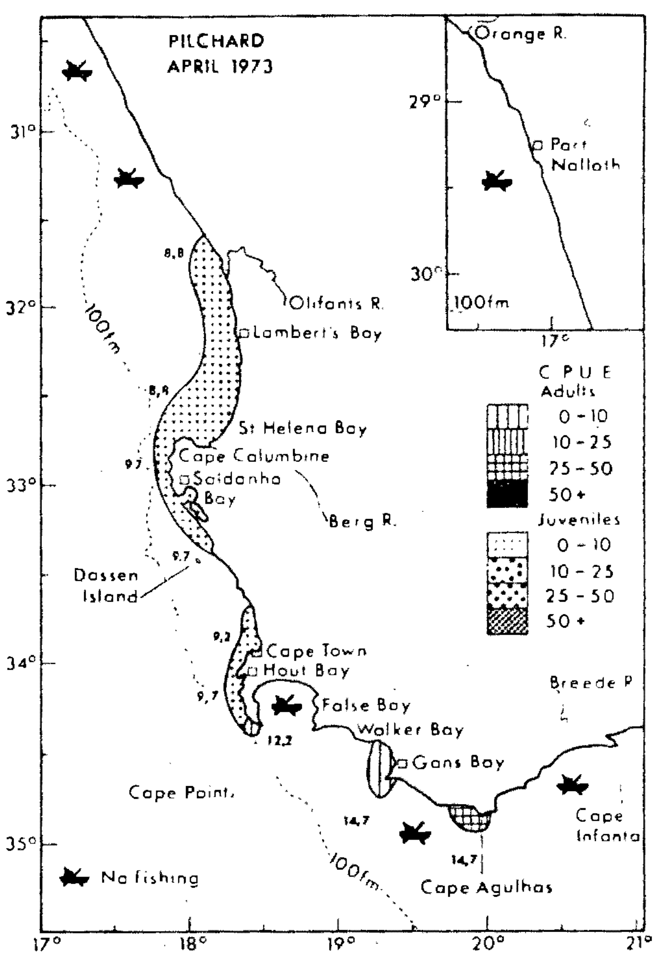
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Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C P U E
Adults
0 - 10
10 - 25
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50 +
Juveniles
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25 - 50
50 +
17°
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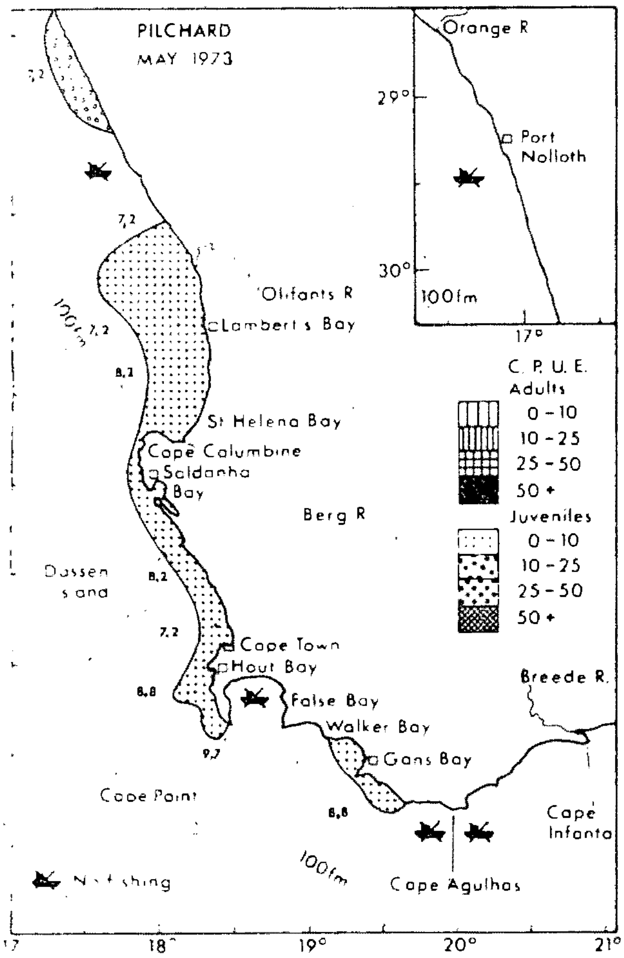
19°
20°
21°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MAY 1973
Orange R
Port Nolloth
29°
30°
100fm
17°
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
7,2
8,2
8,8
9,7
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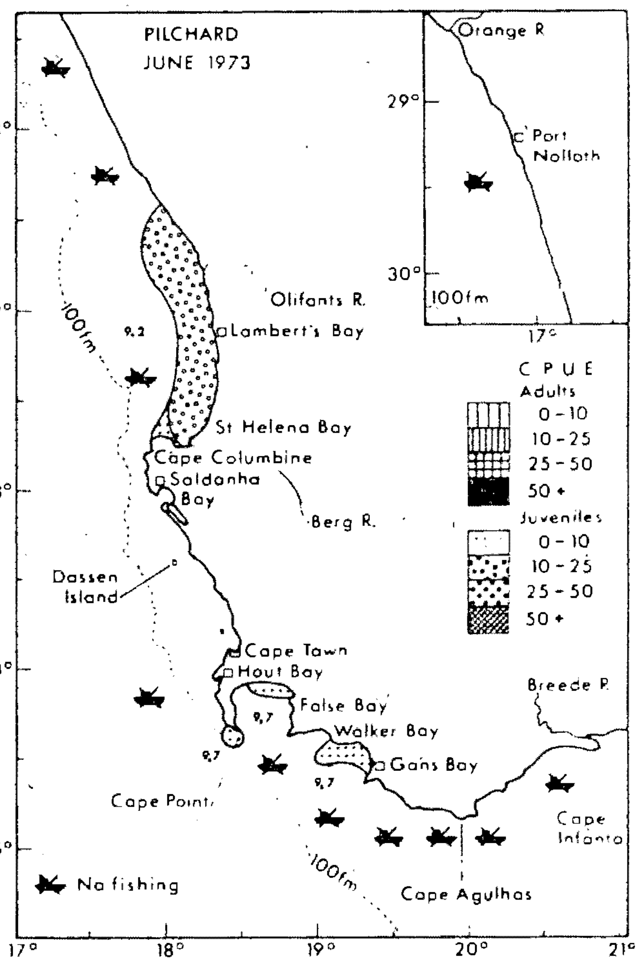
19°
20°
21°


PILCHARD
JUNE 1973
Orange R
Port Nolloth
29°
30°
100fm
17°
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33°
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35°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C P U E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
9,2
9,7
17°
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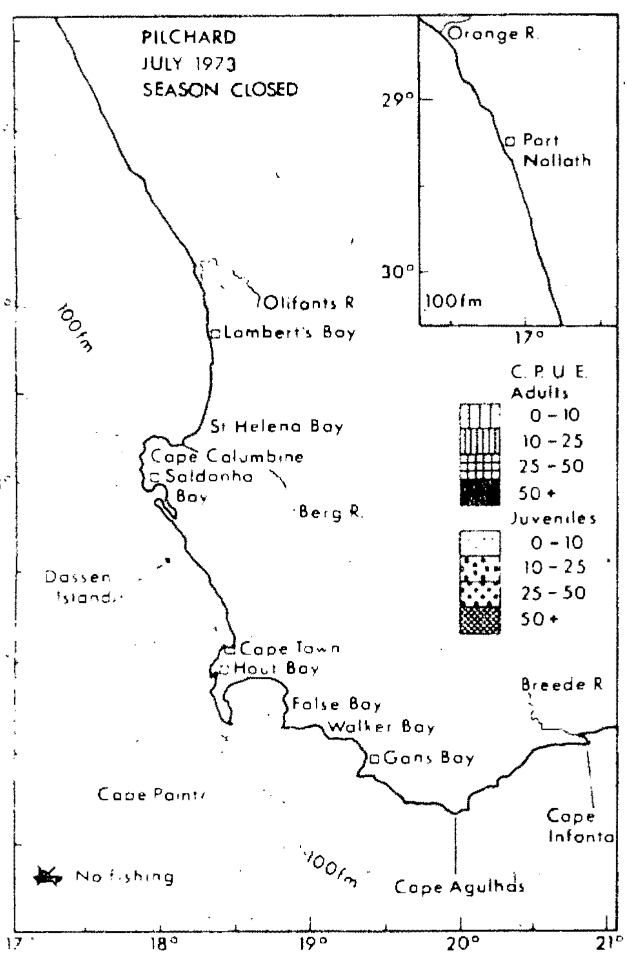
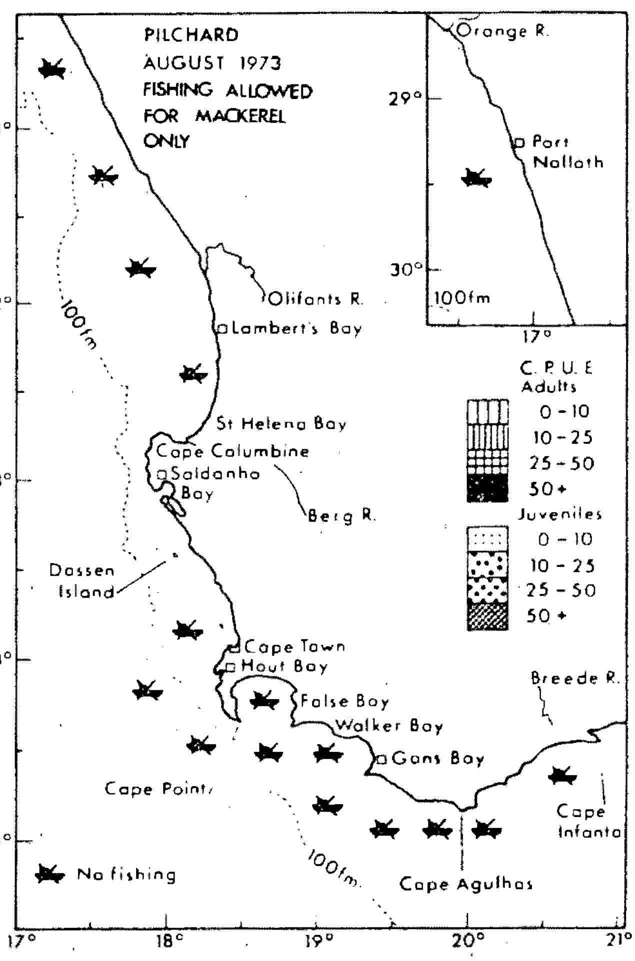

PILCHARD
JULY 1973
SEASON CLOSED
Orange R.
Port Nolloth
29°
30°
100fm
17°
32°
33°
34°
35
100fm
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
18°
19°
20°
21°


PILCHARD
AUGUST 1973
FISHING ALLOWED FOR MACKEREL ONLY
Orange R.
Port Nolloth
29°
30°
100fm
17°
31°
32°
33°
34°
35°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm.
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
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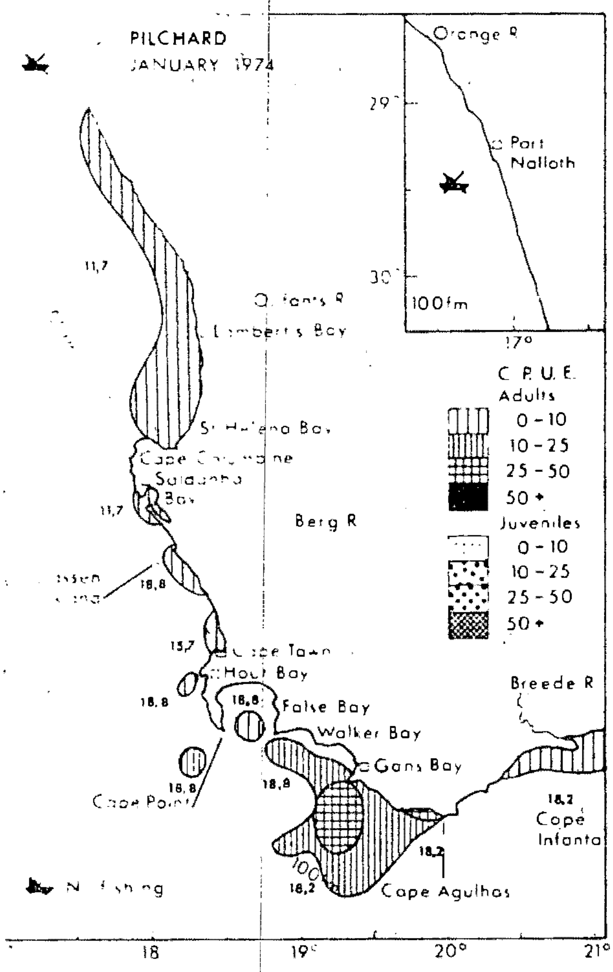
PILCHARD
JANUARY 1974
Orange R
29°
Port
Nolloth
30°
100fm
17°
C.P.U.E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
Lambert's Bay
St Helena Bay
Berg R
Cape Town
Hout Bay
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Gans Bay
Breede R
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Cape Agulhas
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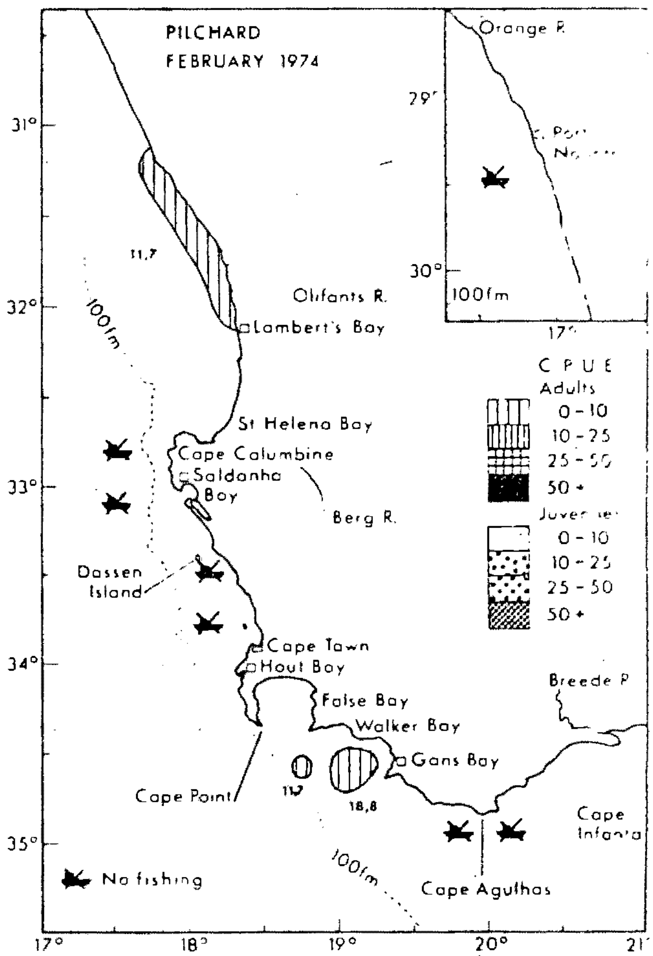
PILCHARD
FEBRUARY 1974
Orange R
29°
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100fm
31°
32°
33°
34°
35°
Olifants R.
Lambert's Bay
C P U E
Adults
0 - 10
10 - 25
50 +
St Helena Bay
Cape Columbine
Saldanha
Bay
Berg R.
Dassen
Island
0 - 10
10 - 25
25 - 50
50 +
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Cape Point
Cape
Infanta
No fishing
Cape Agulhas
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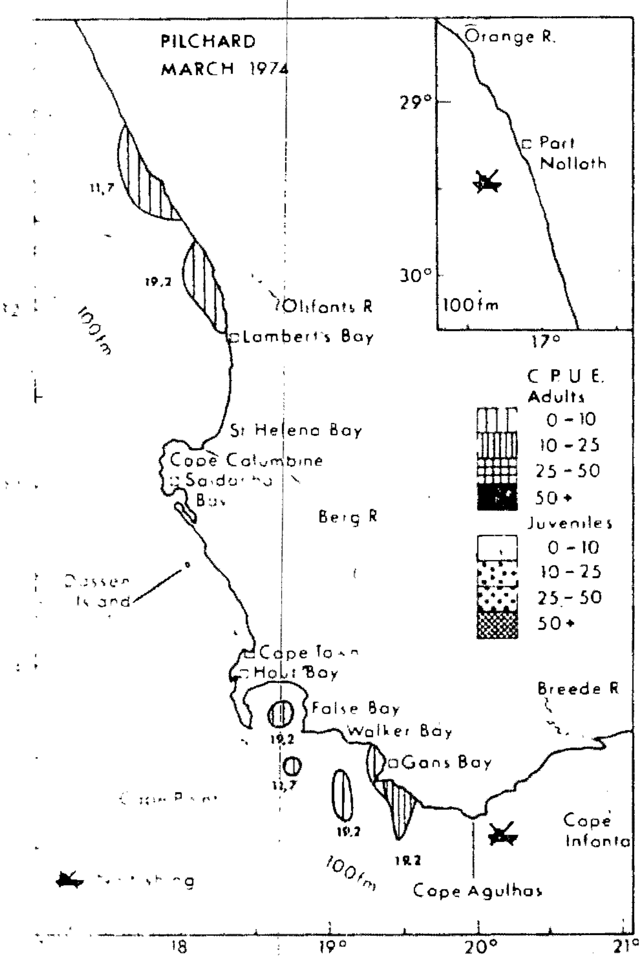
PILCHARD
MARCH 1974
Orange R.
29°
Port
Nolloth
30°
100fm
17°
Olifants R
Lambert's Bay
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Berg R
Cape Town
Hout Bay
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Cape
Infanta
Cape Agulhas
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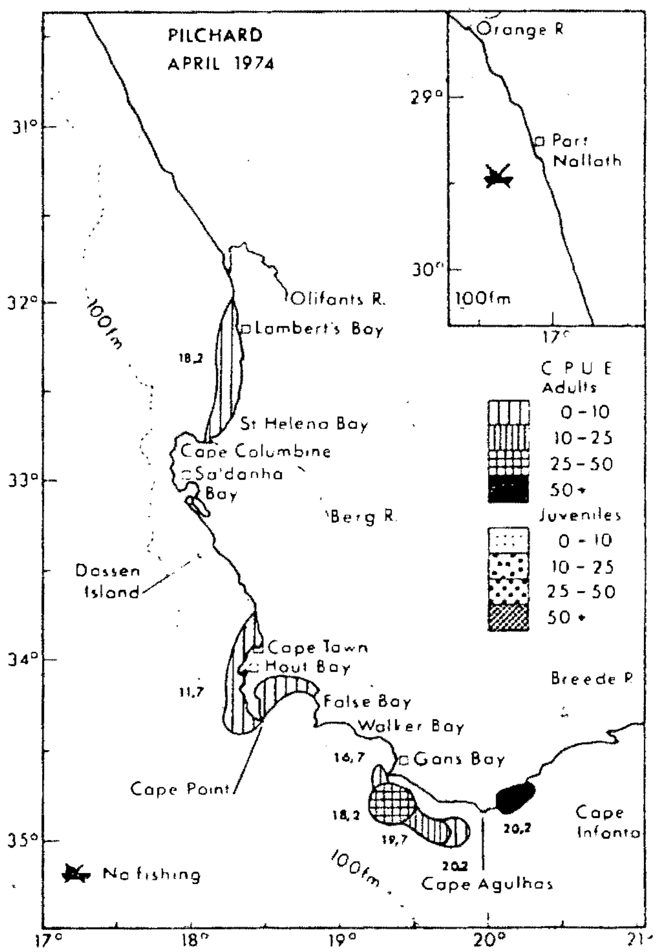
PILCHARD
APRIL 1974
Orange R
29°
Port
Nolloth
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100fm
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35°
Olifants R.
Lambert's Bay
C P U E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha
Bay
Berg R.
Dassen
Island
Cape Town
Hout Bay
Breede R
False Bay
Walker Bay
Gans Bay
Cape Point
Cape
Infanta
No fishing
Cape Agulhas
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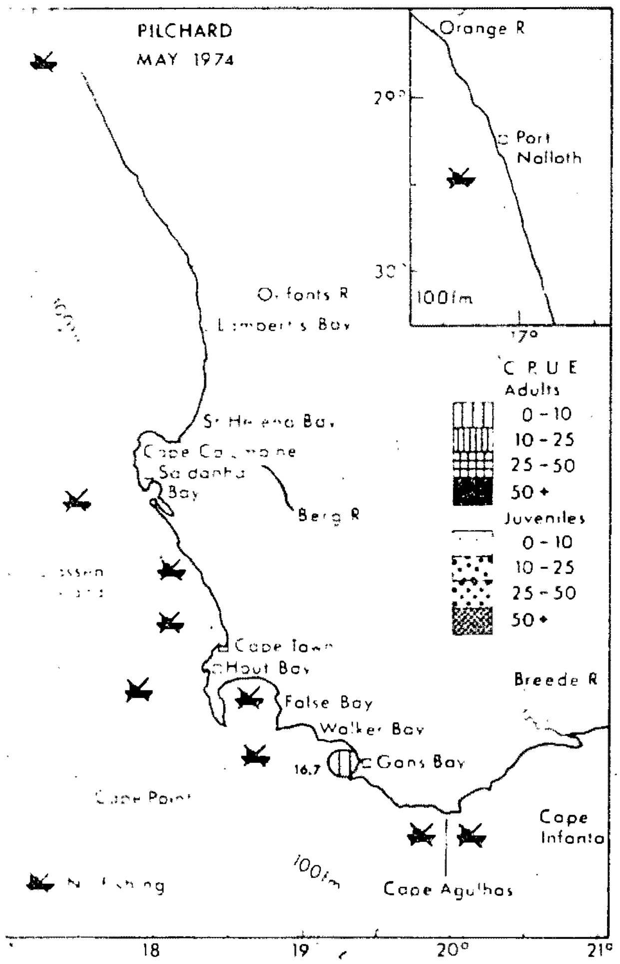
PILCHARD
MAY 1974
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Port Nolloth
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17°
Olifants R
St Helena Bay
Berg R
False Bay
Walker Bay
16.7
Gans Bay
Breede R
Cape Infanta
Cape Agulhas
100fm
C P U E
Adults
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Juveniles
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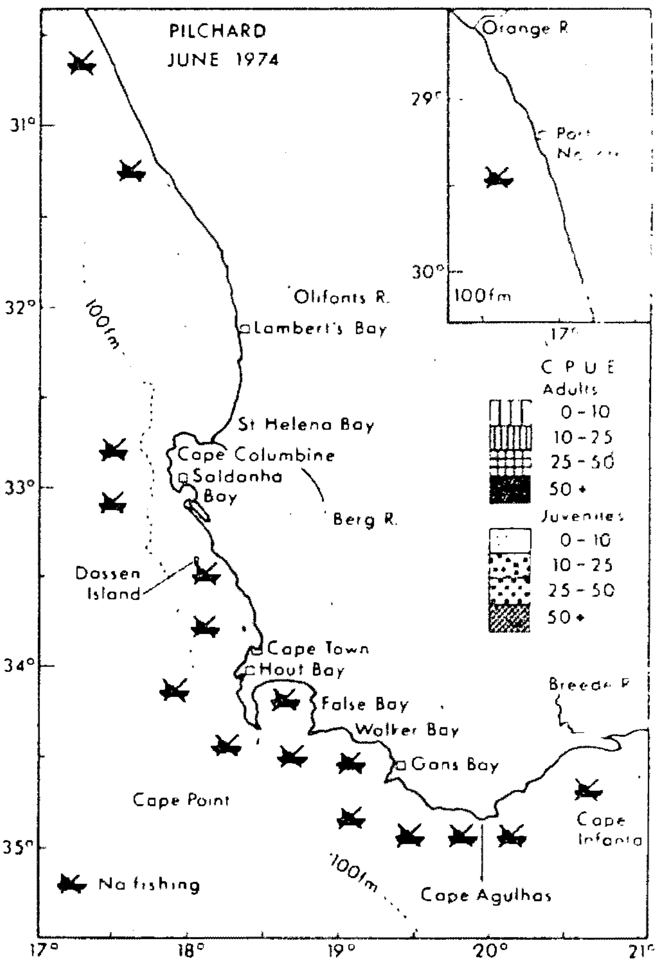
19
20°
21°


PILCHARD
JUNE 1974
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35°
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Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C P U E
Adults
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10 - 25
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50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
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20°
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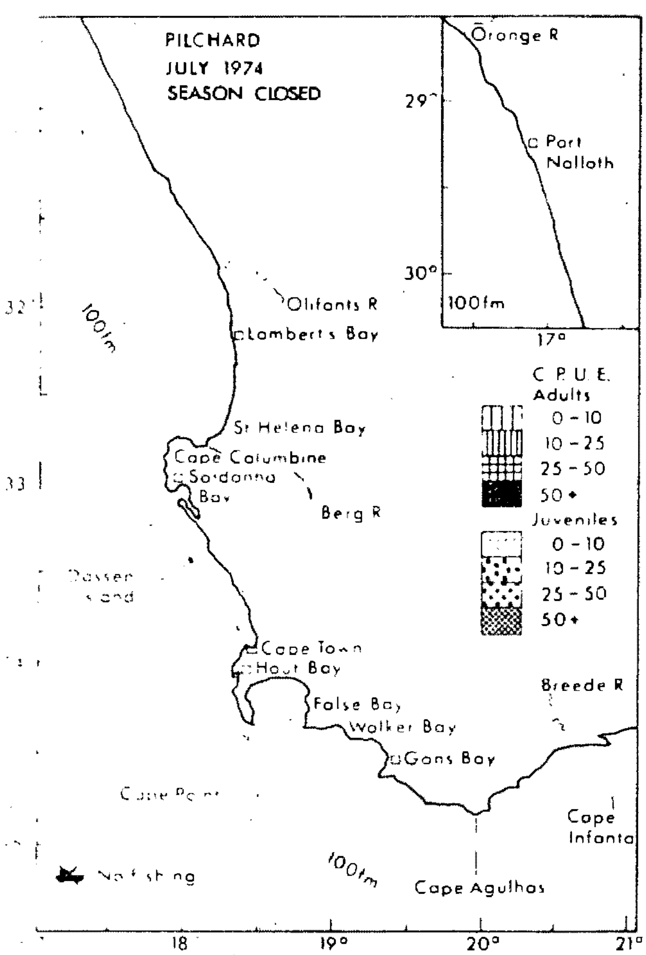
PILCHARD
JULY 1974
SEASON CLOSED
Orange R
29°
Port Nolloth
30°
100fm
17°
Olifants R
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Infanta
Cape Agulhas
100fm
C P U E
Adults
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10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
18
19°
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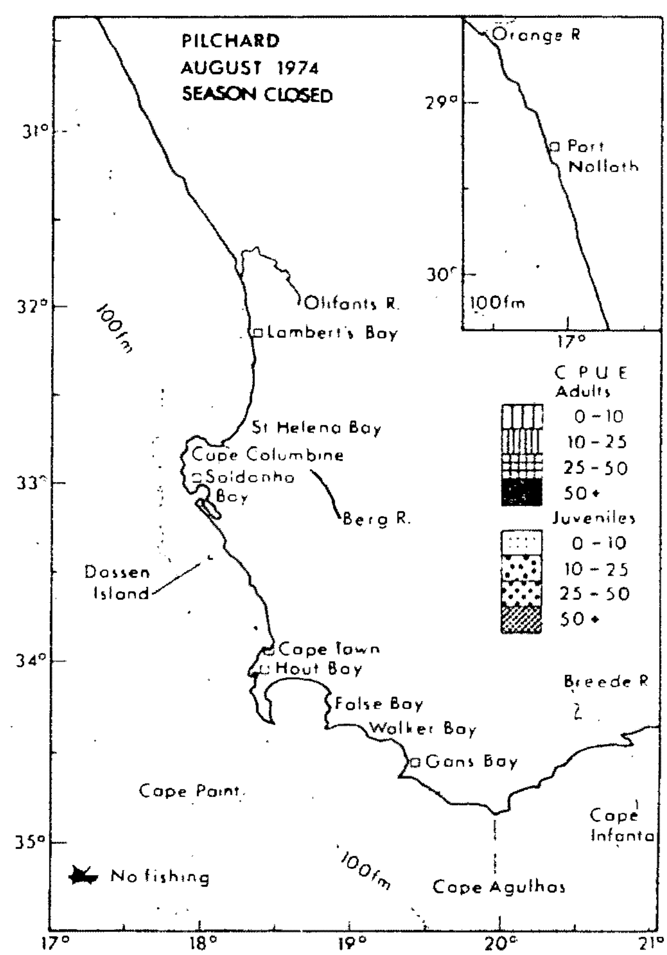
PILCHARD
AUGUST 1974
SEASON CLOSED
Orange R
29°
Port Nolloth
30°
100fm
17°
31°
32°
33°
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35°
Olifants R.
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C P U E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
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25 - 50
50 +
17°
18°
19°
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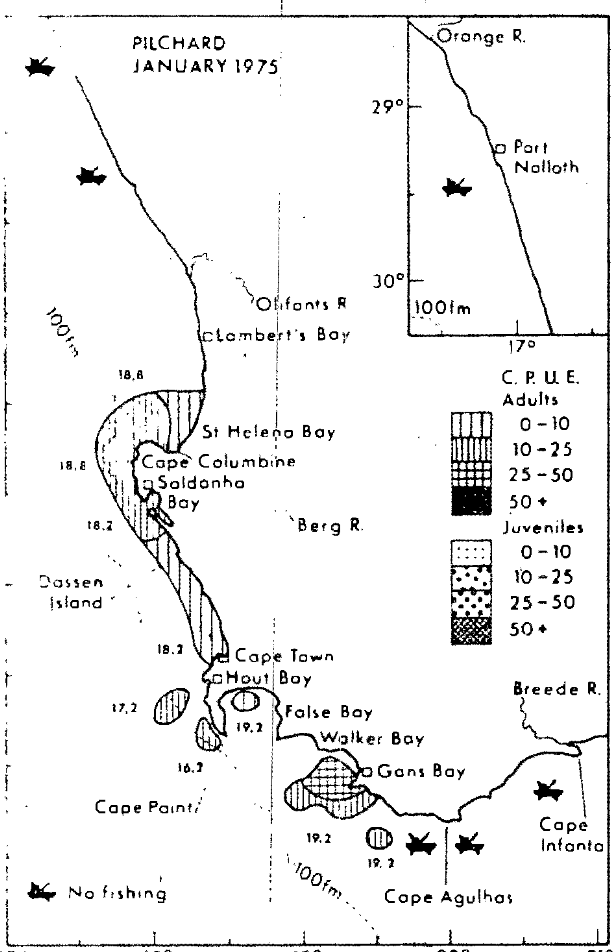
21°


PILCHARD
JANUARY 1975
Orange R.
29°
Port Nolloth
30°
100fm
17°
Olifants R.
Lambert's Bay
100fm
18.8
St Helena Bay
18.8
Cape Columbine
Saldanha Bay
18.2
Berg R.
Dassen Island
18.2
Cape Town
Hout Bay
17.2
False Bay
19.2
Walker Bay
16.2
Gans Bay
Cape Point
19.2
19.2
Cape Infanta
Breede R.
100fm
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
34°
35°
17°
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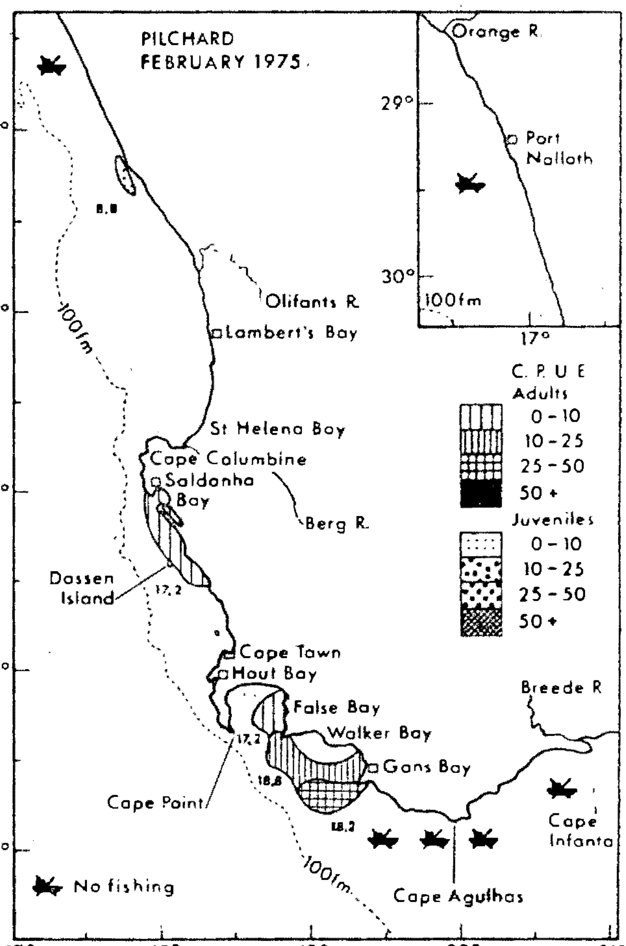
PILCHARD
FEBRUARY 1975
Orange R.
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Port Nolloth
30°
100fm
17°
31°
8.8
Olifants R.
32°
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
33°
Berg R.
Dassen Island
17.2
Cape Town
Hout Bay
34°
False Bay
Breede R
Walker Bay
17.2
Gans Bay
18.8
Cape Point
18.2
Cape Infanta
35°
100fm
No fishing
Cape Agulhas
C. P. U. E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
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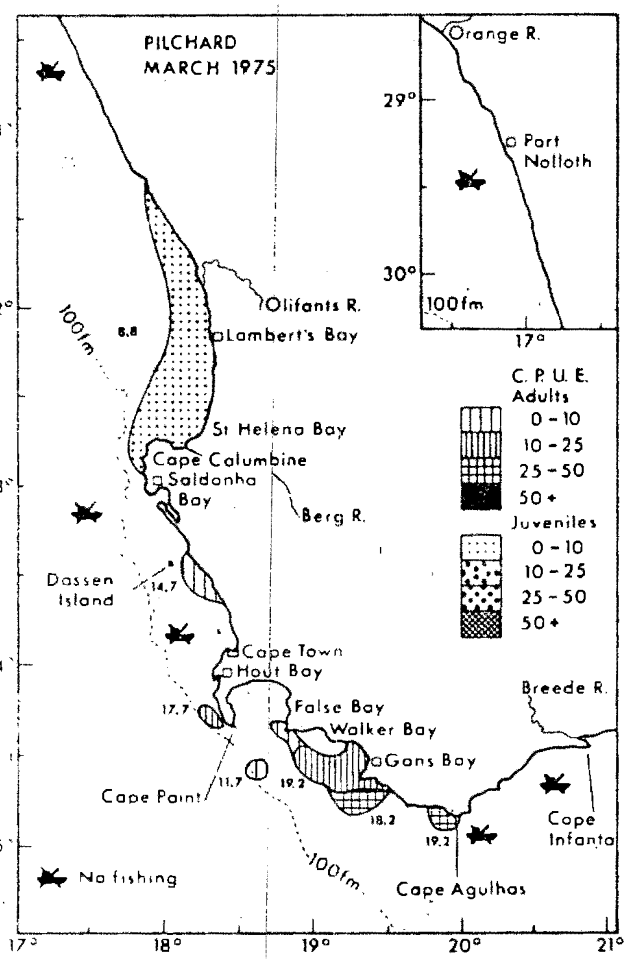
PILCHARD
MARCH 1975
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29°
Port Nolloth
30°
100fm
17°
32°
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Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
14.7
Cape Town
Hout Bay
34°
17.7
False Bay
Walker Bay
Breede R.
Gans Bay
Cape Point
11.7
19.2
18.2
19.2
Cape Infanta
35°
100fm
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
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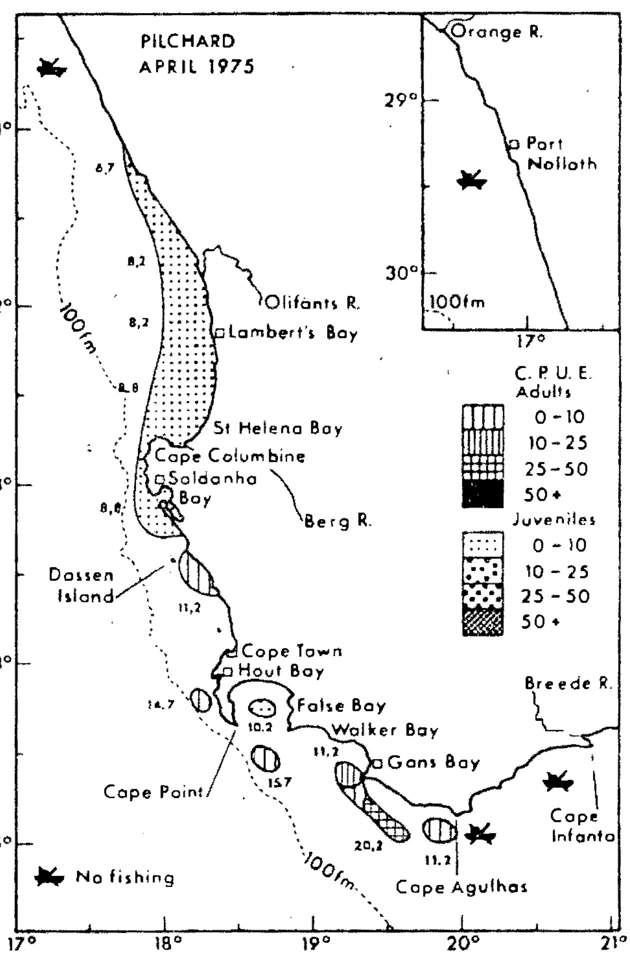
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Orange R.
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Port Nolloth
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17°
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32°
100fm
Olifants R.
Lambert's Bay
8.8
St Helena Bay
Cape Columbine
Saldanha Bay
33°
8.8
Berg R.
Dassen Island
11.2
Cape Town
Hout Bay
34°
14.7
False Bay
10.2
Walker Bay
Breede R.
11.2
Gans Bay
Cape Point
15.7
20.2
11.2
Cape Infanta
35°
100fm
No fishing
Cape Agulhas
C. P. U. E.
Adults
0 - 10
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50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
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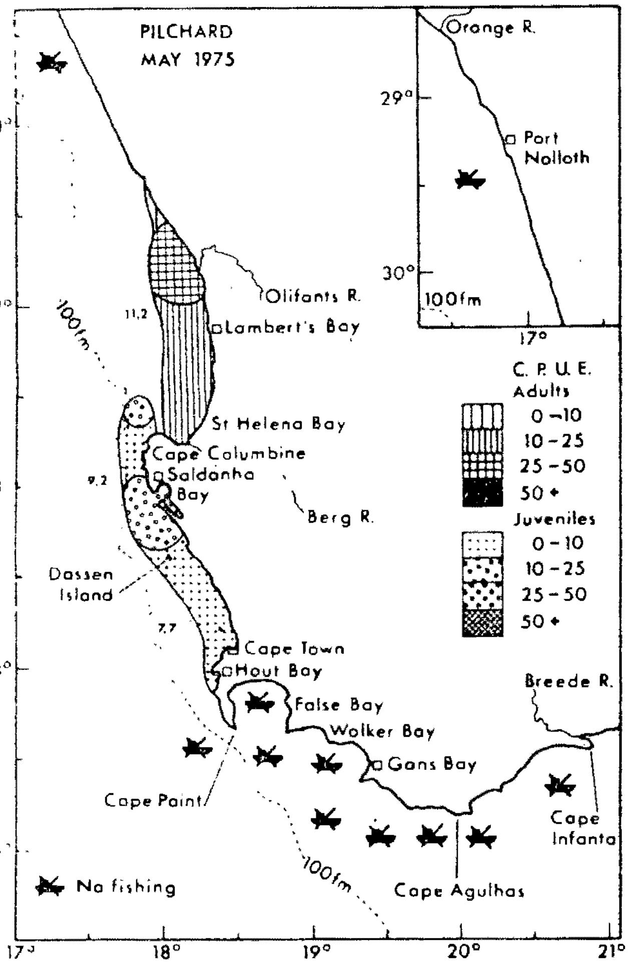
PILCHARD
MAY 1975
Orange R.
29°
Port
Nolloth
30°
100fm
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17°
18°
19°
20°
21°
11.2
9.2
7.7
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha
Bay
Berg R.
Dassen
Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape
Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
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10 - 25
25 - 50
50 +
Juveniles
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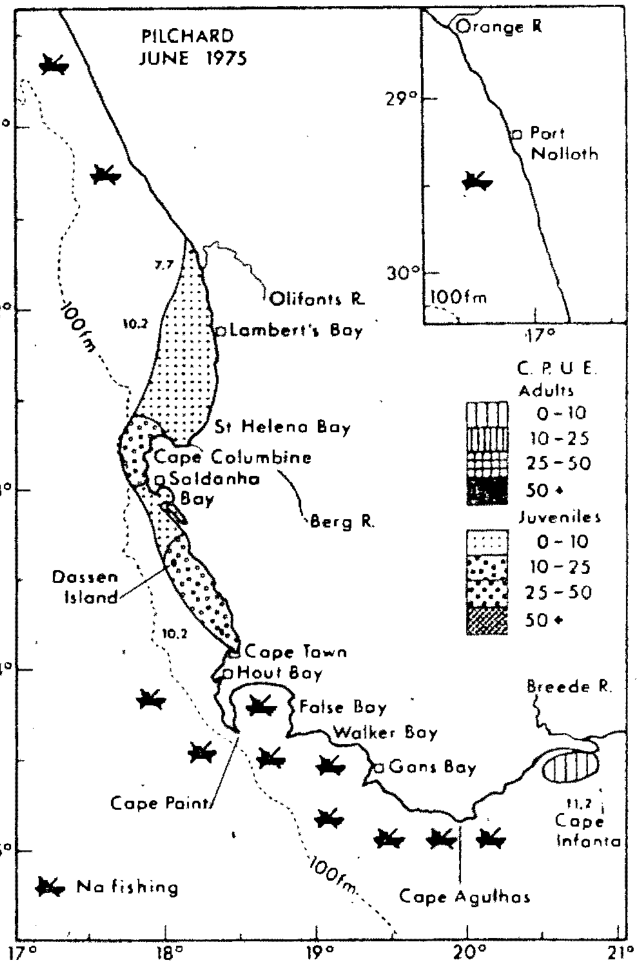
10 - 25
25 - 50
50 +


PILCHARD
JUNE 1975
Orange R
29°
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Nolloth
30°
100fm
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Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha
Bay
Berg R.
Dassen
Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape
Infanta
Cape Agulhas
100fm.
No fishing
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Juveniles
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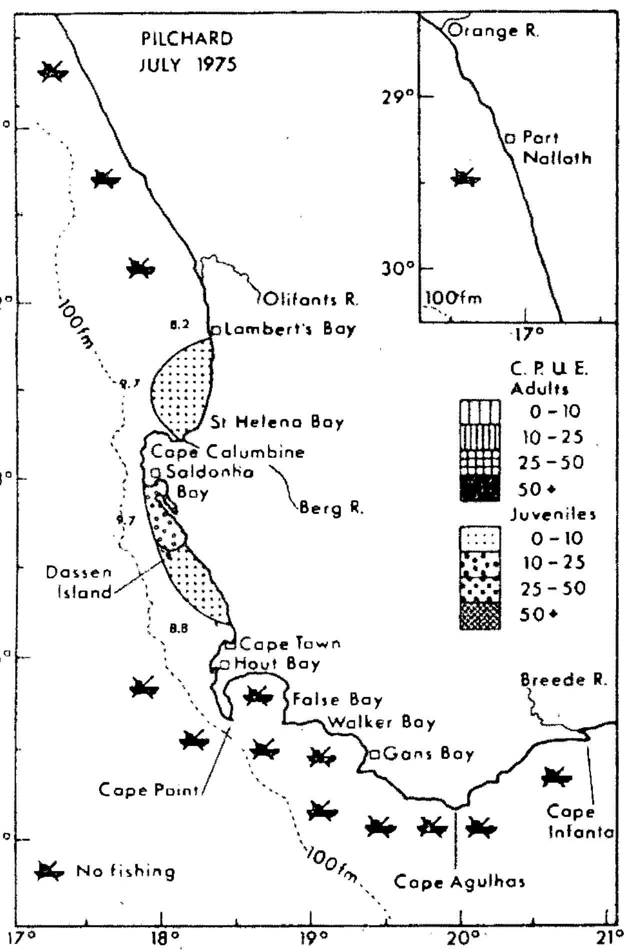
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Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha
Bay
Berg R.
Dassen
Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
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Cape Point
Cape
Infanta
Cape Agulhas
100fm
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Juveniles
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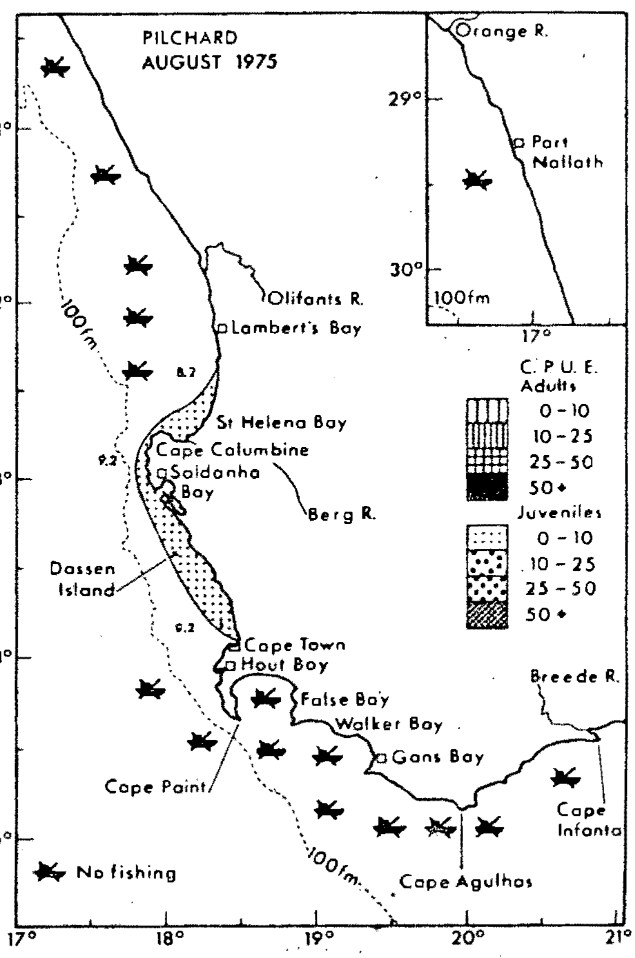
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100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
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Juveniles
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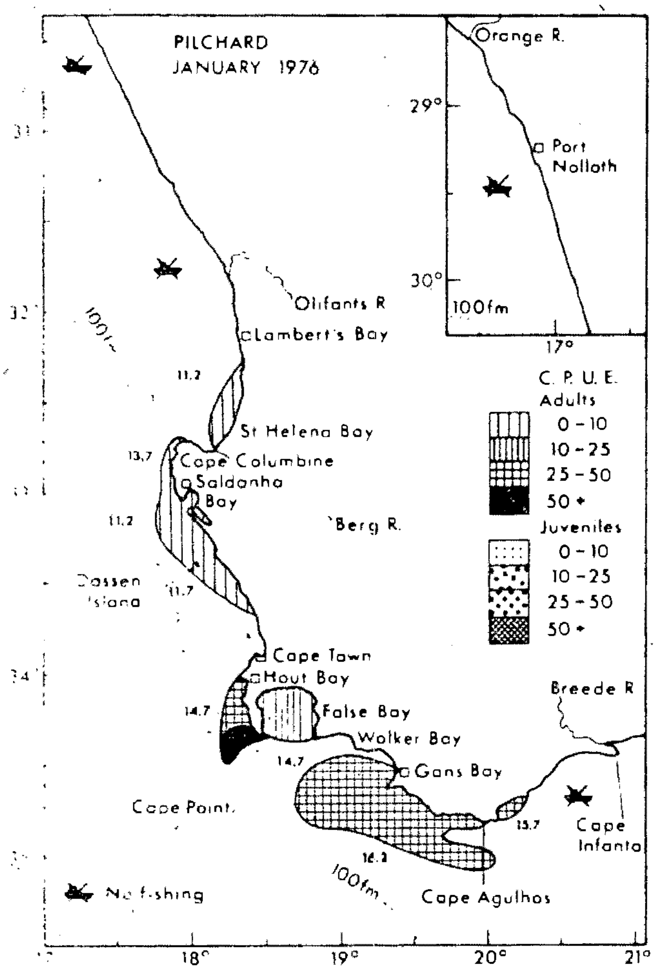
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Berg R.
Dassen Island
Cape Town
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Walker Bay
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Cape Point
Breede R
Cape Infanta
Cape Agulhas
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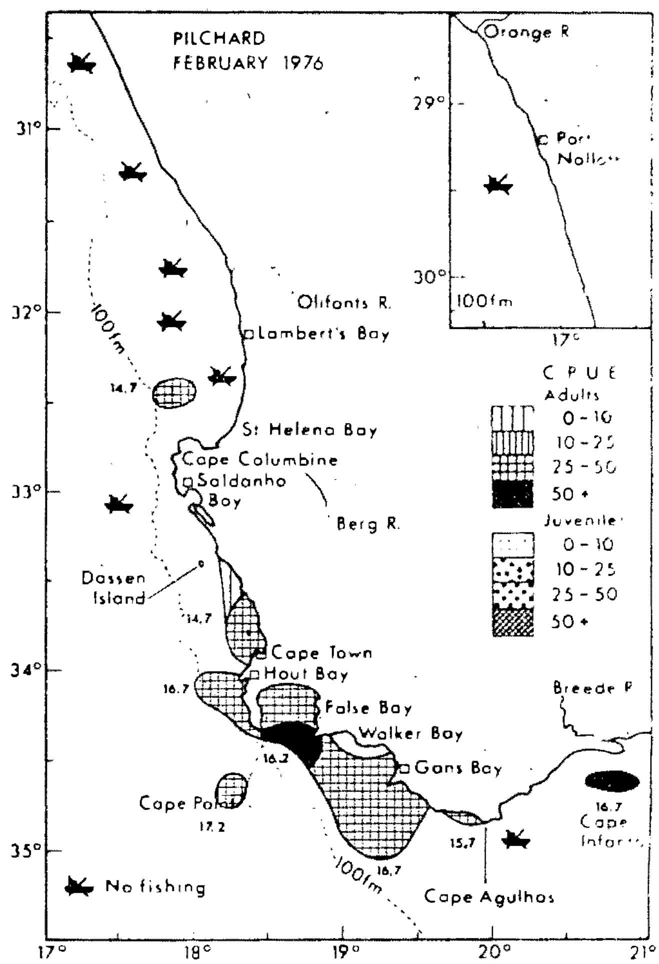
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Dassen Island
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Hout Bay
False Bay
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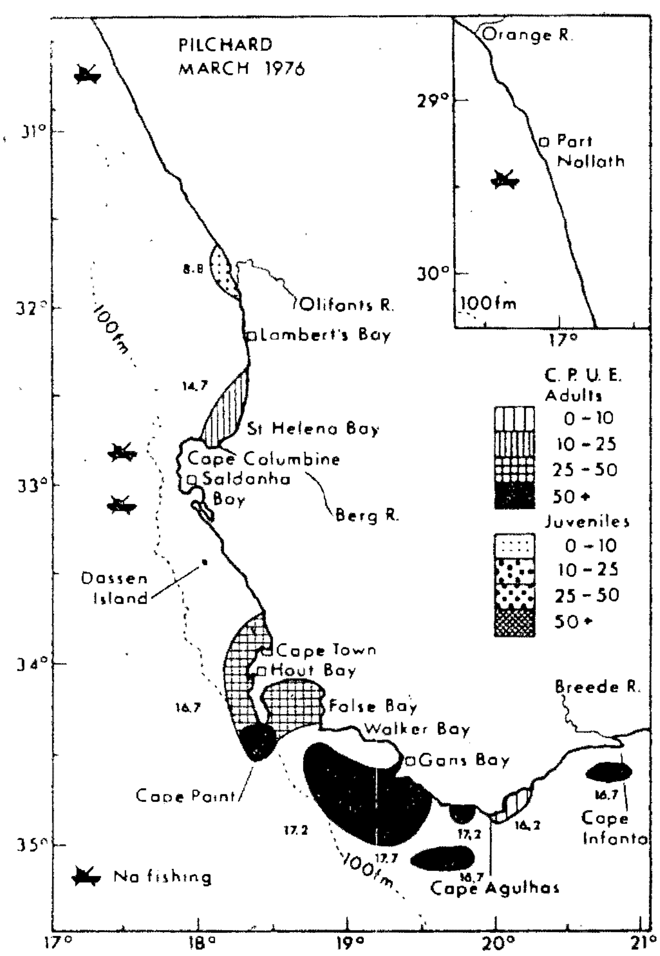
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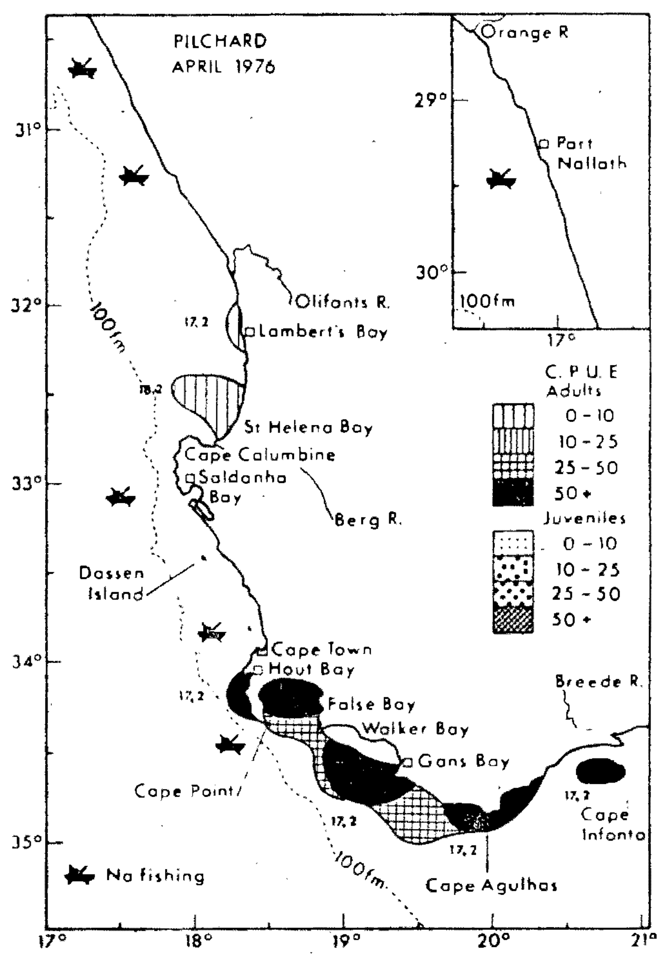
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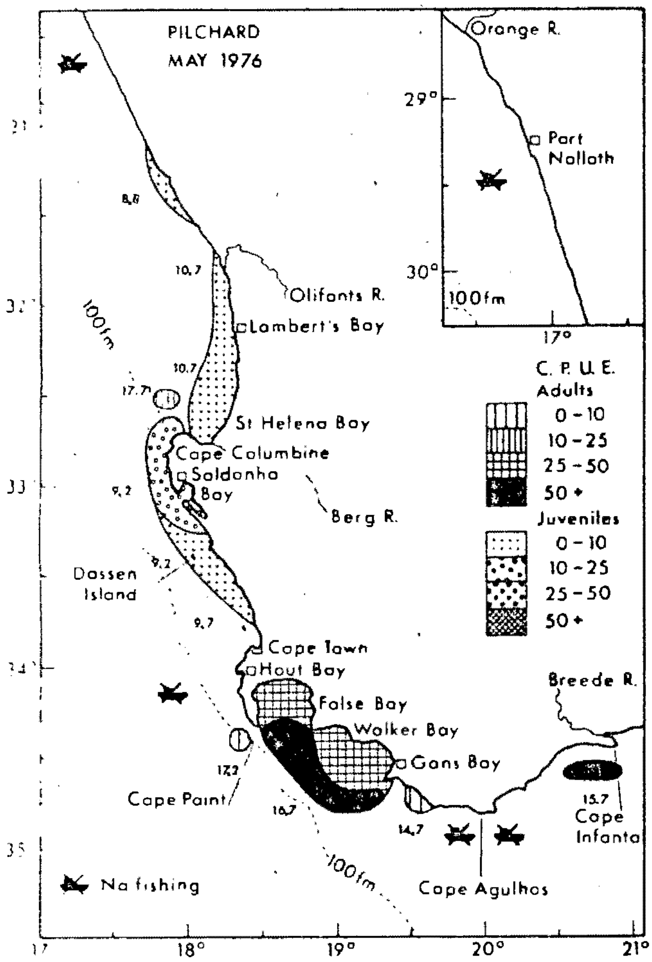
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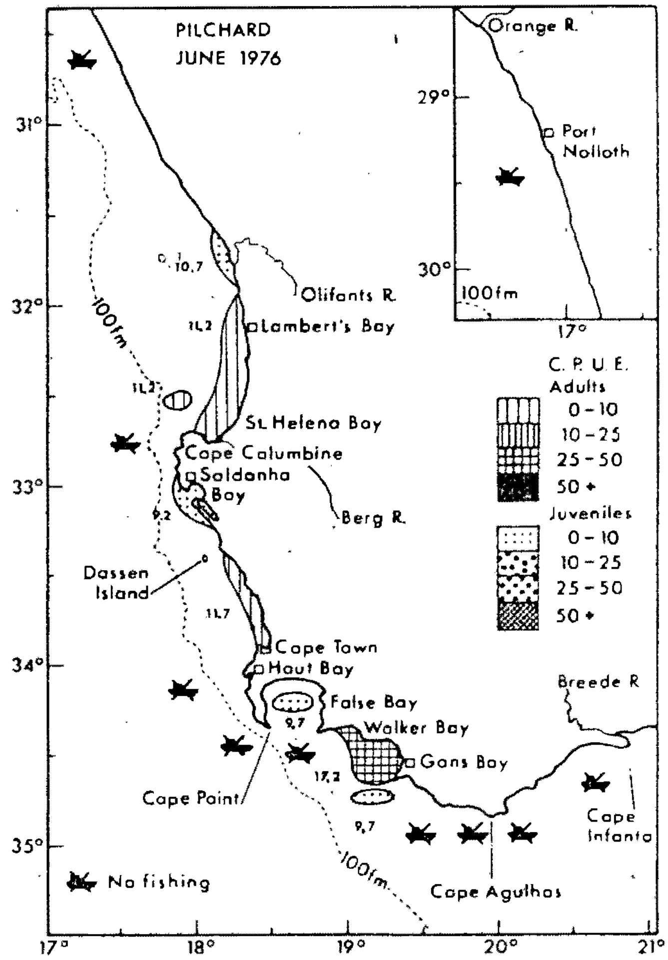
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Berg R.
Dassen Island
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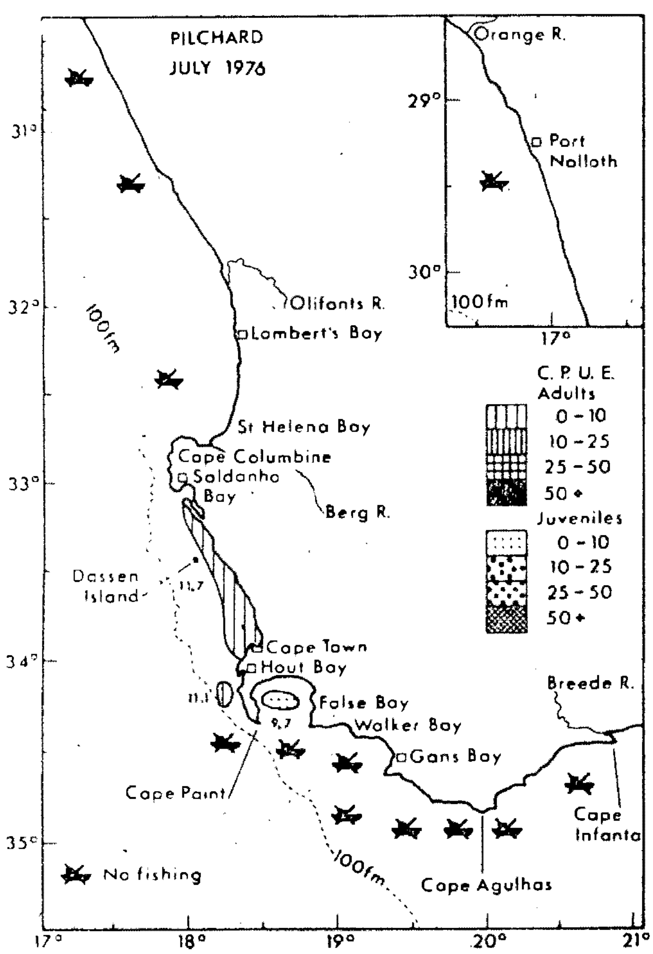
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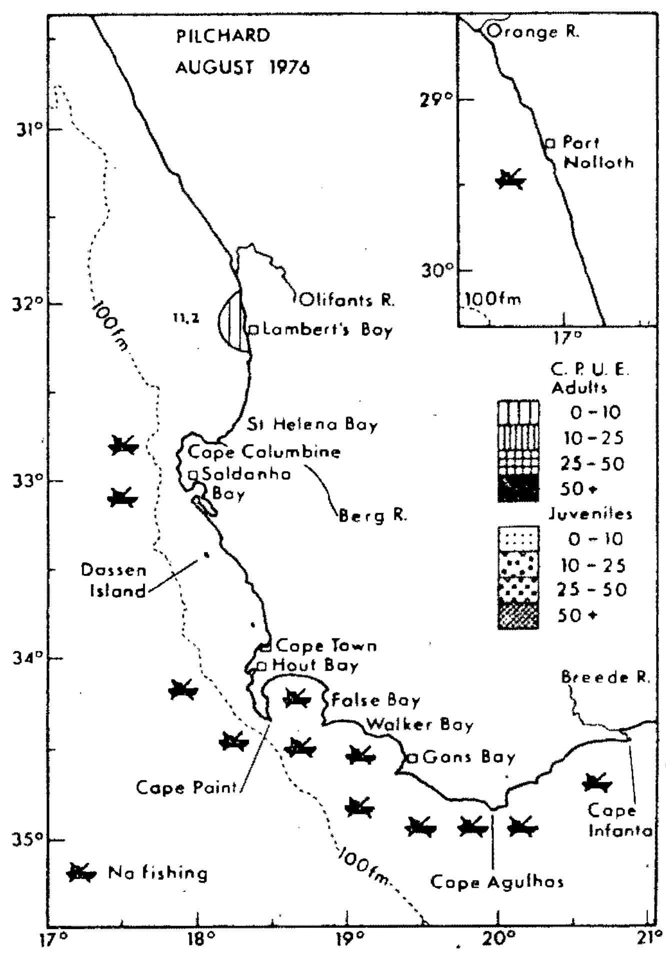
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Port Nolloth
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Lambert's Bay
St Helena Bay
Cape Columbine
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Berg R.
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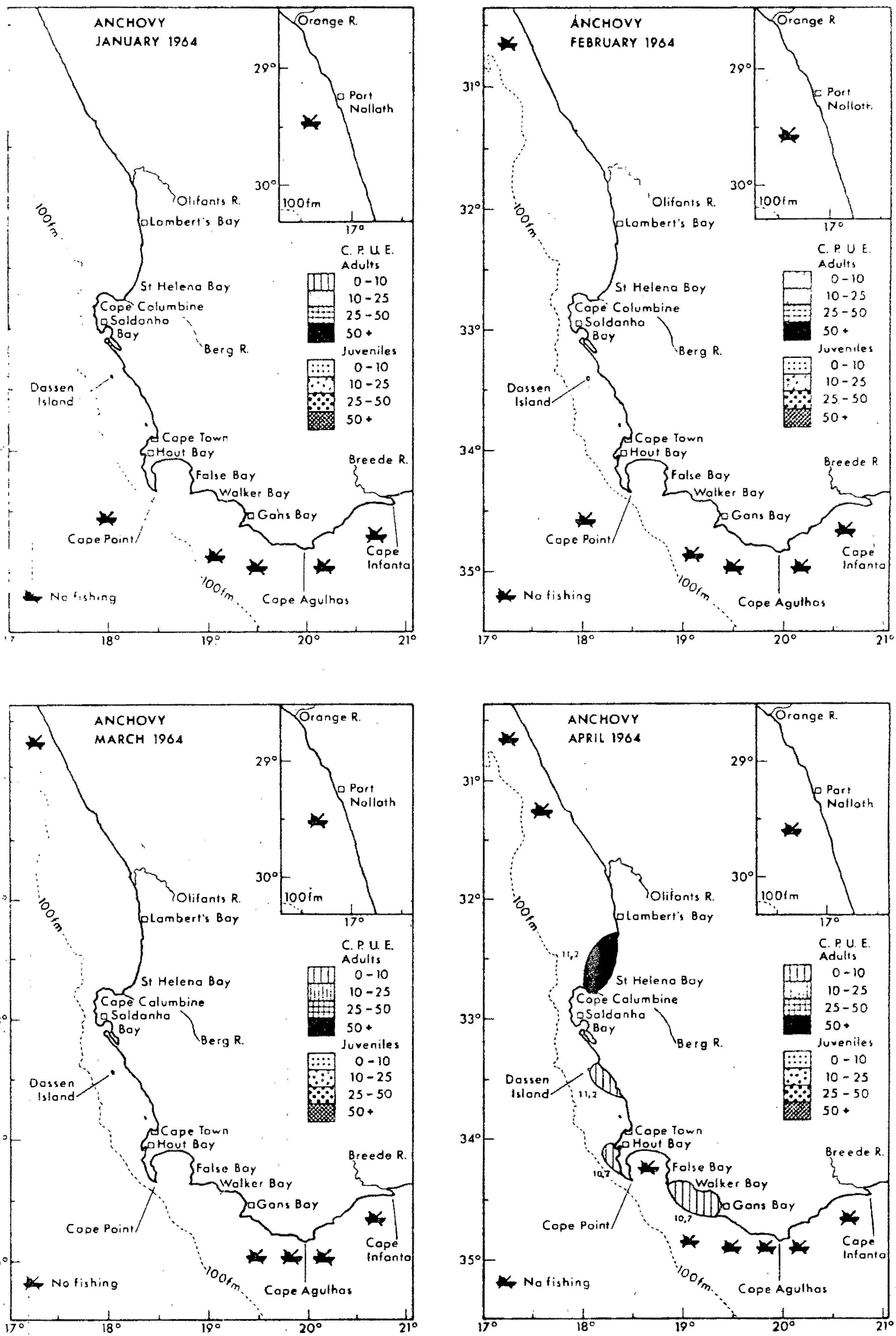
ANCHOVY
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ANCHOVY
FEBRUARY 1964
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MARCH 1964
ANCHOVY
APRIL 1964
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100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
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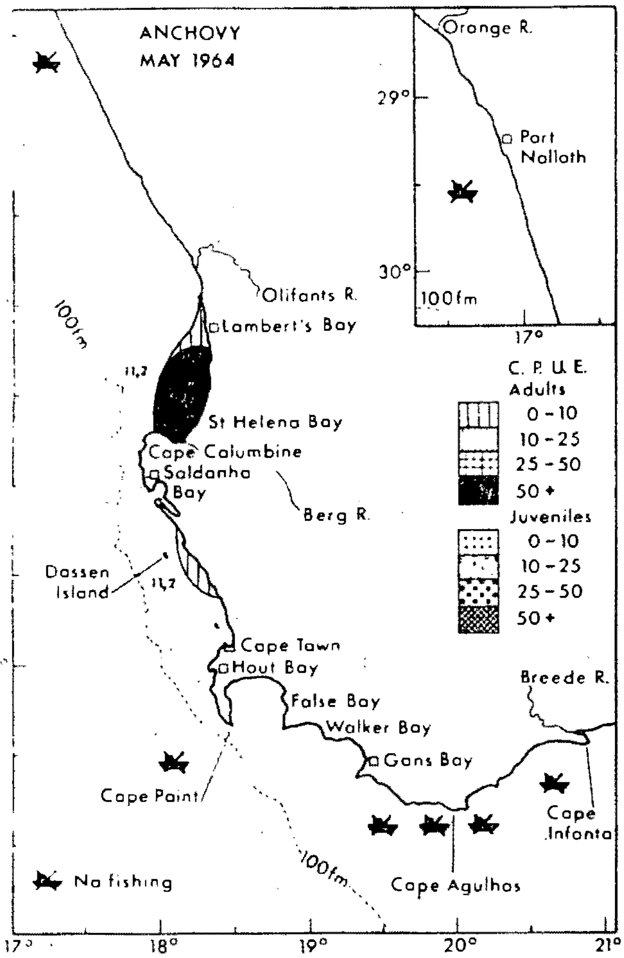

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Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
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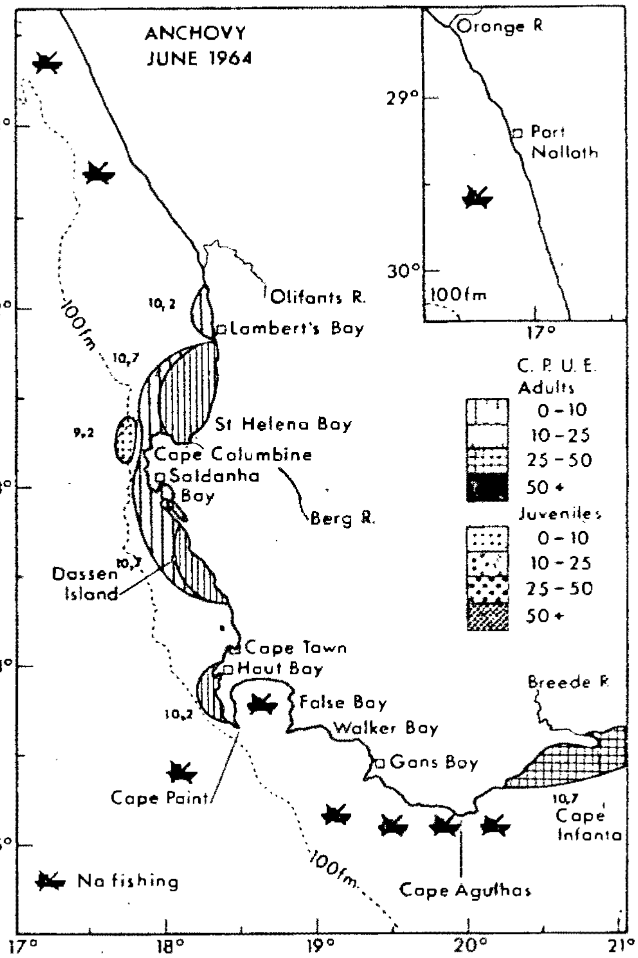

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Saldanha Bay
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Dassen Island
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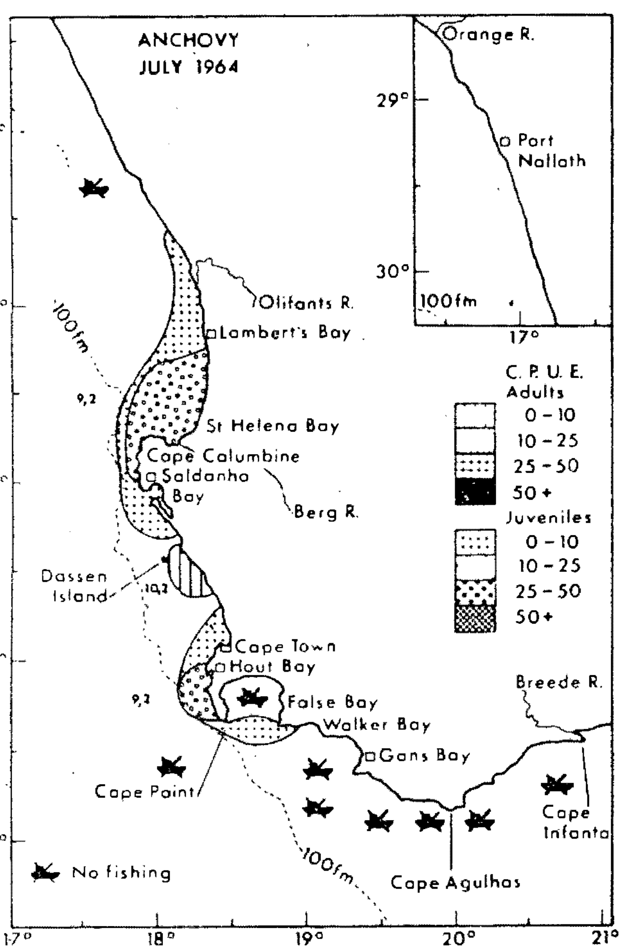

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Dassen Island
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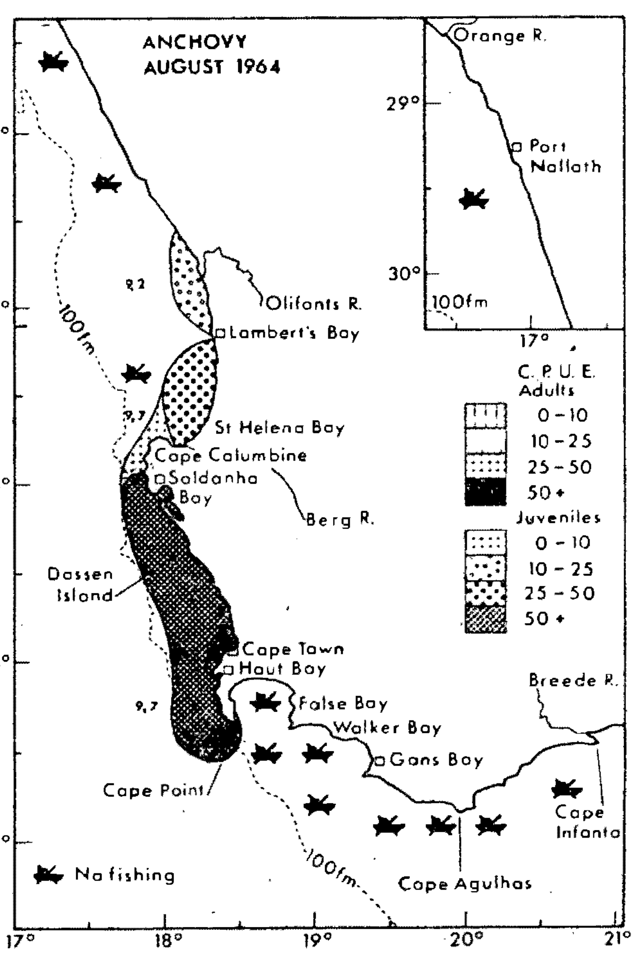

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Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
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Cape Point
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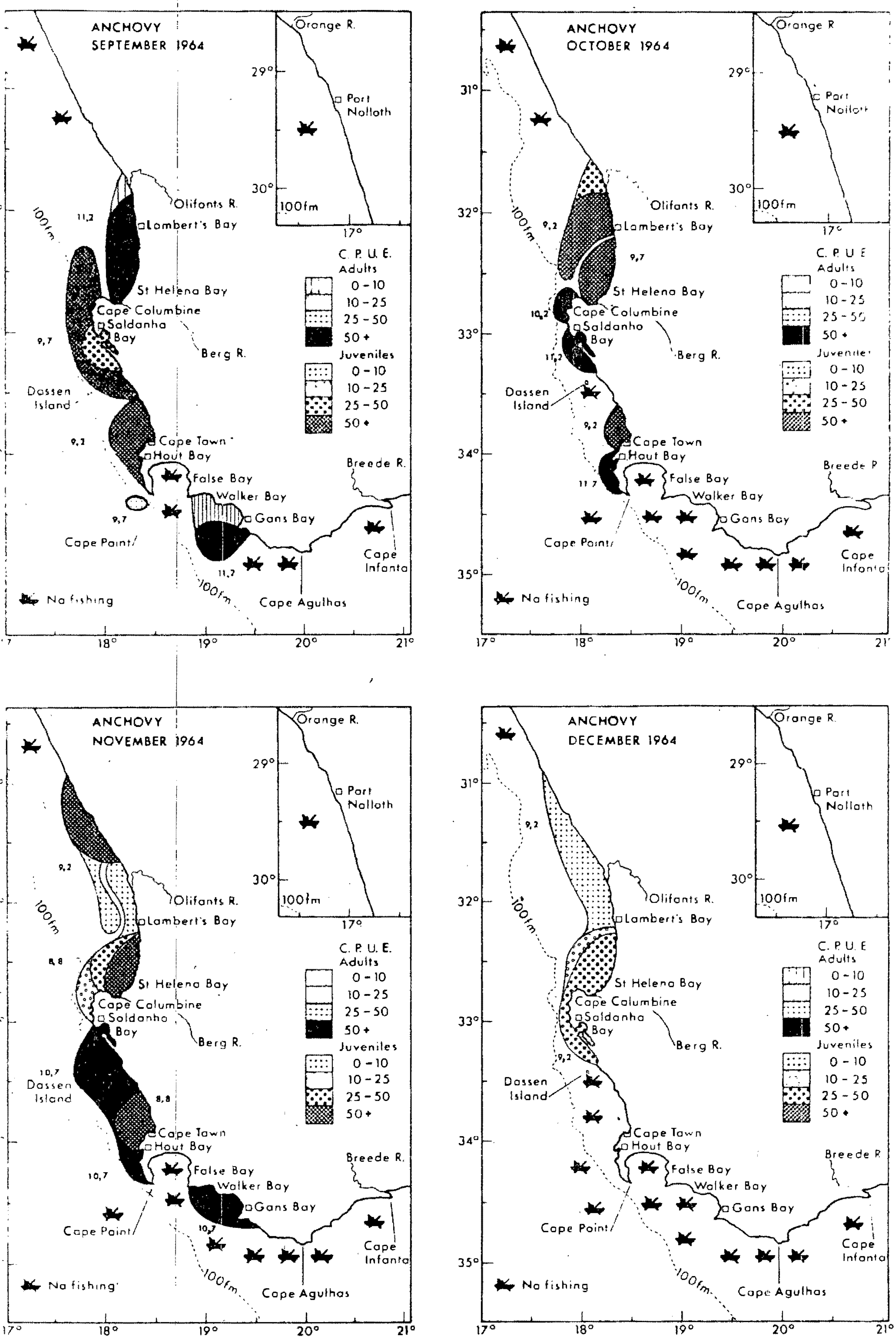
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Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
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Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
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Juveniles
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ANCHOVY
OCTOBER 1964
ANCHOVY
NOVEMBER 1964
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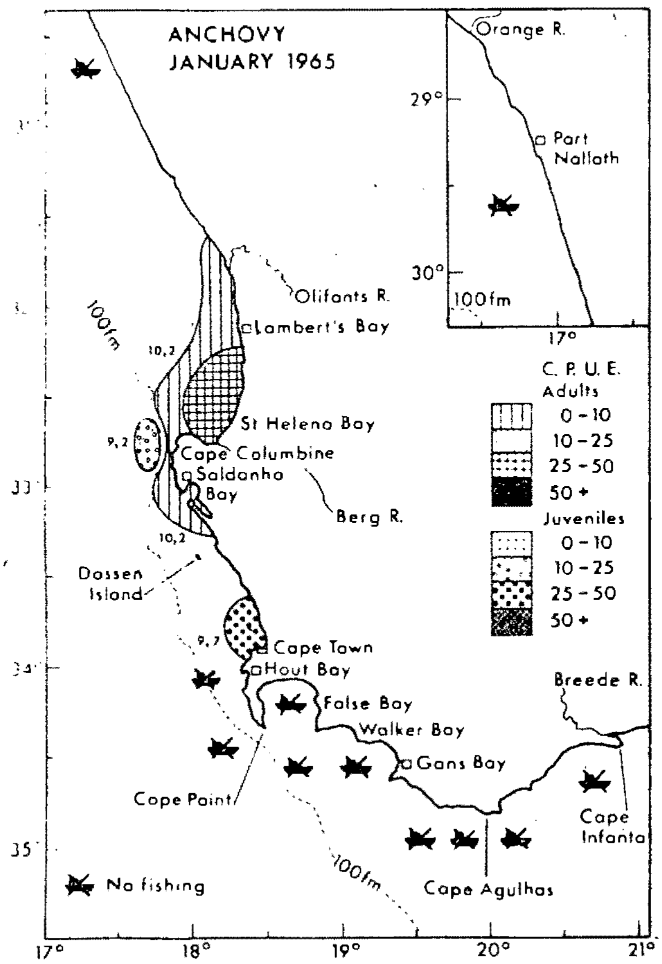
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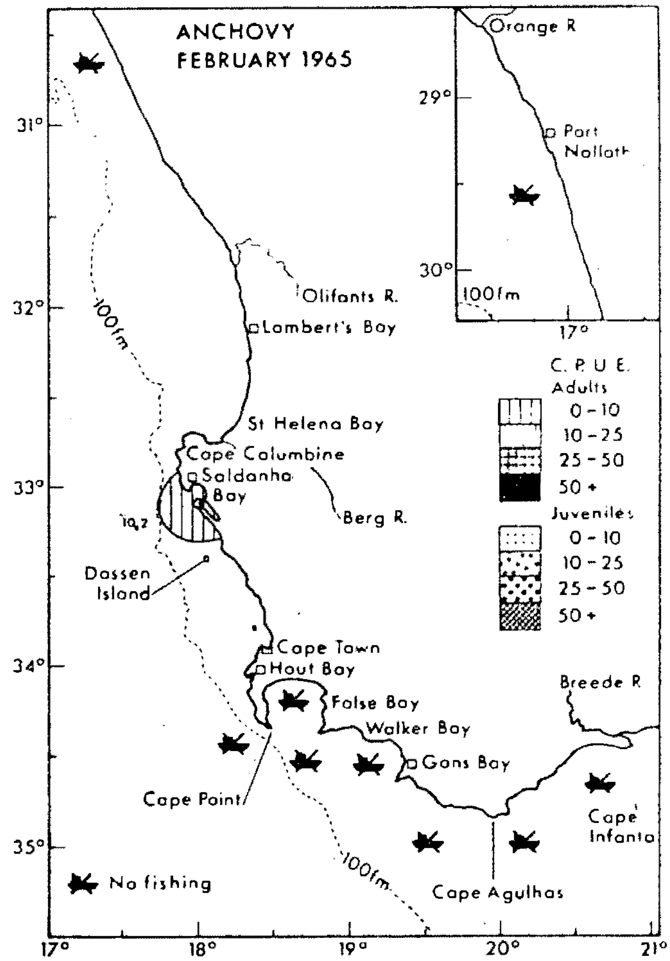
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Cape Point
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No fishing
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Juveniles
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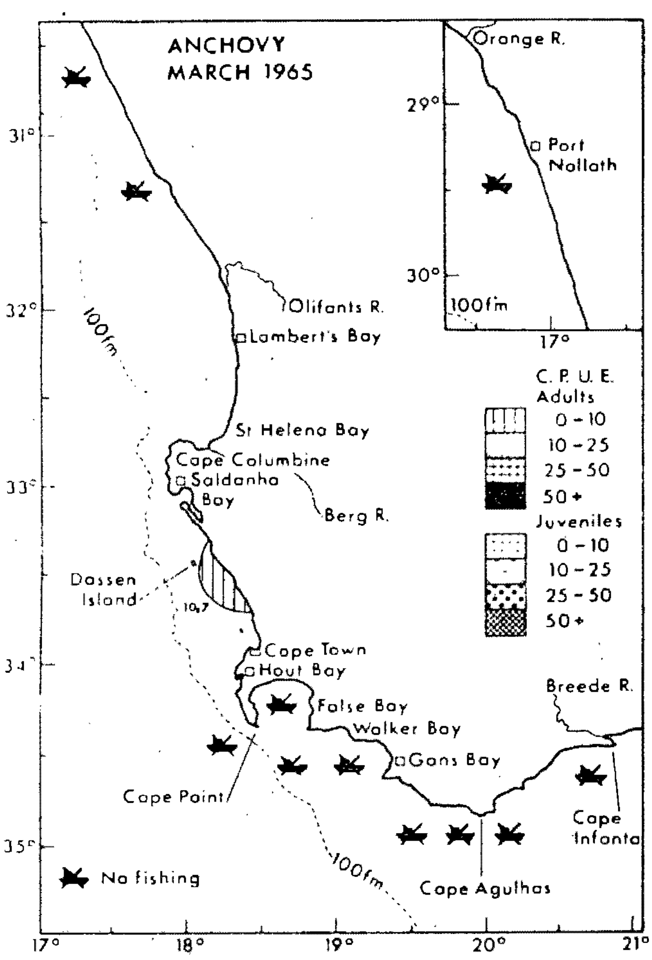
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Lambert's Bay
St Helena Bay
Cape Columbine
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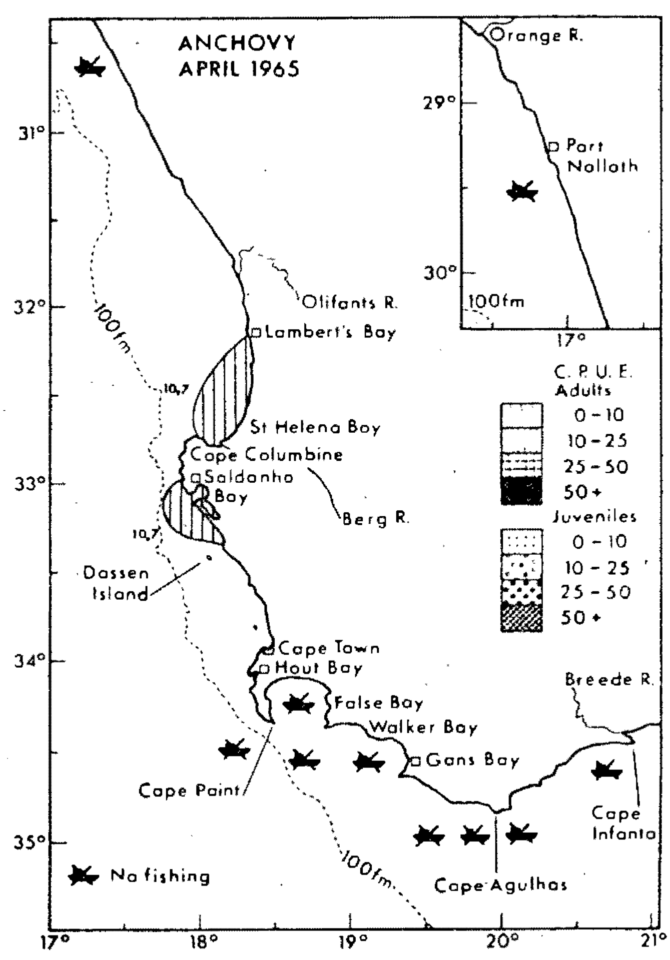
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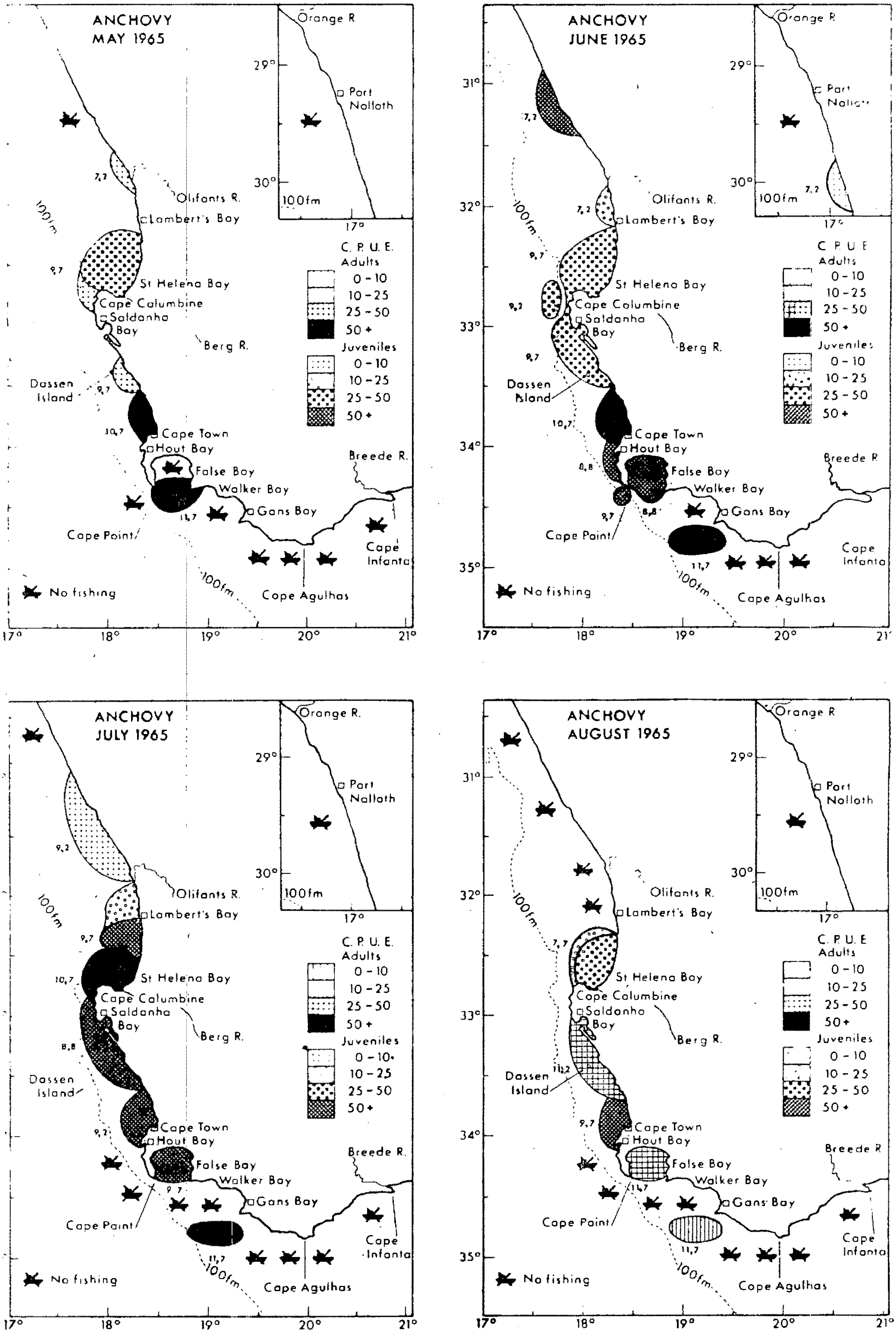
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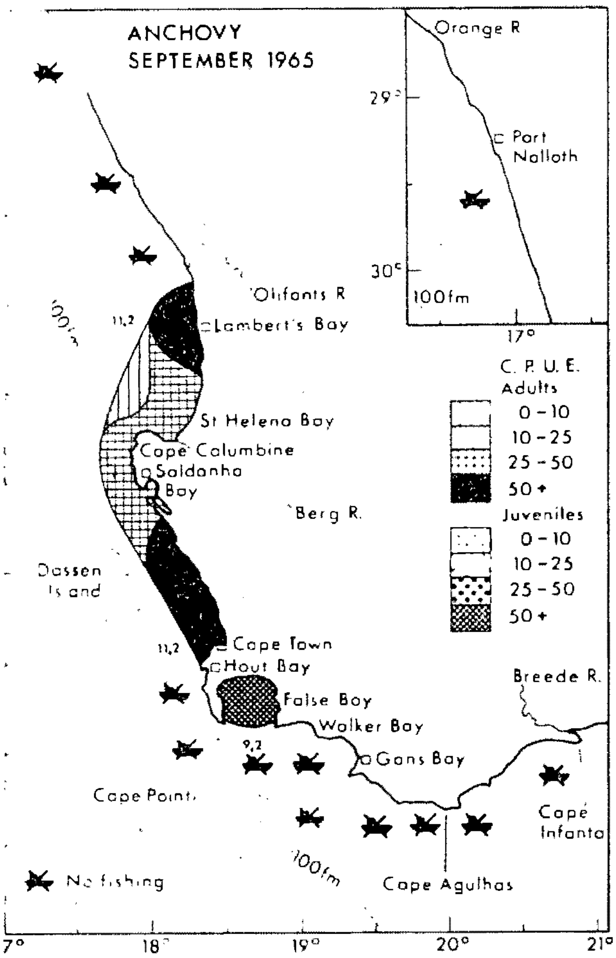
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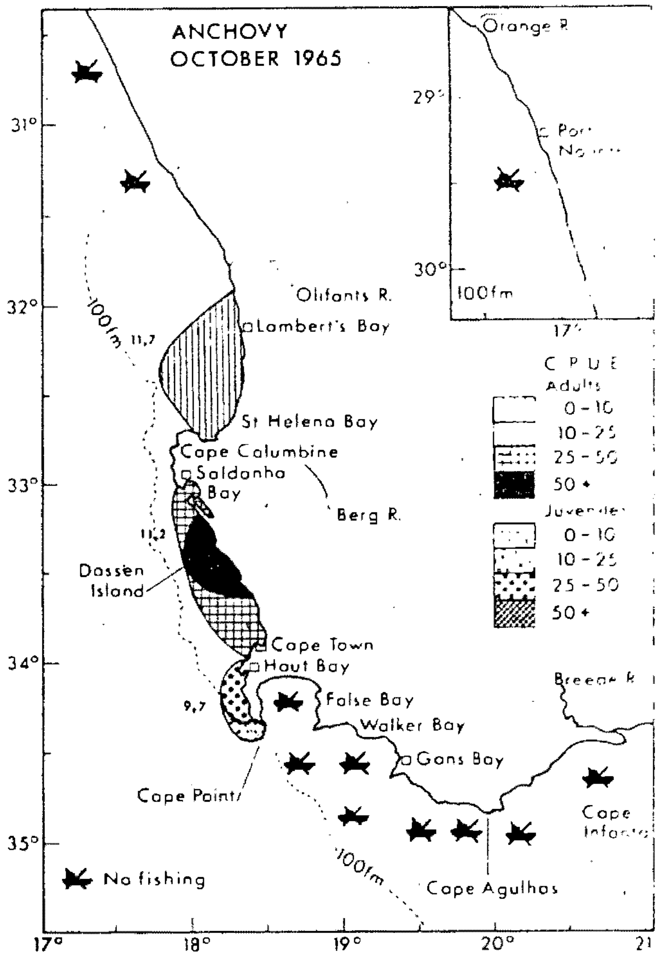
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Lambert's Bay
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Cape Town
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100fm
No fishing
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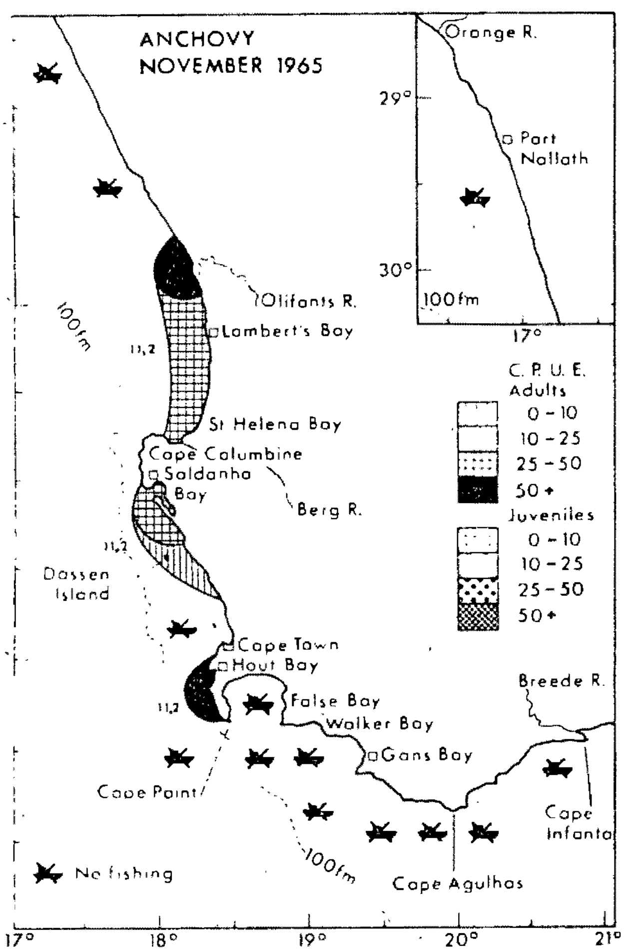
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Lambert's Bay
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Cape Columbine
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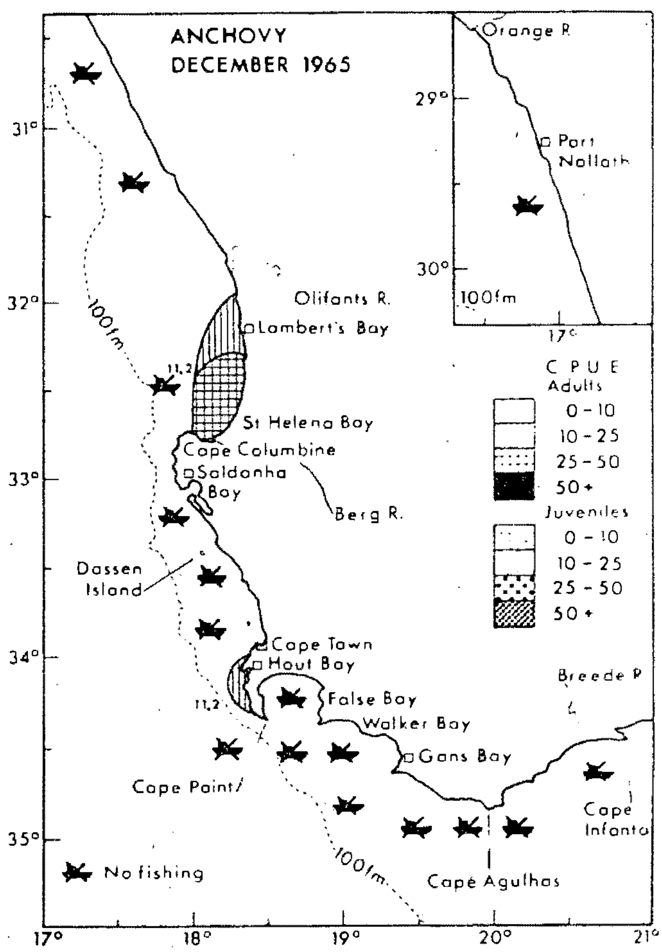
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Lambert's Bay
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Cape Columbine
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Hout Bay
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False Bay
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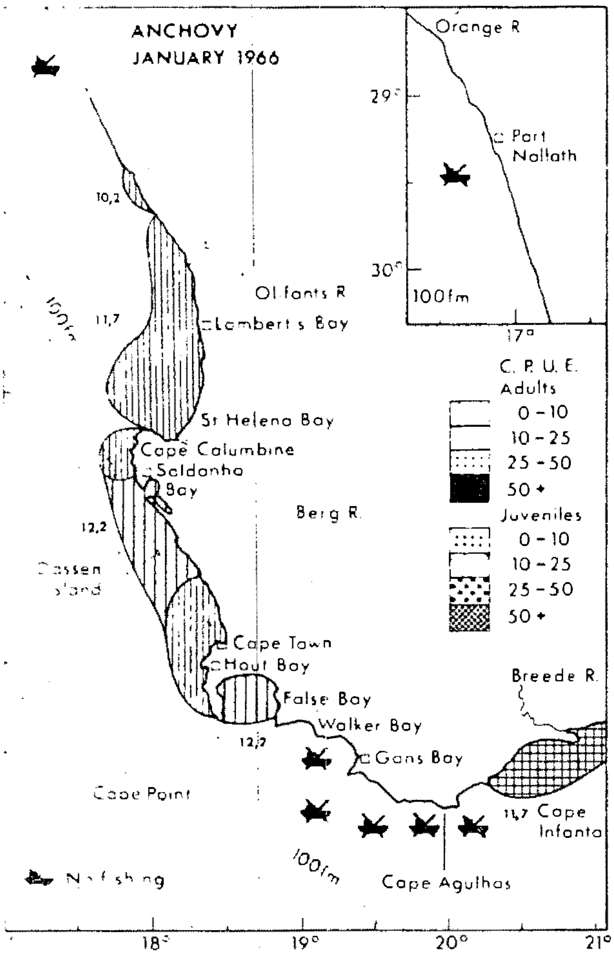
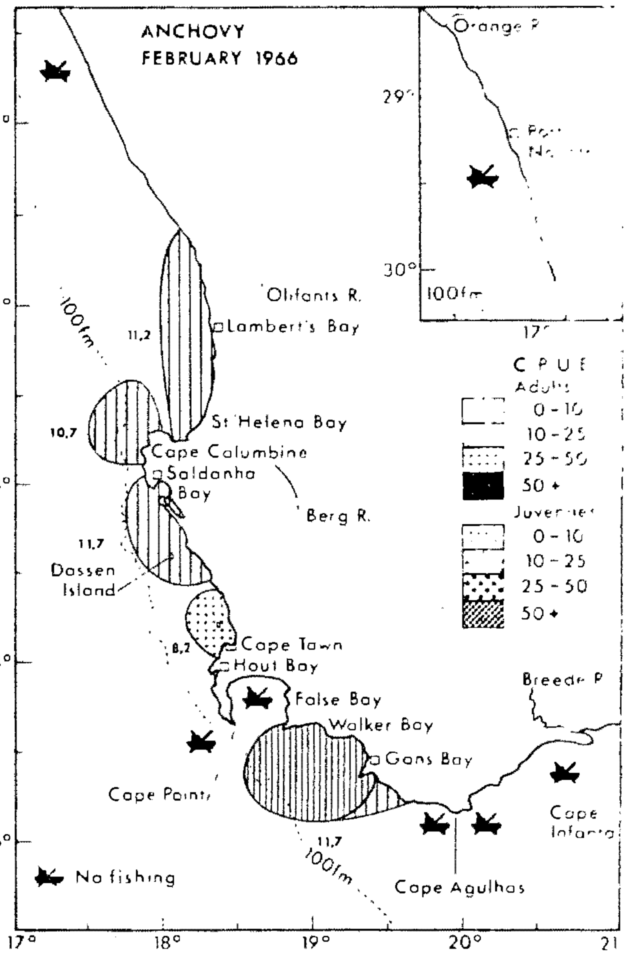
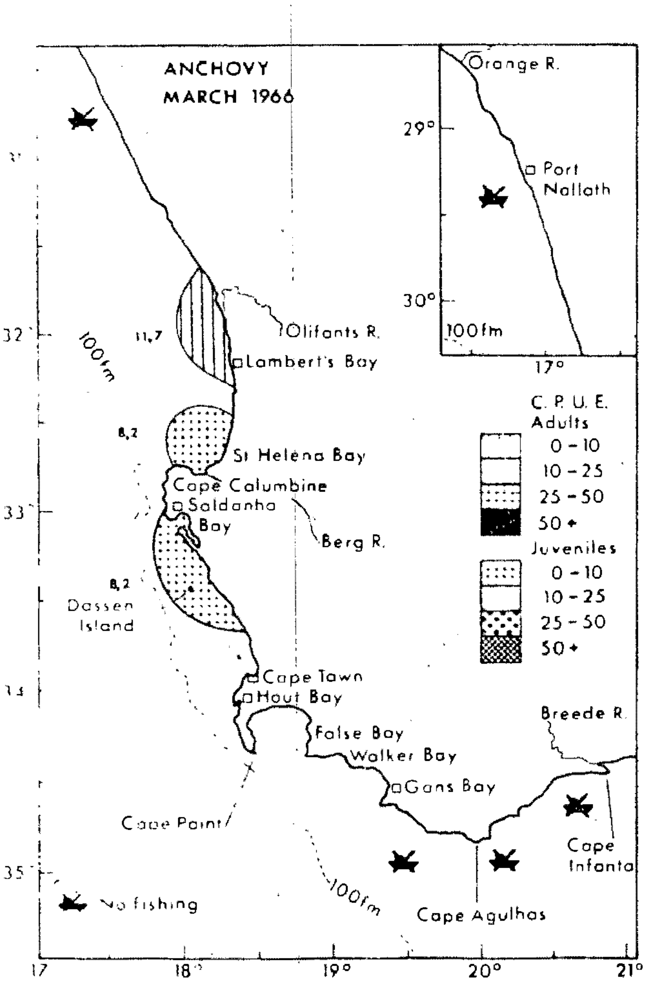
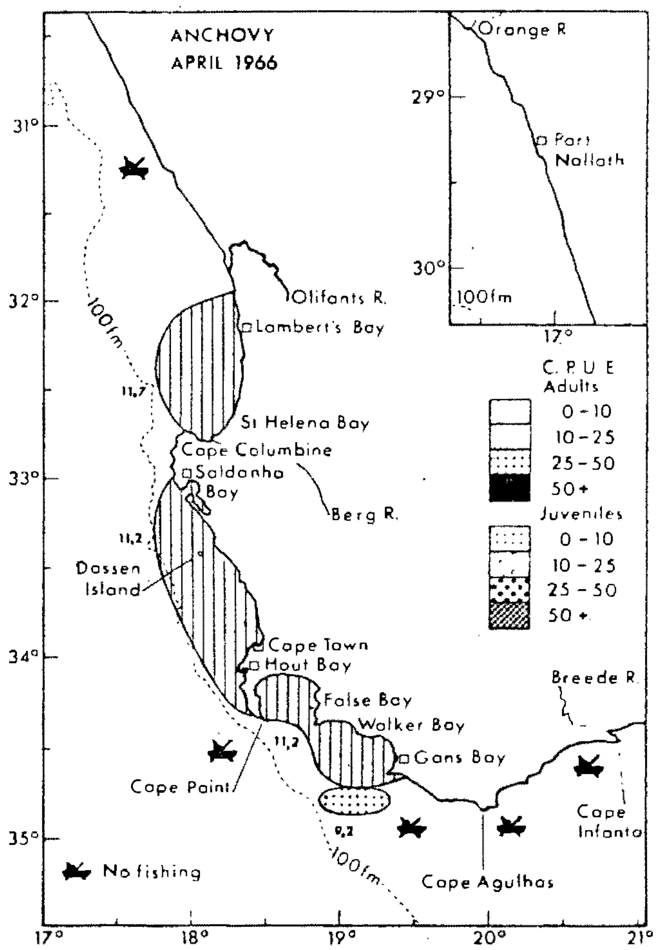
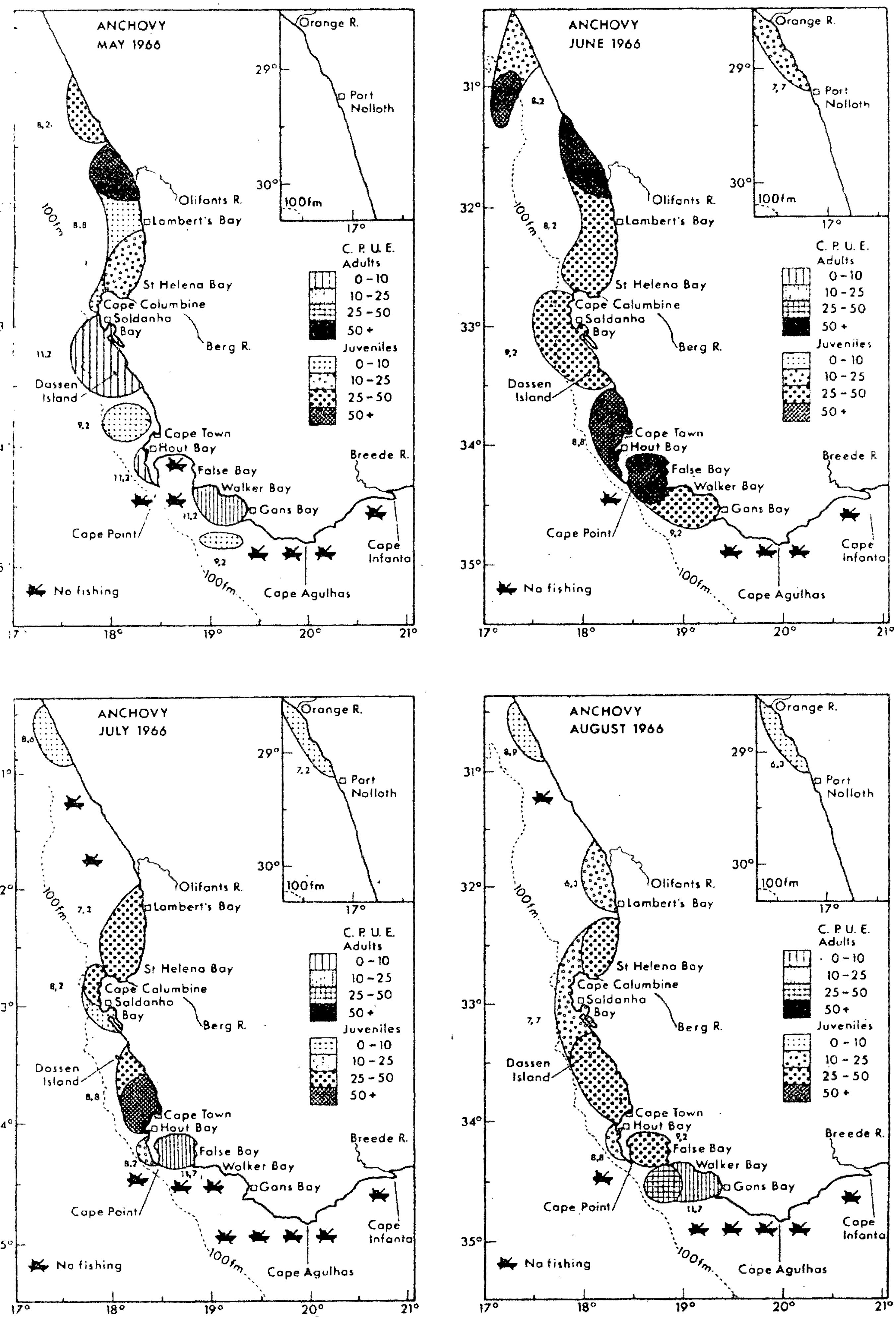
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C P U E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
19°
20°
21°


ANCHOVY
JANUARY 1966
Orange R
Port Nollath
100fm
Olifants R
Lambert's Bay
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Juveniles
0 - 10
10 - 25
25 - 50
50 +
Cape Town
Hout Bay
False Bay
Walker Bay
Breede R.
Gans Bay
Cape Point
Cape Infanta
100fm
Cape Agulhas
18°
19°
20°
21°


ANCHOVY
FEBRUARY 1966
29°
30°
100fm
31°
32°
33°
34°
35°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Cape Point
Cape Agulhas
No fishing
17°
18°
19°
20°


ANCHOVY
MARCH 1966
Orange R.
29°
Port Nollath
30°
100fm
17°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
Cape Town
Hout Bay
False Bay
Walker Bay
Breede R.
Gans Bay
Cape Point
Cape Infanta
100fm
Cape Agulhas
No fishing
17
19°
20°
21°


ANCHOVY
APRIL 1966
Orange R
29°
Port Nollath
30°
100fm
17°
31°
32°
33°
34°
35°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50+
Juveniles
0 - 10
10 - 25
25 - 50
50 +
Cape Town
Hout Bay
False Bay
Walker Bay
Breede R.
Gans Bay
Cape Point
Cape Infanta
100fm
Cape Agulhas
No fishing
17°
18°
19°
20°
21°


ANCHOVY
MAY 1966
ANCHOVY
JUNE 1966
ANCHOVY
JULY 1966
ANCHOVY
AUGUST 1966
Orange R.
Port Nolloth
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Agulhas
Cape Infanta
100fm
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
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20°
21°
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30°
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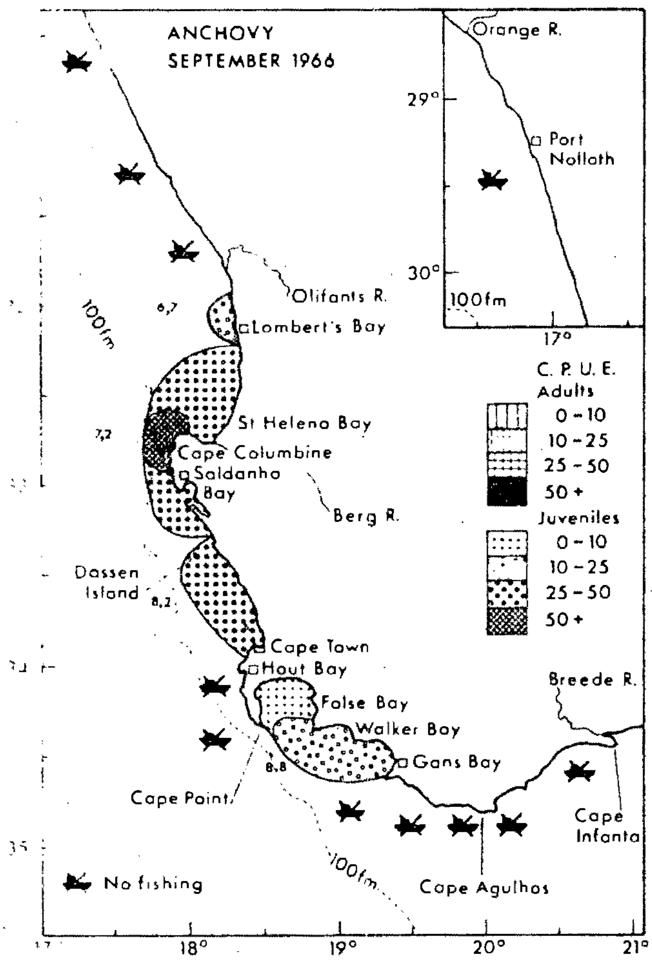
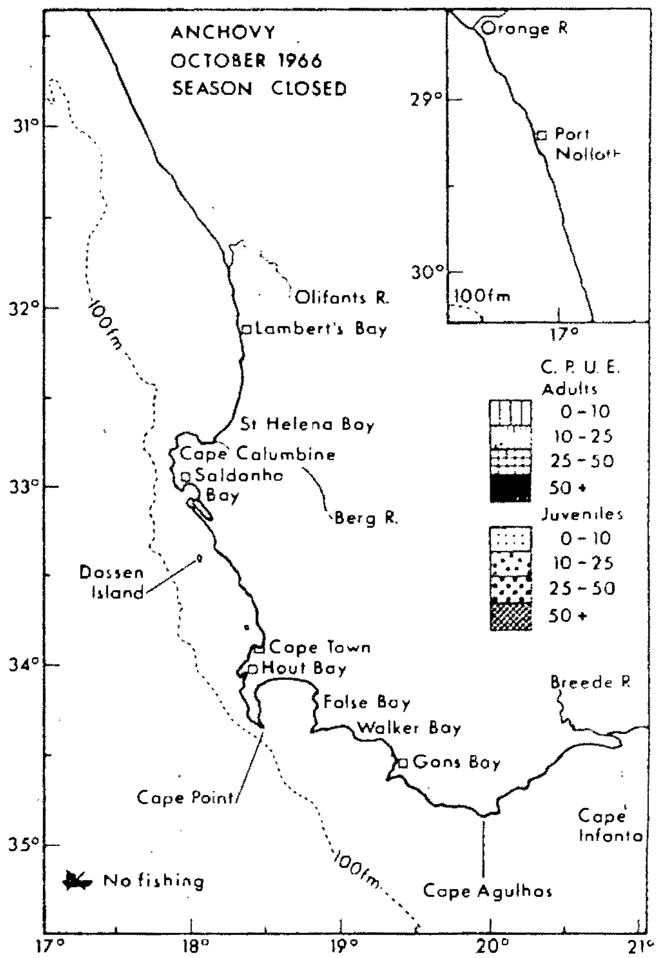
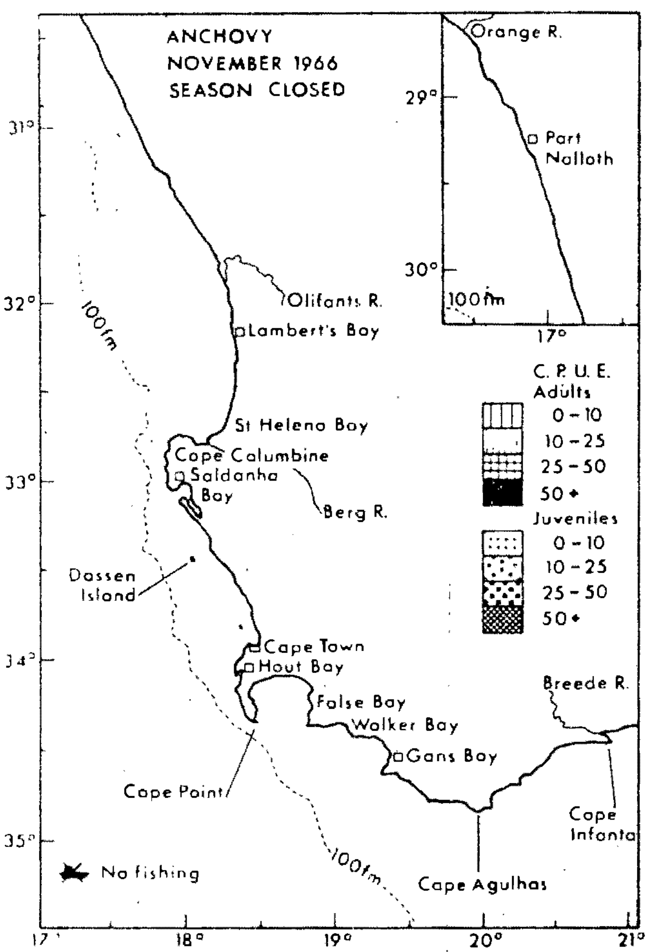
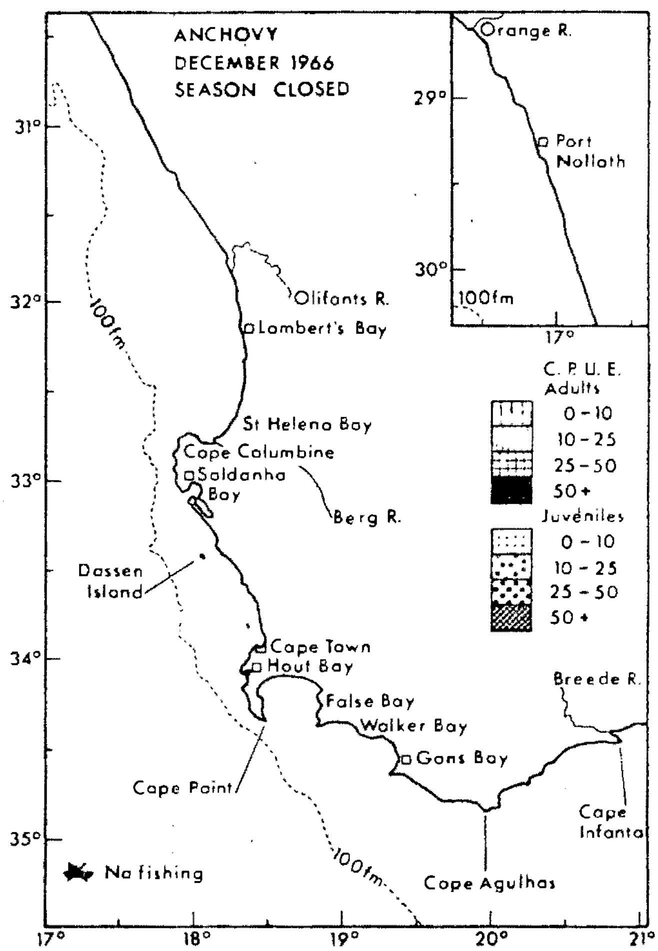
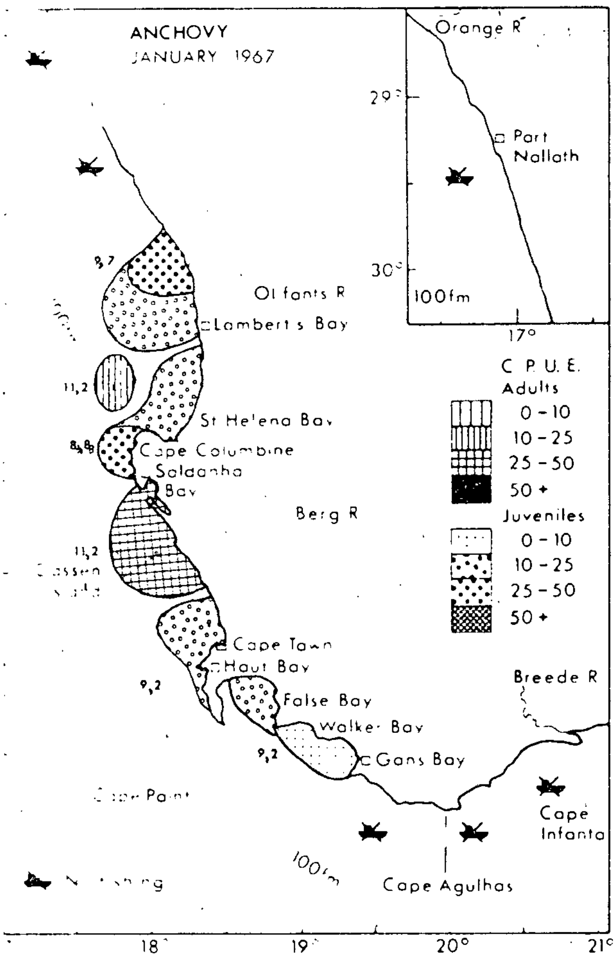
33°
34°
35°


ANCHOVY
SEPTEMBER 1966
Orange R.
Port Nolloth
29°
30°
100fm
17°
Olifants R.
Lambert's Bay
6,7
St Helena Bay
7,2
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
8,2
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
8,8
Cape Point
Cape Infanta
Cape Agulhas
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
No fishing
18°
19°
20°
21°


ANCHOVY
OCTOBER 1966
SEASON CLOSED
Orange R
Port Nolloth
29°
30°
100fm
17°
31°
32°
33°
34°
35°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
No fishing
17°
18°
19°
20°
21°


ANCHOVY
NOVEMBER 1966
SEASON CLOSED
Orange R.
Port Nolloth
29°
30°
100fm
17°
31°
32°
33°
34°
35°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
No fishing
18°
19°
20°
21°


ANCHOVY
DECEMBER 1966
SEASON CLOSED
Orange R.
Port Nolloth
29°
30°
100fm
17°
31°
32°
33°
34°
35°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
No fishing
17°
18°
19°
20°
21°


ANCHOVY
JANUARY 1967
Orange R
29°
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Port Nolloth
100fm
17°
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Infanta
Cape Agulhas
100fm
C.P.U.E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
9,7
11,2
8,8
11,2
9,2
9,2
18°
19°
20°
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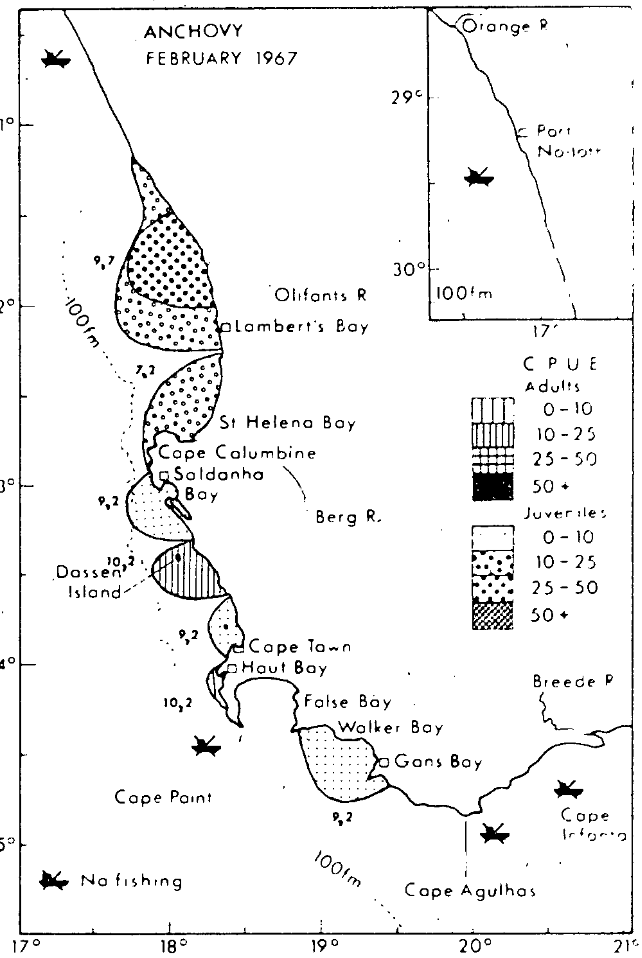
ANCHOVY
FEBRUARY 1967
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29°
30°
100fm
17°
31°
32°
33°
34°
35°
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Agulhas
100fm
No fishing
C P U E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
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9,2
10,2
9,2
17°
18°
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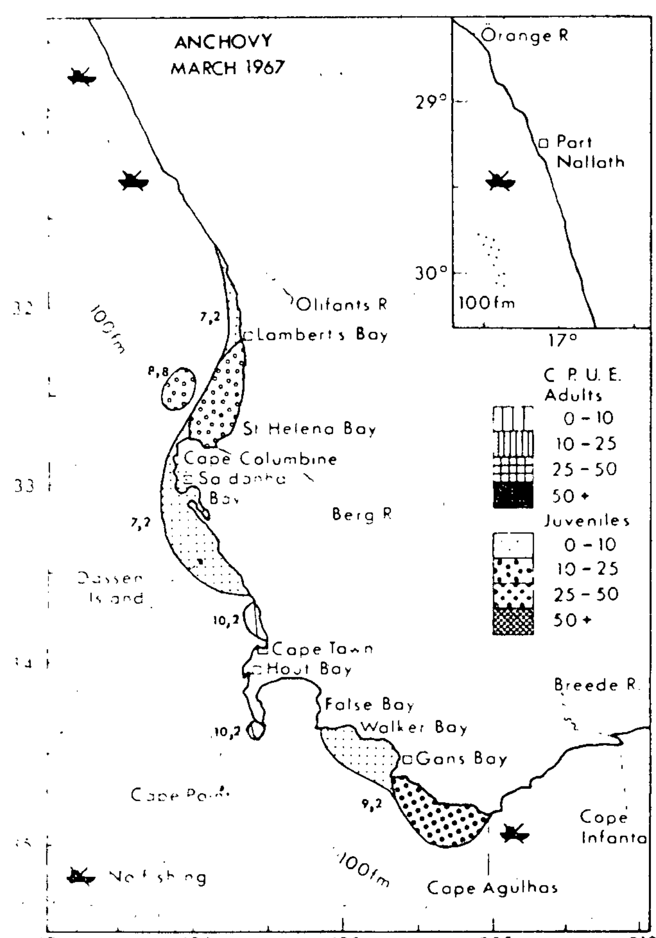
20°


ANCHOVY
MARCH 1967
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29°
Port Nolloth
30°
100fm
17°
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Berg R
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Infanta
Cape Agulhas
100fm
C P U E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
7,2
7,2
10,2
10,2
9,2
33
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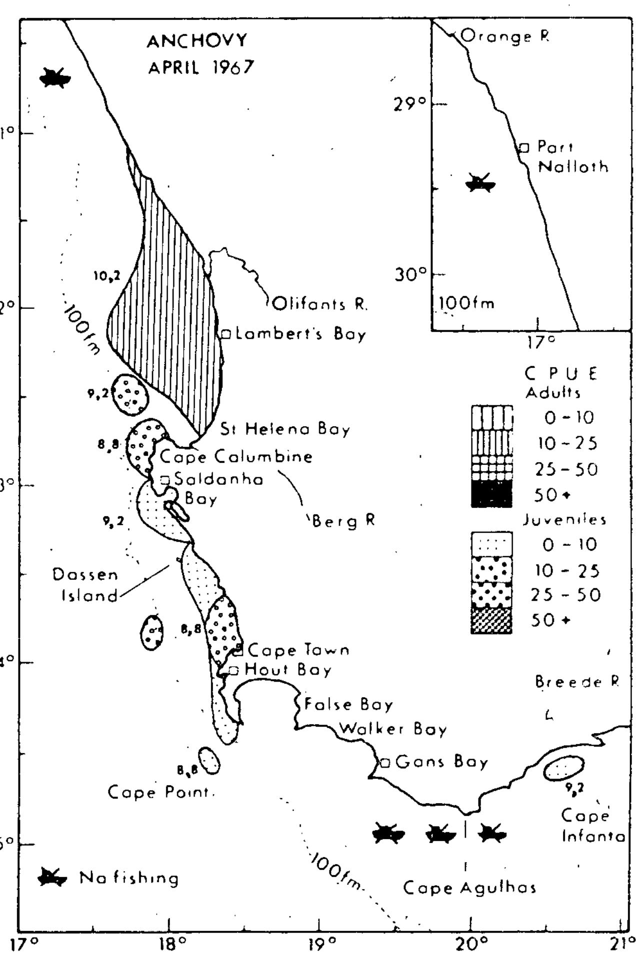
20°
21°


ANCHOVY
APRIL 1967
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29°
Port Nolloth
30°
100fm
17°
31°
32°
33°
34°
35°
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point.
Cape Infanta
Cape Agulhas
100fm.
No fishing
C P U E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
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8,8
9,2
8,8
8,8
9,2
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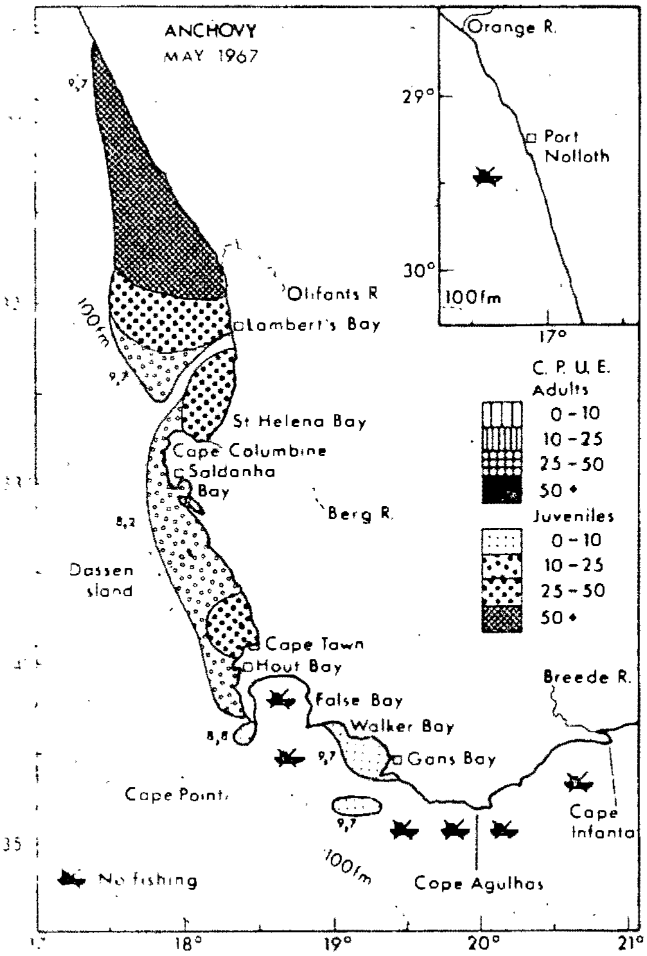
18°
19°
20°
21°


ANCHOVY
MAY 1967
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Port Nolloth
100fm
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
No fishing
100fm
18°
19°
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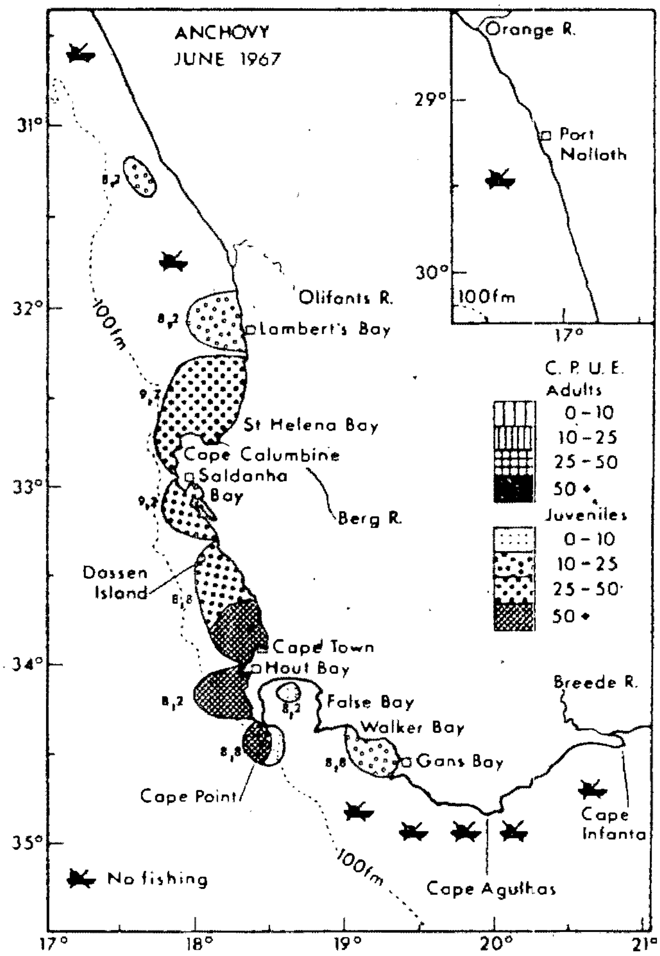
21°


ANCHOVY
JUNE 1967
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Port Nolloth
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Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
No fishing
100fm
17°
18°
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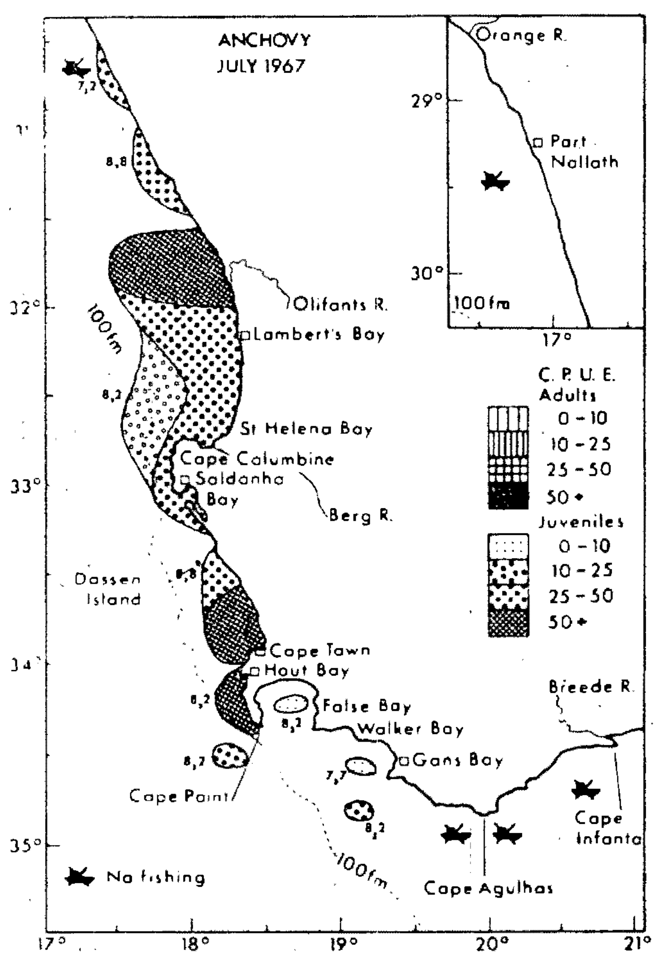
ANCHOVY
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Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
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50 +
No fishing
100fm
17°
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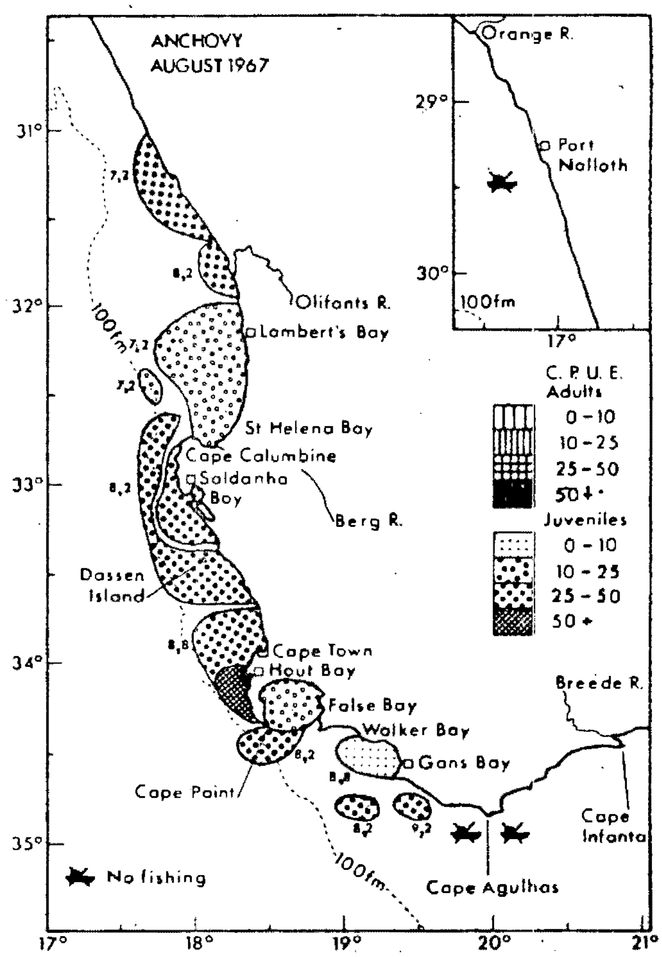
ANCHOVY
AUGUST 1967
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Port Nolloth
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Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
No fishing
100fm
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18°
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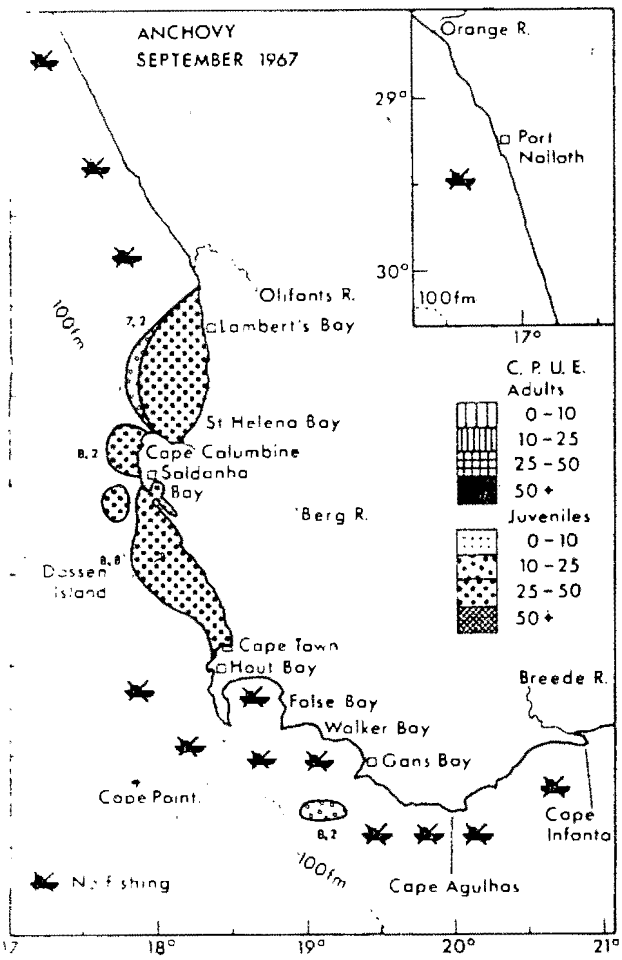
35°


ANCHOVY
SEPTEMBER 1967
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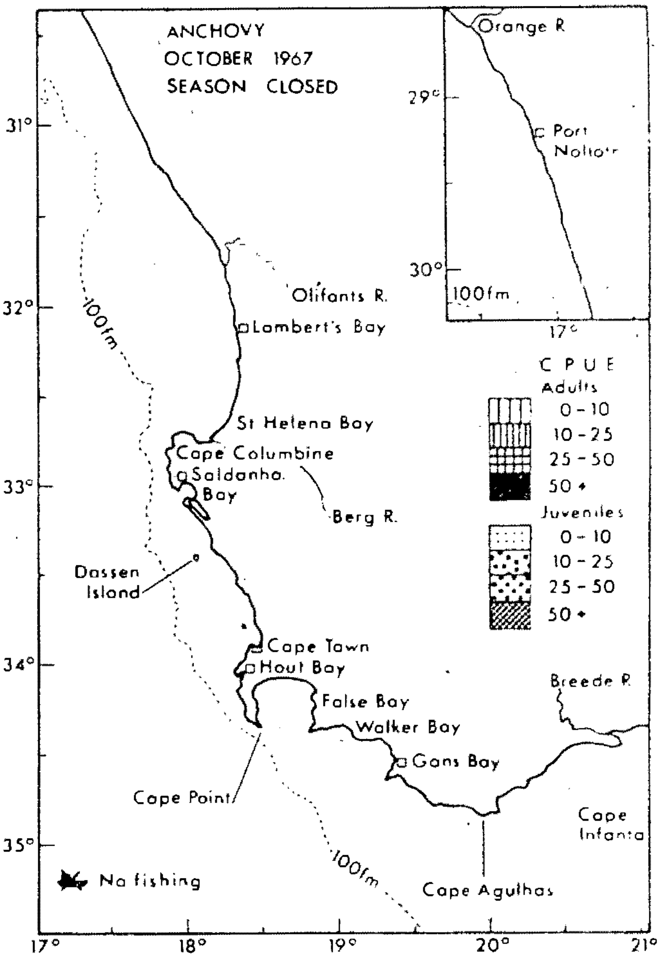
29°
Port Nolloth
30°
100fm
17°
Olifants R.
Lambert's Bay
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
18°
19°
20°
21°


ANCHOVY
OCTOBER 1967
SEASON CLOSED
Orange R
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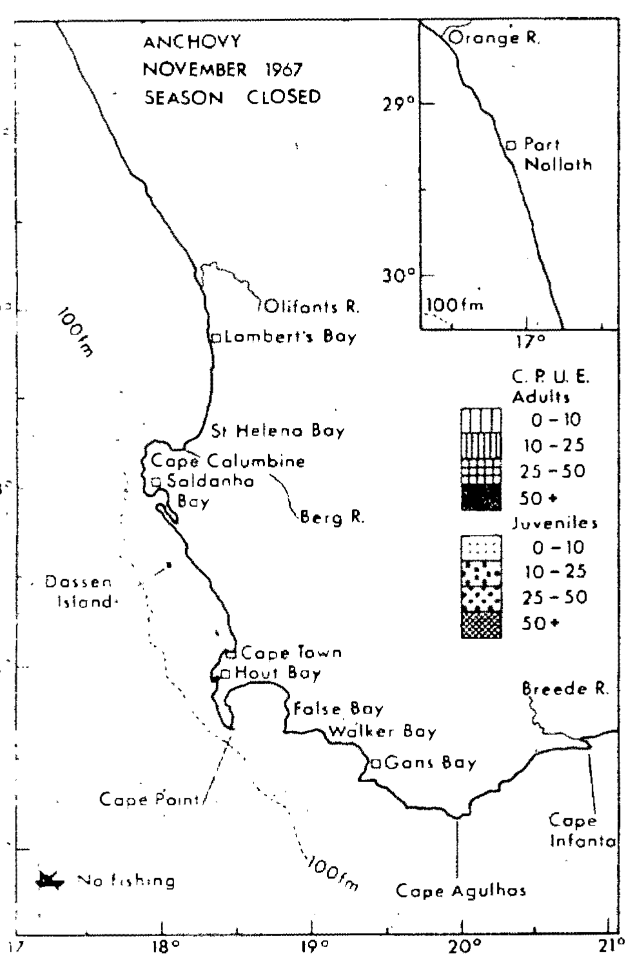
Port Nolloth
30°
100fm
17°
31°
32°
100fm
Olifants R.
Lambert's Bay
C P U E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
33°
Dassen Island
34°
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
35°
No fishing
100fm
Cape Agulhas
17°
18°
19°
20°
21°


ANCHOVY
NOVEMBER 1967
SEASON CLOSED
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29°
Port Nolloth
30°
100fm
17°
Olifants R.
Lambert's Bay
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
No fishing
100fm
Cape Agulhas
18°
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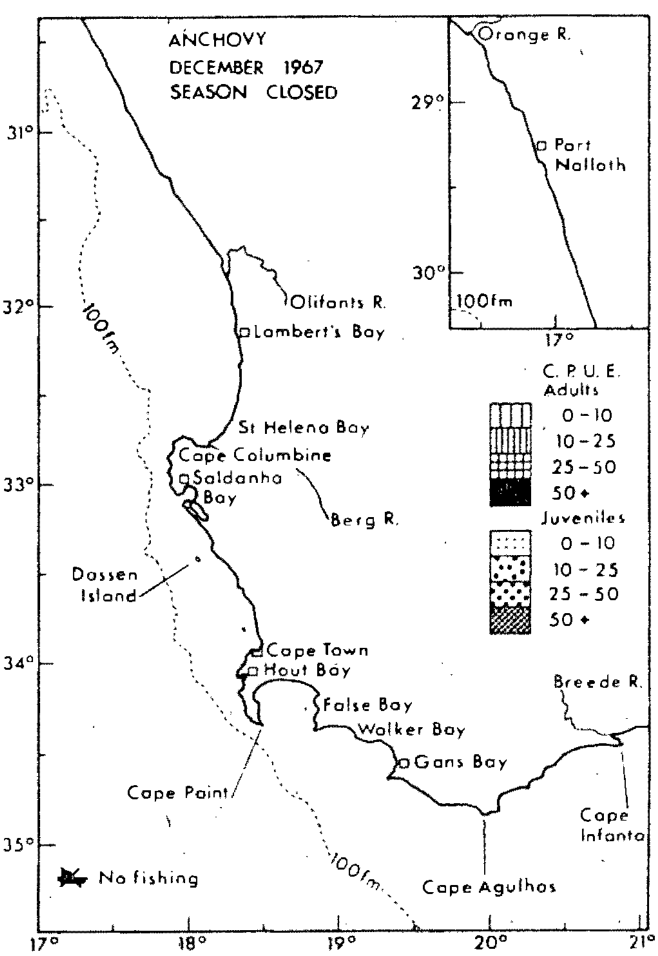
20°
21°


ANCHOVY
DECEMBER 1967
SEASON CLOSED
Orange R.
29°
Port Nolloth
30°
100fm
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31°
32°
100fm
Olifants R.
Lambert's Bay
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
33°
Dassen Island
34°
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
35°
No fishing
100fm
Cape Agulhas
17°
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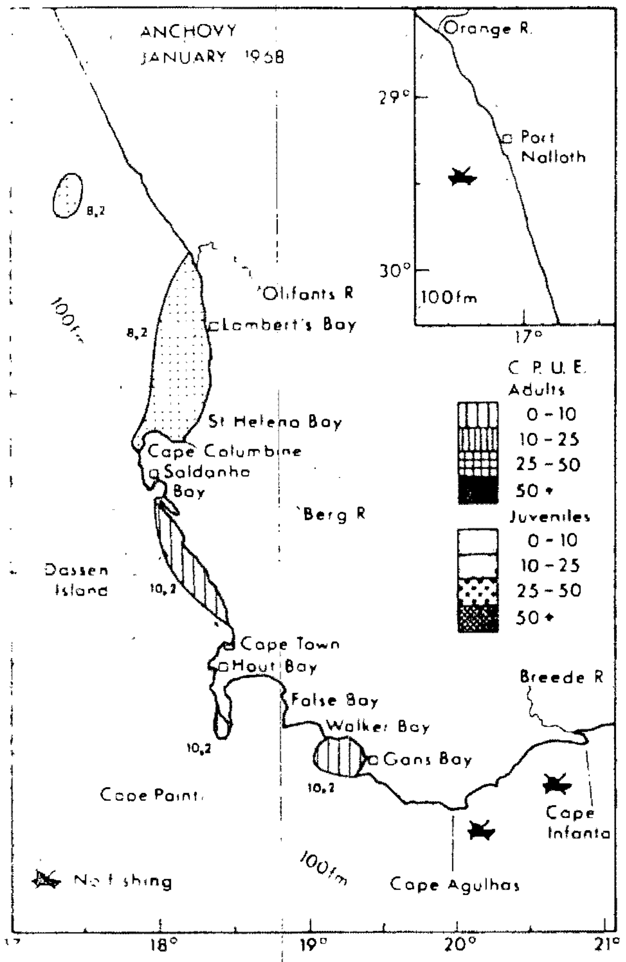
19°
20°
21°


ANCHOVY
JANUARY 1968
Orange R.
Port Nolloth
100fm
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
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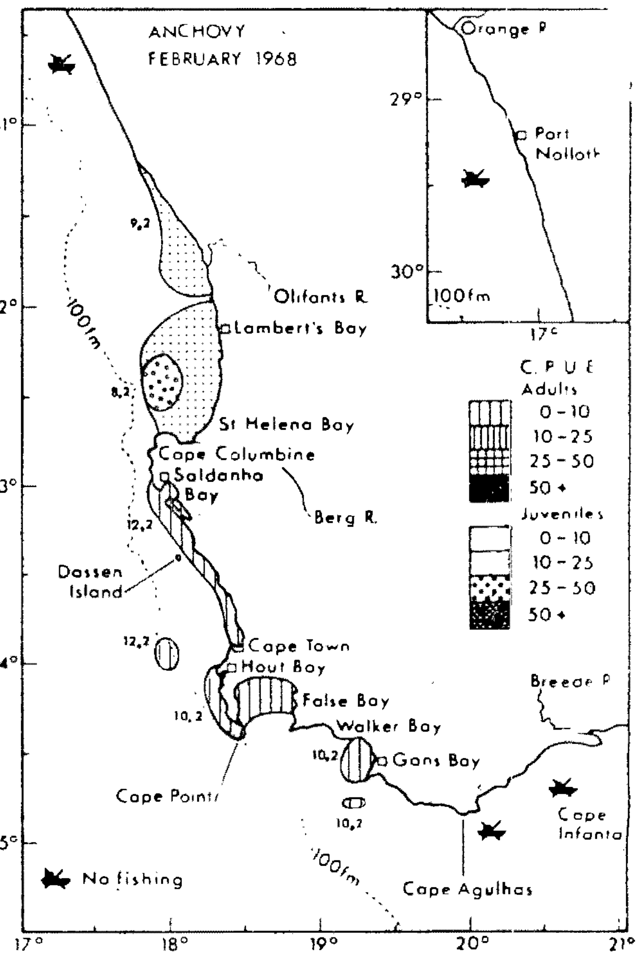
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
8,2
10,2


ANCHOVY
FEBRUARY 1968
Orange R
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
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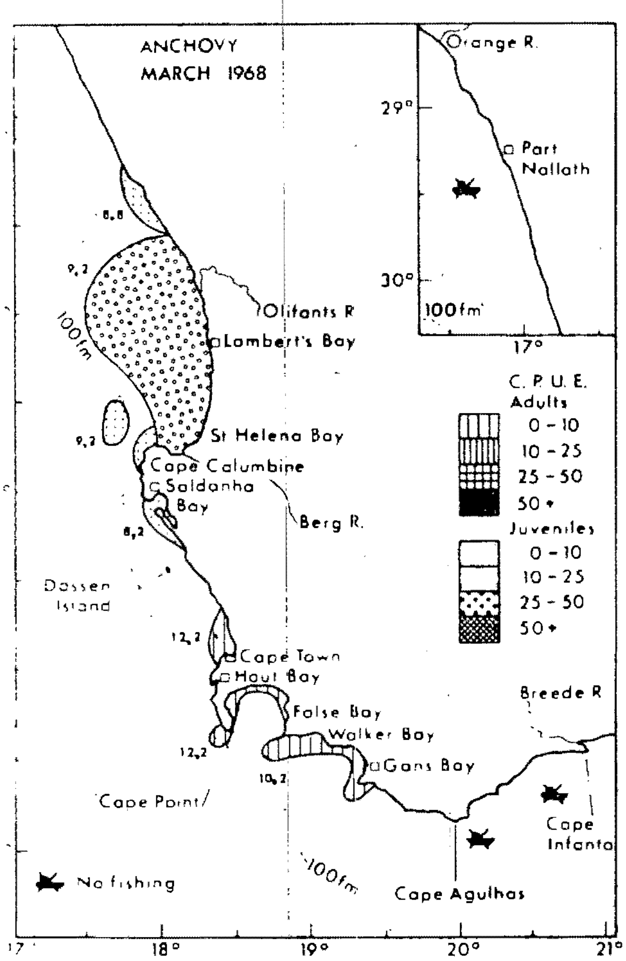
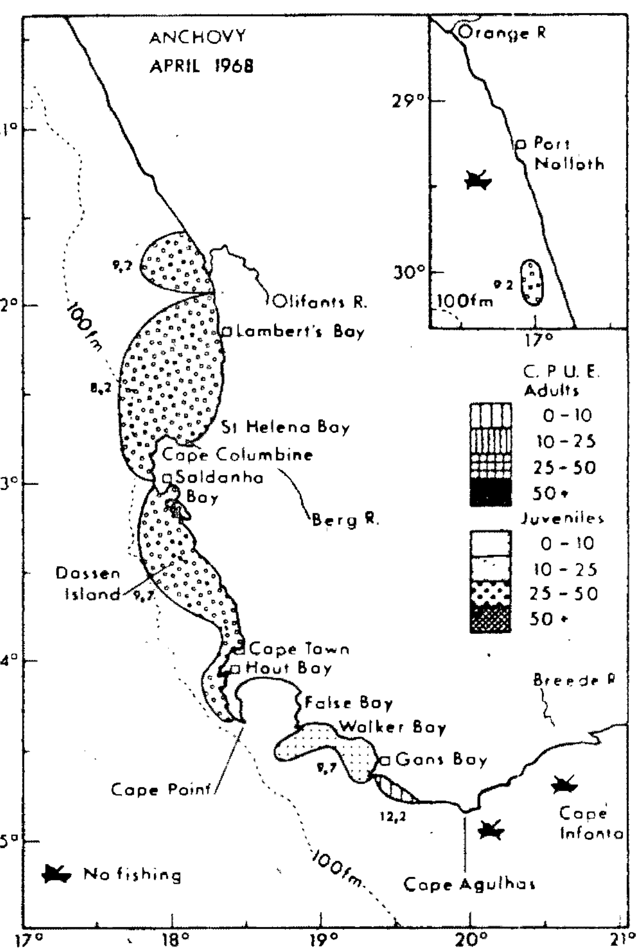
8,2
12,2
10,2


ANCHOVY
MARCH 1968
Orange R.
Port Nolloth
100fm
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
8,8
9,2
8,2
12,2
10,2


ANCHOVY
APRIL 1968
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Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
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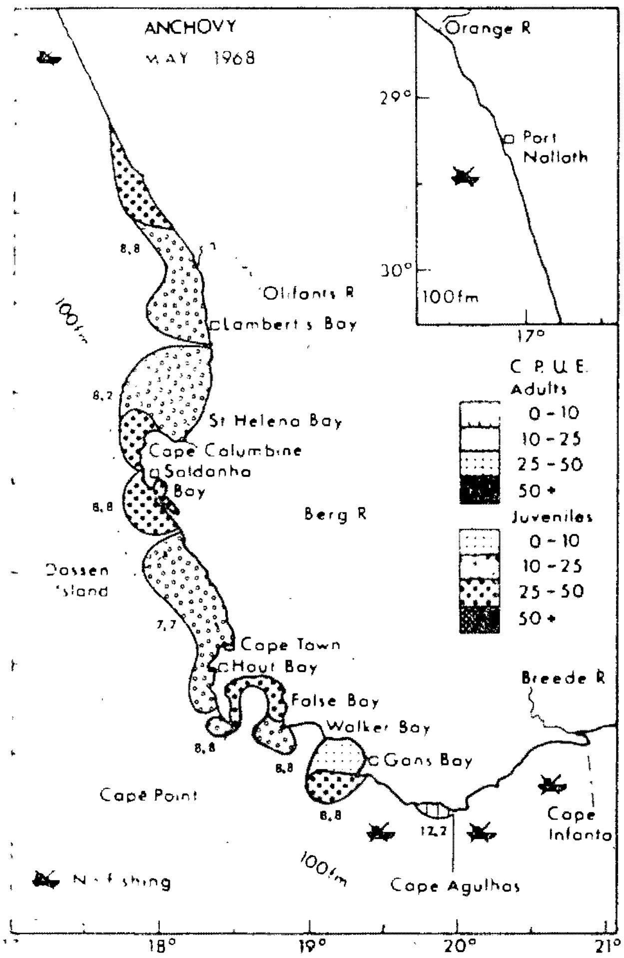
ANCHOVY
MAY 1968
Orange R
Port Nolloth
29°
30°
100fm
17°
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R
Dossen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
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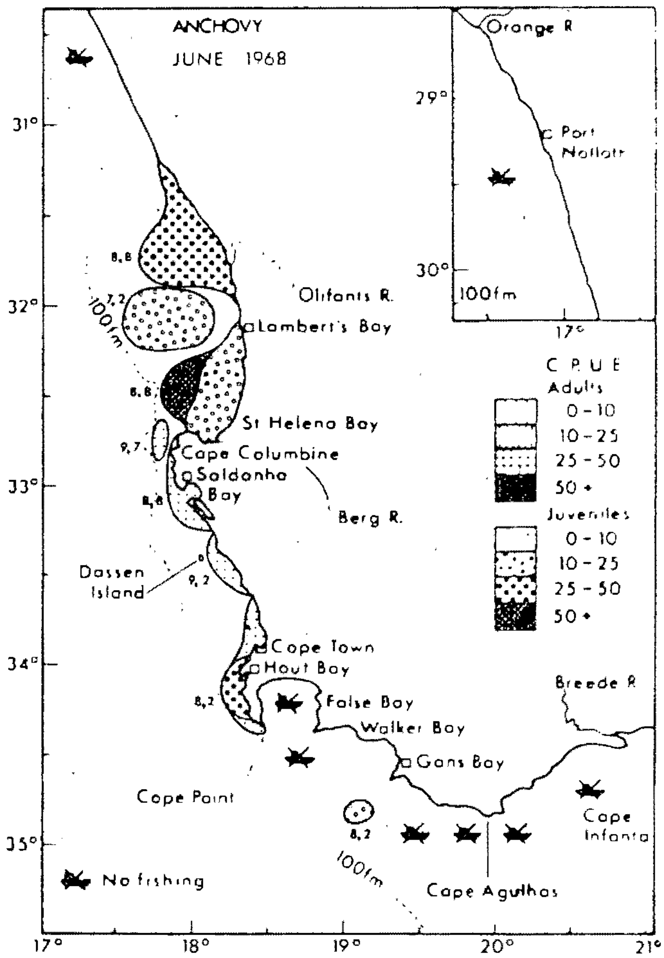
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Port Nolloth
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Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
100fm
100fm
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
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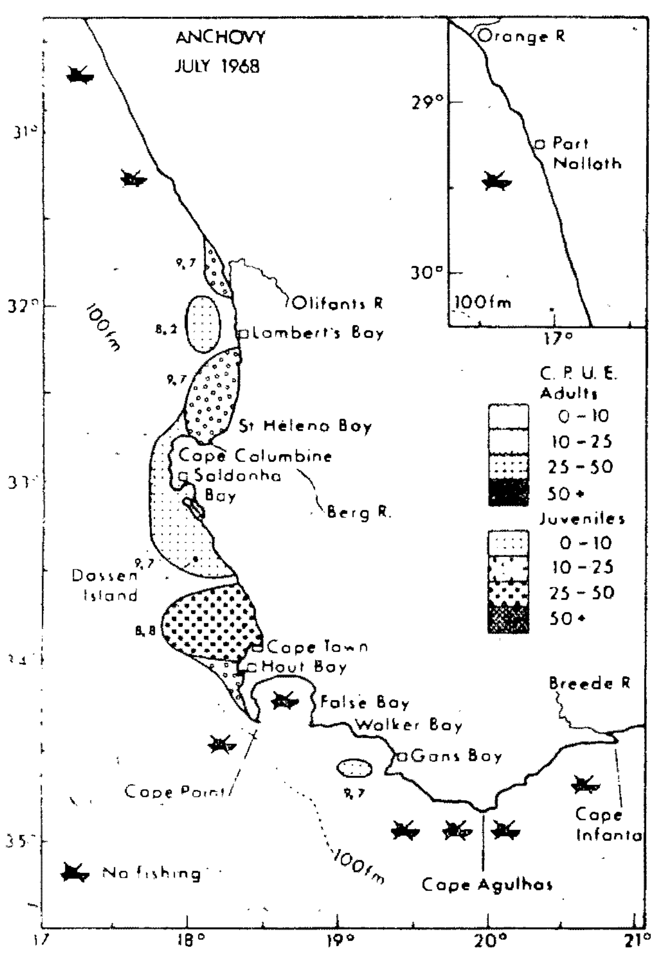
ANCHOVY
JULY 1968
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Port Nolloth
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Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
100fm
100fm
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
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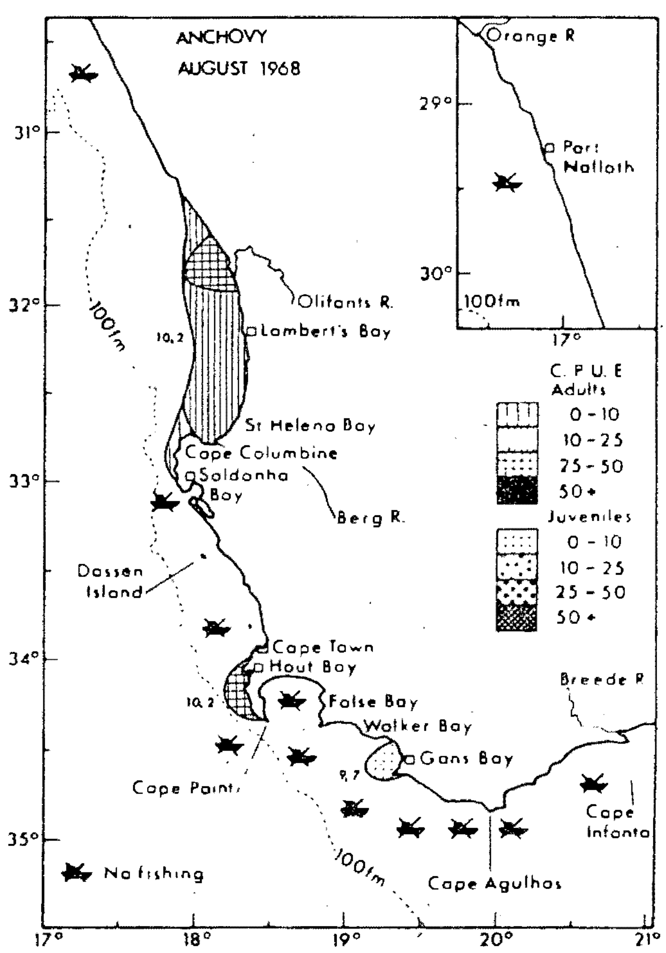
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AUGUST 1968
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Port Nolloth
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Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
100fm
100fm
No fishing
C. P. U. E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
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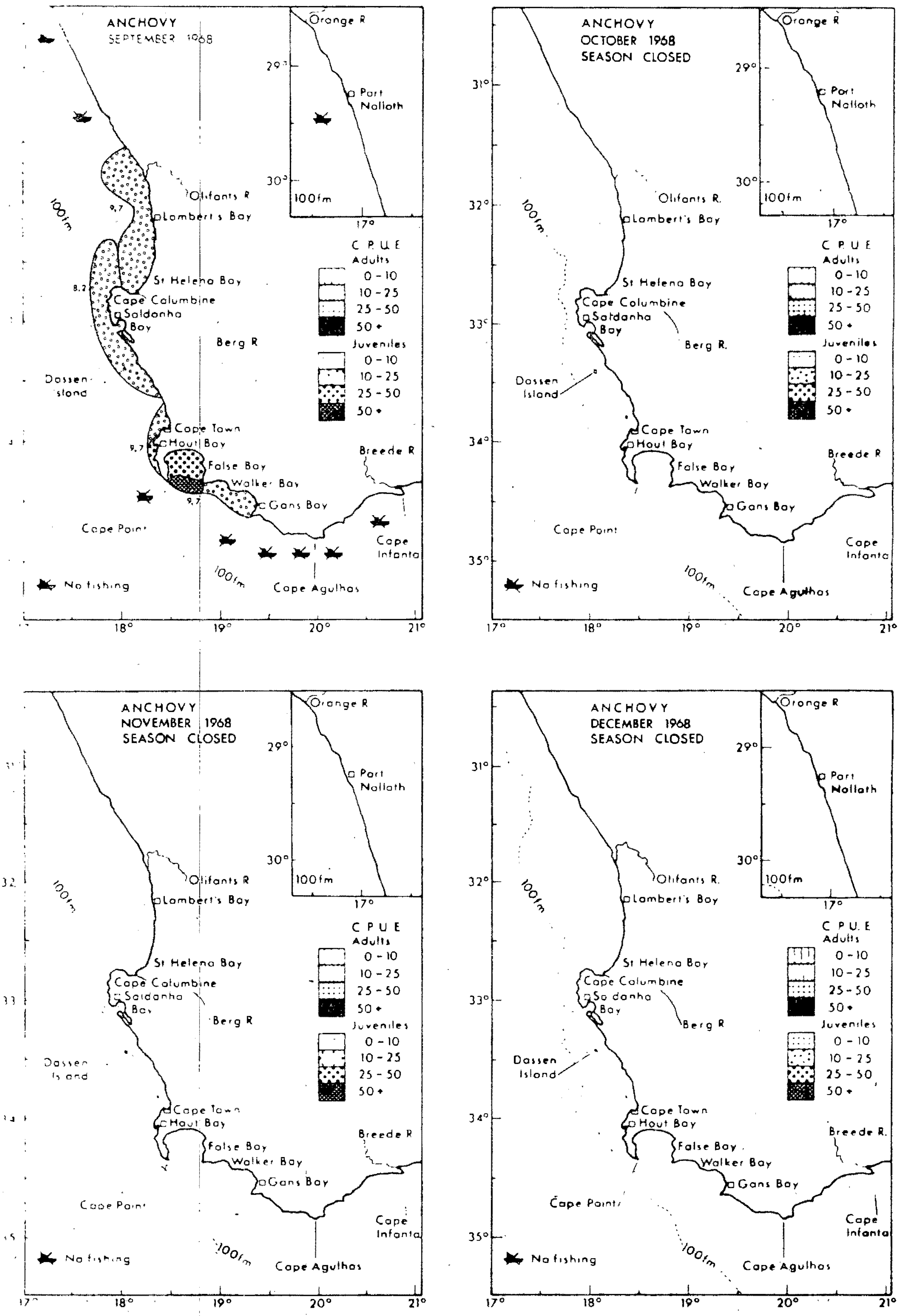
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SEPTEMBER 1968
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Port Nolloth
100fm
Olifants R
Lamberts Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C P U E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
ANCHOVY
OCTOBER 1968
SEASON CLOSED
ANCHOVY
NOVEMBER 1968
SEASON CLOSED
ANCHOVY
DECEMBER 1968
SEASON CLOSED
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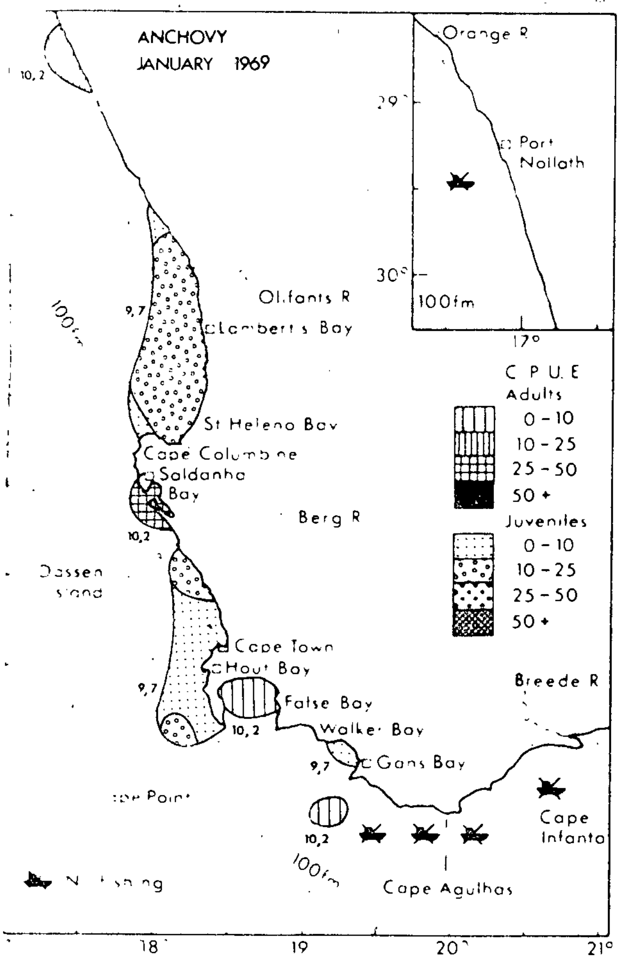
ANCHOVY
JANUARY 1969
Orange R
Port Nolloth
100fm
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Infanta
Cape Agulhas
C.P.U.E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
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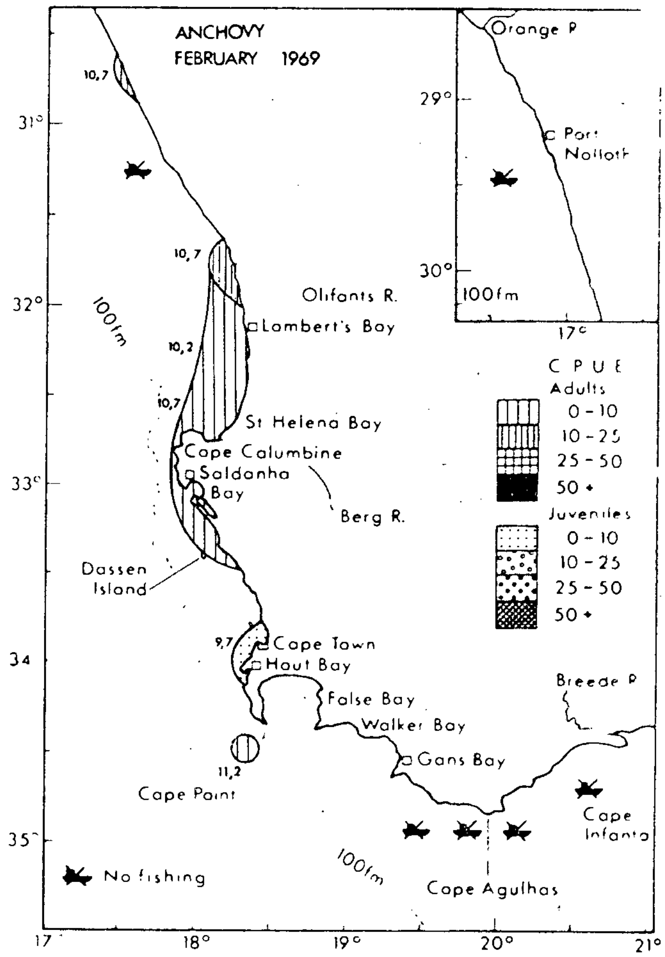
ANCHOVY
FEBRUARY 1969
Orange R
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C P U E
Adults
0 - 10
10 - 25
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50 +
Juveniles
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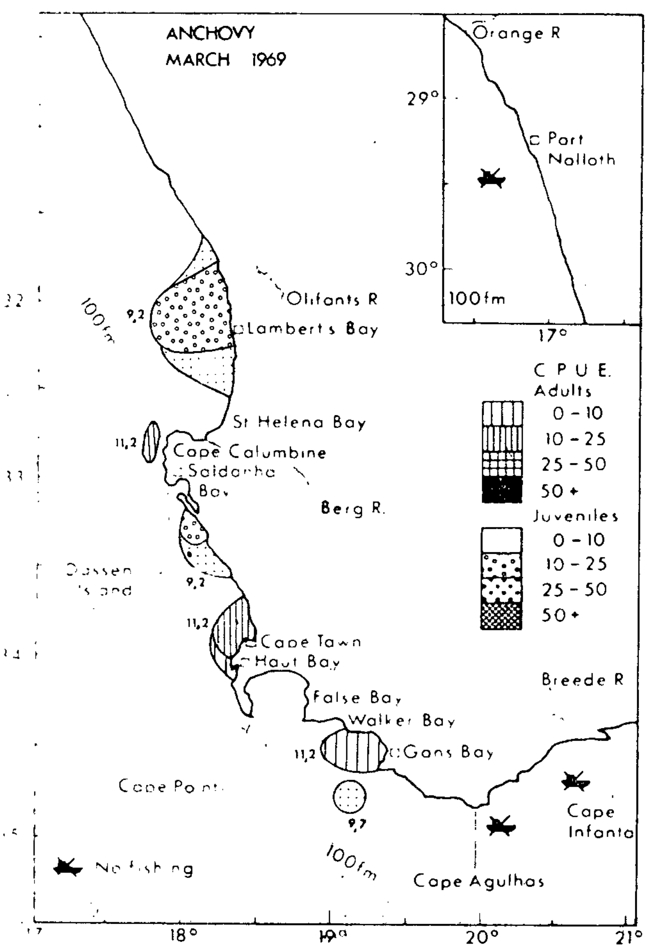
ANCHOVY
MARCH 1969
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Port Nolloth
100fm
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha
Berg R.
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Infanta
Cape Agulhas
C P U E.
Adults
0 - 10
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Juveniles
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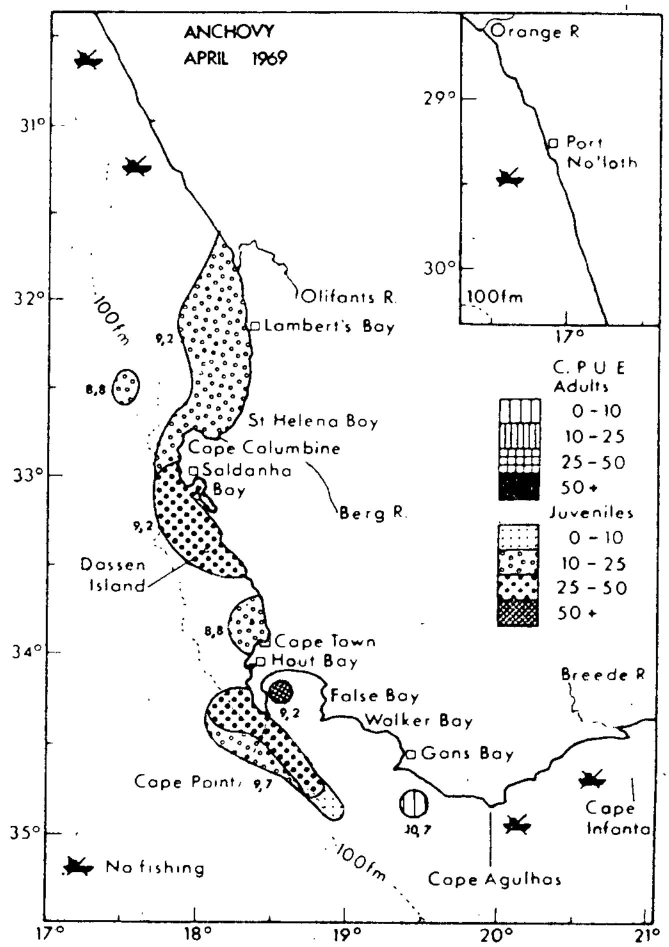
ANCHOVY
APRIL 1969
Orange R
Port No'loth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P U E
Adults
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Juveniles
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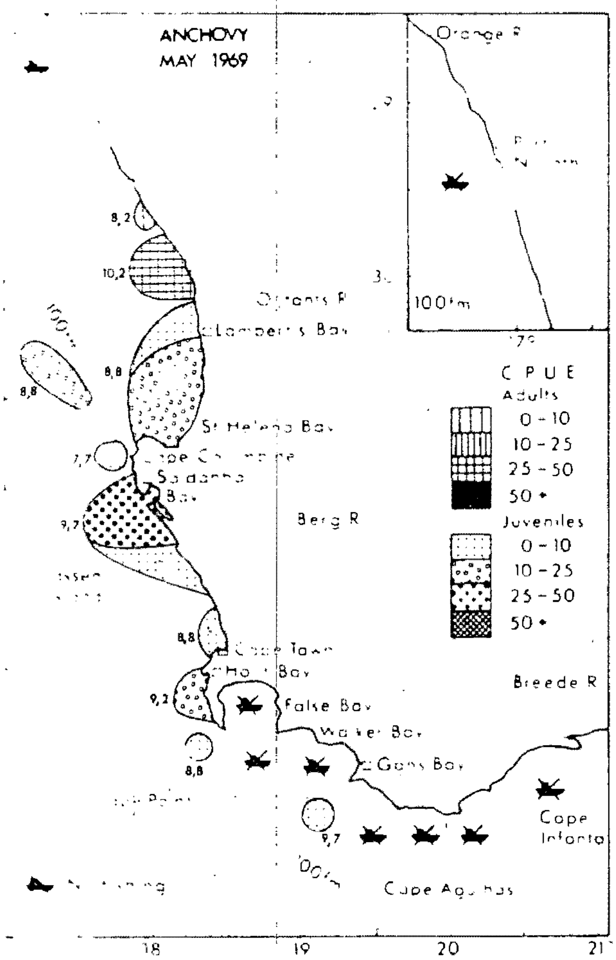
ANCHOVY
MAY 1969
100fm
Lambert's Bay
St Helena Bay
Saldanha Bay
Berg R
Cape Town
Breede R
False Bay
Walker Bay
Gans Bay
Cape Infanta
Cape Agulhas
C P U E
Adults
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25 - 50
50 +
Juveniles
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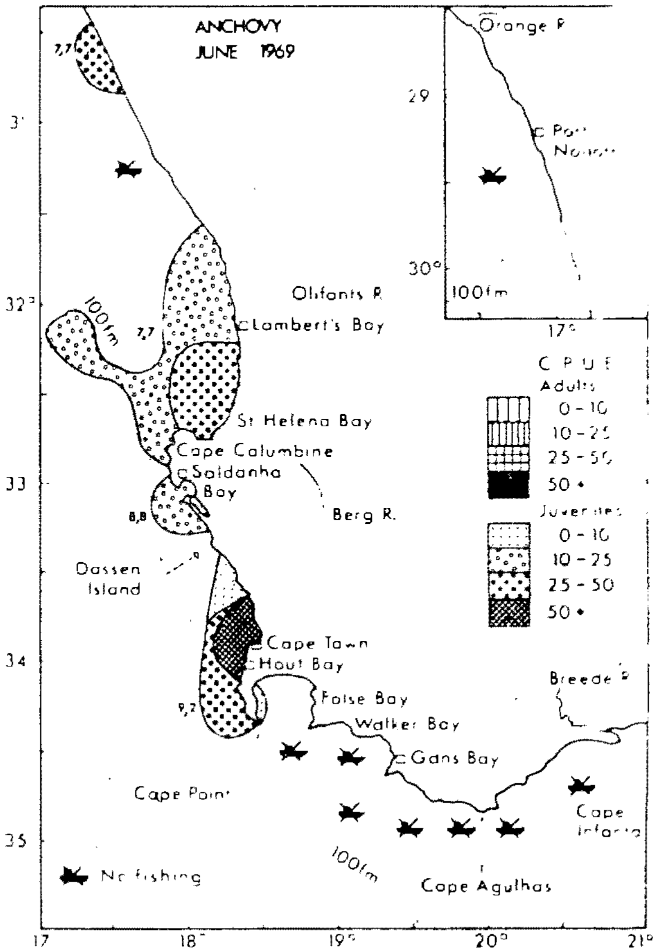
ANCHOVY
JUNE 1969
Orange R
29
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Olifants R
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
100fm
Cape Agulhas
No fishing
C P U E
Adults
Juveniles
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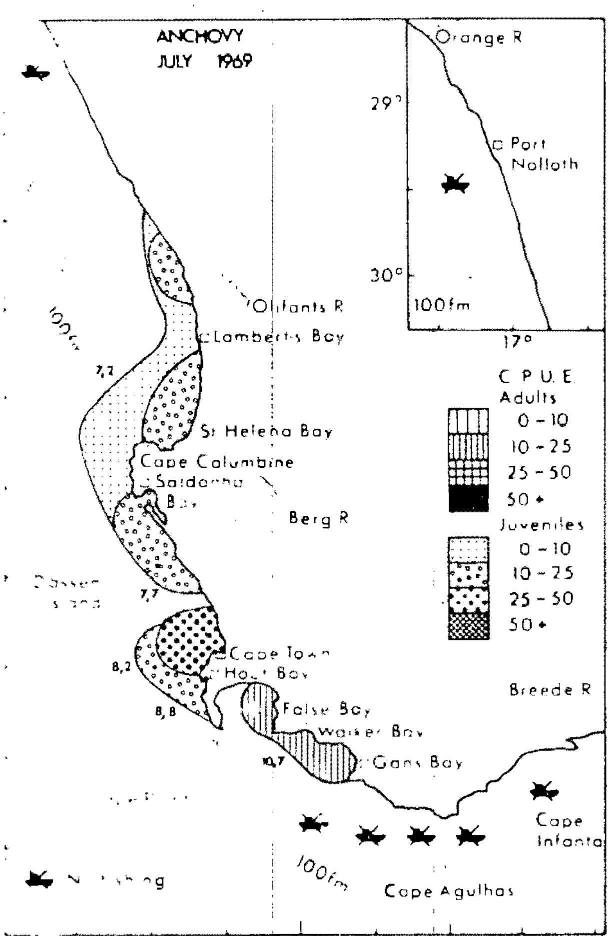
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JULY 1969
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Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R
Cape Town
Hout Bay
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Gans Bay
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Cape Infanta
100fm
Cape Agulhas
C P U E
Adults
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50 +
Juveniles
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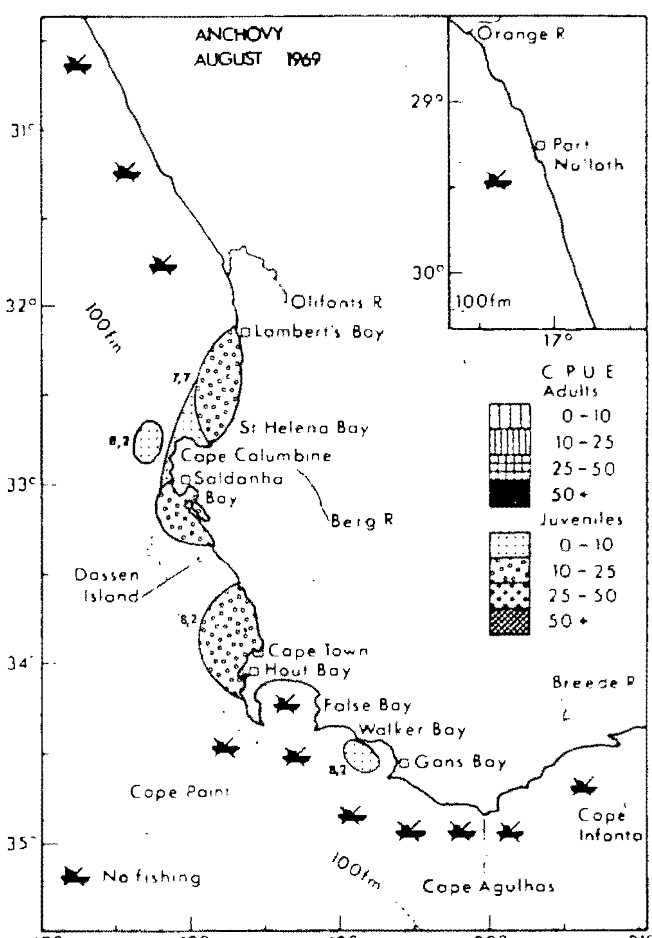
ANCHOVY
AUGUST 1969
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Port Nolloth
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100fm
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Olifants R
100fm
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
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C P U E
Adults
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50 +
Juveniles
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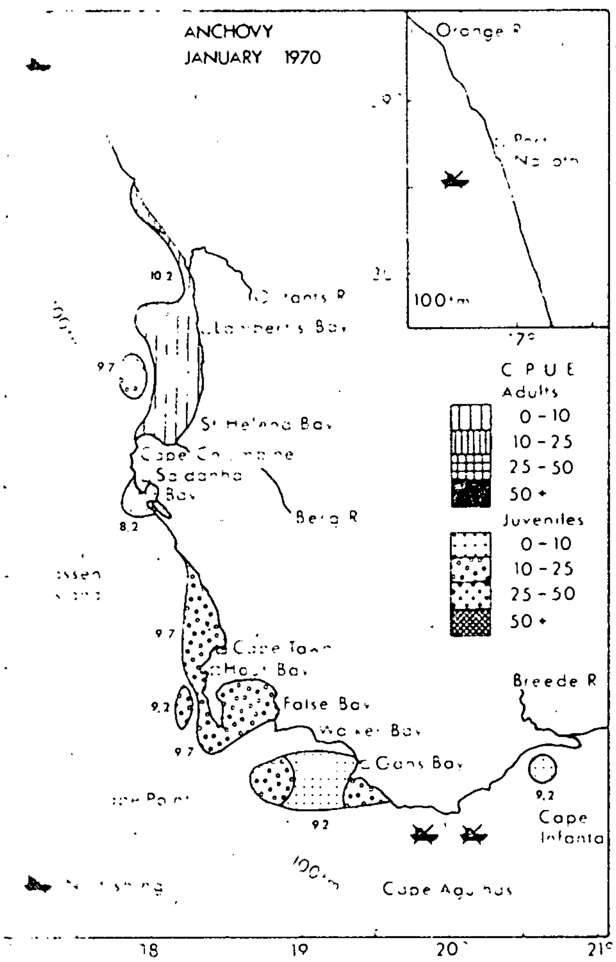
ANCHOVY
JANUARY 1970
Orange R
100 fm
C P U E
Adults
0 - 10
10 - 25
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Juveniles
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50 +
St Helena Bay
Berg R
Cape Town
Hout Bay
False Bay
Gans Bay
Breede R
Cape Infanta
Cape Agulhas
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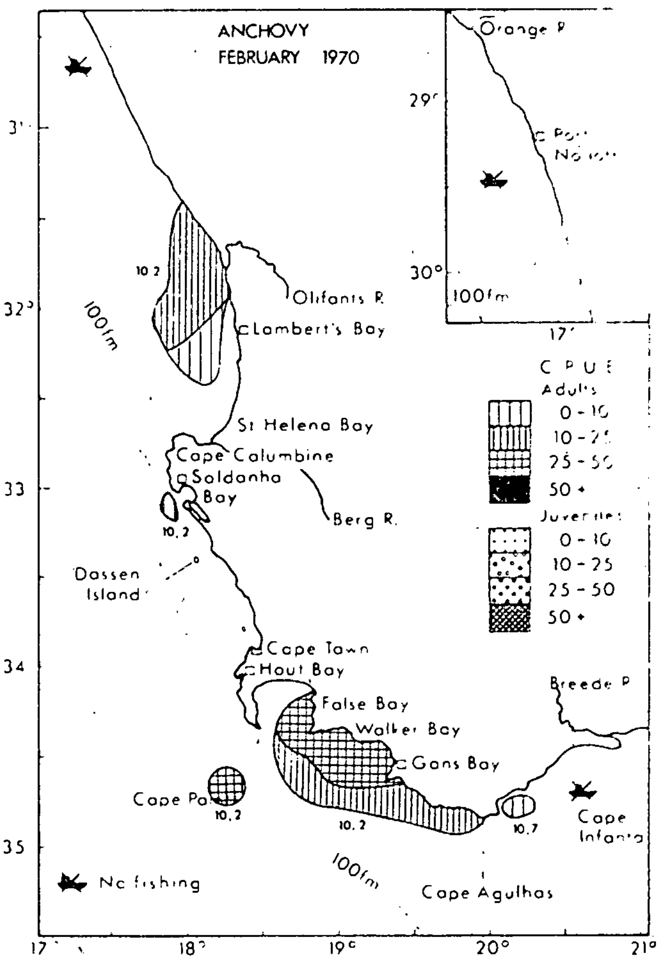
21°


ANCHOVY
FEBRUARY 1970
Orange R
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Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha
Bay
Berg R.
Dassen
Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Infanta
Cape Agulhas
No fishing
C P U E
Adults
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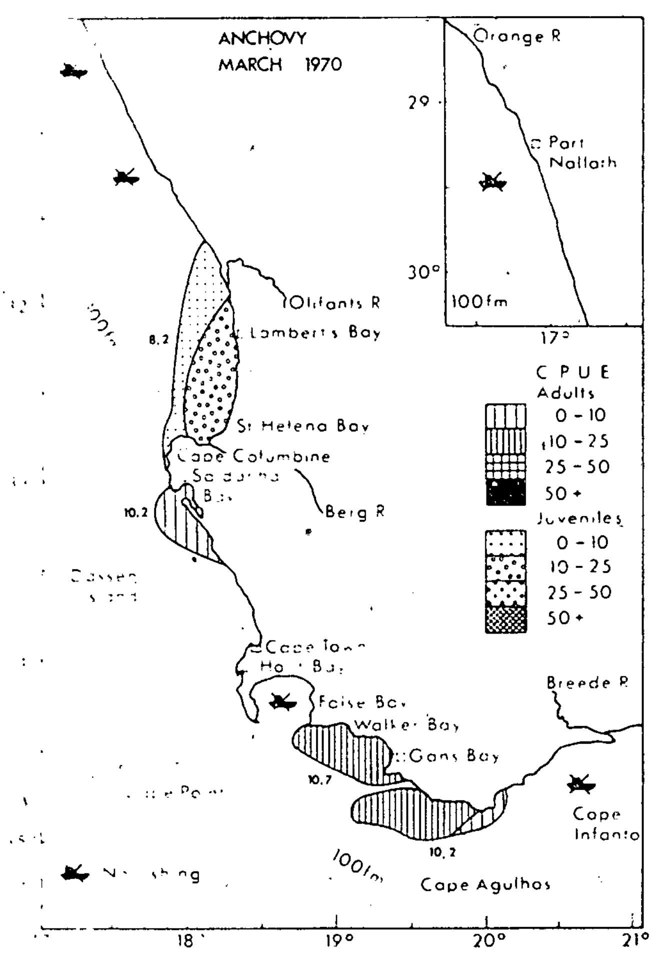
ANCHOVY
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Lambert's Bay
St Helena Bay
Cape Columbine
Berg R
Cape Town
False Bay
Walker Bay
Gans Bay
Breede R
Cape Infanta
Cape Agulhas
C P U E
Adults
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Juveniles
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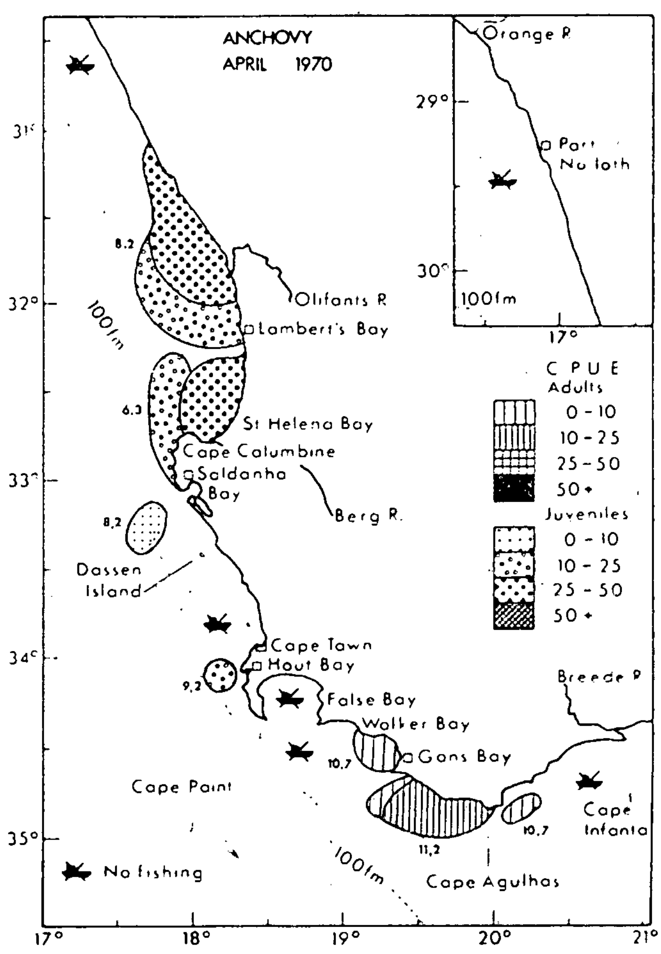
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Port
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St Helena Bay
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Saldanha
Bay
Berg R.
Dassen
Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C P U E
Adults
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Juveniles
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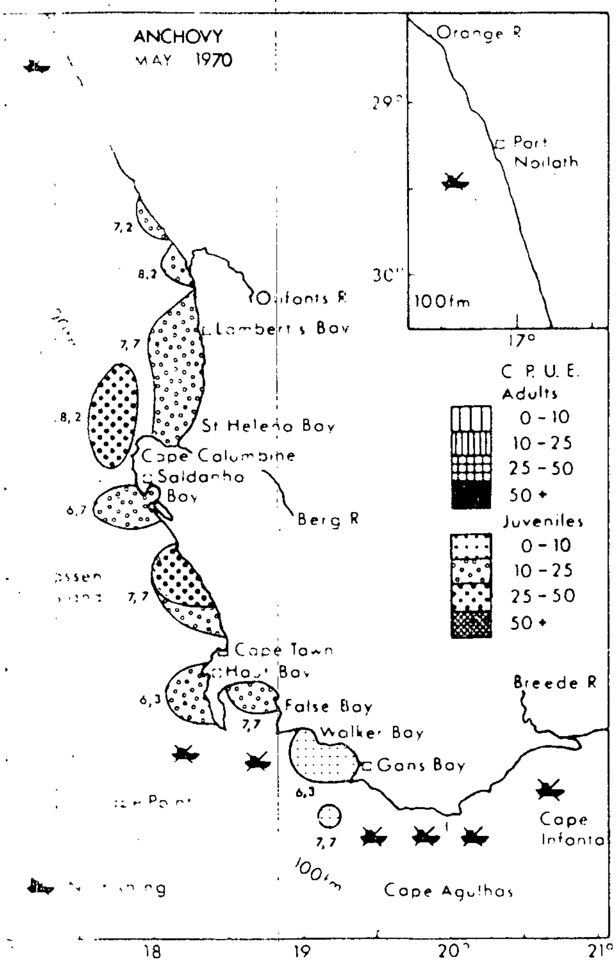
ANCHOVY
MAY 1970
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Port Nolloth
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Lambert's Bay
St Helena Bay
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Saldanha Bay
Berg R
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Infanta
Cape Agulhas
100fm
C.P.U.E.
Adults
0 - 10
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50 +
Juveniles
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25 - 50
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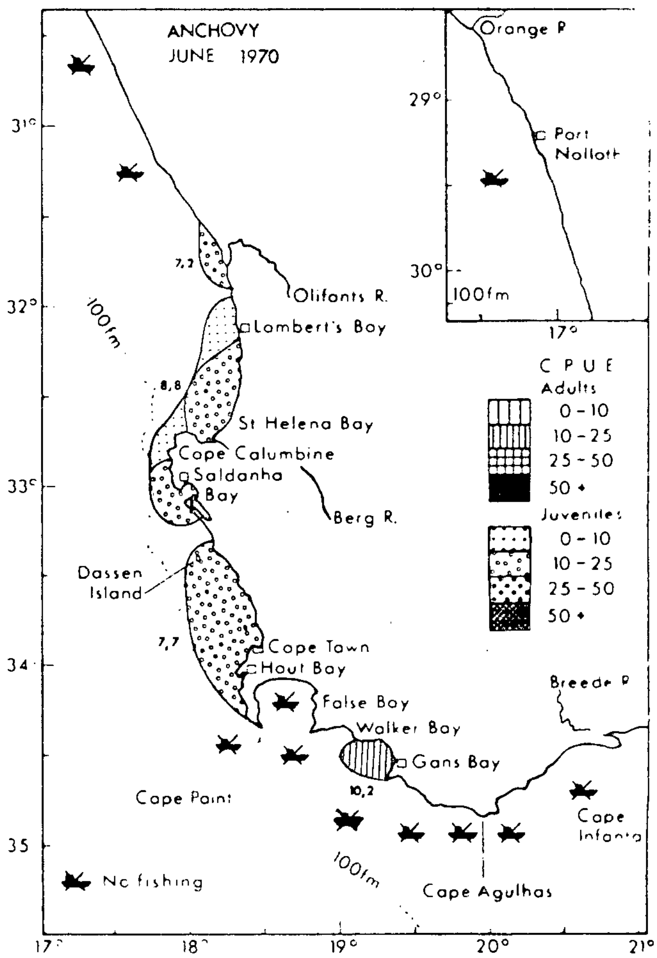
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100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C P U E
Adults
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50 +
Juveniles
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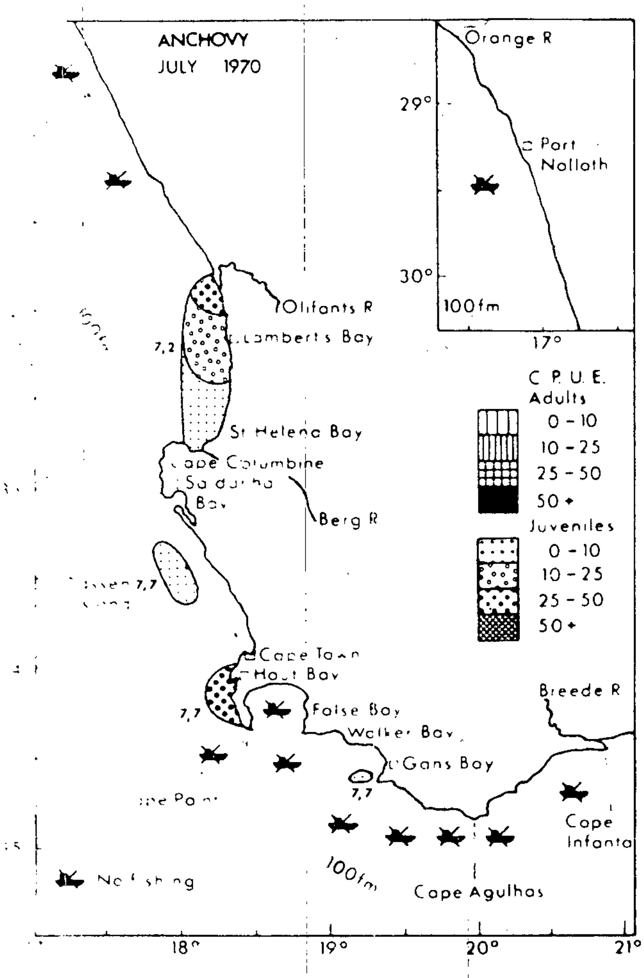
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Port Nolloth
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Lambert's Bay
St Helena Bay
Saldanha
Berg R
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Infanta
Cape Agulhas
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
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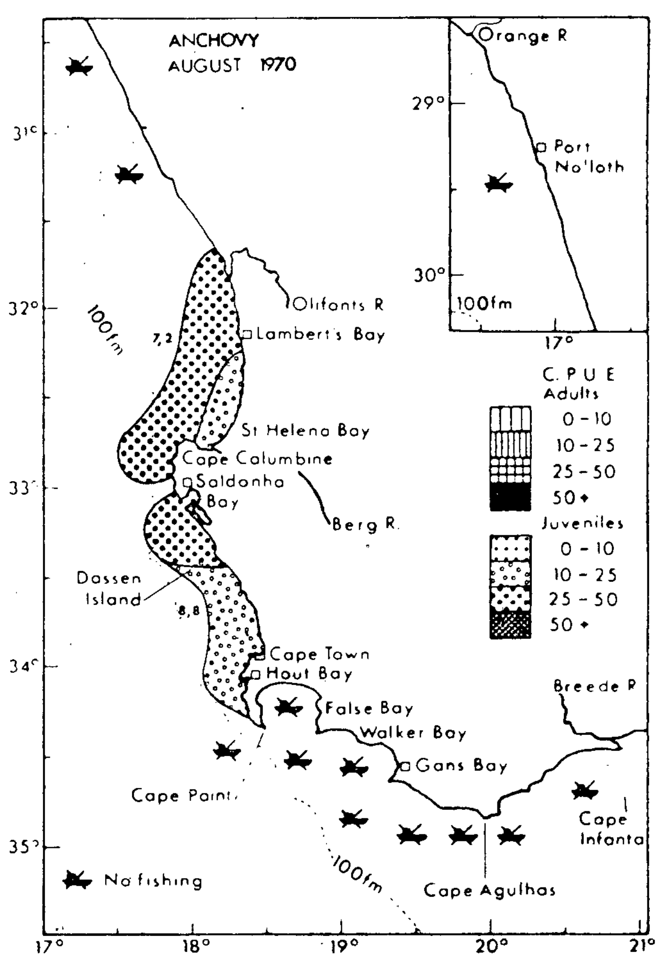
ANCHOVY
AUGUST 1970
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Port No'loth
100fm
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100fm
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
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Gans Bay
Breede R
Cape Point
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100fm
No fishing
C. P U E
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Juveniles
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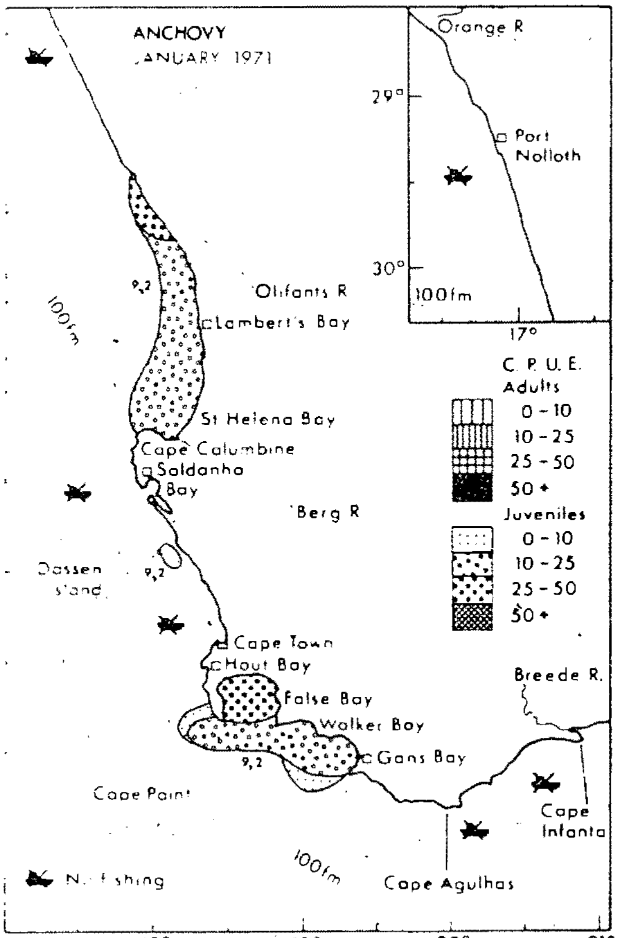
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JANUARY 1971
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100fm
17°
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
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Cape Point
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100fm
9,2
No fishing
C. P. U. E.
Adults
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50 +
Juveniles
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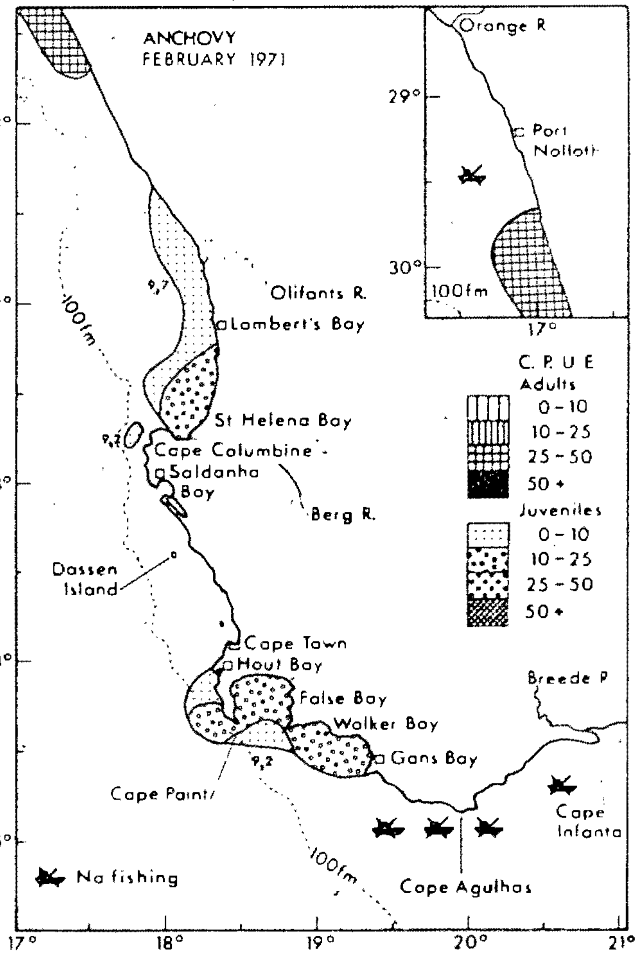
ANCHOVY
FEBRUARY 1971
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Port Nolloth
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Lambert's Bay
St Helena Bay
Cape Columbine
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Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
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Cape Point
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No fishing
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Adults
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Juveniles
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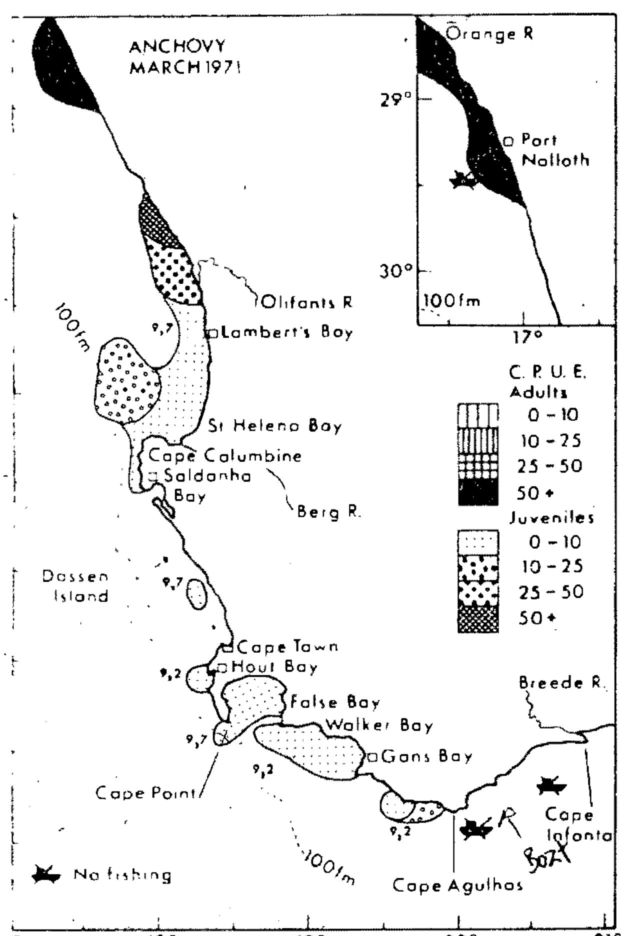
ANCHOVY
MARCH 1971
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Port Nolloth
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100fm
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100fm
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9,2
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
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Breede R.
Cape Point
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No fishing
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Adults
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50 +
Juveniles
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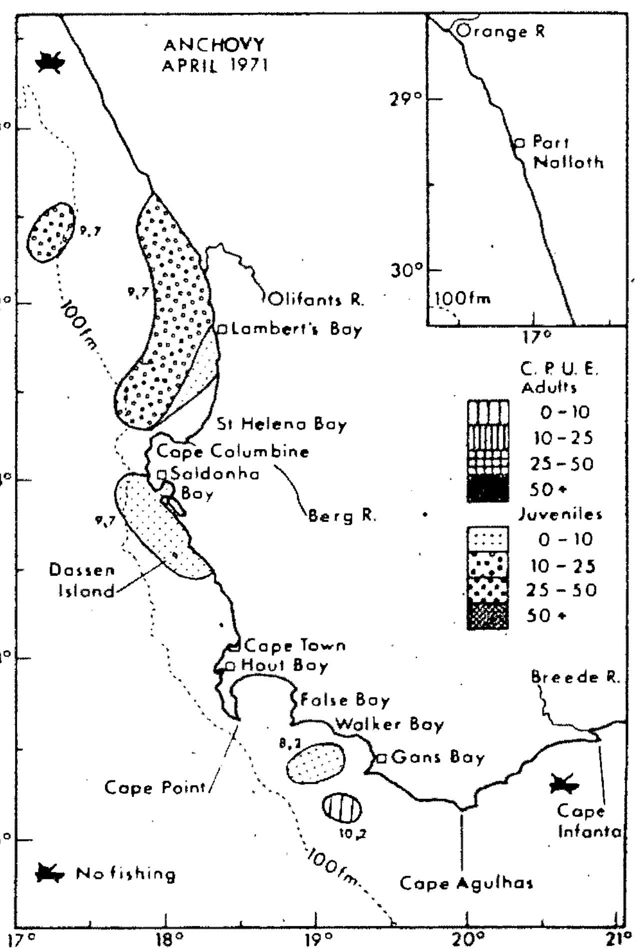
ANCHOVY
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Port Nolloth
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Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
19°
20°
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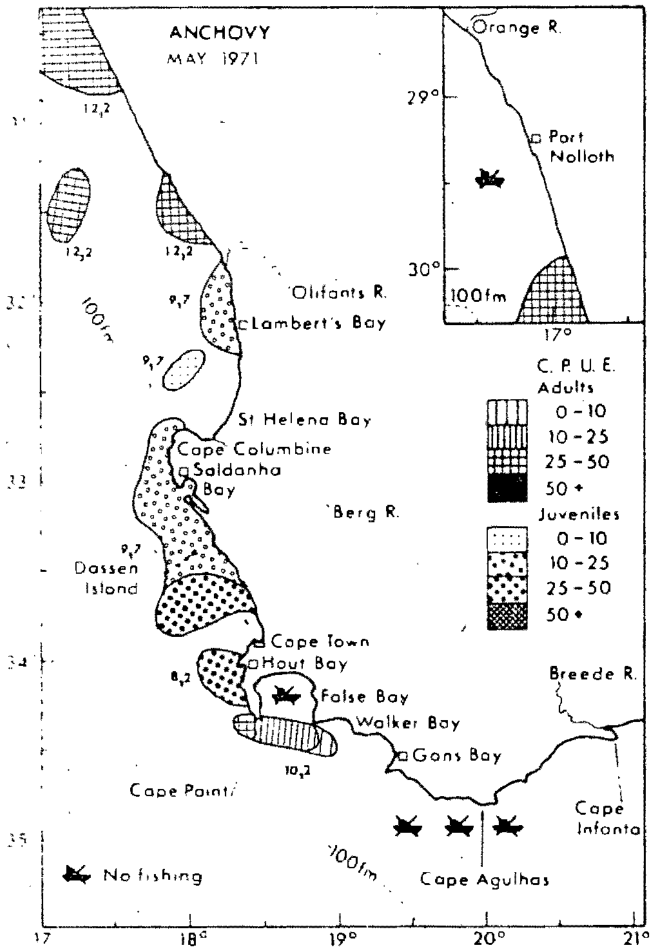
ANCHOVY
MAY 1971
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
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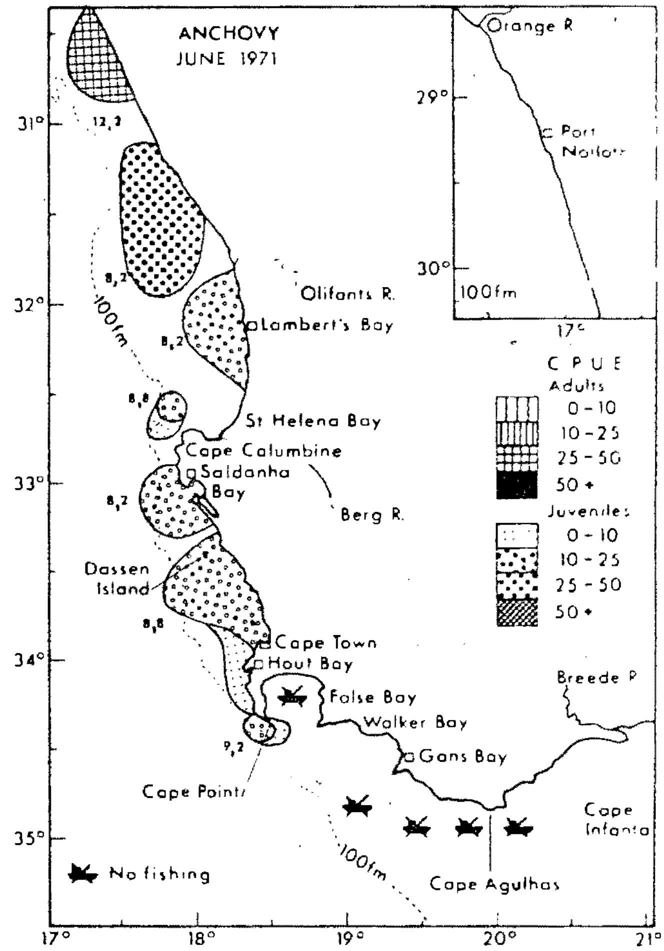
25 - 50
50 +


ANCHOVY
JUNE 1971
Orange R
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C P U E
Adults
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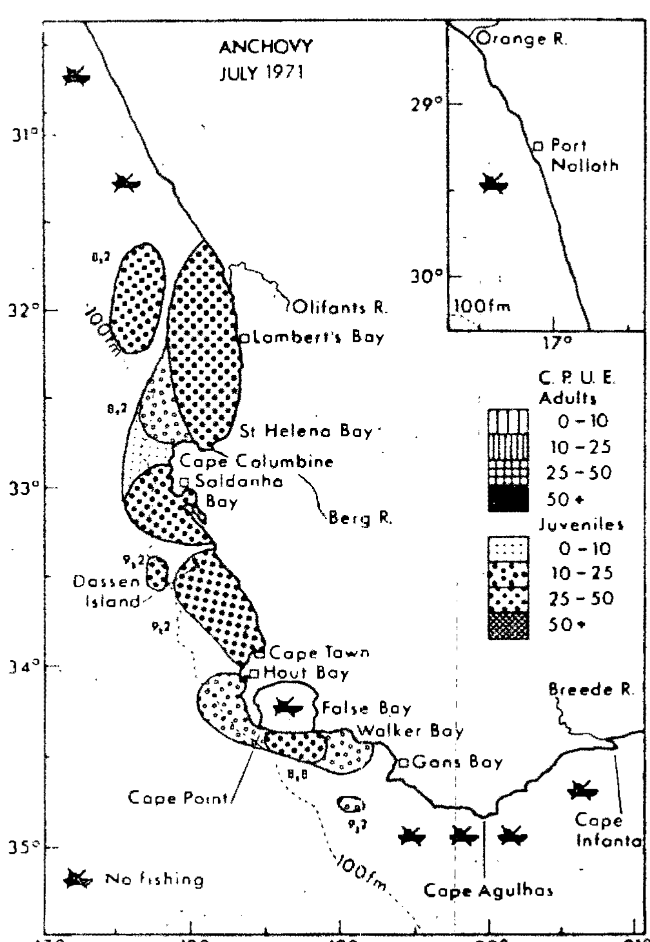
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +


ANCHOVY
JULY 1971
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
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25 - 50
50 +
Juveniles
0 - 10
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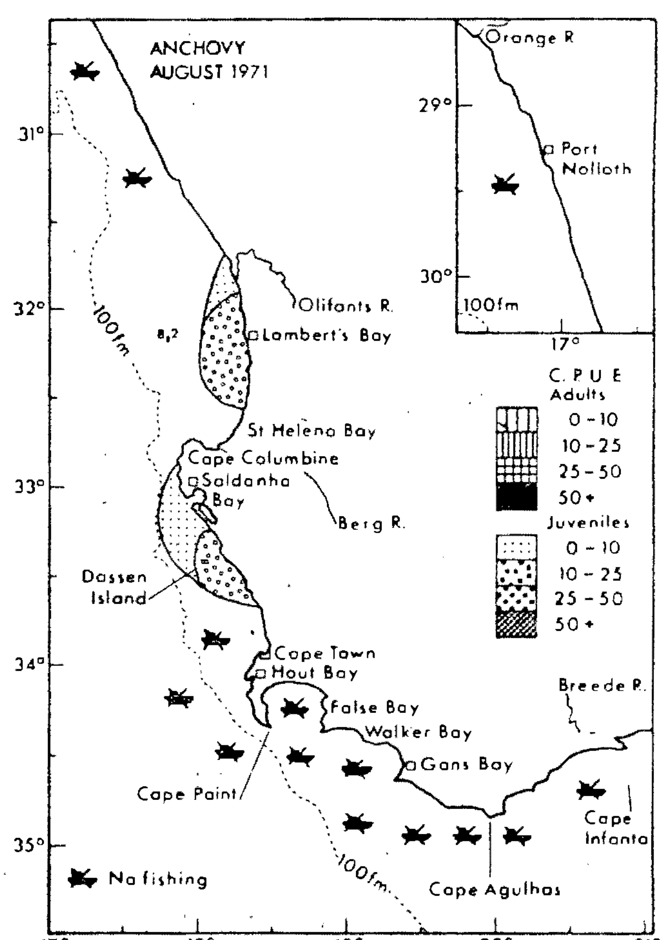
ANCHOVY
AUGUST 1971
Orange R
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E
Adults
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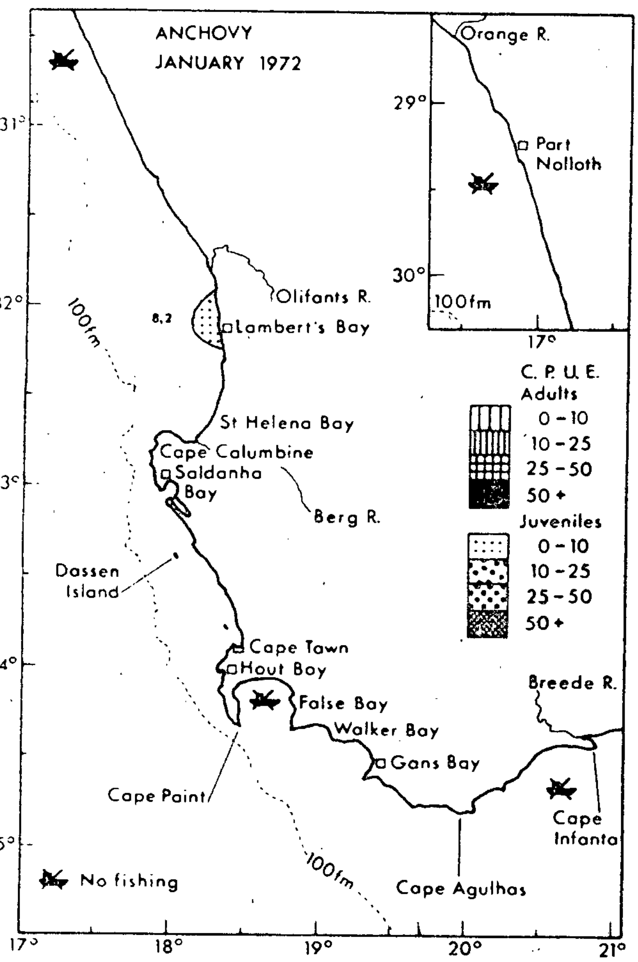
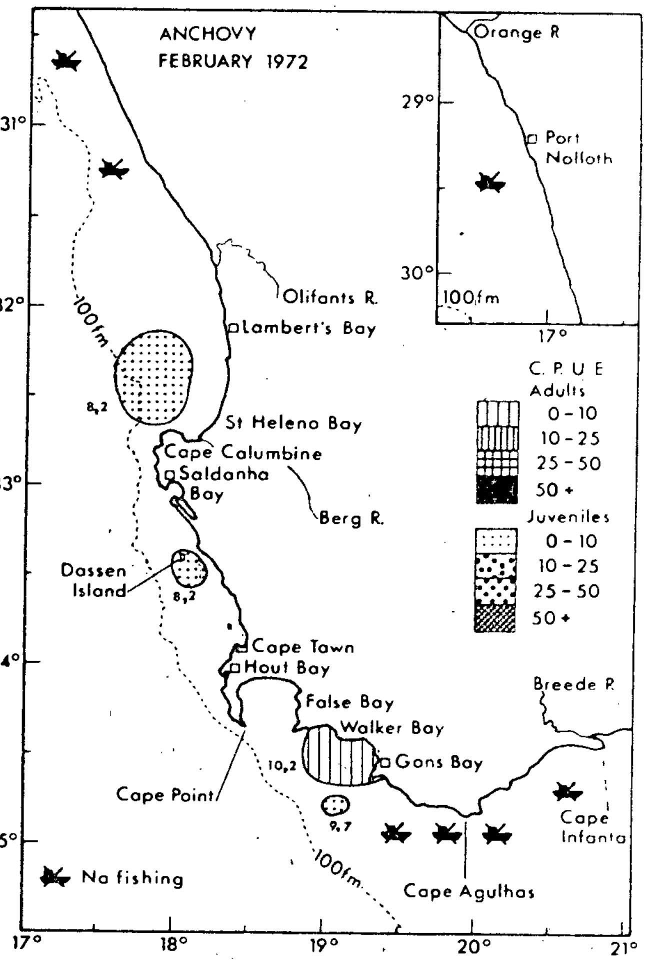
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +


ANCHOVY
JANUARY 1972
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
8,2
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +


ANCHOVY
FEBRUARY 1972
Orange R
Port Nolloth
100fm
Olifants R.
Lambert's Bay
8,2
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
8,2
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
10,2
9,7
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E
Adults
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10 - 25
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50 +
Juveniles
0 - 10
10 - 25
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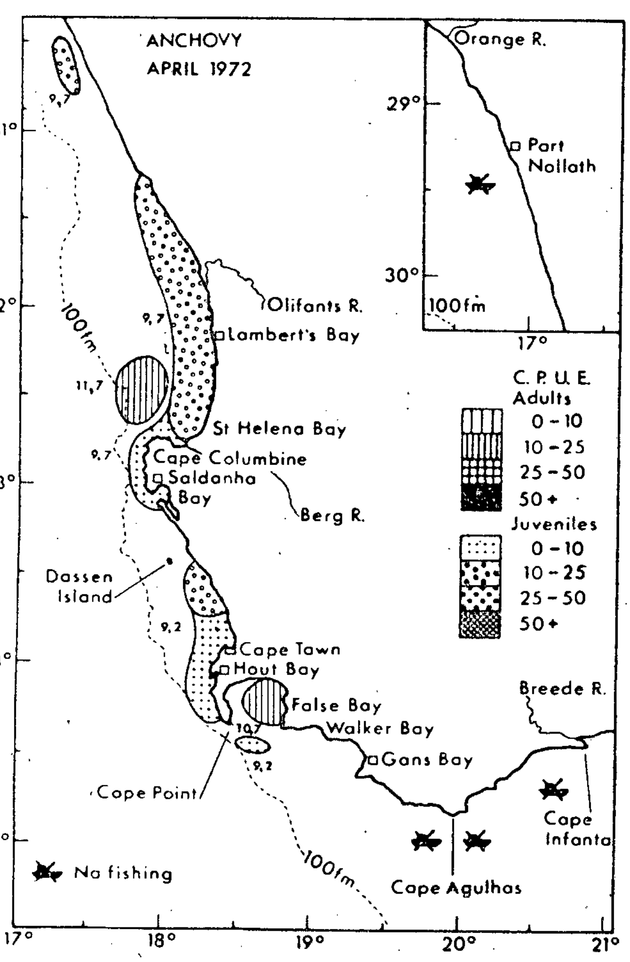
50 +


ANCHOVY
APRIL 1972
Orange R.
Port Nolloth
100fm
9,7
Olifants R.
Lambert's Bay
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St Helena Bay
9,7
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
9,2
Cape Town
Hout Bay
False Bay
10,7
Walker Bay
9,2
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
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25 - 50
50 +
Juveniles
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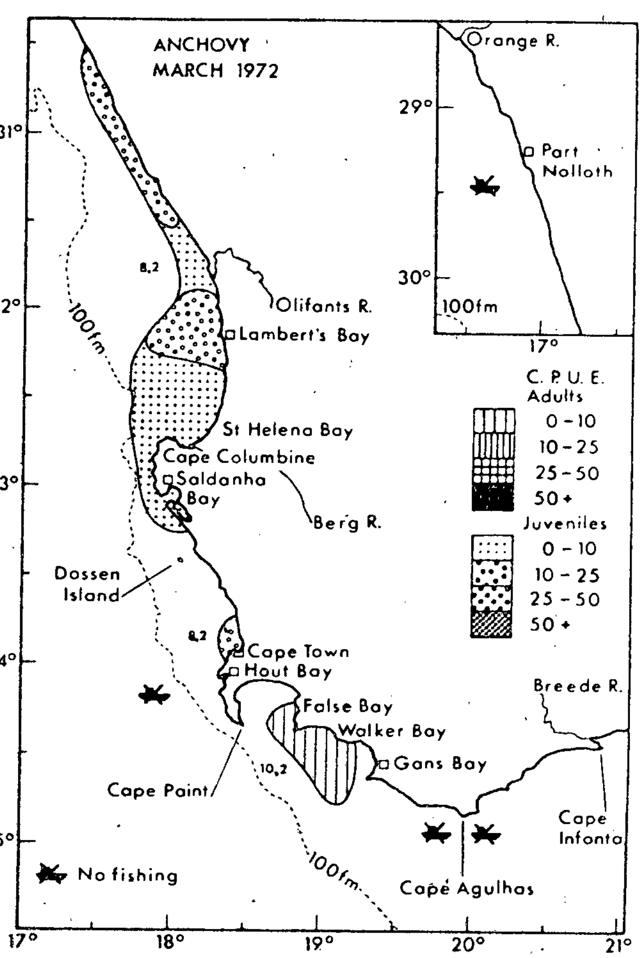
50 +


ANCHOVY
MARCH 1972
Orange R.
Port Nolloth
100fm
8,2
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
8,2
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
10,2
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
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Adults
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50 +
Juveniles
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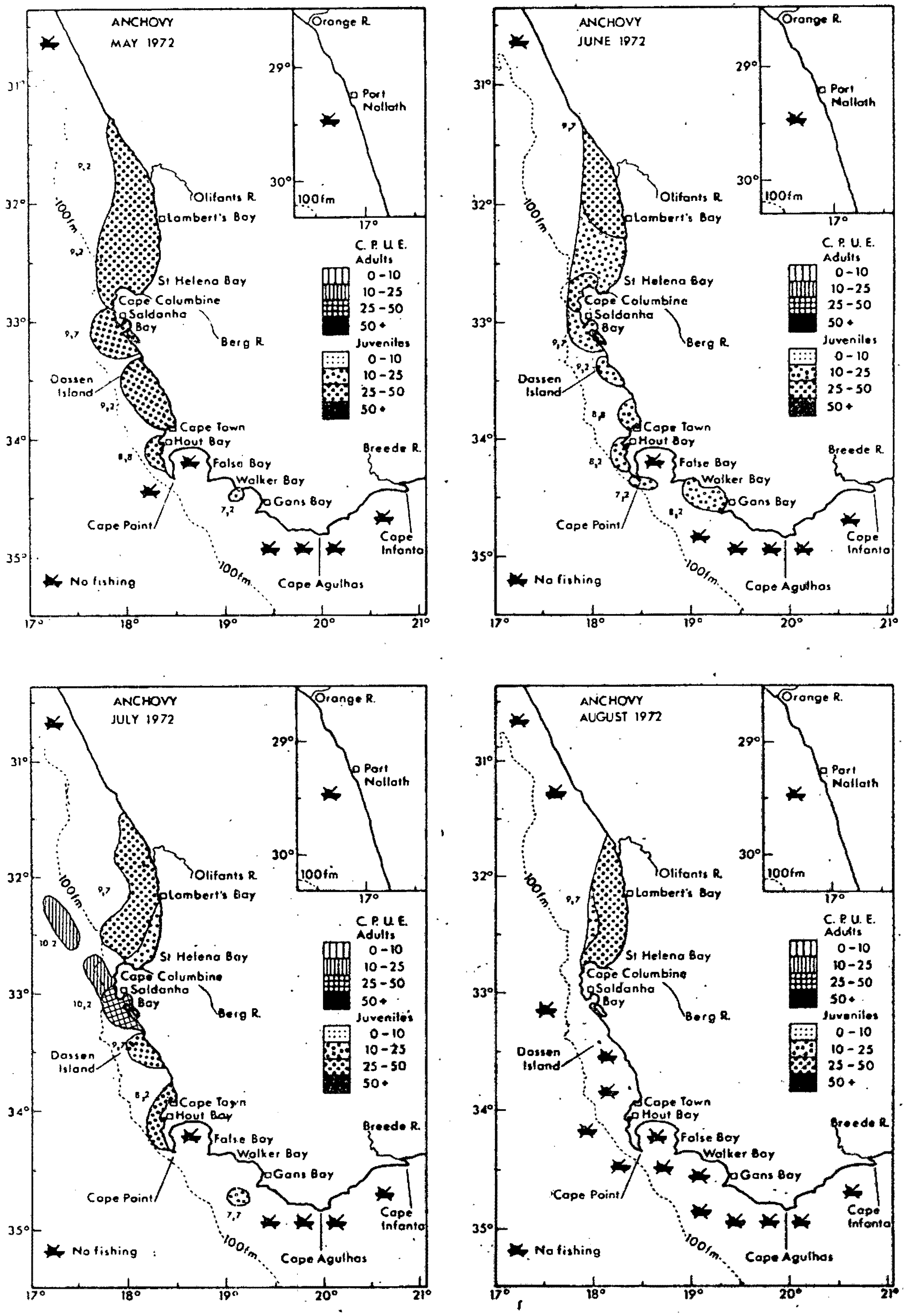
ANCHOVY
MAY 1972
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
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Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Cape Point
Breede R.
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
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50 +
Juveniles
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ANCHOVY
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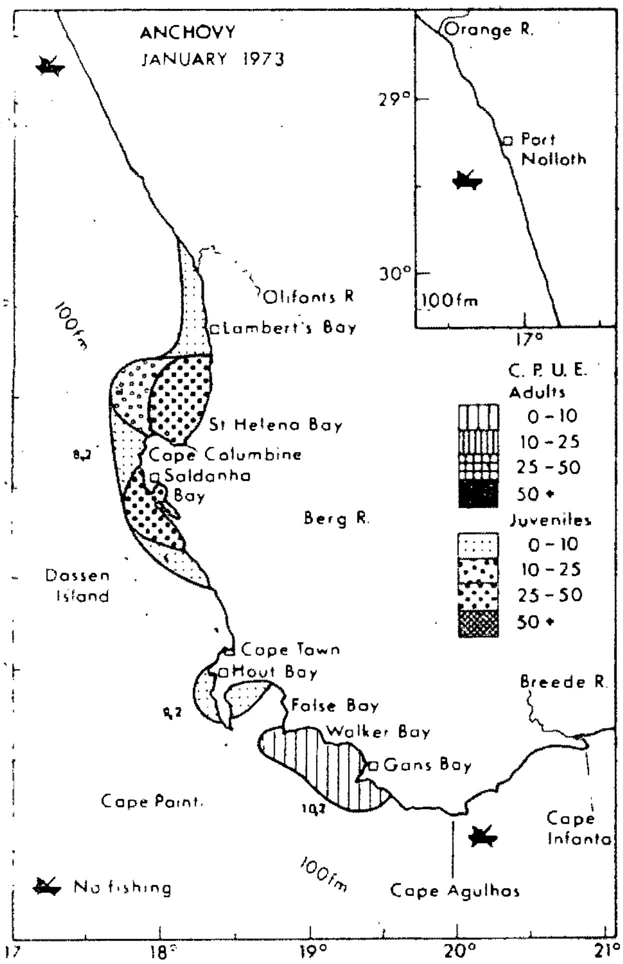
ANCHOVY
JULY 1972
ANCHOVY
AUGUST 1972


ANCHOVY
JANUARY 1973
Orange R.
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Port Nolloth
30°
100fm
17°
Olifants R
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
100fm
Cape Agulhas
No fishing
C. P. U. E.
Adults
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50 +
Juveniles
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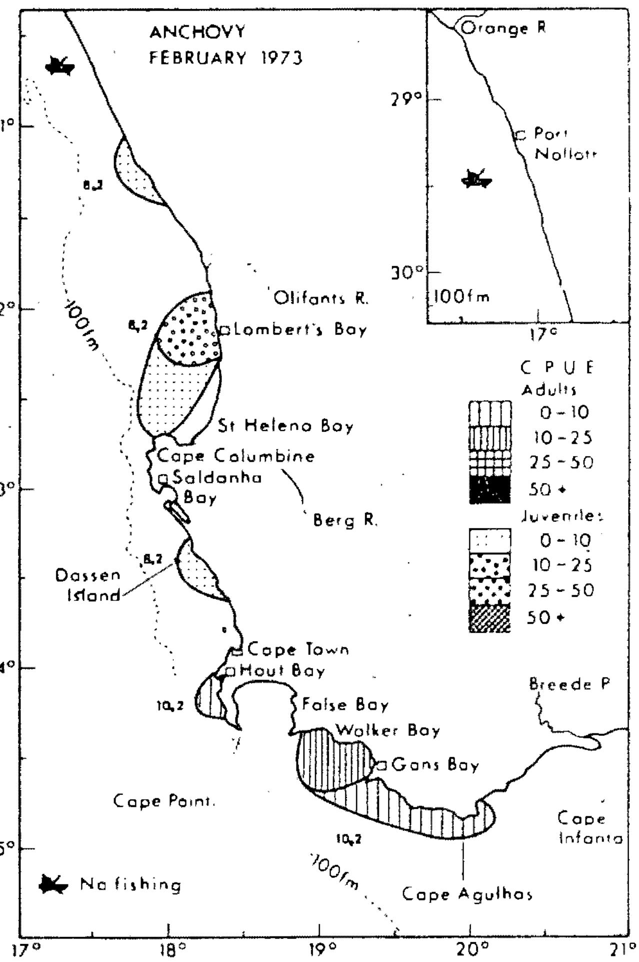
ANCHOVY
FEBRUARY 1973
Orange R
29°
Port Nolloth
30°
100fm
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32°
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35°
Olifants R.
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
100fm
Cape Agulhas
No fishing
C P U E
Adults
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Juveniles
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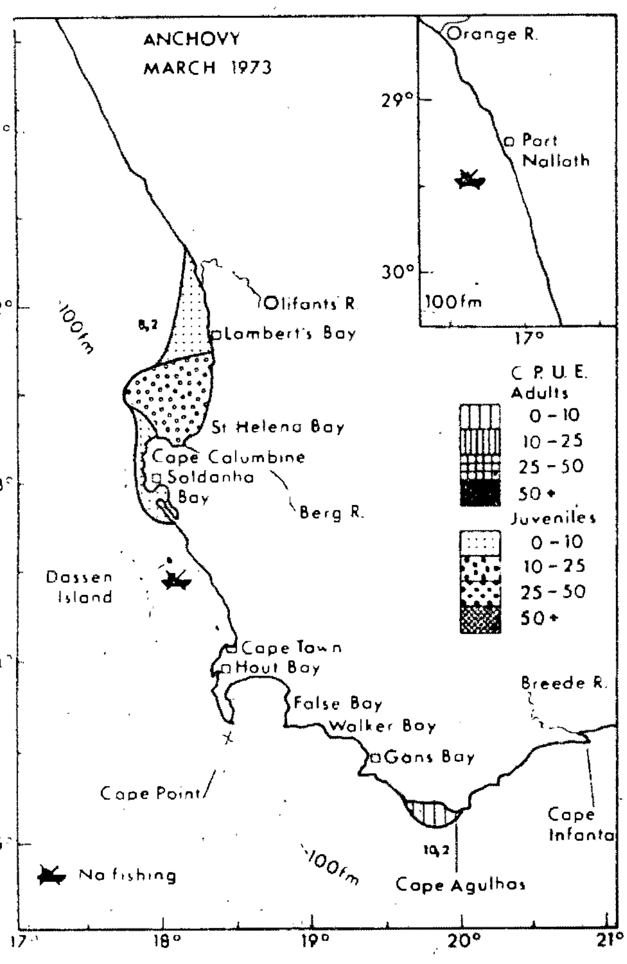
ANCHOVY
MARCH 1973
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Port Nolloth
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100fm
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Olifants R
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
100fm
Cape Agulhas
No fishing
C. P. U. E.
Adults
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25 - 50
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Juveniles
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18°
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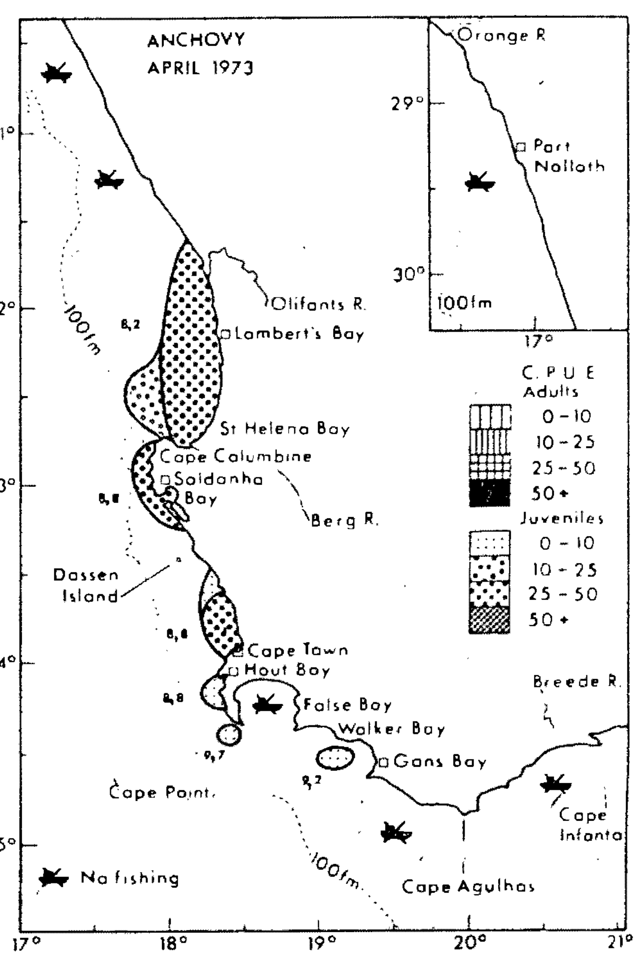
ANCHOVY
APRIL 1973
Orange R
29°
Port Nolloth
30°
100fm
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Olifants R.
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
100fm
Cape Agulhas
No fishing
C. P U E
Adults
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10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
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50 +
17°
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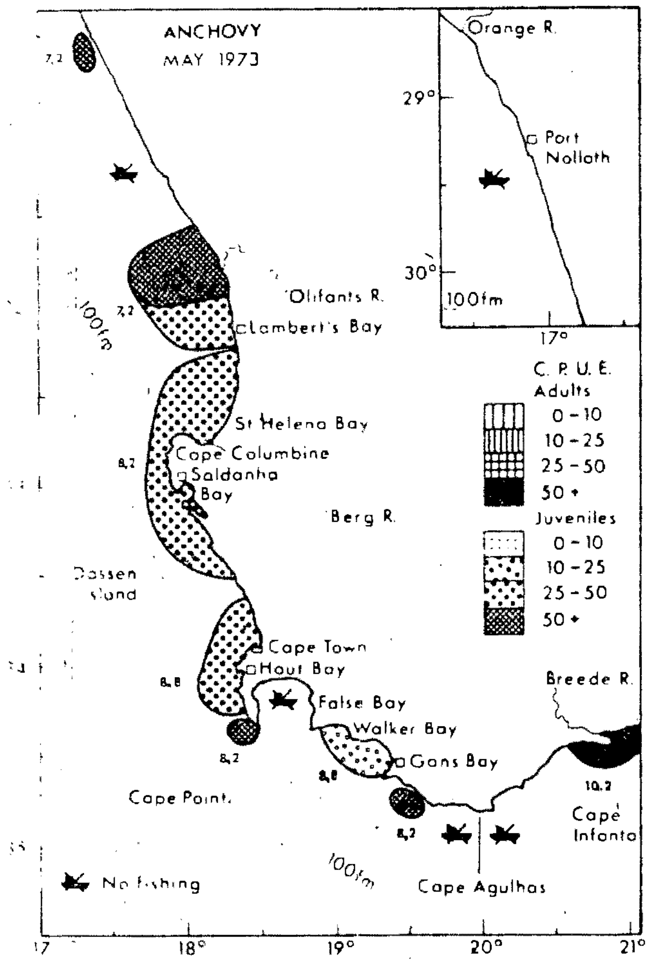
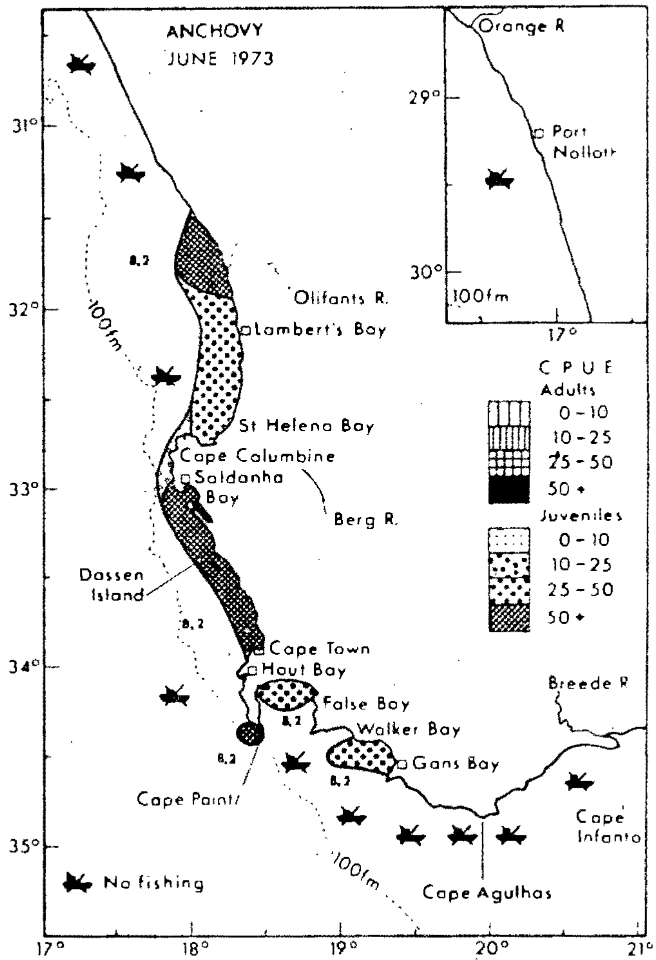

ANCHOVY
MAY 1973
Orange R.
29°
Port Nolloth
30°
100fm
17°
Olifants R.
Lambert's Bay
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point.
Cape Infanta
Cape Agulhas
100fm
No fishing
17
18°
19°
20°
21°


ANCHOVY
JUNE 1973
Orange R
29°
Port Nolloth
30°
100fm
17°
31°
32°
33°
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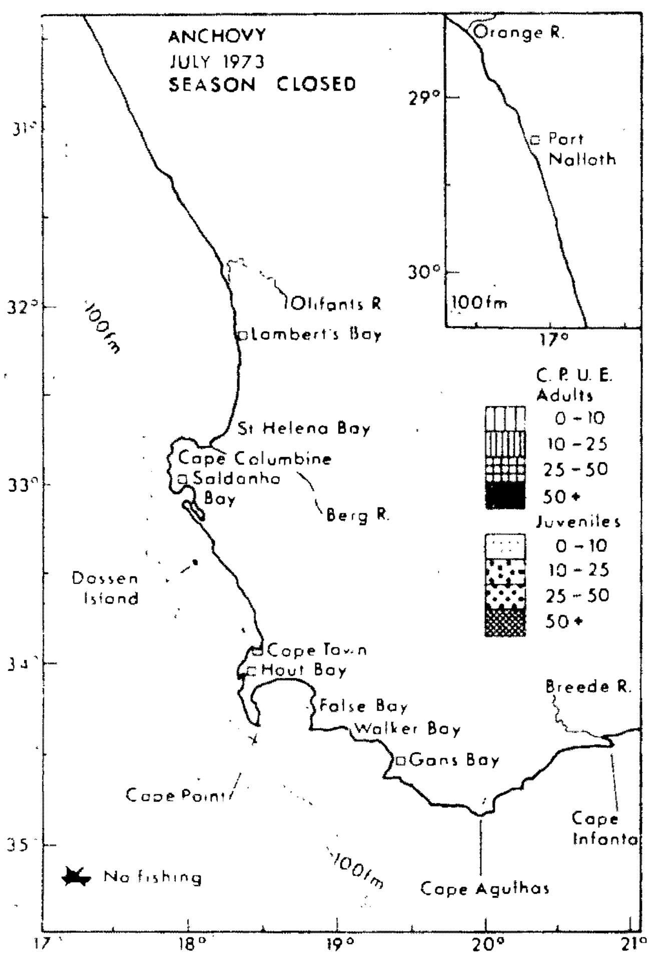
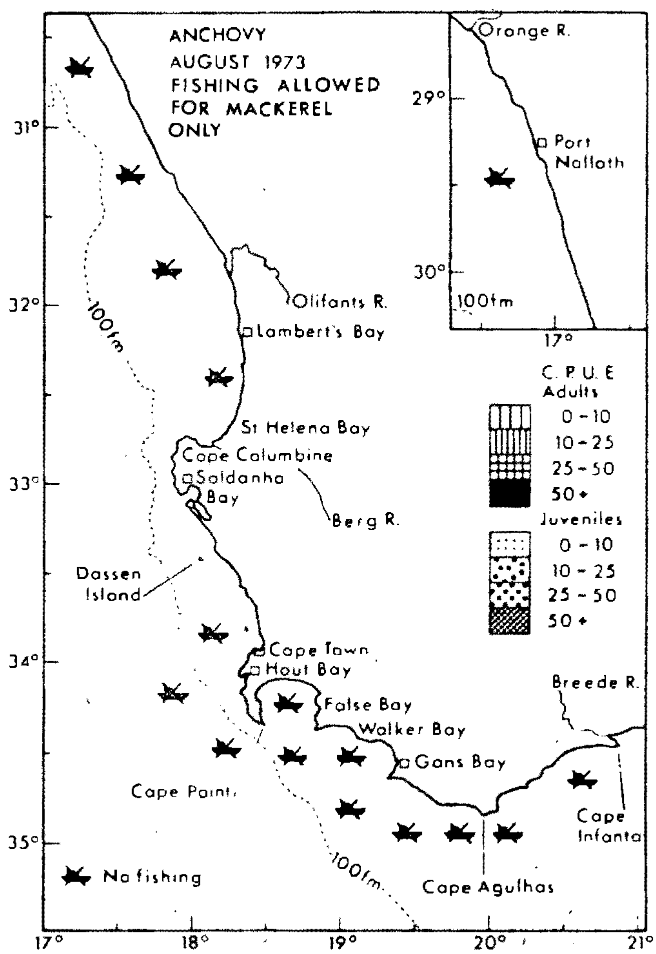
35°
Olifants R.
Lambert's Bay
100fm
C P U E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
17°
18°
19°
20°
21°


ANCHOVY
JULY 1973
SEASON CLOSED
Orange R.
29°
Port Nolloth
30°
100fm
17°
Olifants R
Lambert's Bay
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
18°
19°
20°
21°


ANCHOVY
AUGUST 1973
FISHING ALLOWED
FOR MACKEREL
ONLY
Orange R.
29°
Port Nolloth
30°
100fm
17°
31°
32°
33°
34°
35°
Olifants R.
Lambert's Bay
100fm
C. P. U. E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point.
Cape Infanta
Cape Agulhas
100fm
No fishing
17°
18°
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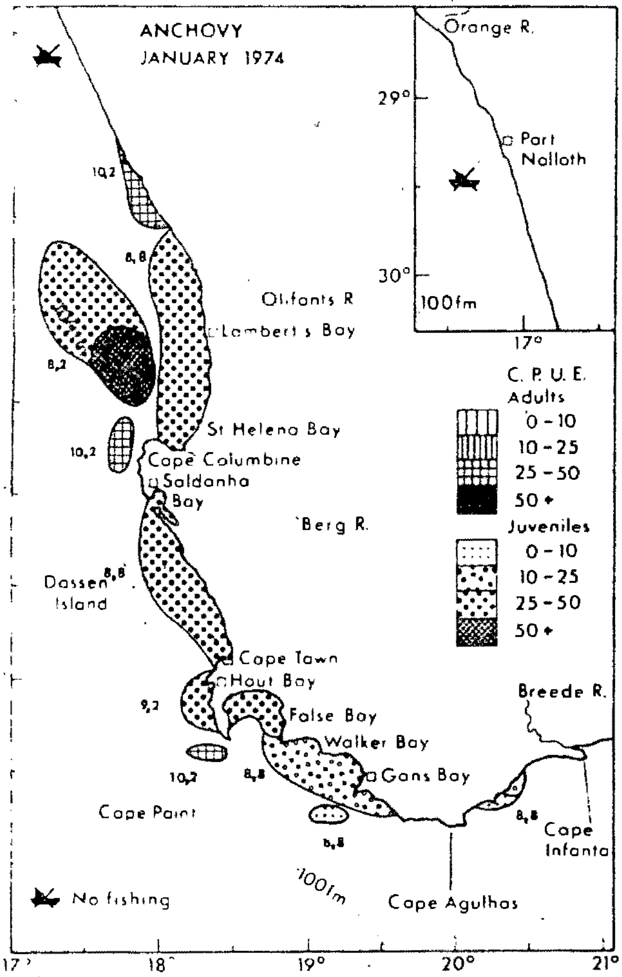
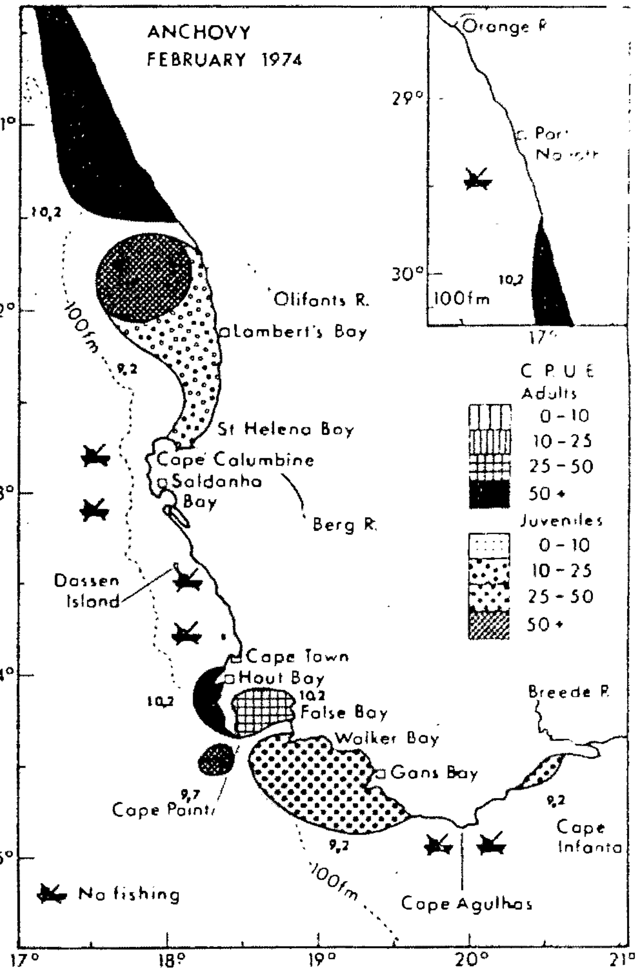
20°
21°


ANCHOVY
JANUARY 1974
Orange R.
29°
Port Nolloth
30°
100fm
17°
10,2
8,8
Olifants R
Lambert's Bay
8,2
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
10,2
Cape Columbine
Saldanha Bay
33°
Berg R.
Juveniles
0 - 10
10 - 25
25 - 50
50 +
Dassen Island
8,8
Cape Town
34°
Hout Bay
9,2
False Bay
Breede R.
Walker Bay
10,2
8,8
Gans Bay
Cape Point
8,8
Cape Infanta
35
No fishing
100fm
Cape Agulhas
18°
19°
20°
21°


ANCHOVY
FEBRUARY 1974
Orange R
29°
Port Nolloth
31°
10,2
30°
10,2
100fm
Olifants R.
32°
Lambert's Bay
100fm
9,2
C P U E
Adults
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
33°
Berg R.
Juveniles
0 - 10
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25 - 50
50 +
Dassen Island
Cape Town
34°
Hout Bay
10,2
10,2
False Bay
Breede R
Walker Bay
Gans Bay
9,7
Cape Point
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Cape Infanta
35°
100fm
No fishing
Cape Agulhas
17°
18°
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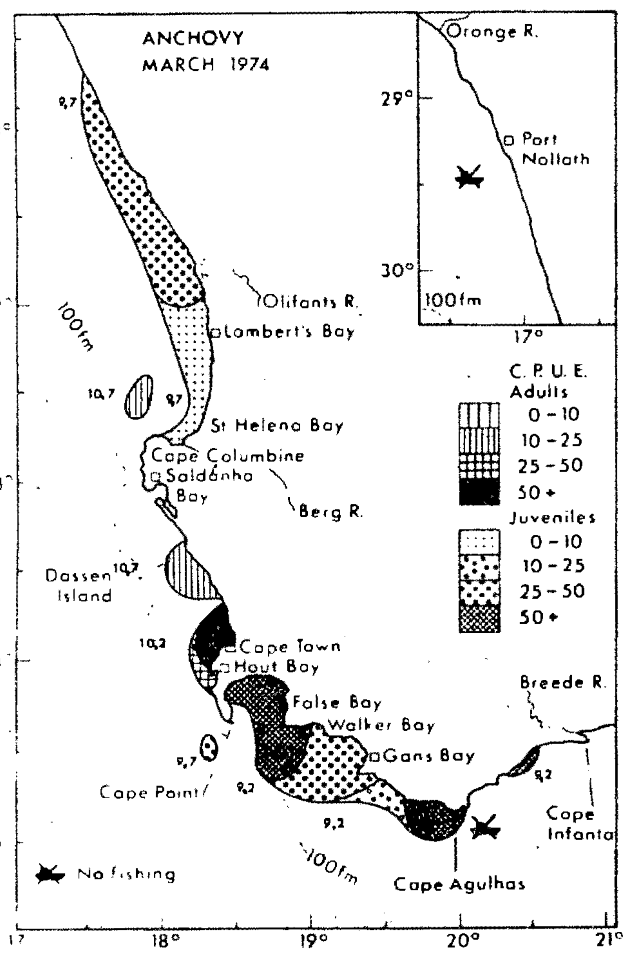
21°


ANCHOVY
MARCH 1974
Orange R.
9,7
29°
Port Nolloth
31°
30°
100fm
Olifants R.
32°
Lambert's Bay
100fm
10,7
9,7
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
33°
Berg R.
Juveniles
0 - 10
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25 - 50
50 +
Dassen Island
10,7
10,2
Cape Town
34
Hout Bay
False Bay
Breede R.
Walker Bay
9,7
Gans Bay
Cape Point
9,2
9,2
9,2
Cape Infanta
35
No fishing
100fm
Cape Agulhas
17
18°
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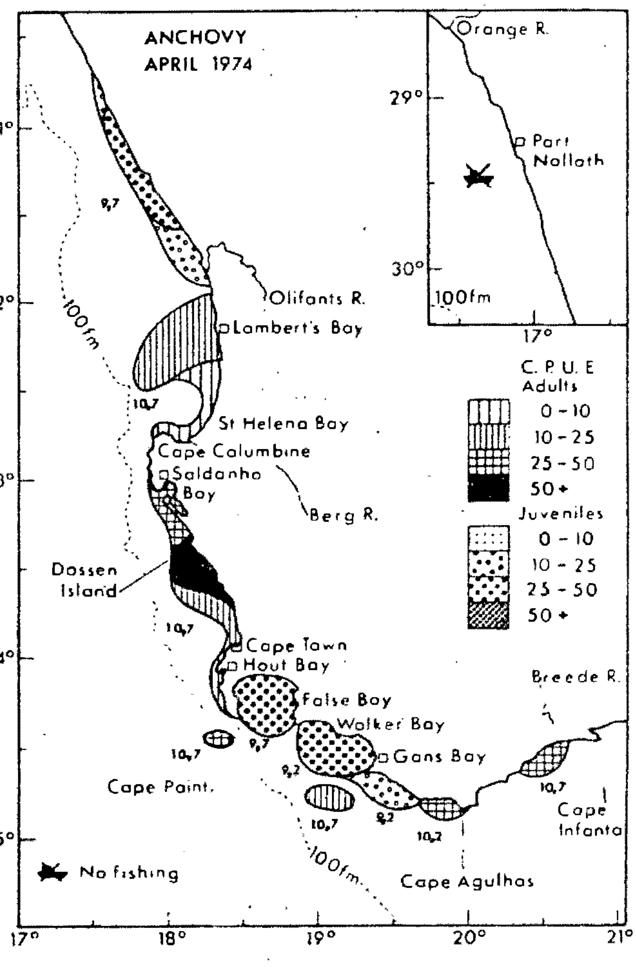
ANCHOVY
APRIL 1974
Orange R.
29°
Port Nolloth
31°
9,7
30°
100fm
Olifants R.
32°
Lambert's Bay
100fm
C. P. U. E
Adults
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10 - 25
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50 +
10,7
St Helena Bay
Cape Columbine
Saldanha Bay
33°
Berg R.
Juveniles
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25 - 50
50 +
Dossen Island
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Cape Town
34°
Hout Bay
False Bay
Breede R.
Walker Bay
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Gans Bay
Cape Point
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Cape Infanta
35°
No fishing
100fm
Cape Agulhas
17°
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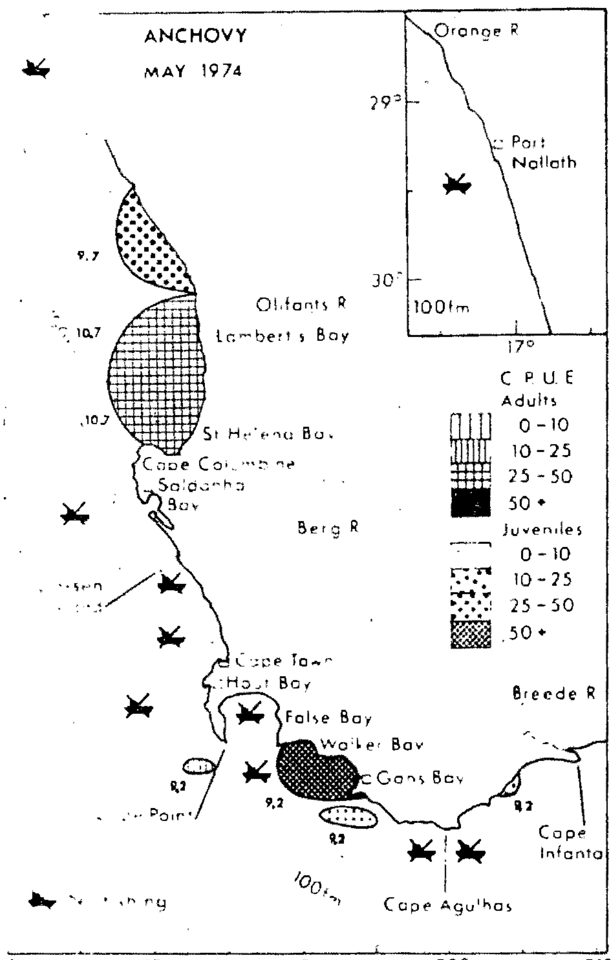
ANCHOVY
MAY 1974
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29°
Port Nolloth
30°
100fm
17°
Olifants R
Lambert's Bay
St Helena Bay
Berg R
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape
Infanta
Cape Agulhas
100fm
C P U E
Adults
0 - 10
10 - 25
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Juveniles
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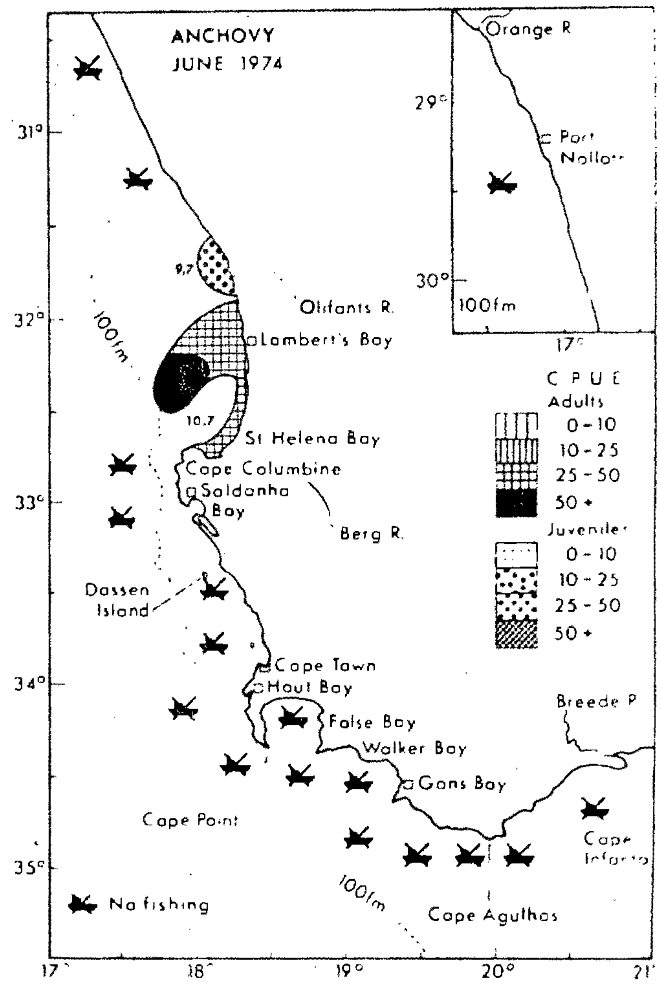
ANCHOVY
JUNE 1974
Orange R
29°
Port Nolloth
30°
100fm
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100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha
Bay
Berg R.
Dassen
Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Cape Point
Cape Agulhas
9,7
10,7
C P U E
Adults
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Juveniles
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25 - 50
50 +
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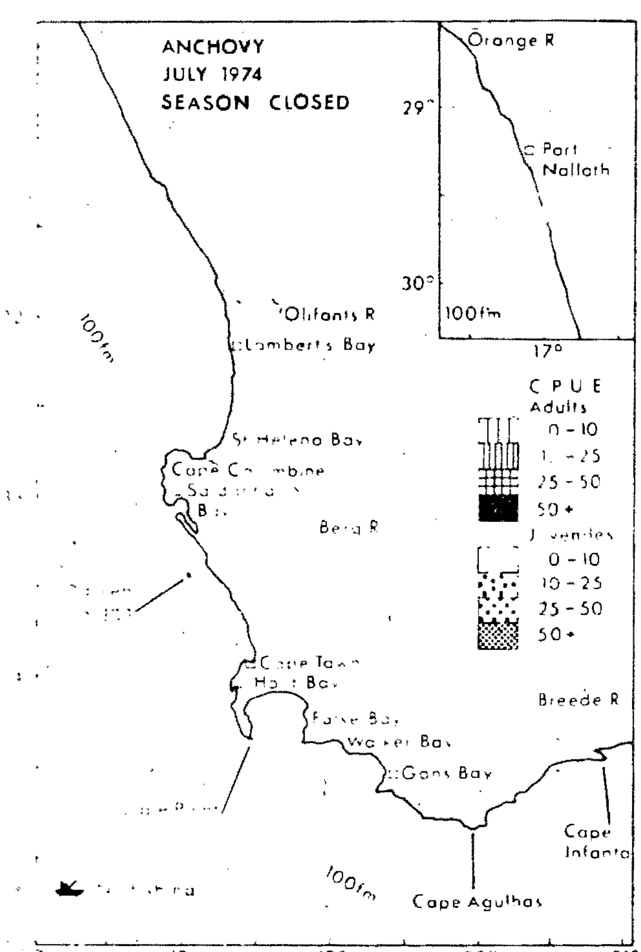
ANCHOVY
JULY 1974
SEASON CLOSED
Orange R
29°
Port
Nolloth
30°
100fm
17°
100fm
Olifants R
Lamberts Bay
St Helena Bay
Berg R
Breede R
Gans Bay
Cape
Infanta
Cape Agulhas
C P U E
Adults
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50 +
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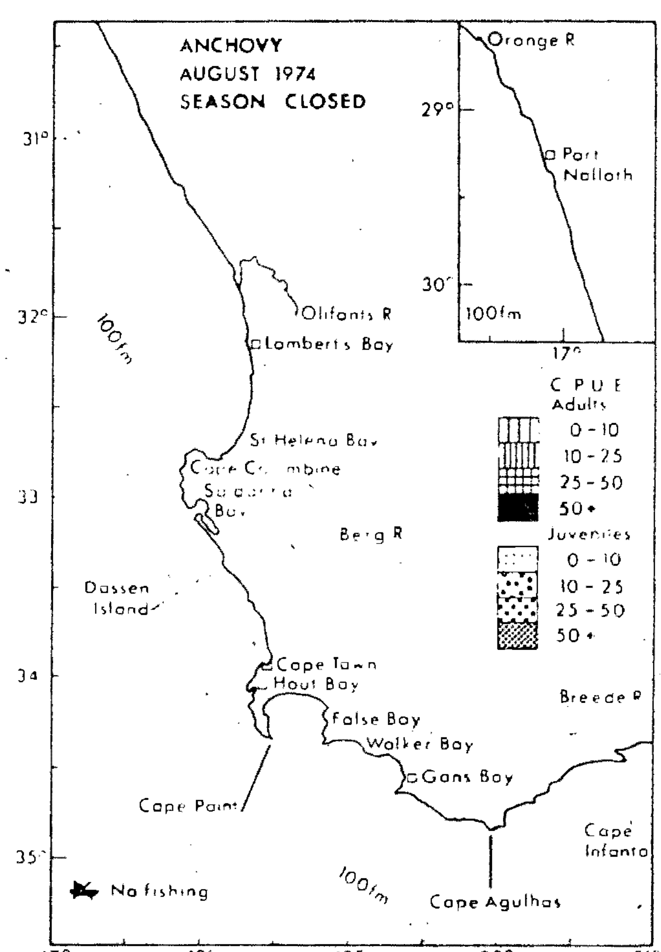
ANCHOVY
AUGUST 1974
SEASON CLOSED
Orange R
29°
Port
Nolloth
30°
100fm
17°
31°
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35°
100fm
Olifants R
Lamberts Bay
St Helena Bay
Berg R
Dassen
Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Cape Point
Breede R
Cape
Infanta
Cape Agulhas
C P U E
Adults
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10 - 25
25 - 50
50 +
Juveniles
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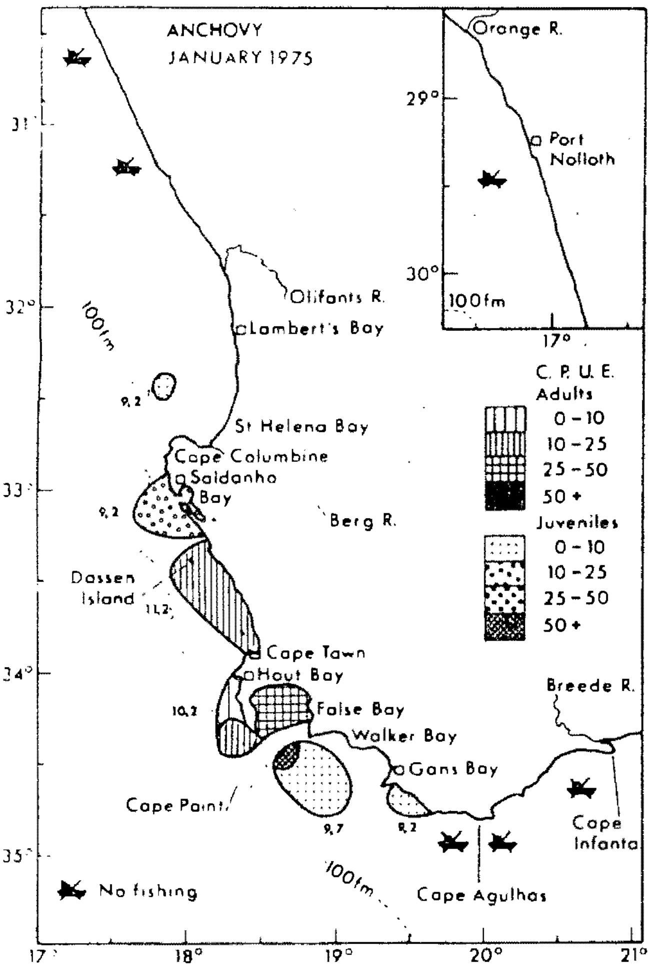
10 - 25
25 - 50
50 +
No fishing
17°
19°
20°
21°


ANCHOVY
JANUARY 1975
Orange R.
29°
Port Nolloth
30°
100fm
17°
31°
32°
33°
34°
35°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
9,2
9,2
11,2
10,2
9,7
9,2
C. P. U. E.
Adults
0 - 10
10 - 25
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50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
No fishing
17°
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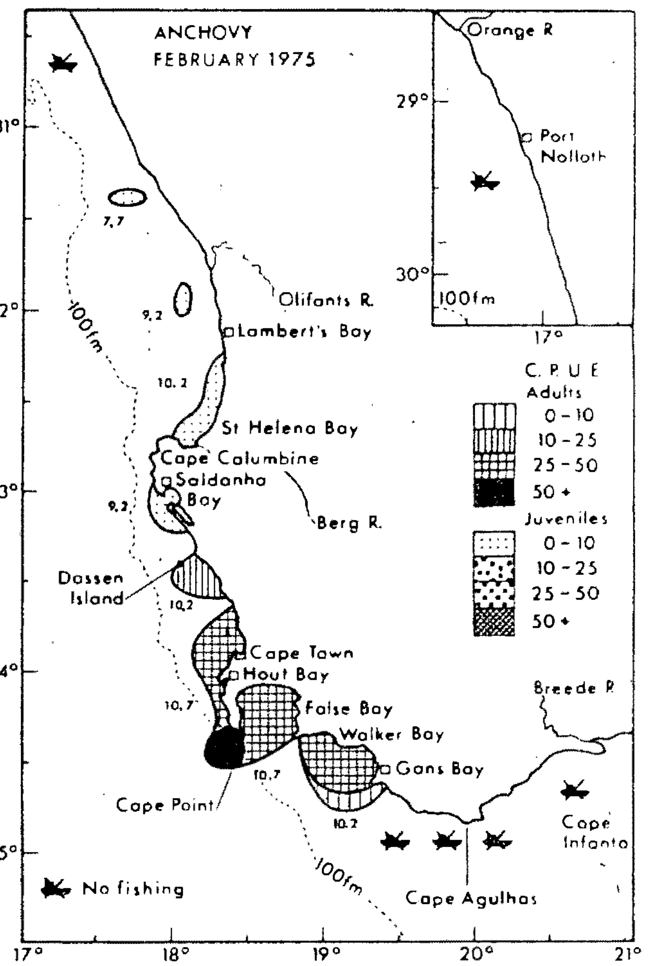
ANCHOVY
FEBRUARY 1975
Orange R
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Port Nolloth
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33°
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Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
9,2
Dassen Island
10,2
Cape Town
Hout Bay
10,7
False Bay
Walker Bay
Gans Bay
Breede R
10,7
10,2
Cape Point
Cape Infanta
Cape Agulhas
C. P. U. E.
Adults
0 - 10
10 - 25
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Juveniles
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25 - 50
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No fishing
17°
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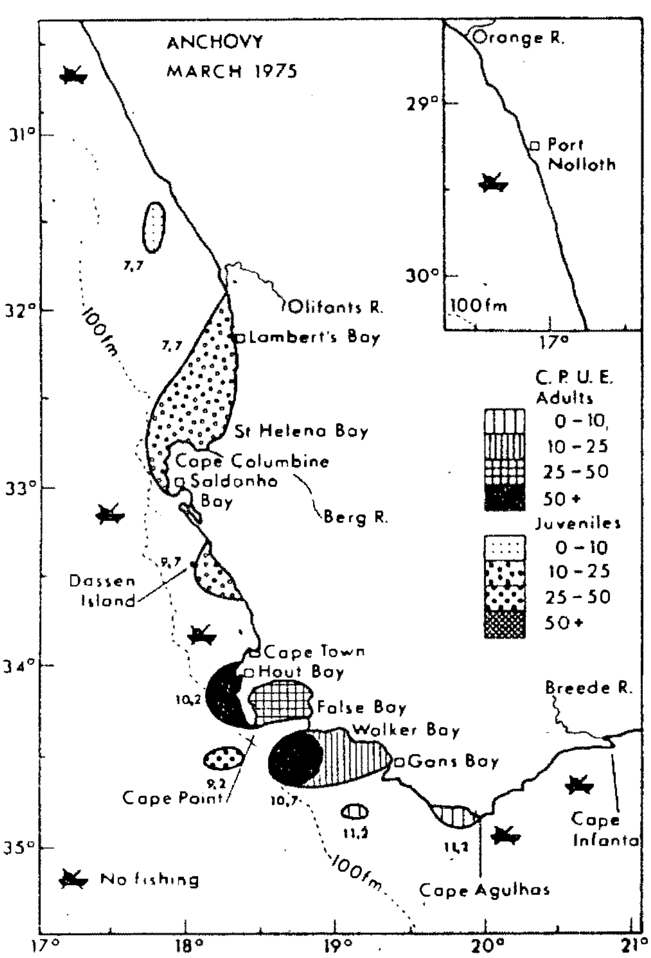
ANCHOVY
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Port Nolloth
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100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
9,7
Dassen Island
Cape Town
Hout Bay
10,2
False Bay
Walker Bay
Gans Bay
Breede R.
9,2
Cape Point
10,7
11,2
11,2
Cape Infanta
Cape Agulhas
C. P. U. E.
Adults
0 - 10,
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Juveniles
0 - 10
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25 - 50
50 +
No fishing
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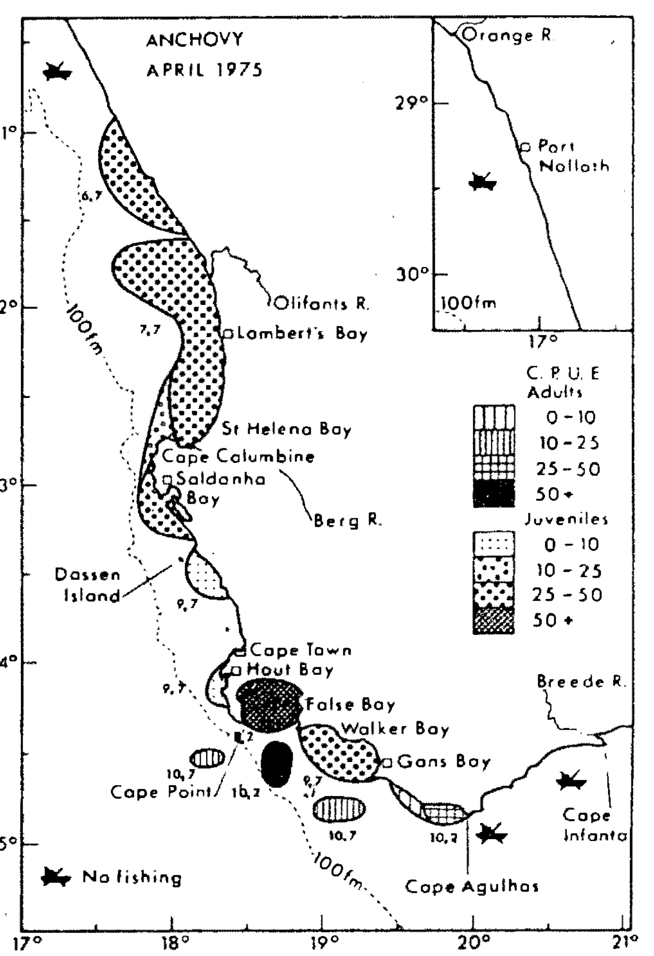
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Olifants R.
Lambert's Bay
St Helena Bay
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Berg R.
Dassen Island
9,7
Cape Town
Hout Bay
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False Bay
Walker Bay
Gans Bay
Breede R.
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Cape Point
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Cape Infanta
Cape Agulhas
C. P. U. E
Adults
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Juveniles
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No fishing
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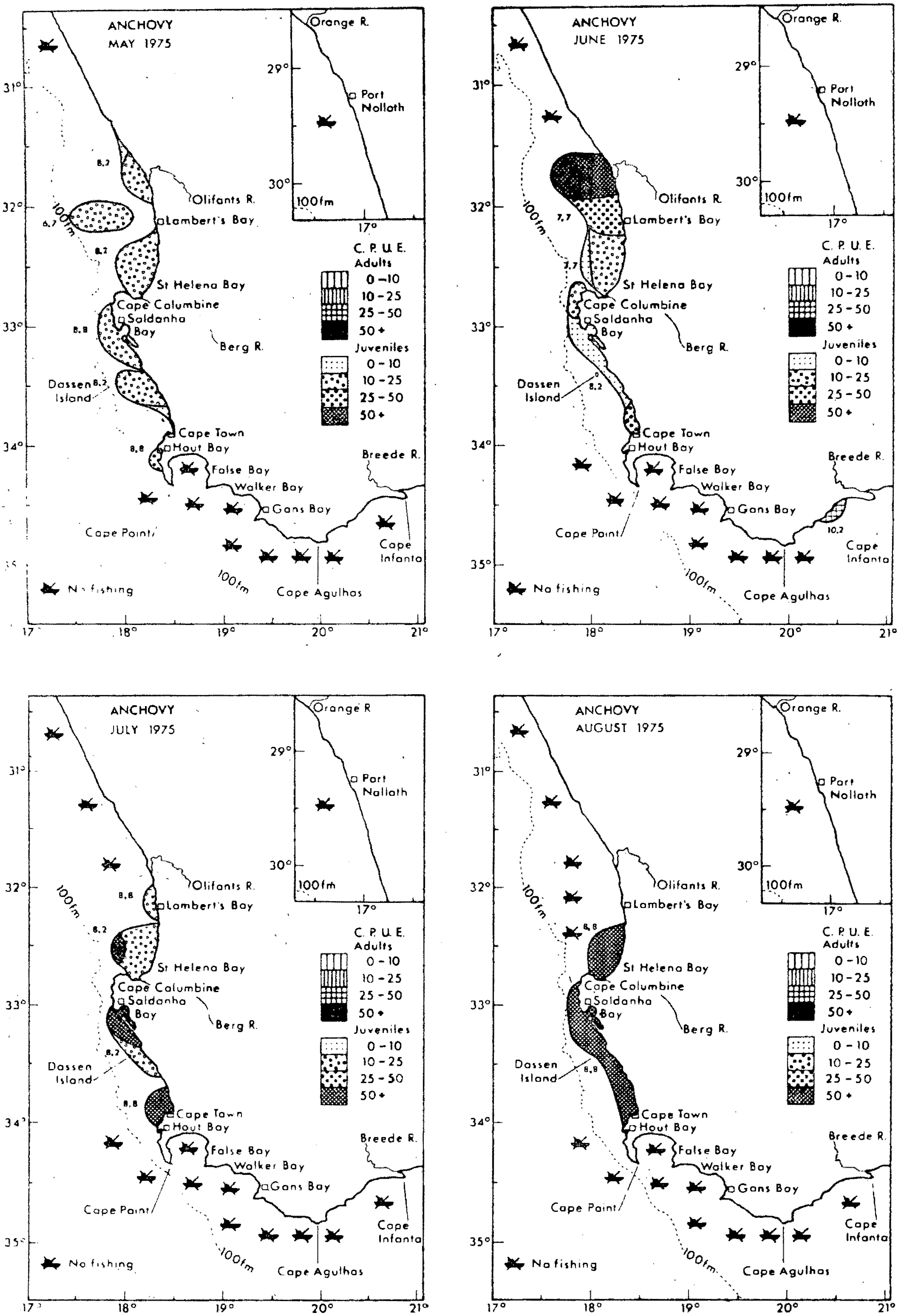
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MAY 1975
ANCHOVY
JUNE 1975
ANCHOVY
JULY 1975
ANCHOVY
AUGUST 1975
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Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
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Walker Bay
Gans Bay
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Cape Point
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Cape Infanta
No fishing
C. P. U. E.
Adults
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50 +
Juveniles
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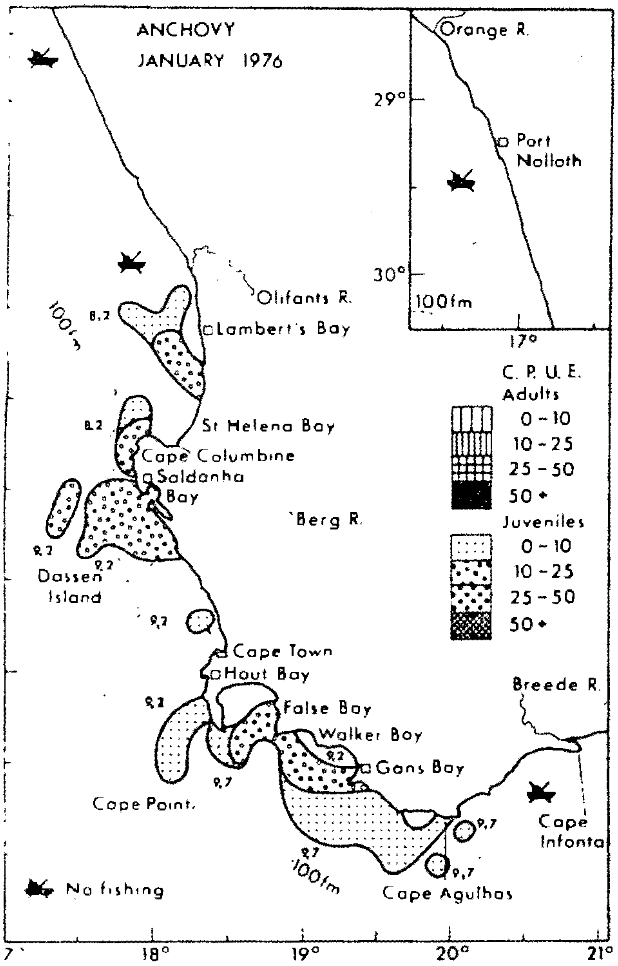
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JANUARY 1976
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100fm
C. P. U. E.
Adults
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Juveniles
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25 - 50
50 +
No fishing
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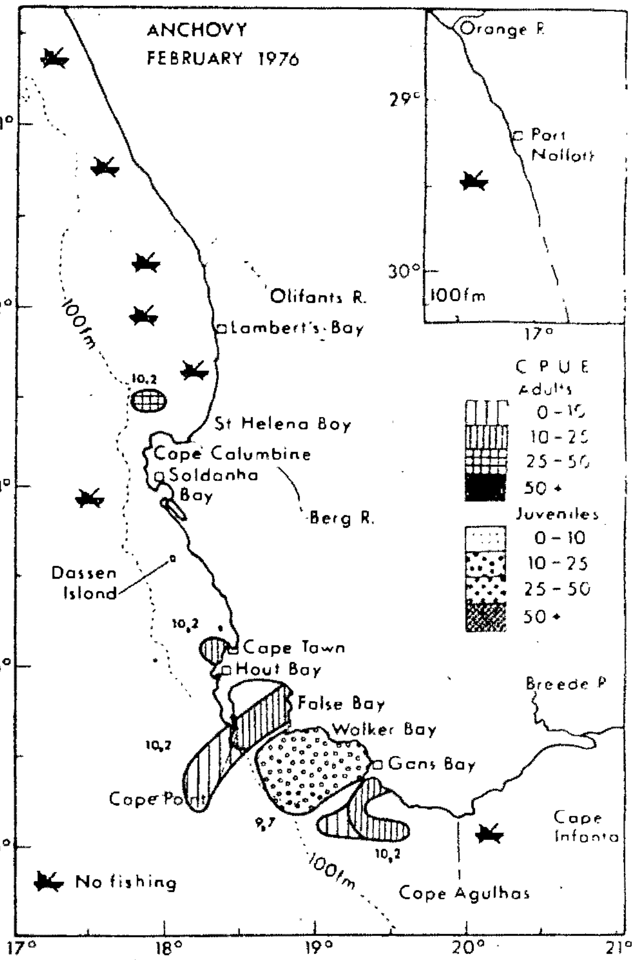
ANCHOVY
FEBRUARY 1976
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No fishing
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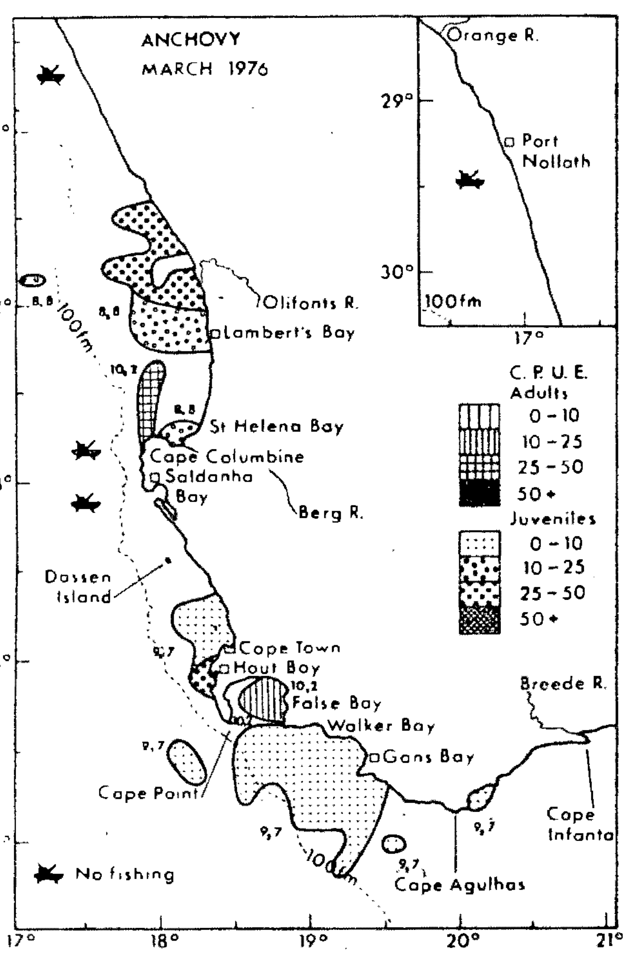
ANCHOVY
MARCH 1976
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Port Nolloth
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Juveniles
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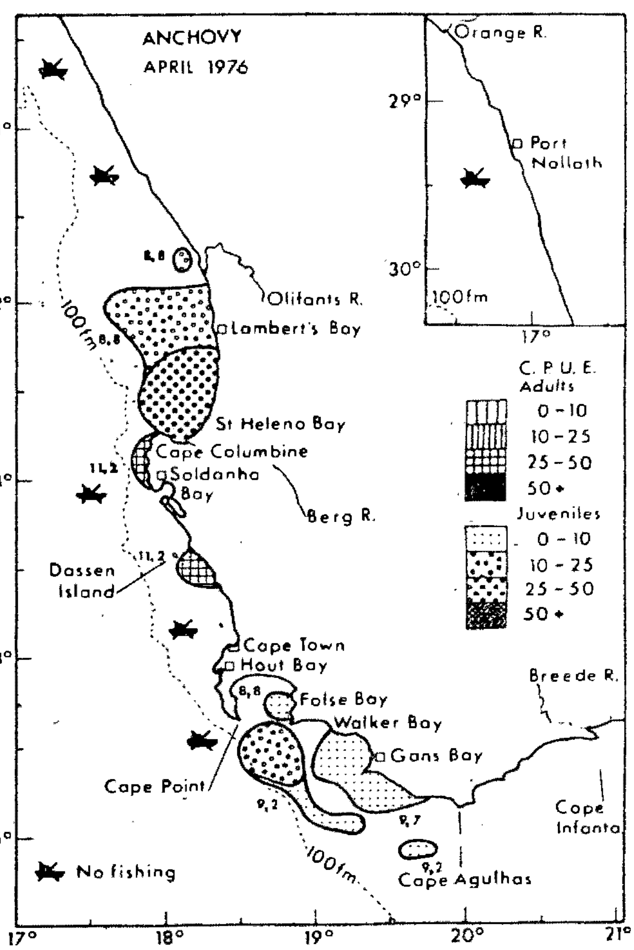
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APRIL 1976
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Port Nolloth
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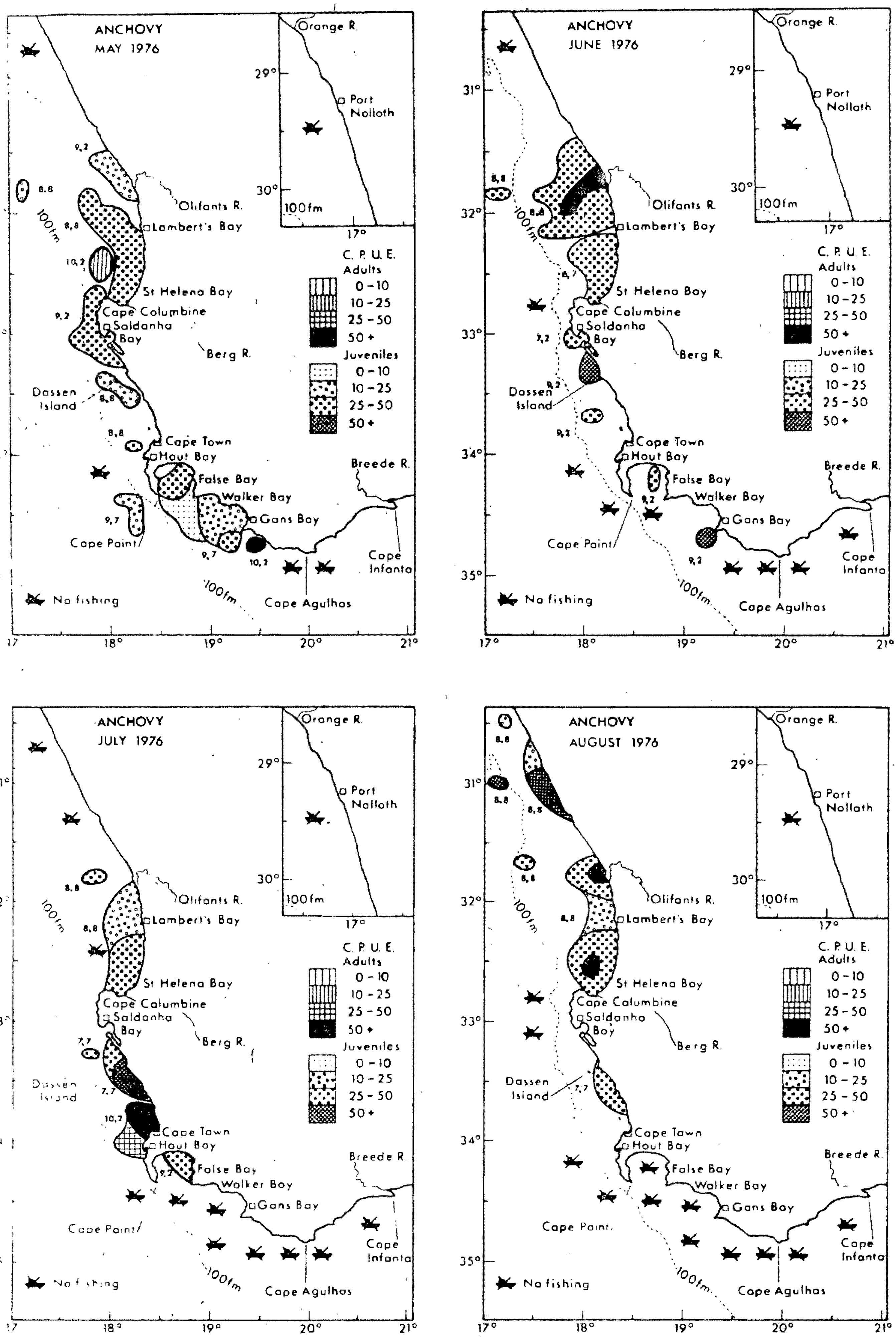
ANCHOVY
MAY 1976
ANCHOVY
JUNE 1976
ANCHOVY
JULY 1976
ANCHOVY
AUGUST 1976
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
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Saldanha Bay
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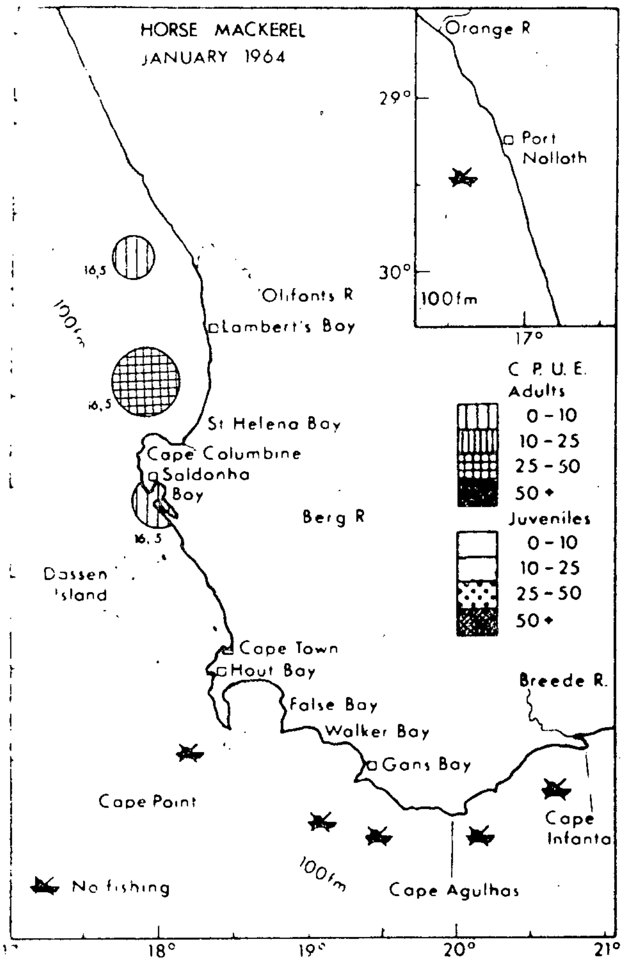
HORSE MACKEREL
JANUARY 1964
Orange R
29°
Port Nolloth
30°
100fm
17°
Olifants R
Lambert's Bay
100fm
16,5
C.P.U.E.
Adults
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50 +
Juveniles
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St Helena Bay
Cape Columbine
Saldanha Bay
Berg R
Dassen Island
Cape Town
Hout Bay
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False Bay
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Gans Bay
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Cape Infanta
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Cape Agulhas
No fishing
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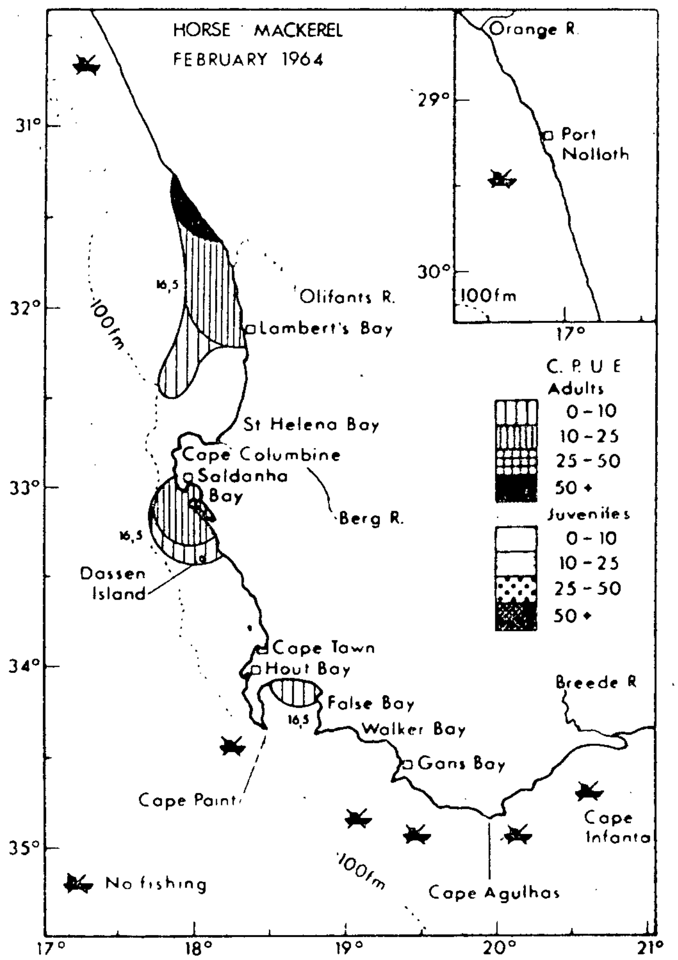
HORSE MACKEREL
FEBRUARY 1964
Orange R.
29°
Port Nolloth
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St Helena Bay
Cape Columbine
Saldanha Bay
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Breede R
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Cape Infanta
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Cape Agulhas
No fishing
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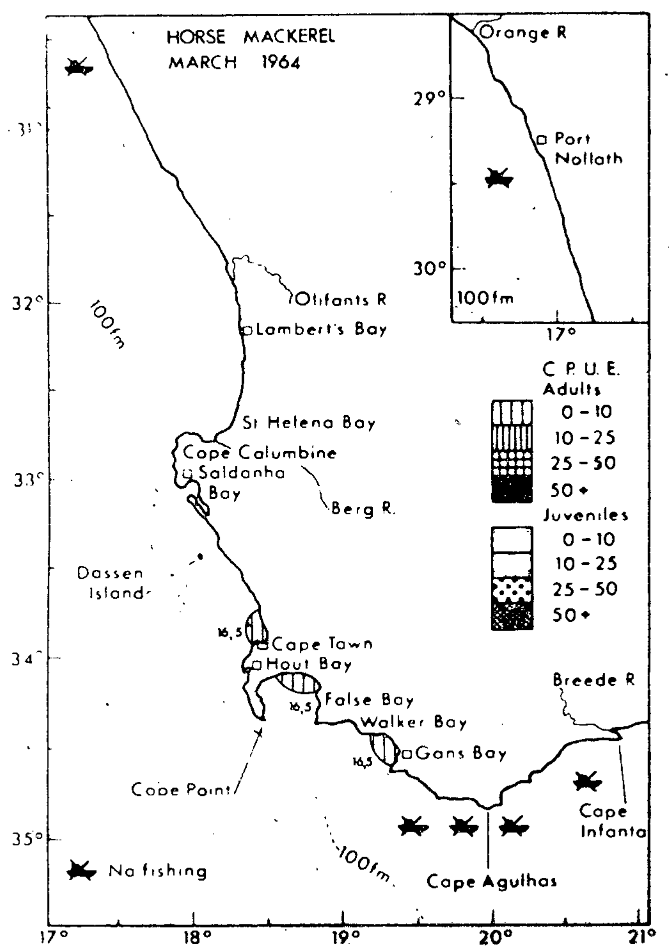
HORSE MACKEREL
MARCH 1964
Orange R
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Port Nolloth
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Olifants R
Lambert's Bay
C.P.U.E.
Adults
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Juveniles
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St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
16,5
Cape Town
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Gans Bay
Cape Point
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Cape Agulhas
No fishing
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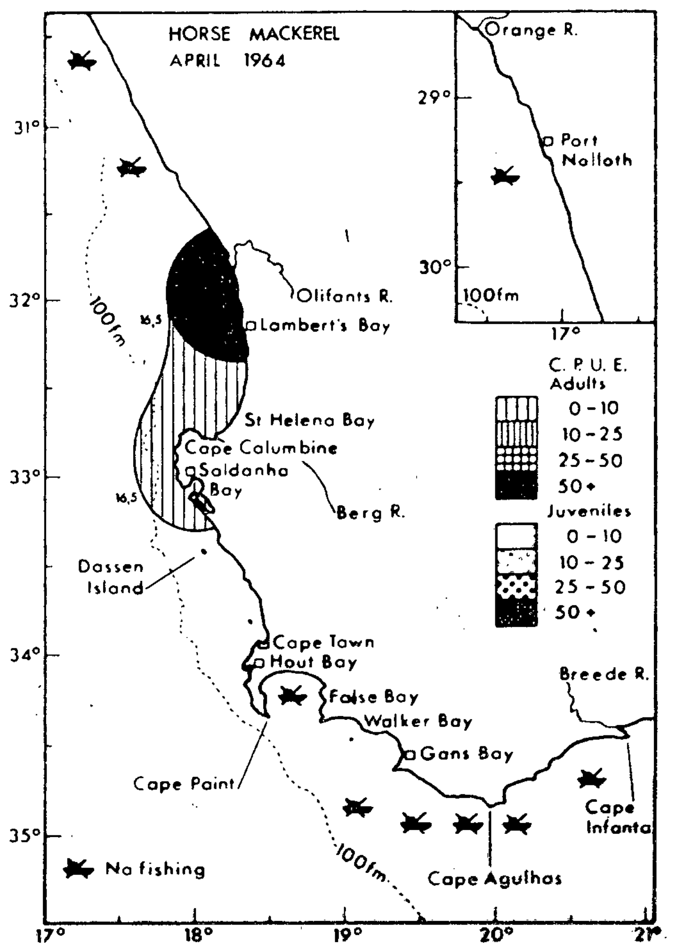
HORSE MACKEREL
APRIL 1964
Orange R.
29°
Port Nolloth
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Olifants R.
Lambert's Bay
C.P.U.E.
Adults
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50 +
Juveniles
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50 +
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
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Breede R.
False Bay
Walker Bay
Gans Bay
Cape Point
Cape Infanta
100fm
Cape Agulhas
No fishing
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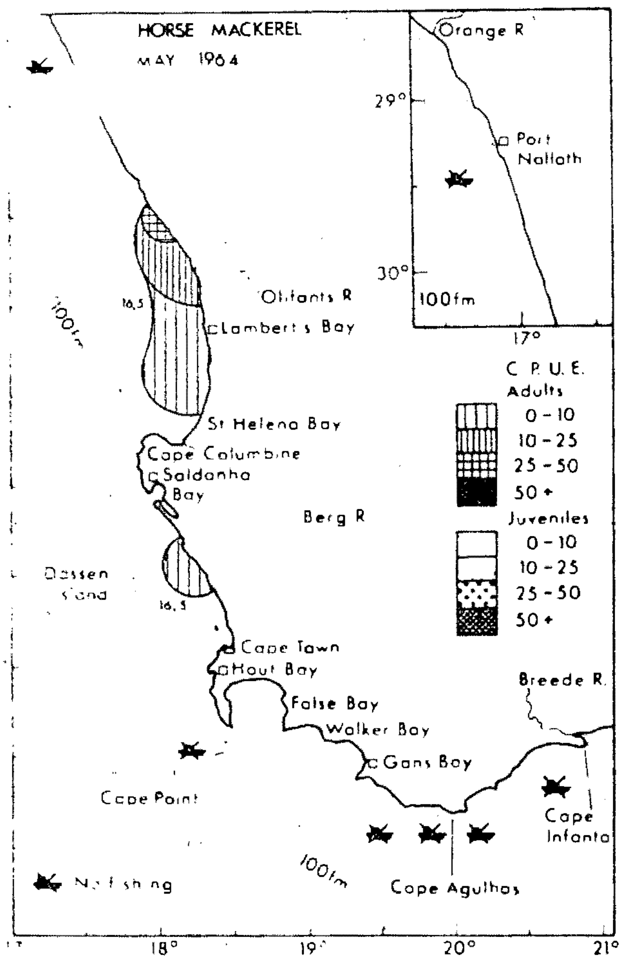
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MAY 1964
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Port Nolloth
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Juveniles
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Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R
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100fm
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
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Cape Infanta
Cape Agulhas
No fishing
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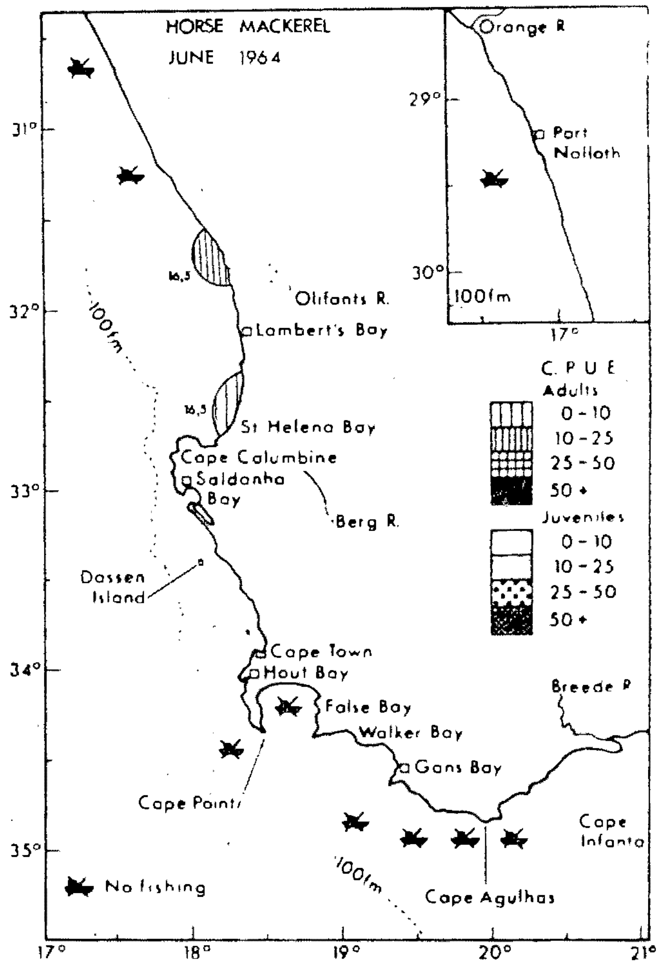
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JUNE 1964
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Port Nolloth
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100fm
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C. P. U. E.
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Juveniles
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Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
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100fm
Cape Town
Hout Bay
False Bay
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Cape Point
Cape Infanta
Cape Agulhas
No fishing
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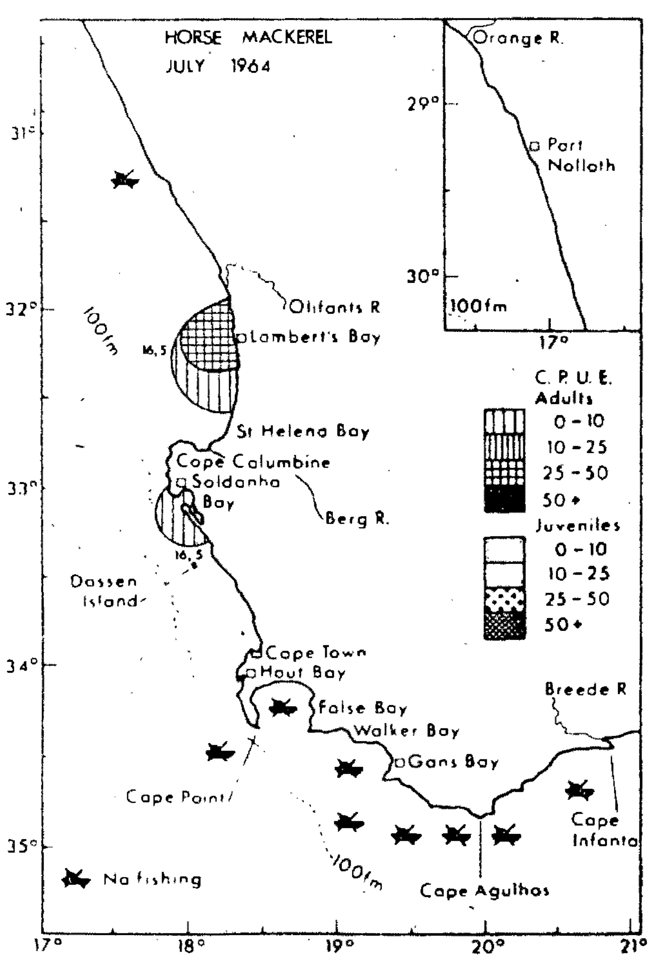
HORSE MACKEREL
JULY 1964
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Port Nolloth
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100fm
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C. P. U. E.
Adults
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Juveniles
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Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
16,5
100fm
Cape Town
Hout Bay
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Cape Point
Cape Infanta
Cape Agulhas
No fishing
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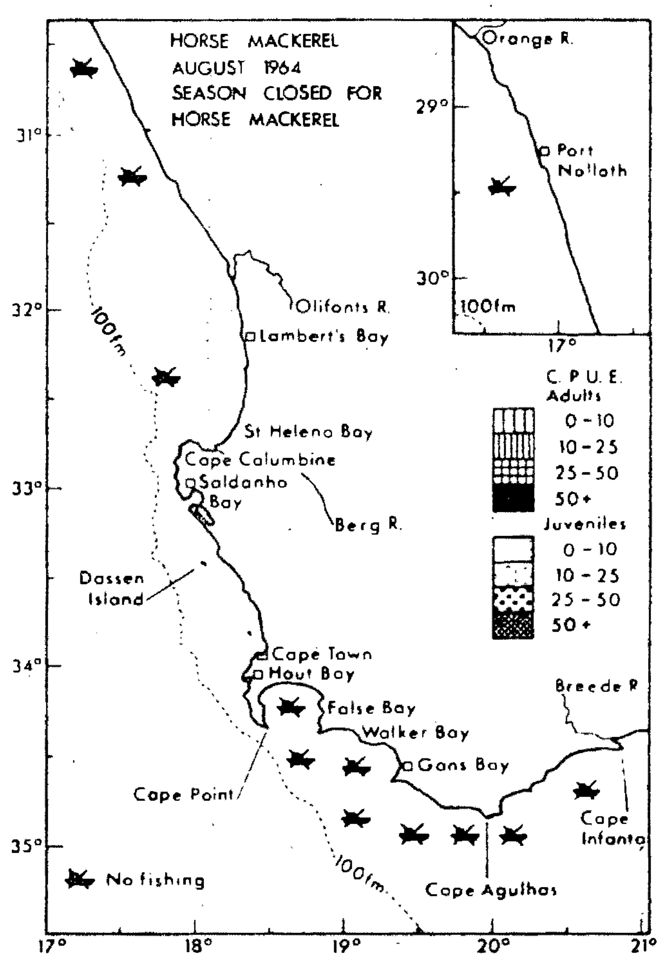
HORSE MACKEREL
AUGUST 1964
SEASON CLOSED FOR
HORSE MACKEREL
Orange R.
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Port Nolloth
30°
100fm
17°
C. P. U. E.
Adults
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10 - 25
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50 +
Juveniles
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Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
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Hout Bay
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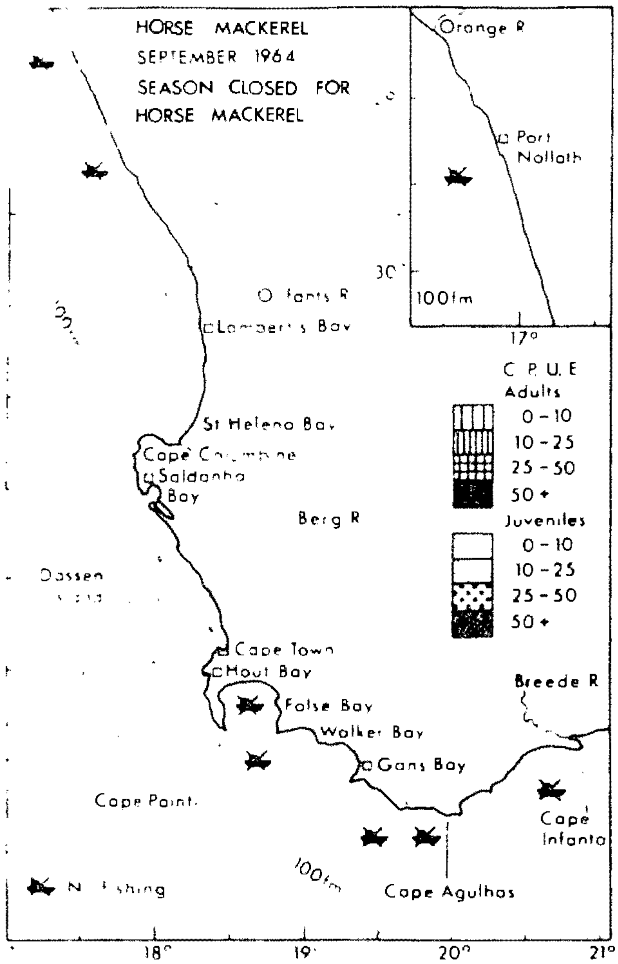
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SEPTEMBER 1964
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Port Nolloth
100fm
Lambert's Bay
St Helena Bay
Saldanha Bay
Berg R
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
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Juveniles
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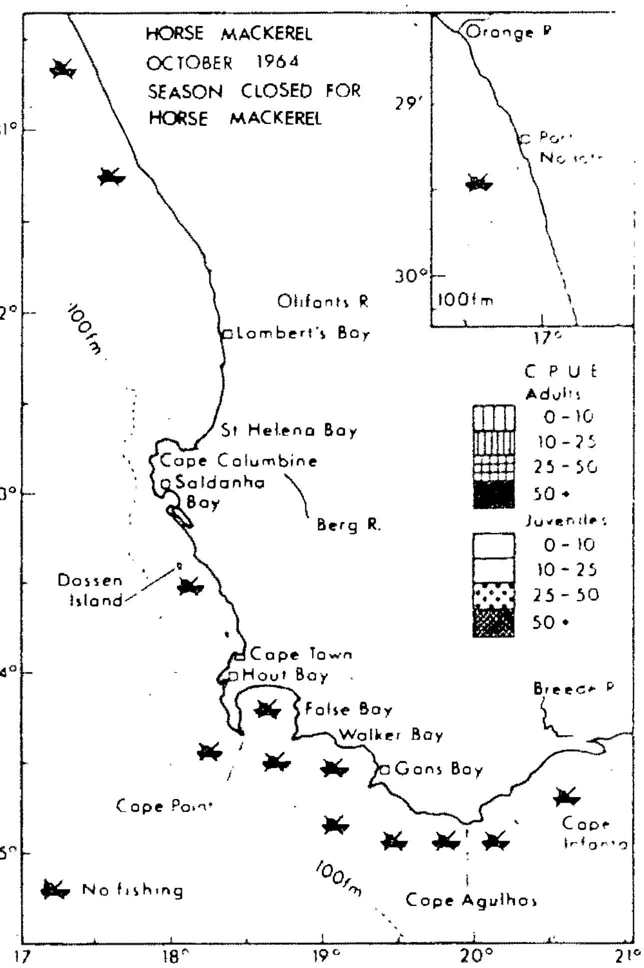
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OCTOBER 1964
SEASON CLOSED FOR
HORSE MACKEREL
Orange R
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Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Cape Point
Cape Agulhas
No fishing
C P U E
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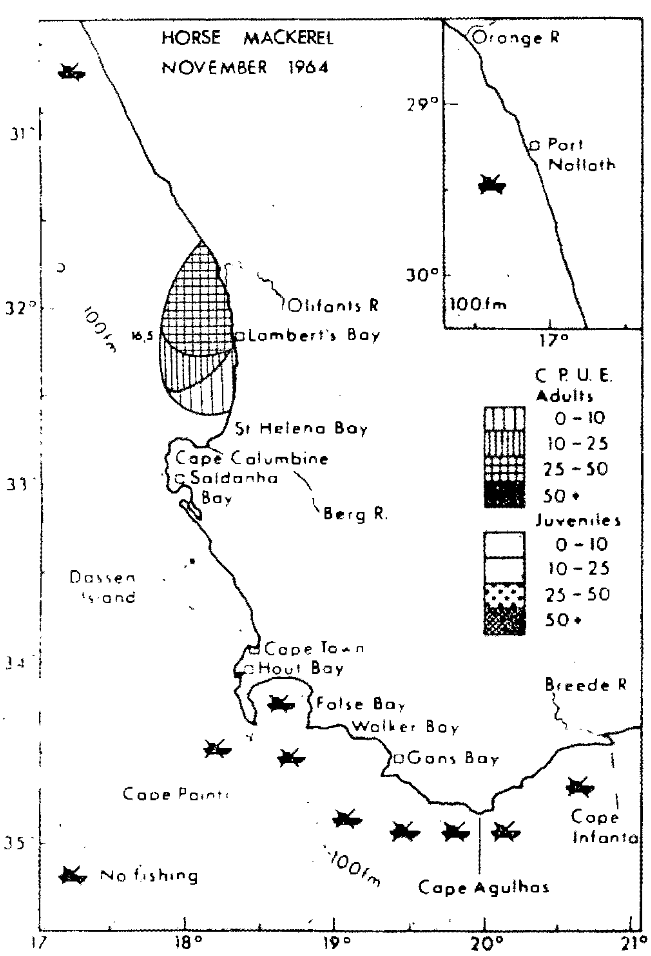
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Port Nolloth
100fm
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16,5
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen
Cape Town
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No fishing
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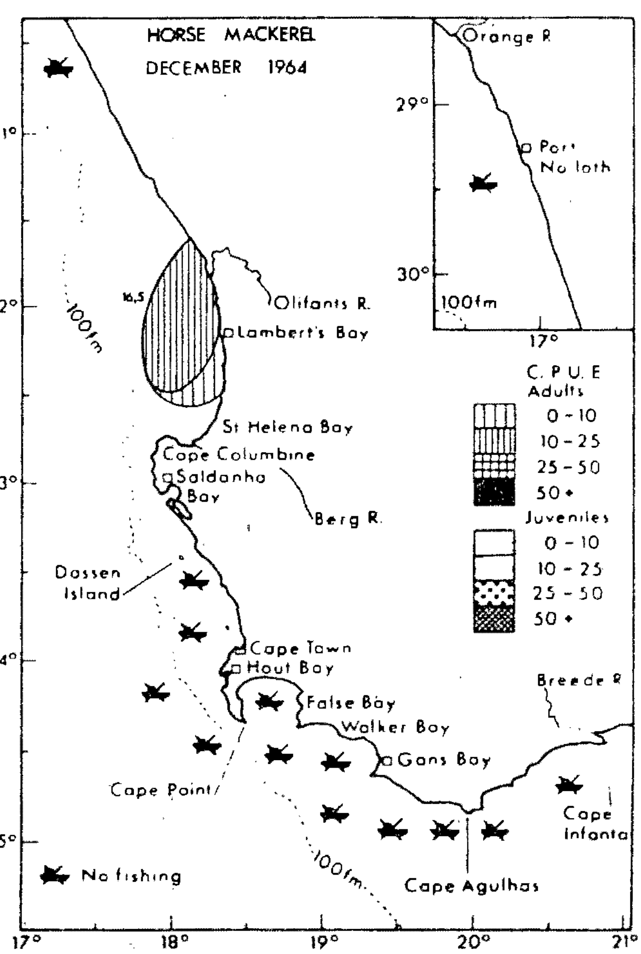
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DECEMBER 1964
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100fm
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16,5
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
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Cape Point
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Juveniles
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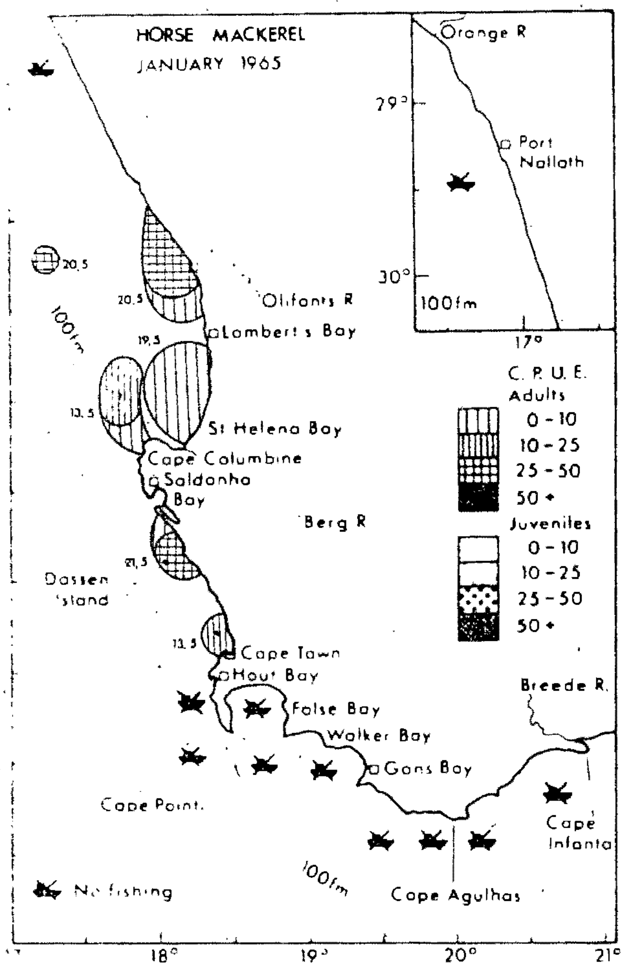
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JANUARY 1965
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Port Nolloth
100fm
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R
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No fishing
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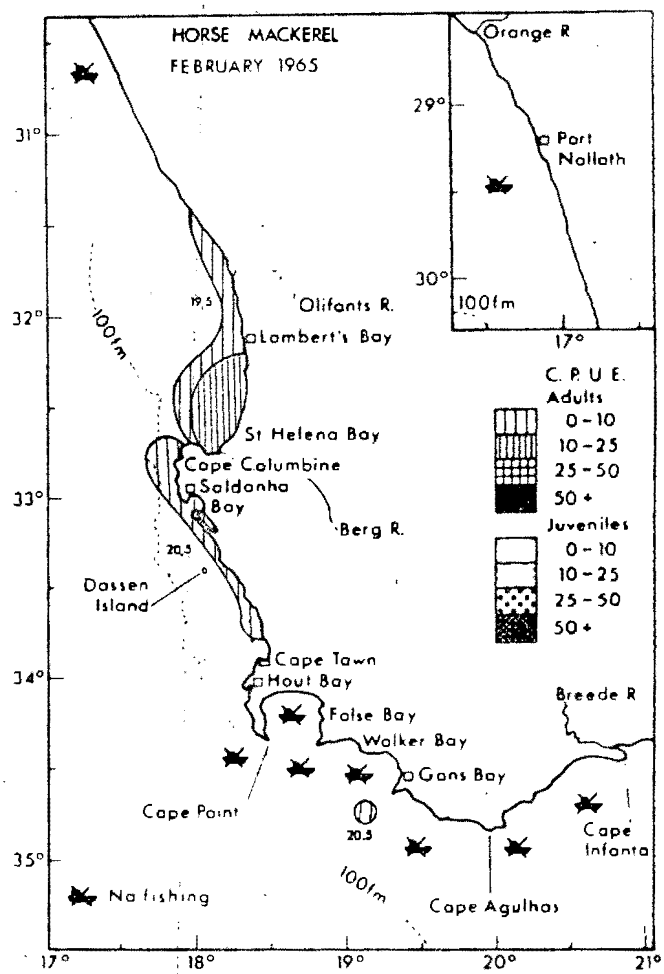
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FEBRUARY 1965
Orange R
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
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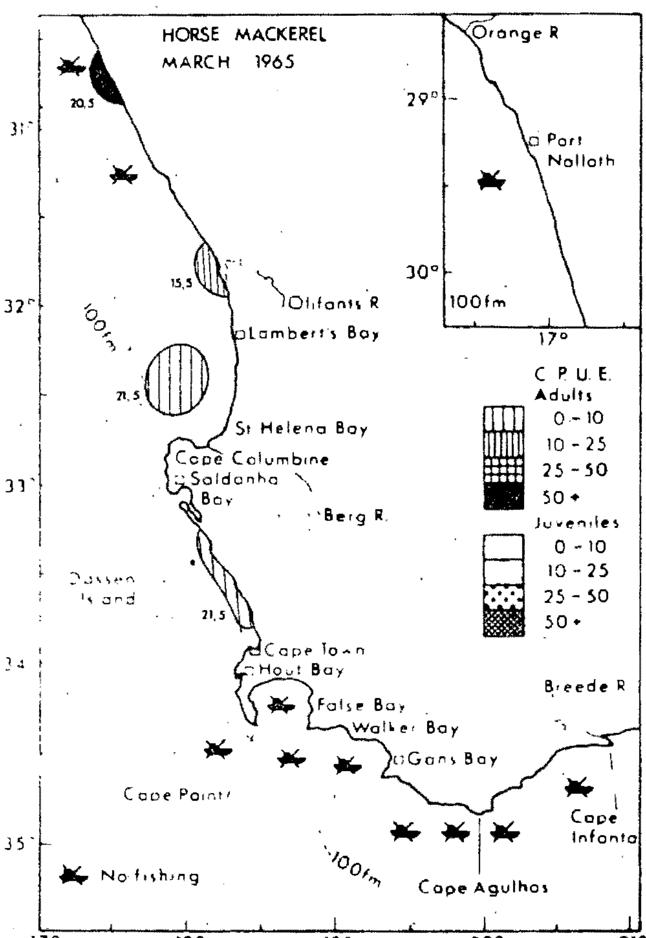
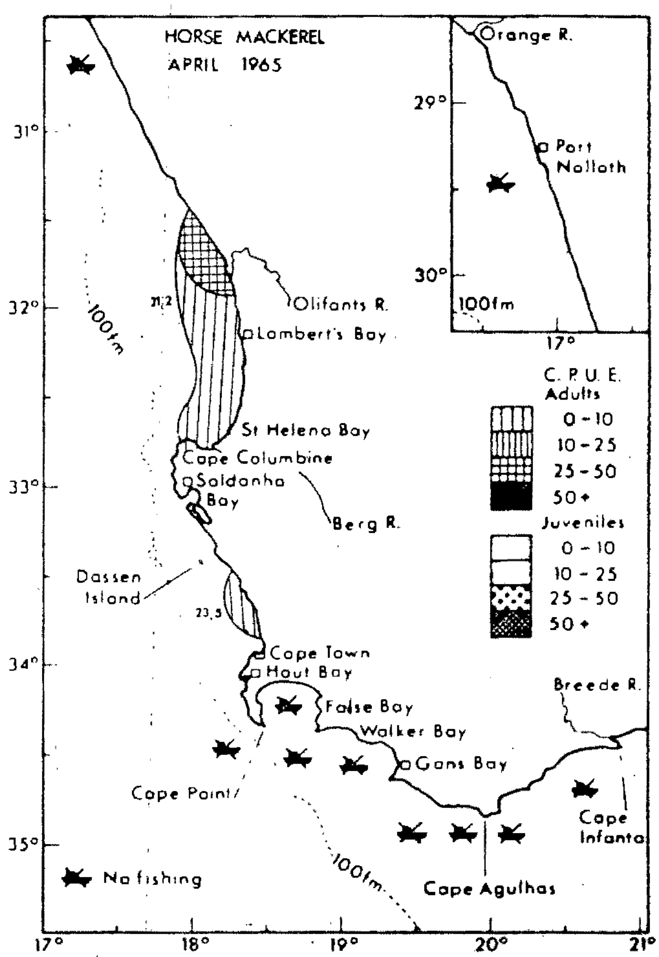

HORSE MACKEREL
MARCH 1965
Orange R
Port Nolloth
100fm
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
20,5
15,5
21,5
17°
18°
19°
20°
21°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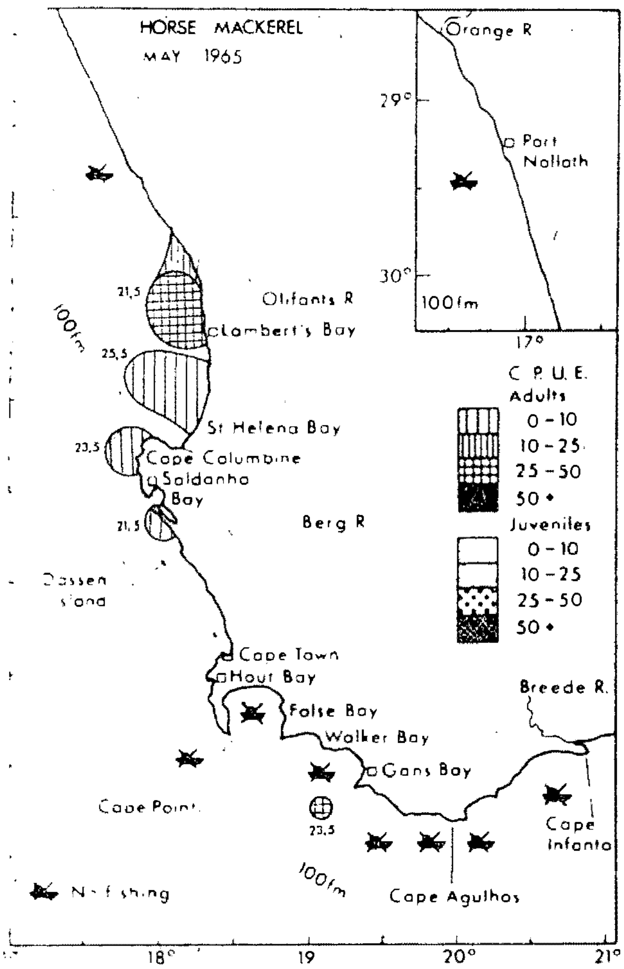
APRIL 1965
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
23,5
31°
32°
33°
34°
35°
17°
18°
19°
20°
21°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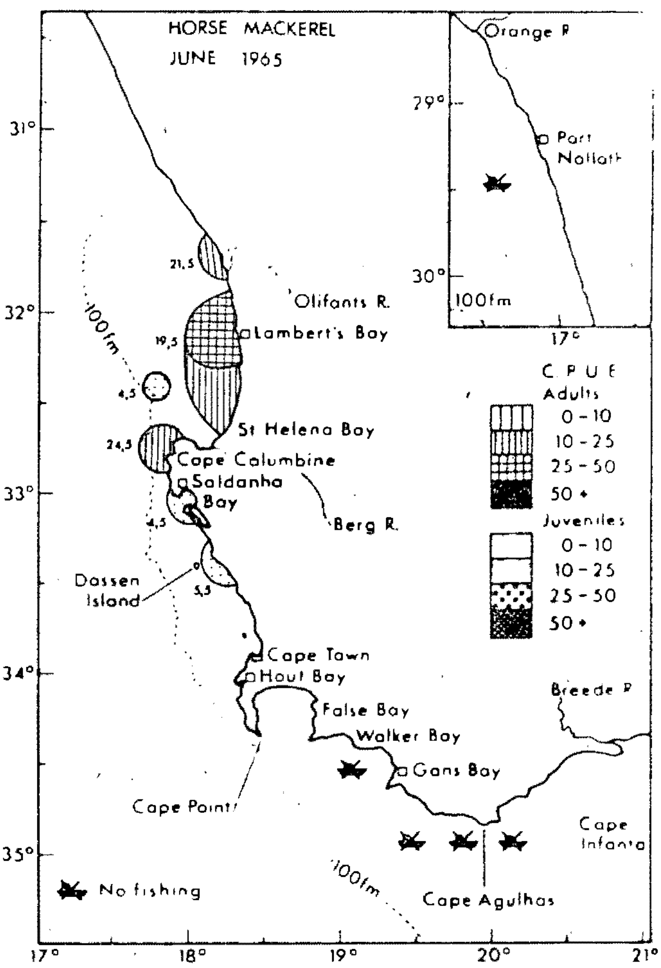
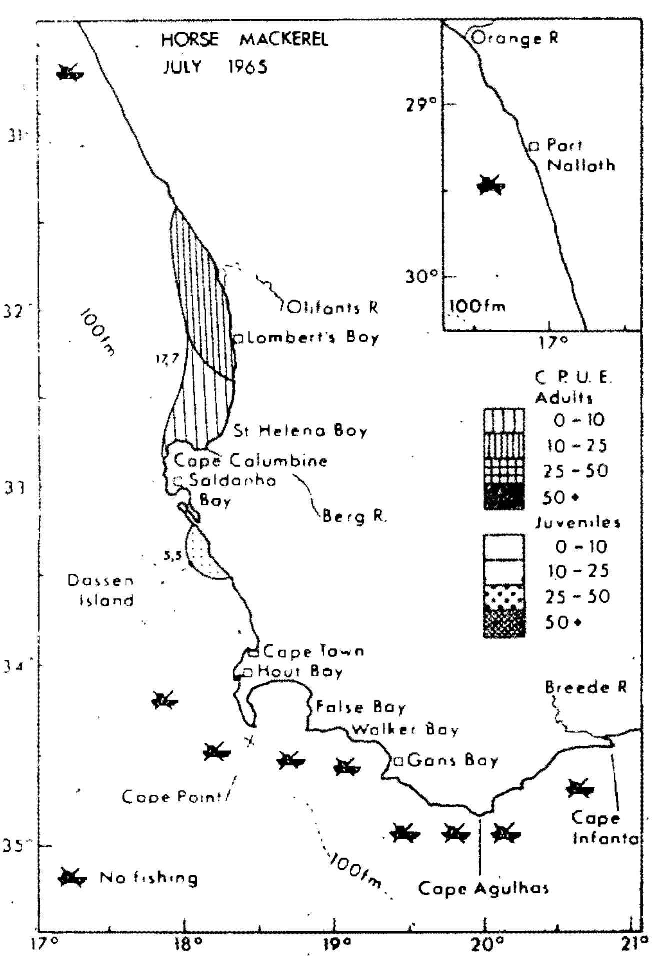
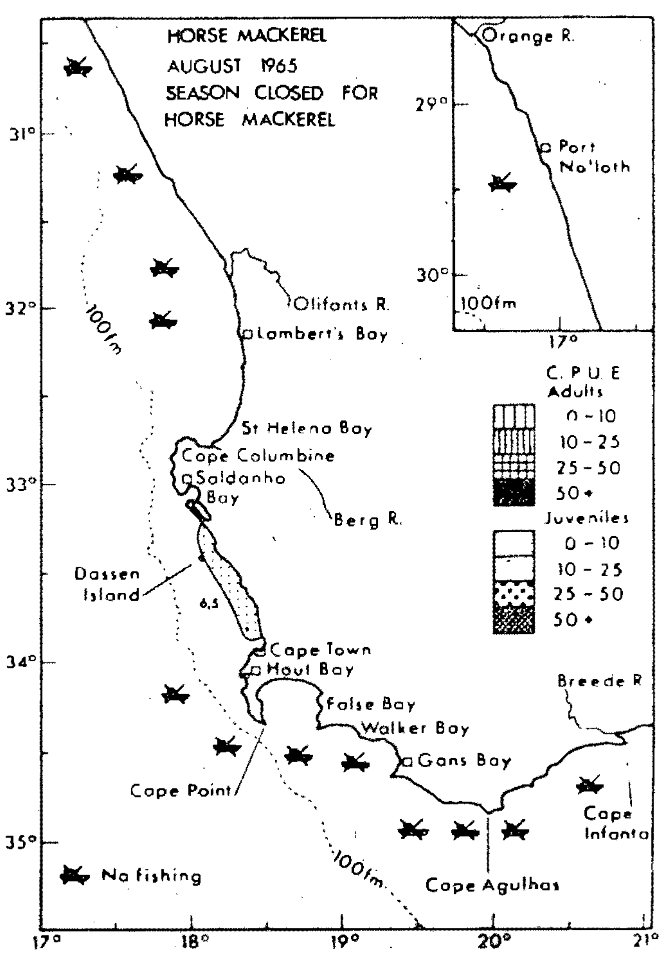
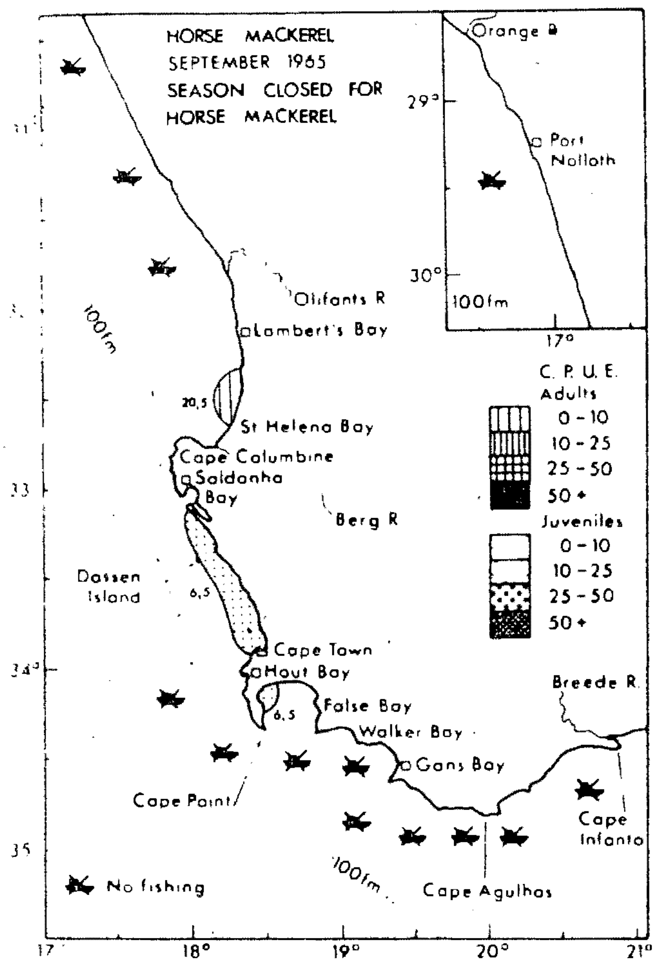
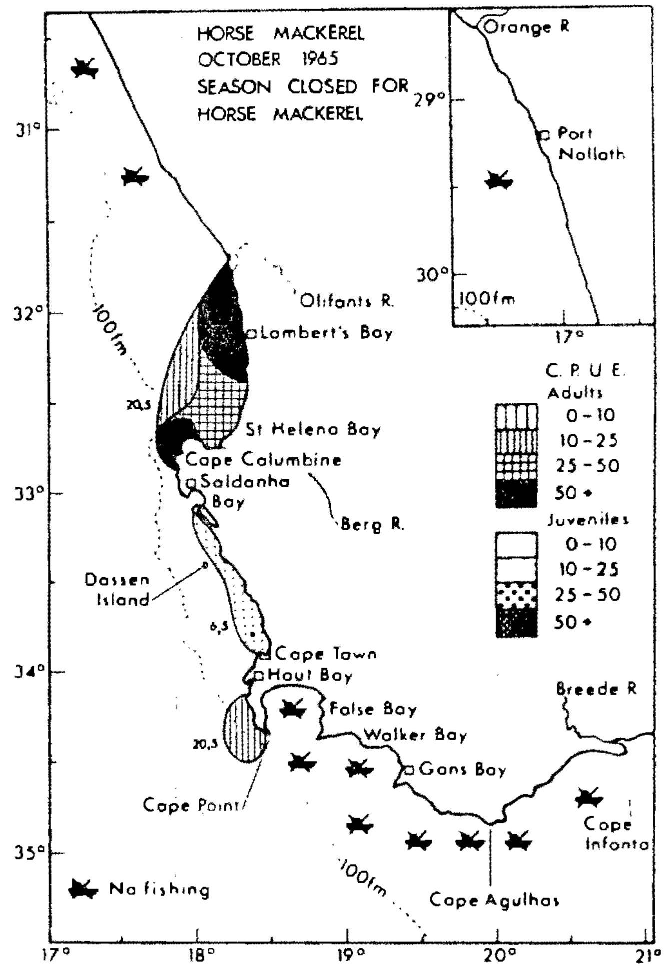
MAY 1965
Orange R
29°
Port Nolloth
30°
100fm
17°
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
21,5
25,5
23,5
21,5
23,5
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
18°
19
20°
21°

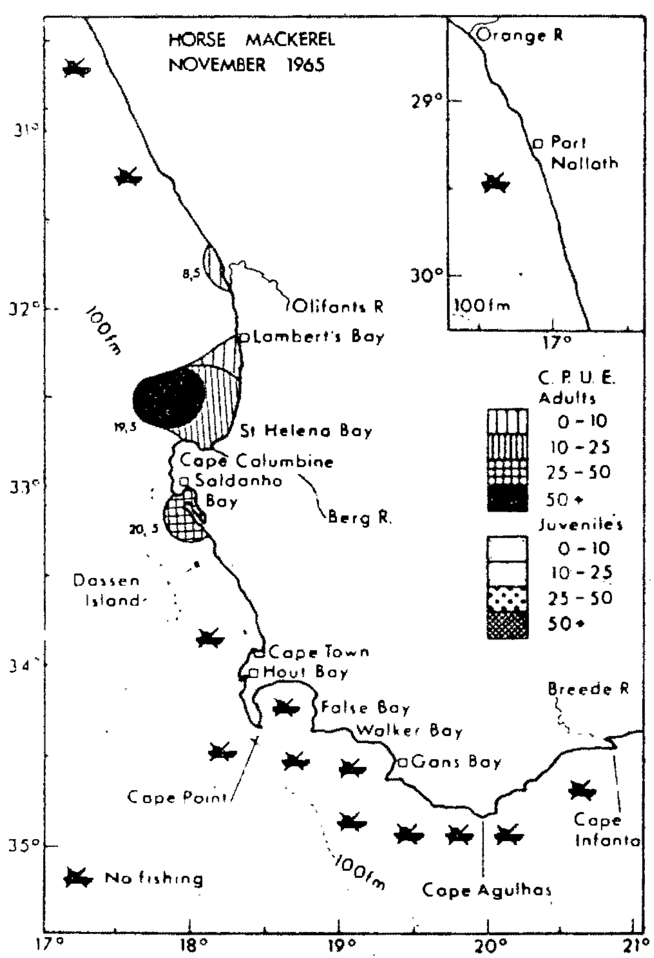

HORSE MACKEREL
JUNE 1965
Orange R
29°
Port Nolloth
30°
100fm
17°
31°
32°
33°
34°
35°
100fm
21,5
19,5
4,5
24,5
4,5
5,5
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
19°
20°
21°

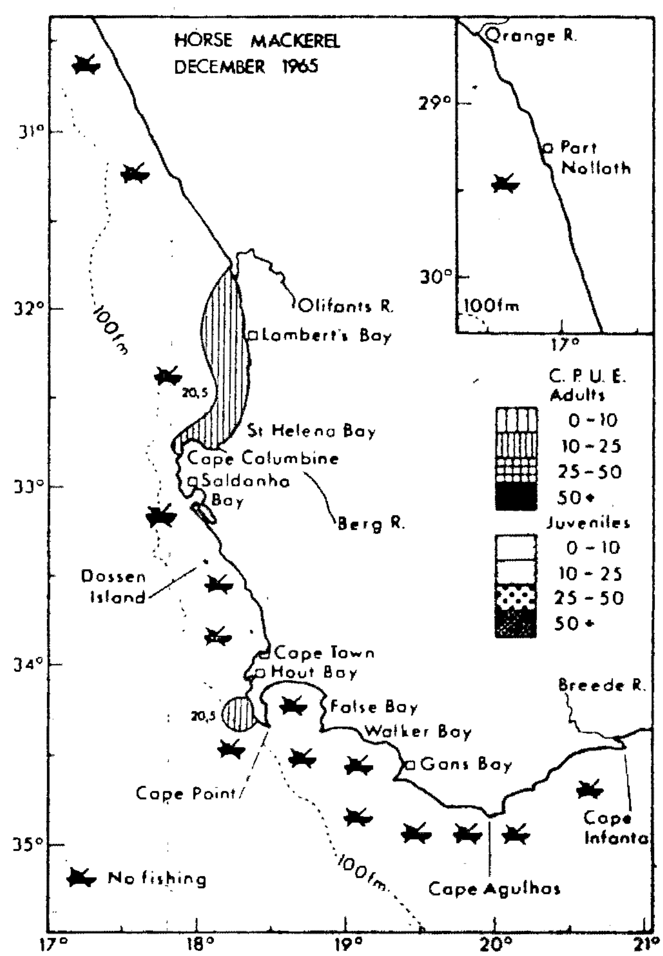

HORSE MACKEREL
JULY 1965
Orange R
29°
Port Nolloth
30°
100fm
17°
31
32
33
34
35
100fm
17,7
5,5
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
19°
20°
21°

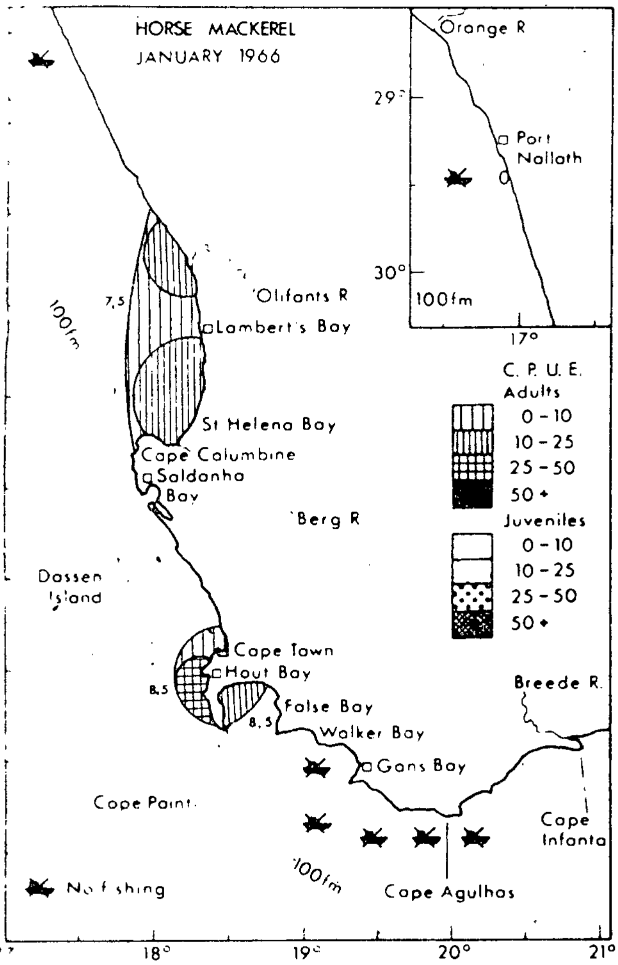

HORSE MACKEREL
AUGUST 1965
SEASON CLOSED FOR
HORSE MACKEREL
Orange R.
29°
Port Nolloth
30°
100fm
17°
31°
32°
33°
34°
35°
100fm
6,5
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
19°
20°
21°

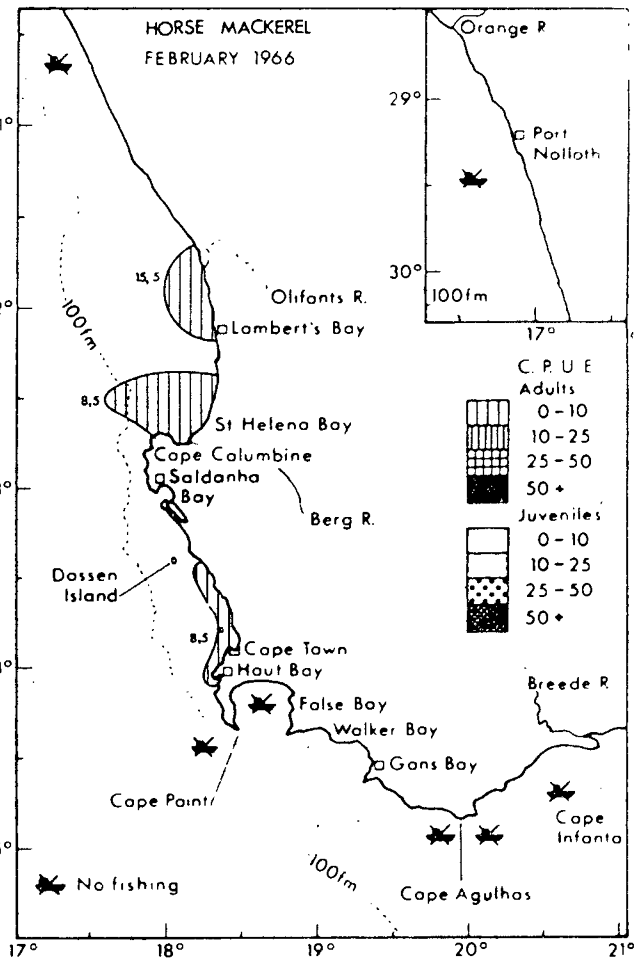

HORSE MACKEREL
SEPTEMBER 1965
SEASON CLOSED FOR HORSE MACKEREL
Orange R
Port Nolloth
100fm
Olifants R
Lambert's Bay
20,5
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R
Dassen Island
6,5
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +

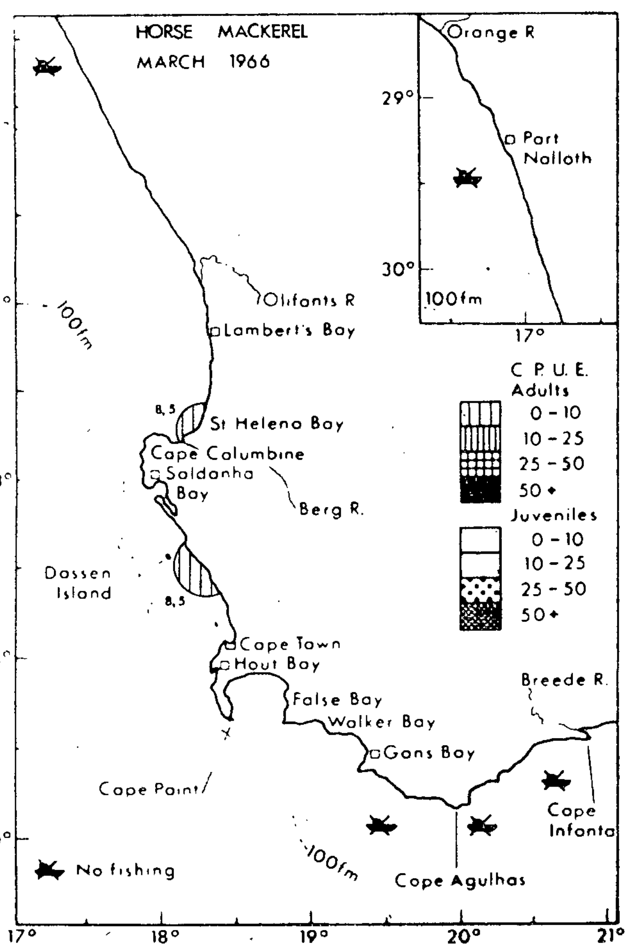

HORSE MACKEREL
OCTOBER 1965
SEASON CLOSED FOR HORSE MACKEREL
Orange R
Port Nolloth
100fm
Olifants R.
Lambert's Bay
20,5
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
6,5
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +

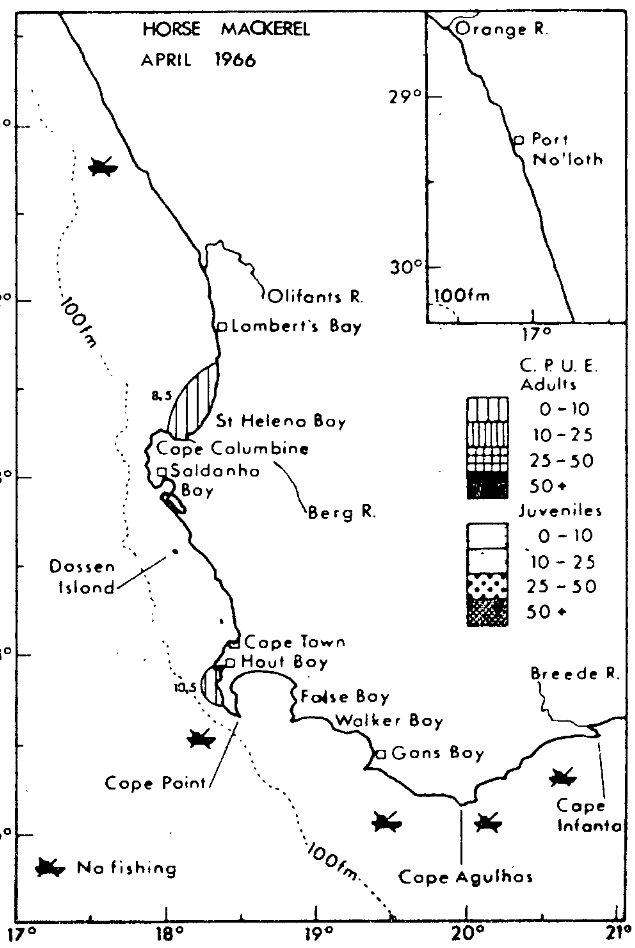

HORSE MACKEREL
NOVEMBER 1965
Orange R
Port Nolloth
100fm
8,5
Olifants R
Lambert's Bay
19,5
St Helena Bay
Cape Columbine
Saldanha Bay
20,5
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +

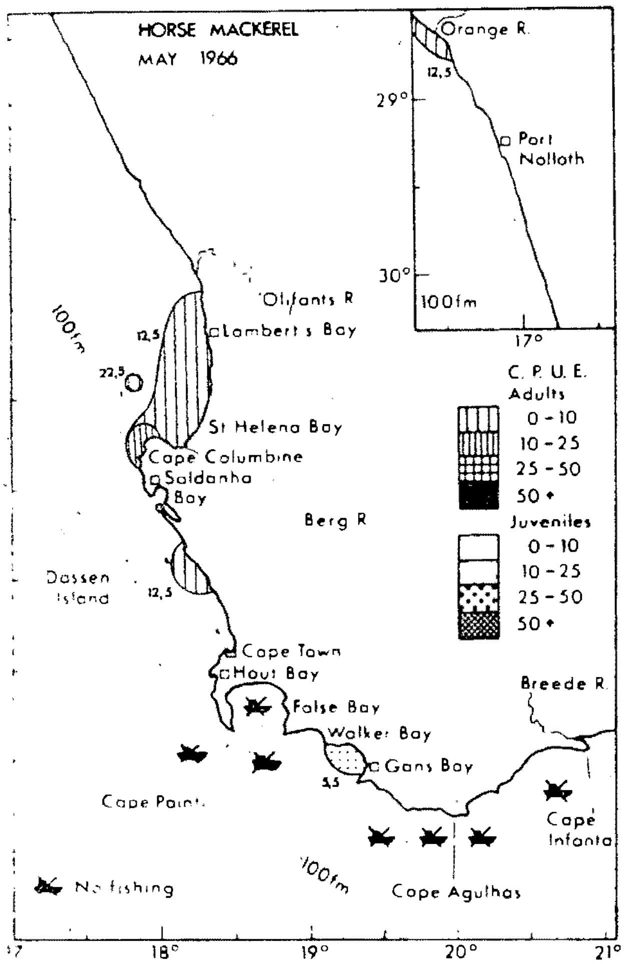

HORSE MACKEREL
DECEMBER 1965
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
20,5
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
20,5
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +

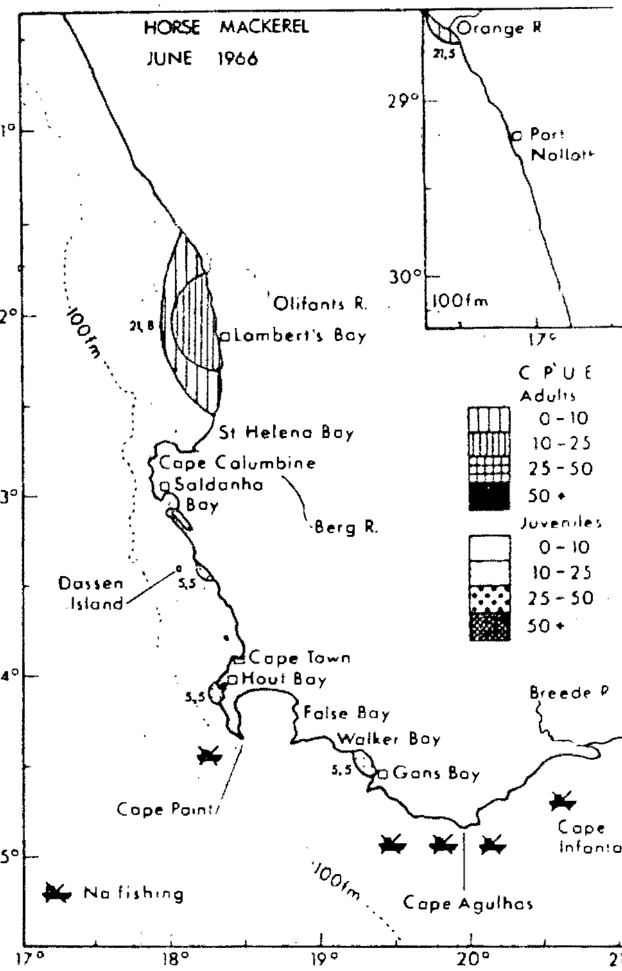

HORSE MACKEREL
JANUARY 1966
Orange R
Port Nolloth
29°
30°
100fm
17°
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R
Dossen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
7,5
8,5
8, 5
33
35
18°
19°
20°
21°

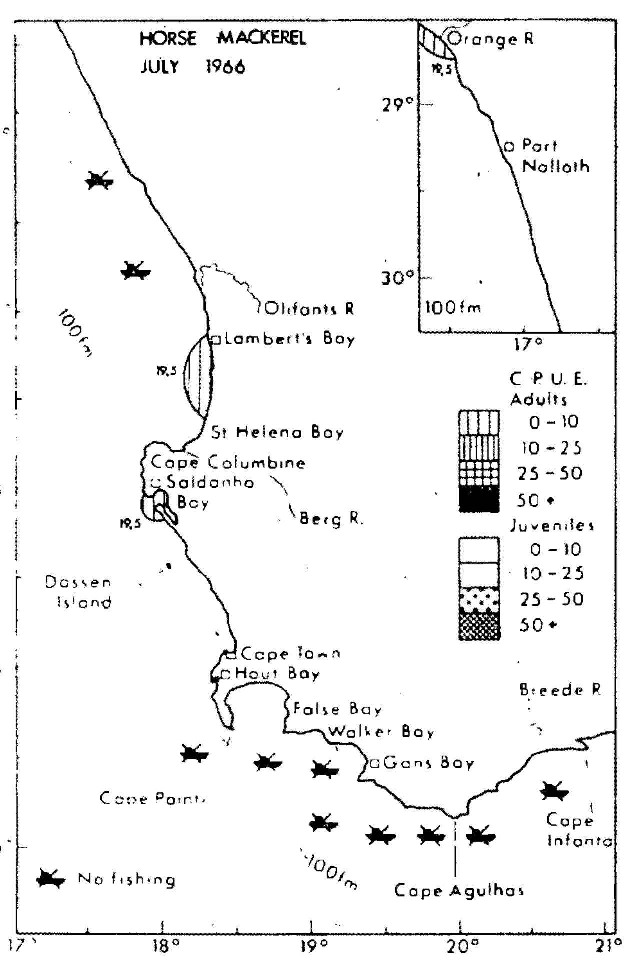

HORSE MACKEREL
FEBRUARY 1966
Orange R
Port Nolloth
29°
30°
100fm
17°
31°
32°
33°
34°
35°
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dossen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
15, 5
8,5
8,5
17°
18°
19°
20°
21°


HORSE MACKEREL
MARCH 1966
Orange R
Port Nolloth
29°
30°
100fm
17°
32°
33°
34°
35°
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dossen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
8,5
8,5
17°
18°
19°
20°
21°


HORSE MACKEREL
APRIL 1966
Orange R.
Port Nolloth
29°
30°
100fm
17°
31°
32°
33°
34°
35°
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dossen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
8,5
10,5
17°
18°
19°
20°
21°


HORSE MACKEREL
MAY 1966
Orange R.
12,5
29°
Port Nolloth
30°
100fm
17°
Olifants R
100fm
12,5
Lambert's Bay
22,5
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R
Dassen Island
12,5
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
5,5
Breede R.
Cape Point
Cape Infanta
No fishing
100fm
Cape Agulhas
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
18°
19°
20°
21°


HORSE MACKEREL
JUNE 1966
Orange R
21,5
29°
Port Nolloth
30°
100fm
17°
31°
32°
100fm
21,8
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
33°
Dassen Island
5,5
Cape Town
Hout Bay
34°
5,5
False Bay
Walker Bay
5,5
Gans Bay
Breede R
Cape Point
35°
No fishing
100fm
Cape Agulhas
Cape Infanta
C P U E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
19°
20°
21°


HORSE MACKEREL
JULY 1966
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19,5
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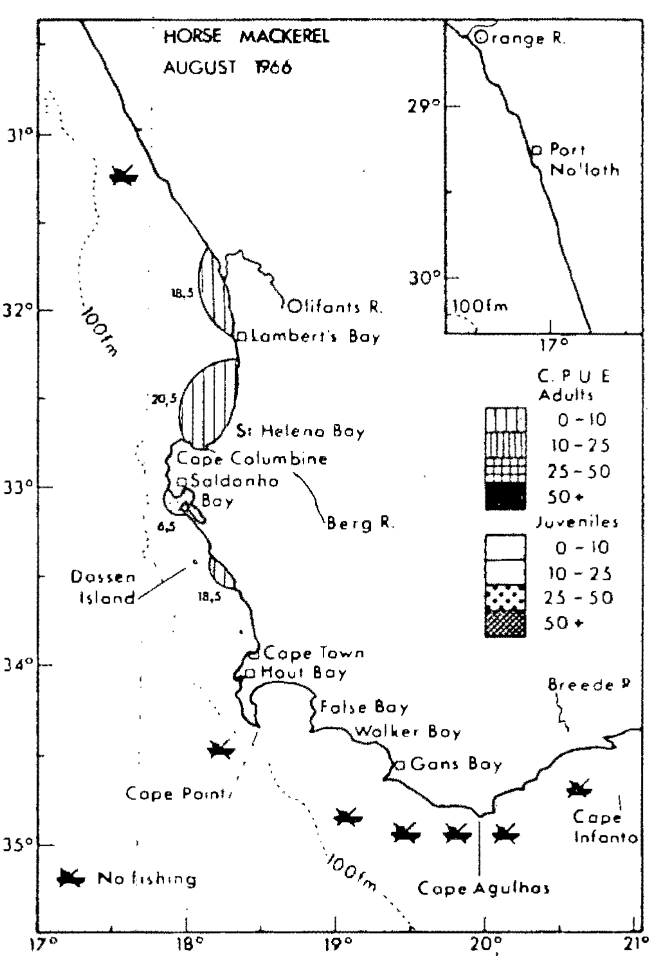
Port Nolloth
30°
100fm
17°
31°
32°
100fm
Olifants R
Lambert's Bay
19,5
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
33
19,5
Dassen Island
34
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
35
No fishing
100fm
Cape Agulhas
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17
18°
19°
20°
21°


HORSE MACKEREL
AUGUST 1966
Orange R.
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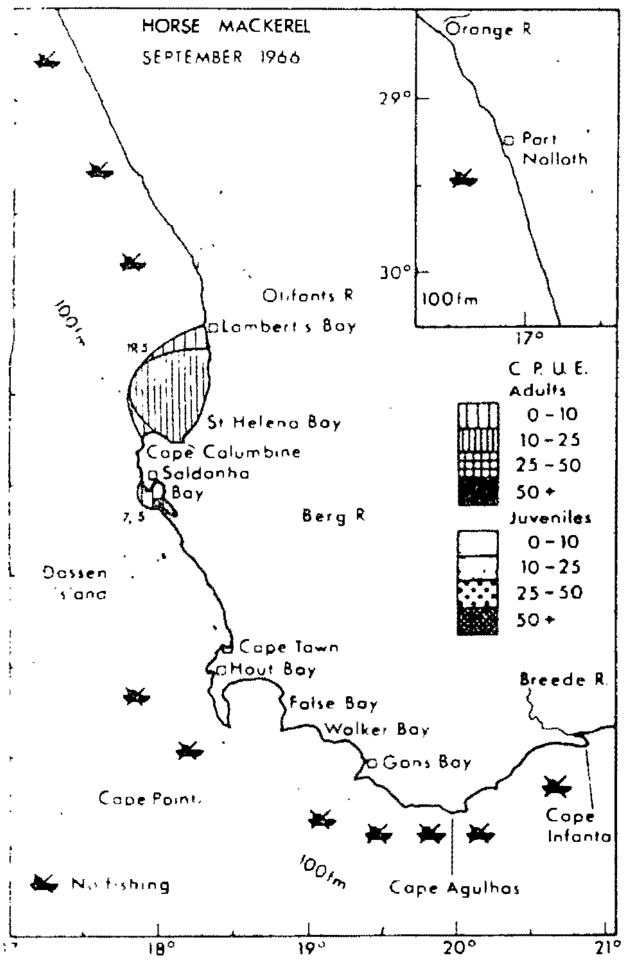
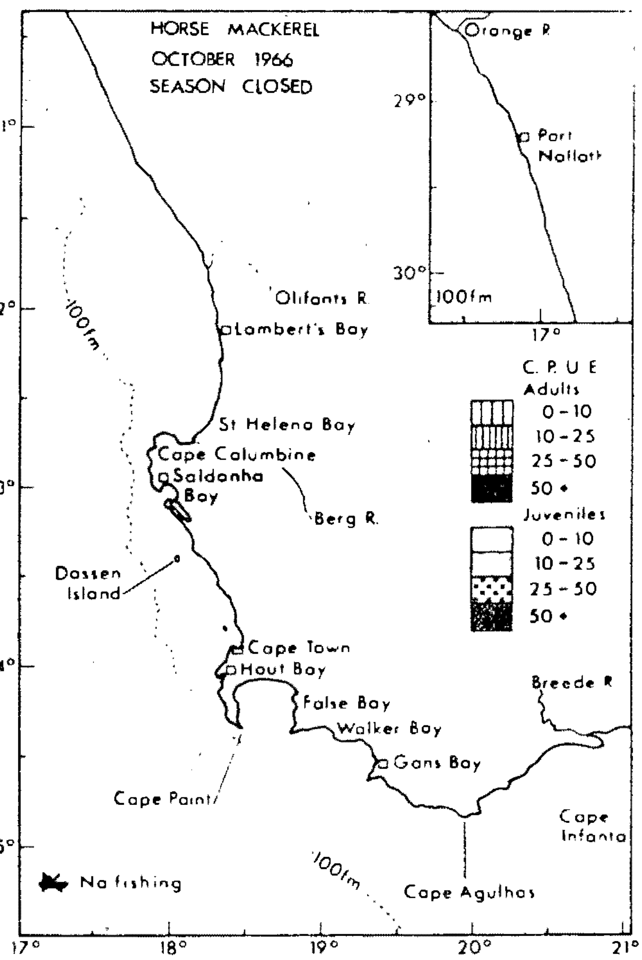
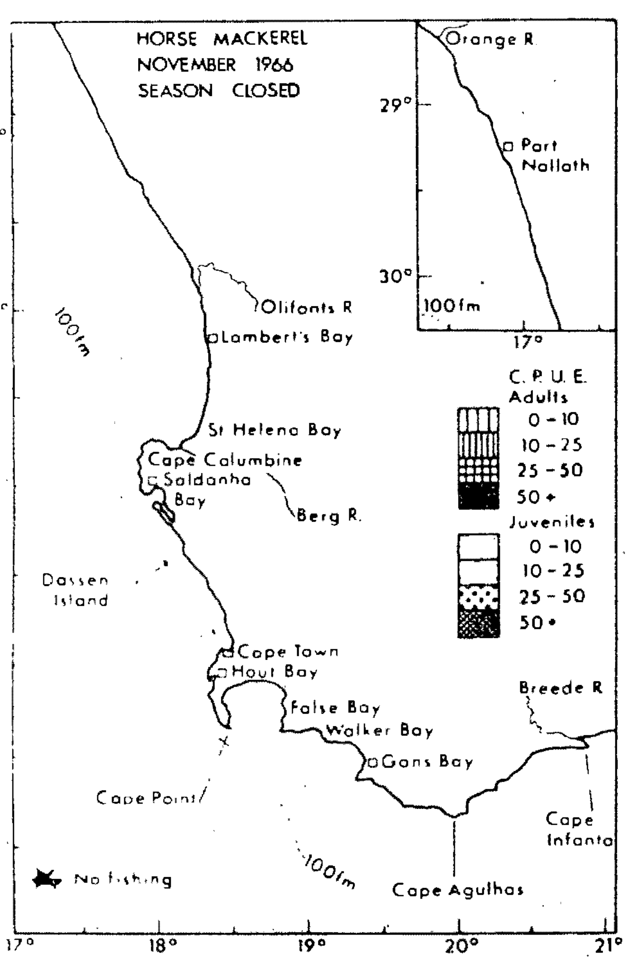
Port Nolloth
30°
100fm
17°
31°
18,5
Olifants R.
32°
100fm
Lambert's Bay
20,5
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
33°
6,5
Dassen Island
18,5
Cape Town
Hout Bay
34°
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
35°
No fishing
100fm
Cape Agulhas
C. P. U. E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
19°
20°
21°


HORSE MACKEREL
SEPTEMBER 1966
Orange R
29°
Port Nolloth
30°
100fm
17°
Olifants R
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
100fm
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
18°
19°
20°
21°


HORSE MACKEREL
OCTOBER 1966
SEASON CLOSED
Orange R
29°
Port Nolloth
30°
100fm
17°
31°
32°
33°
34°
35°
Olifants R
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
100fm
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
19°
20°
21°


HORSE MACKEREL
NOVEMBER 1966
SEASON CLOSED
Orange R
29°
Port Nolloth
30°
100fm
17°
31°
32°
33°
34°
35°
Olifants R
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
100fm
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
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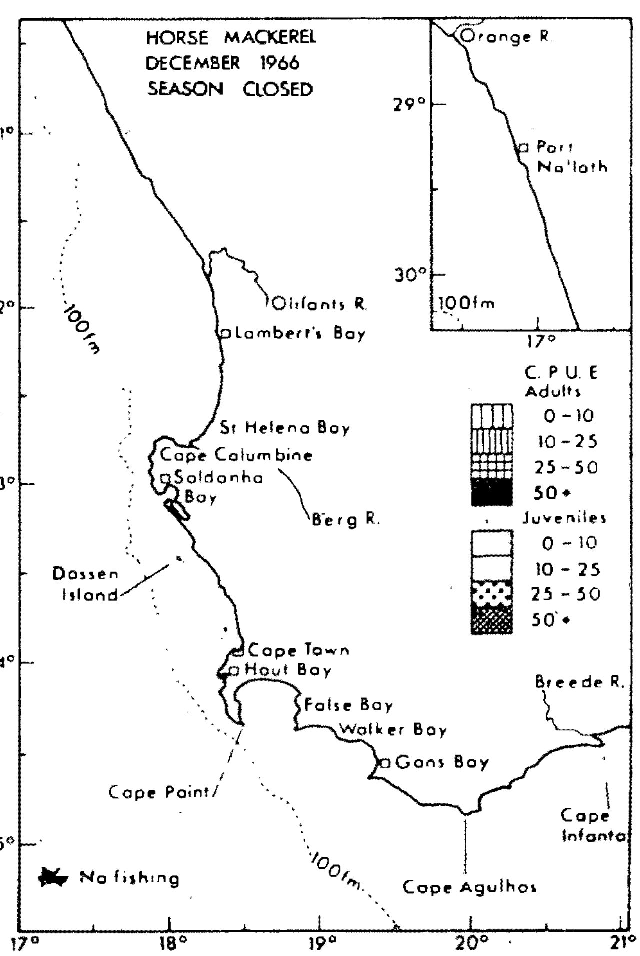
HORSE MACKEREL
DECEMBER 1966
SEASON CLOSED
Orange R
29°
Port Nolloth
30°
100fm
17°
31°
32°
33°
34°
35°
Olifants R
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
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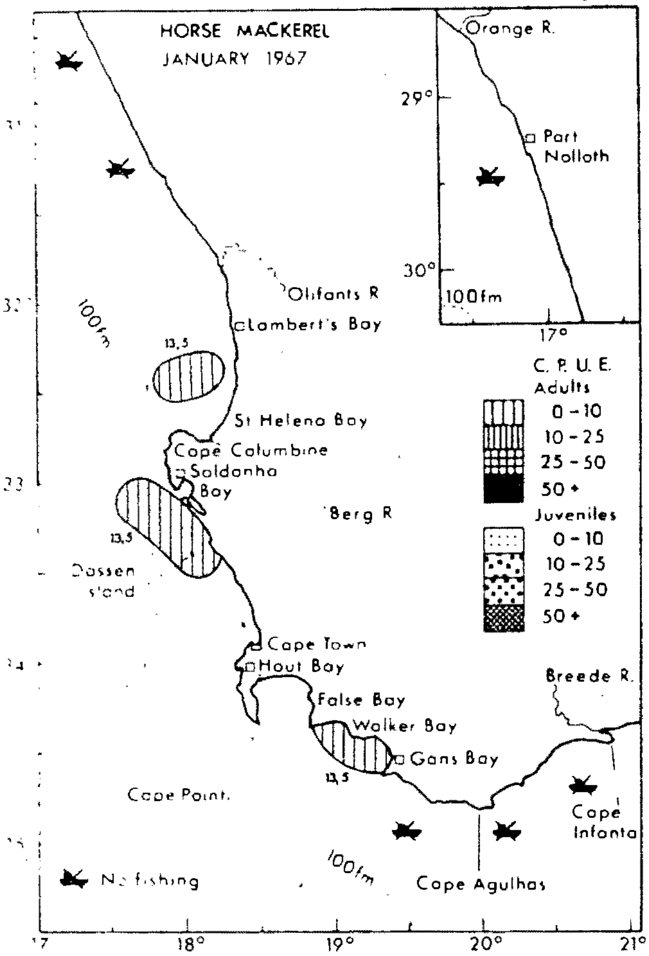
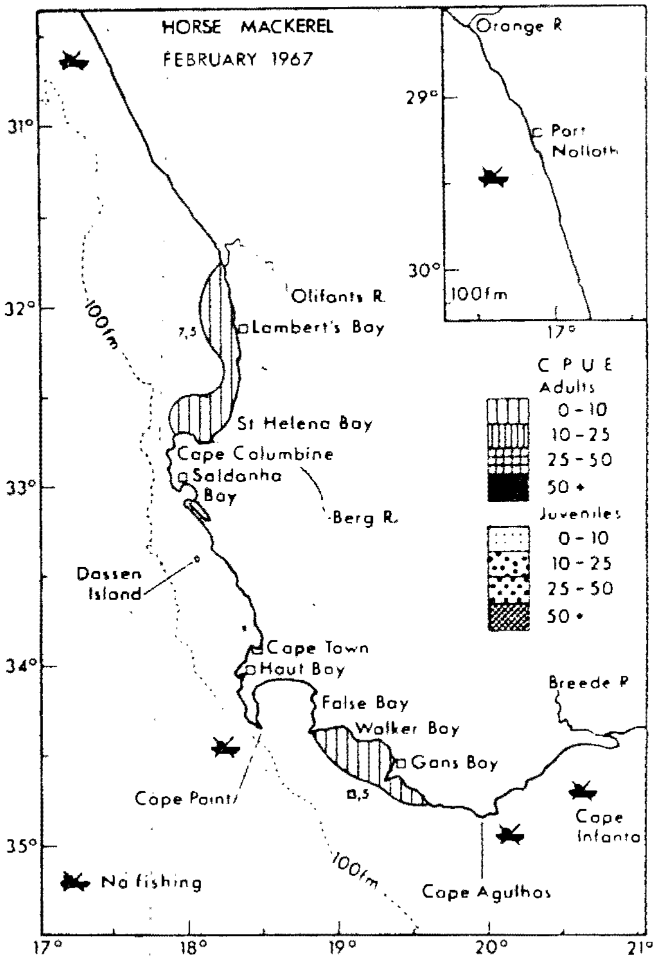
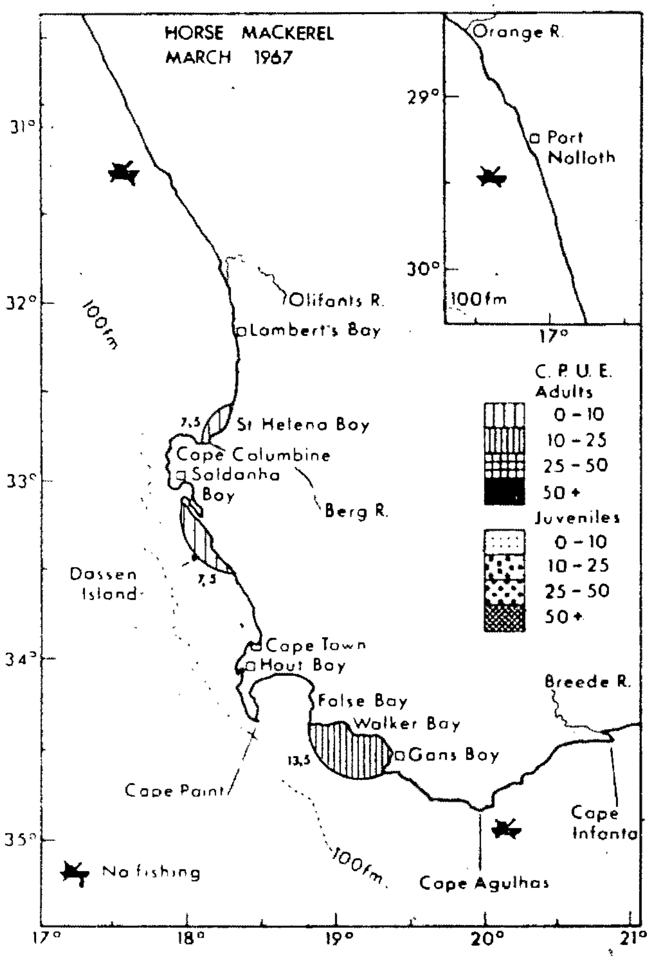
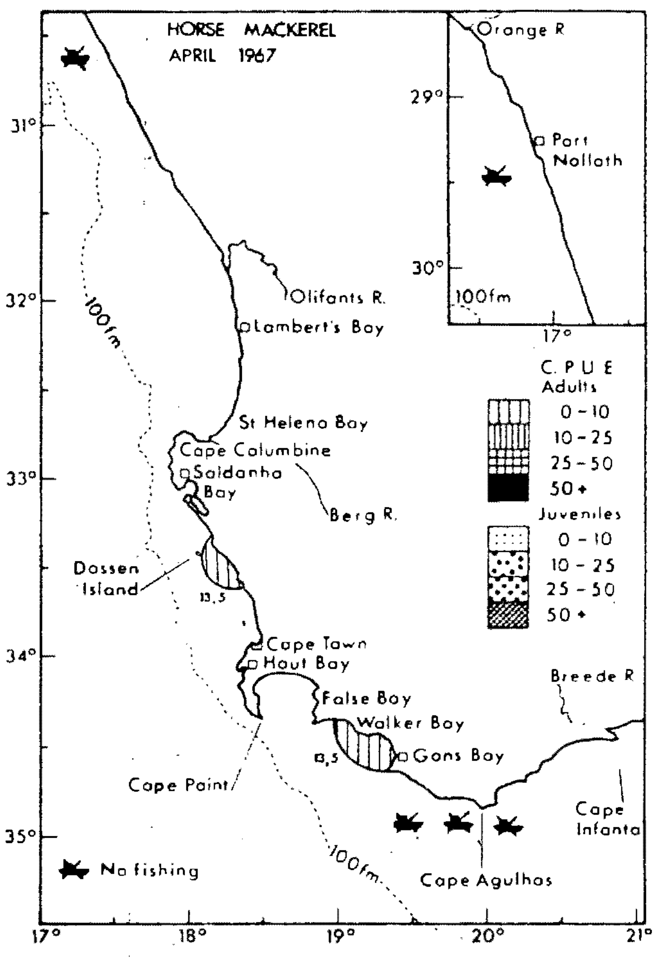
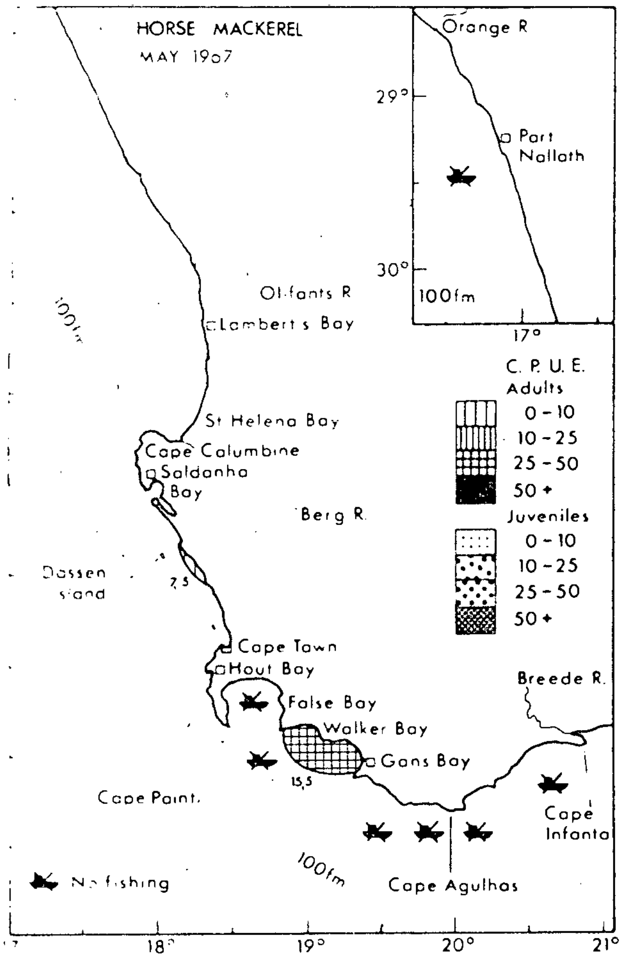
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
100fm
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
19°
20°
21°


HORSE MACKEREL
JANUARY 1967
Orange R.
Port Nolloth
100fm
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +


HORSE MACKEREL
FEBRUARY 1967
Orange R
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C P U E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +


HORSE MACKEREL
MARCH 1967
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +


HORSE MACKEREL
APRIL 1967
Orange R
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P U E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +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MAY 1967
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Port Nollath
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30°
100fm
17°
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
7,5
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
15,5
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
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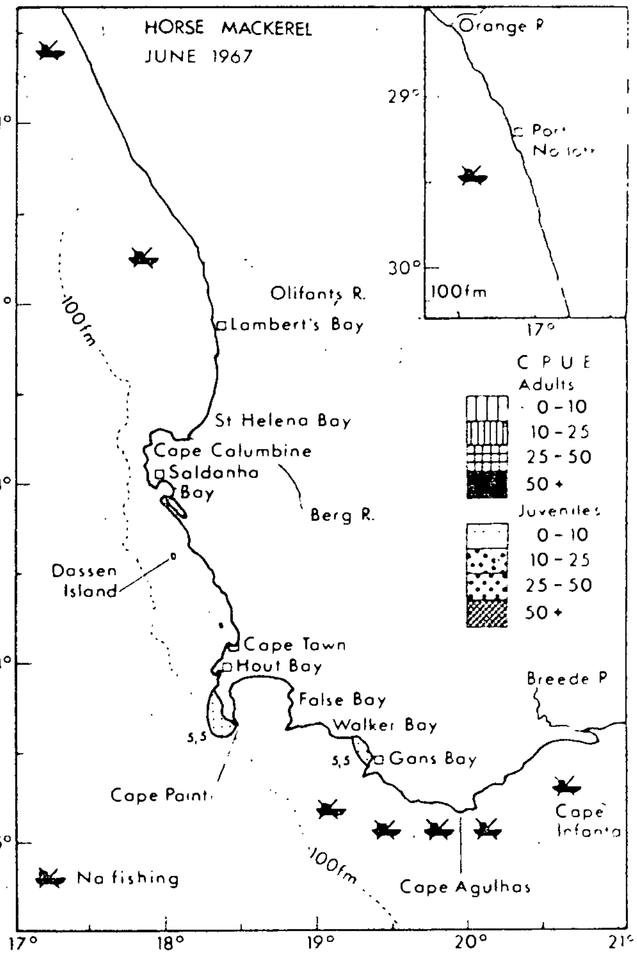
50 +
18°
19°
20°
21°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JUNE 1967
Orange R
Port Nolloth
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100fm
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34°
35°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
5,5
5,5
Breede R
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C P U E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
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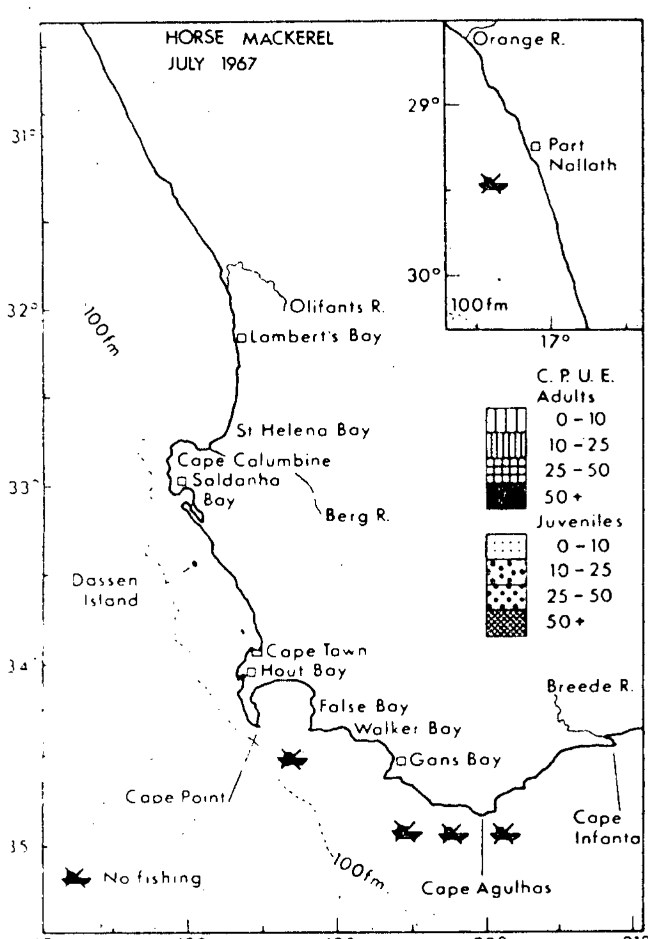
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JULY 1967
Orange R.
Port Nollath
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100fm
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34°
35°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
0 - 10
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50 +
Juveniles
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10 - 25
25 - 50
50 +
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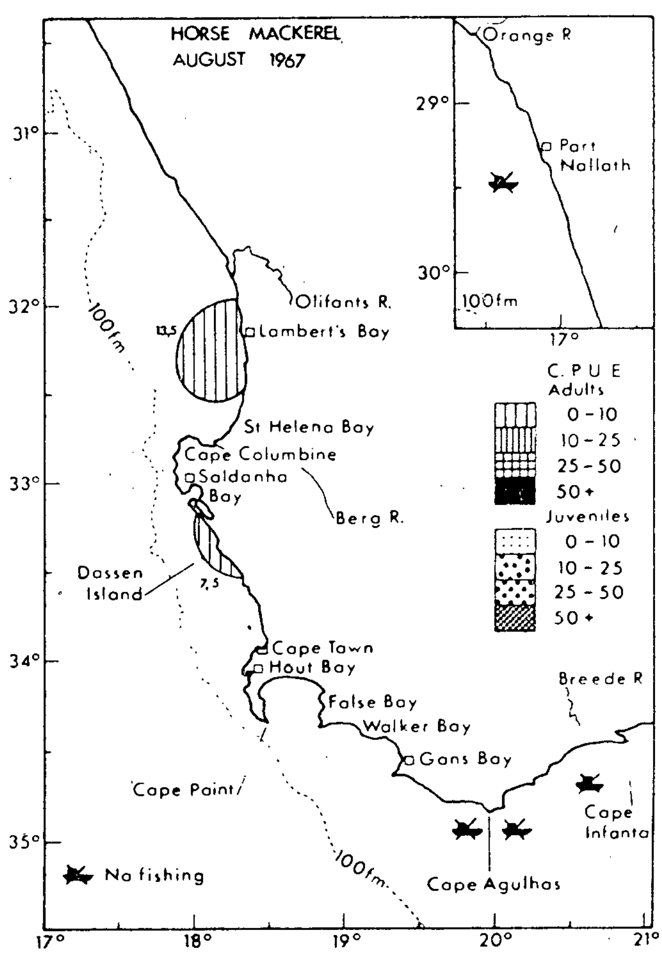
HORSE MACKEREL
AUGUST 1967
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Port Nollath
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35°
100fm
Olifants R.
Lambert's Bay
13,5
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
7,5
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P U E
Adults
0 - 10
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50 +
Juveniles
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25 - 50
50 +
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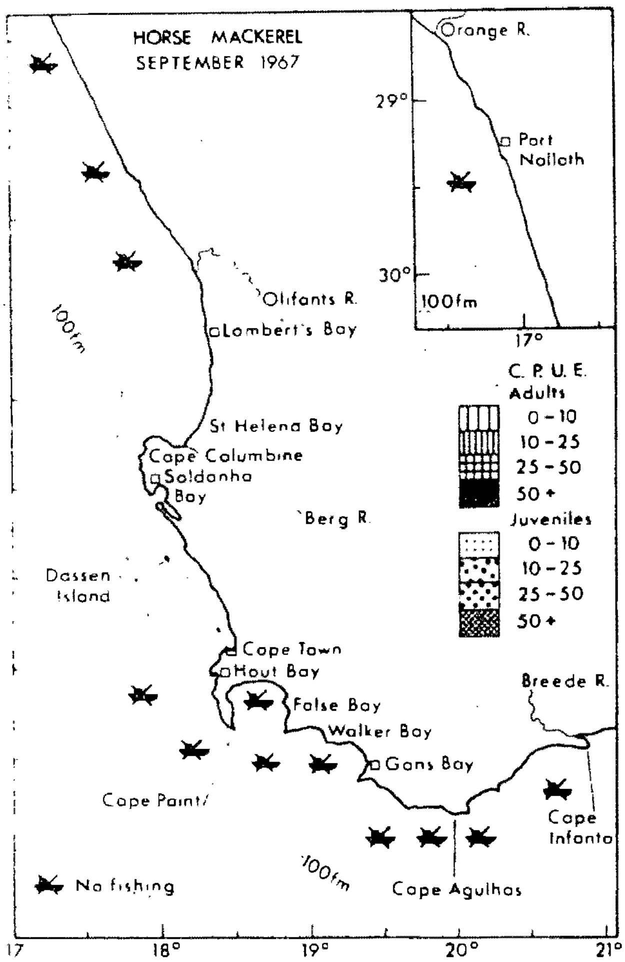
HORSE MACKEREL
SEPTEMBER 1967
Orange R.
29°
Port Nolloth
30°
100fm
17°
Olifants R.
Lambert's Bay
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
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10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
33
Cape Town
Hout Bay
False Bay
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Breede R.
Gans Bay
Cape Point
Cape Infanta
35
100fm
Cape Agulhas
No fishing
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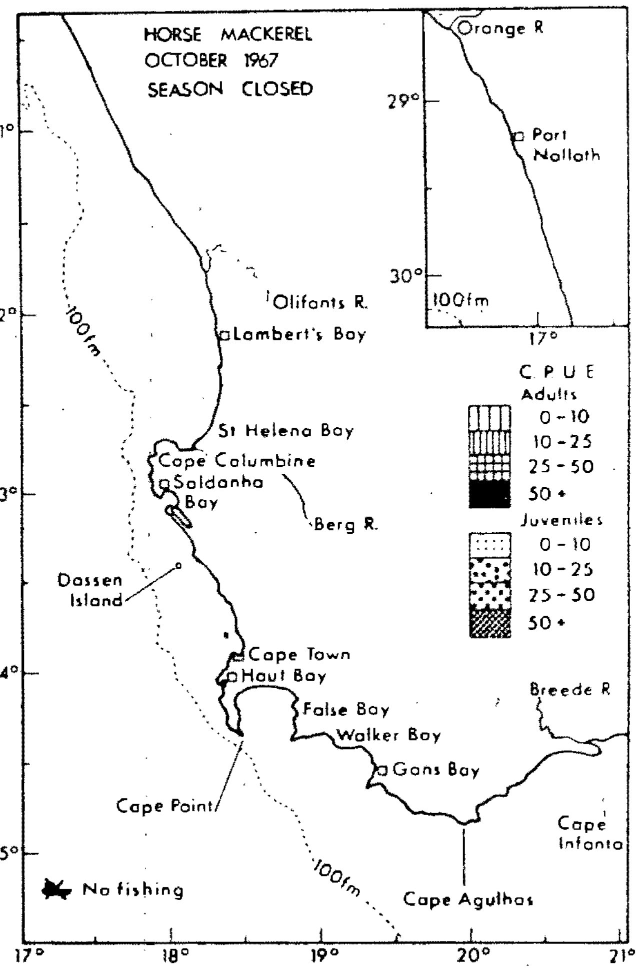
21°


HORSE MACKEREL
OCTOBER 1967
SEASON CLOSED
Orange R
29°
Port Nolloth
30°
100fm
17°
31°
32°
100fm
Olifants R.
Lambert's Bay
C. P. U. E.
Adults
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10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
33°
Dassen Island
Cape Town
Hout Bay
34°
False Bay
Walker Bay
Breede R
Gans Bay
Cape Point
Cape Infanta
35°
100fm
Cape Agulhas
No fishing
17°
18°
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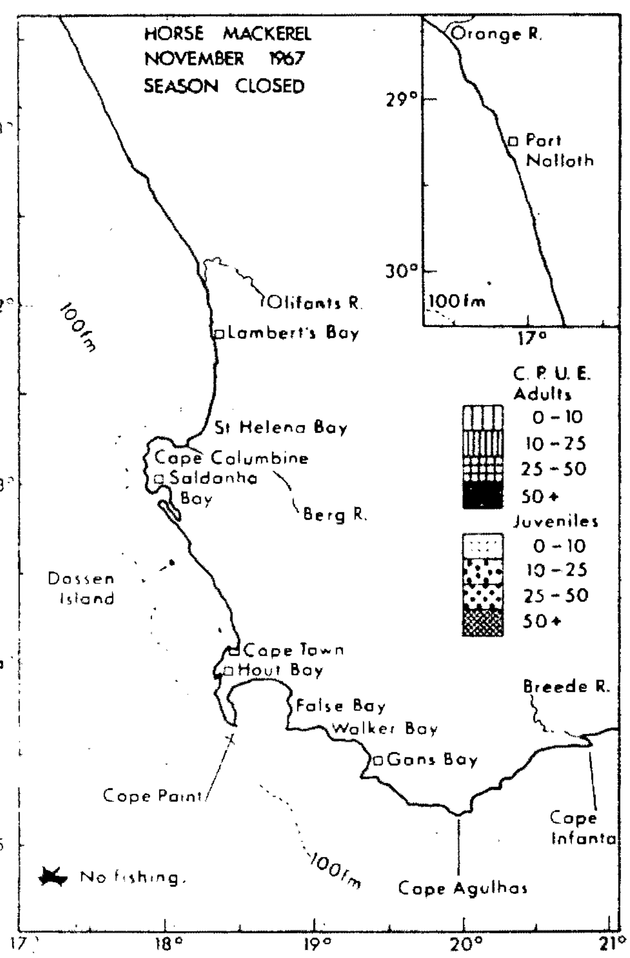
21°


HORSE MACKEREL
NOVEMBER 1967
SEASON CLOSED
Orange R.
29°
Port Nolloth
30°
100fm
17°
100fm
Olifants R.
Lambert's Bay
C. P. U. E.
Adults
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10 - 25
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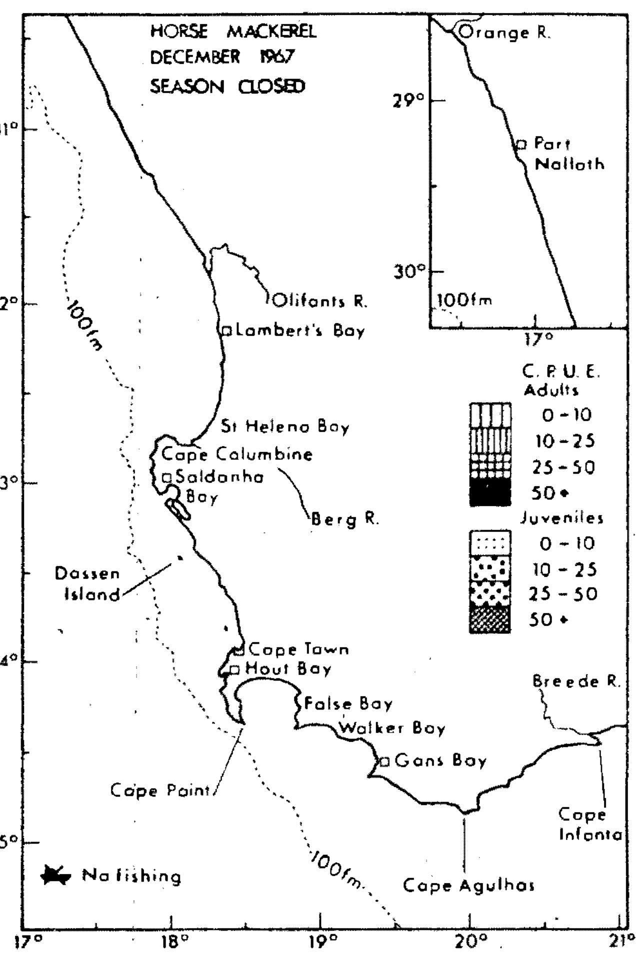
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Breede R.
Gans Bay
Cape Point
Cape Infanta
35
100fm
Cape Agulhas
No fishing.
18°
19°
20°
21°


HORSE MACKEREL
DECEMBER 1967
SEASON CLOSED
Orange R.
29°
Port Nolloth
30°
100fm
17°
31°
32°
100fm
Olifants R.
Lambert's Bay
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
33°
Dassen Island
Cape Town
Hout Bay
34°
False Bay
Walker Bay
Breede R.
Gans Bay
Cape Point
Cape Infanta
35°
100fm
Cape Agulhas
No fishing
17°
18°
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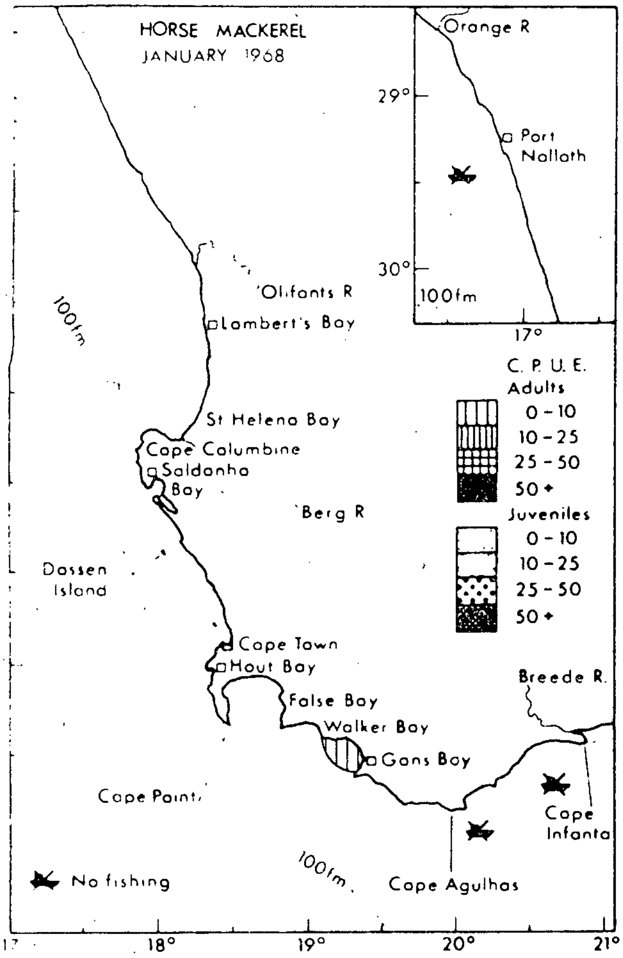
21°


HORSE MACKEREL
JANUARY 1968
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Port Nolloth
100fm
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Olifants R
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
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Juveniles
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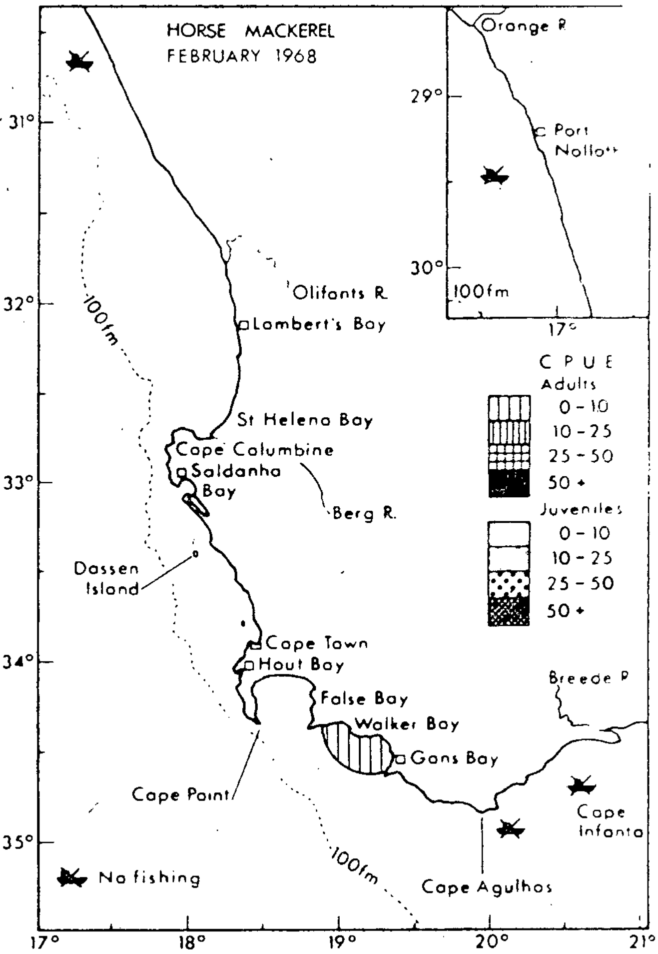
HORSE MACKEREL
FEBRUARY 1968
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30°
Port
100fm
17°
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Olifants R
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
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Dassen Island
Cape Town
Hout Bay
False Bay
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Gans Bay
Cape Point
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Cape Agulhas
100fm
No fishing
C P U E
Adults
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50 +
Juveniles
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50 +
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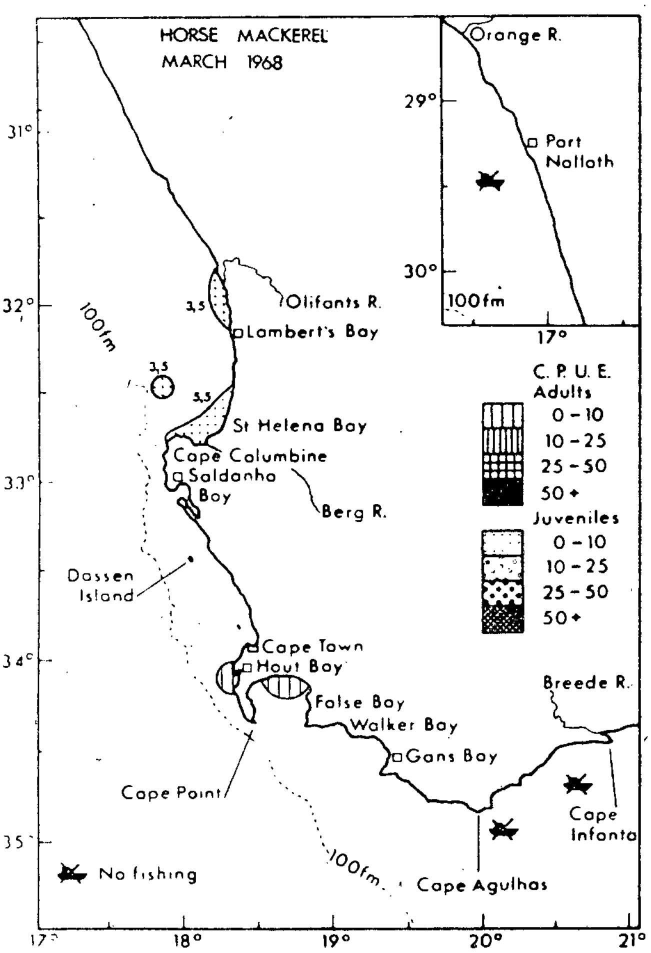
HORSE MACKEREL
MARCH 1968
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Port Nolloth
100fm
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31°
32°
34°
Olifants R.
Lambert's Bay
100fm
3,5
3,5
5,5
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
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25 - 50
50 +
Juveniles
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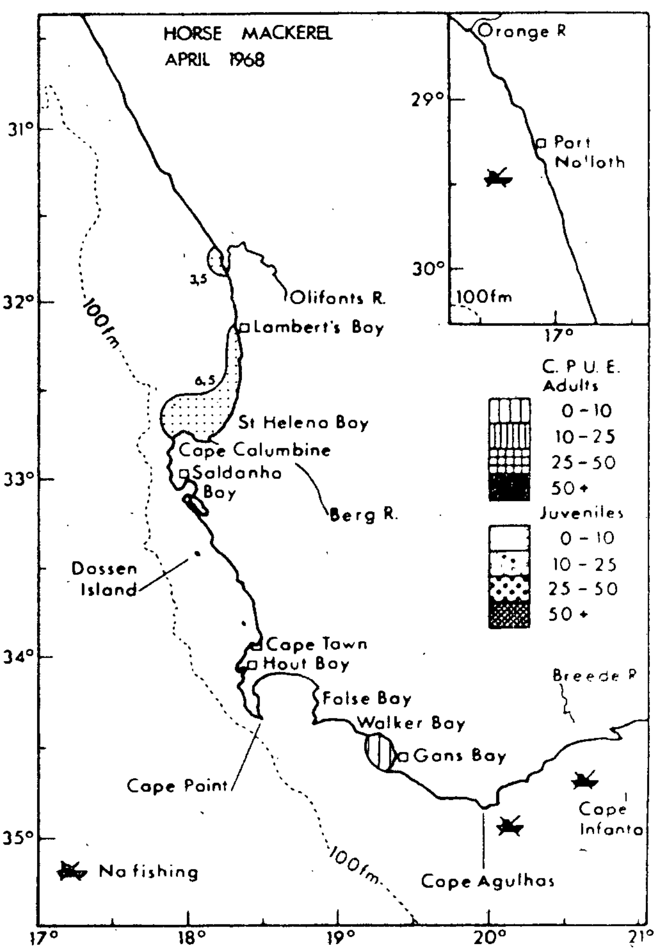
HORSE MACKEREL
APRIL 1968
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Olifants R.
Lambert's Bay
100fm
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St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
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Juveniles
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50 +
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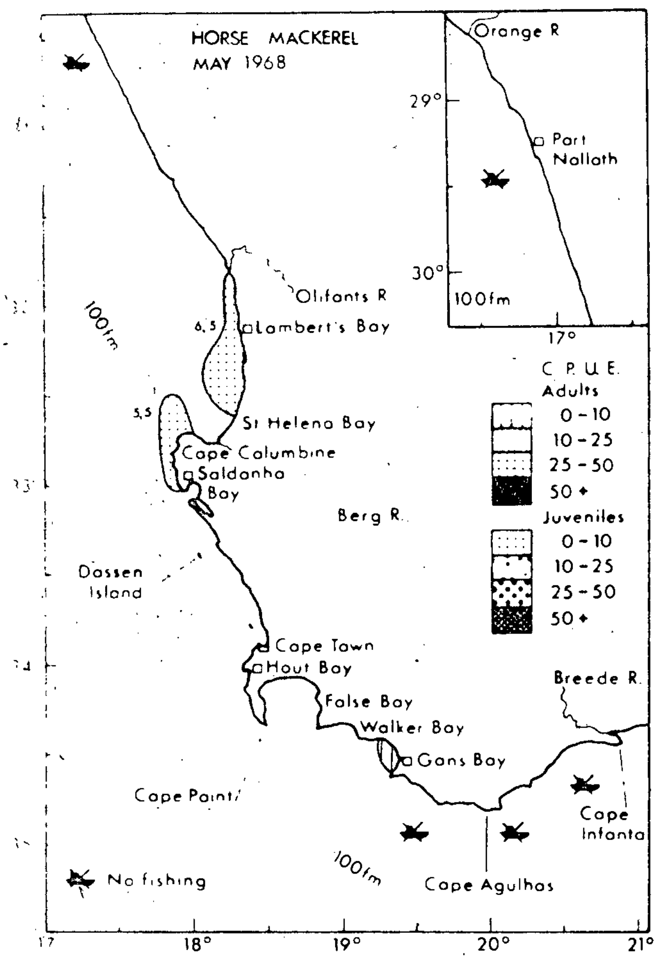
HORSE MACKEREL
MAY 1968
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Port Nolloth
30°
100fm
17°
Olifants R
Lambert's Bay
100fm
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St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
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No fishing
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Juveniles
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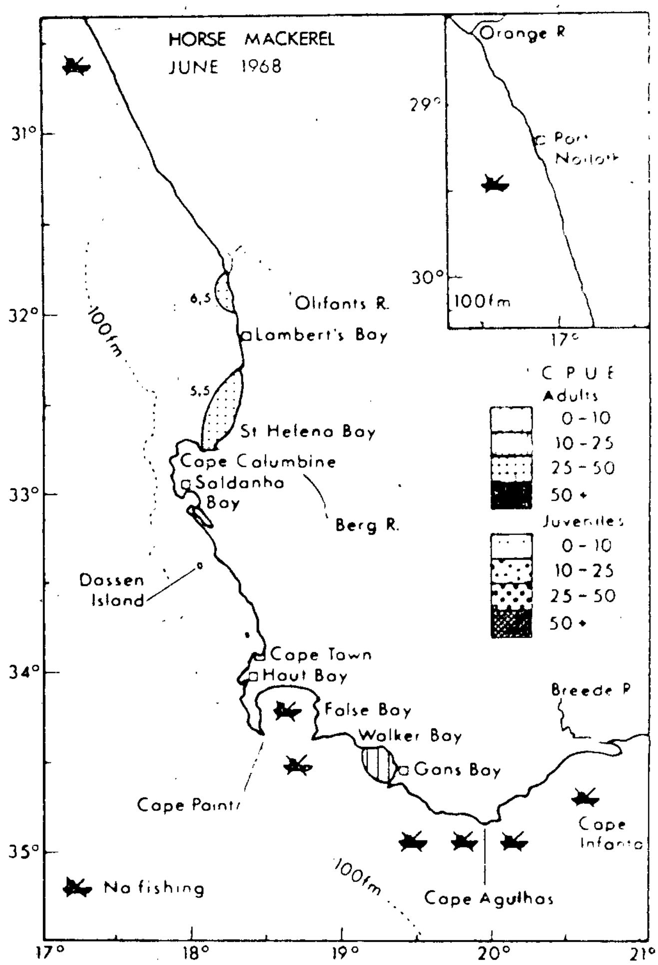
HORSE MACKEREL
JUNE 1968
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Lambert's Bay
100fm
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Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
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Cape Agulhas
No fishing
C P U E
Adults
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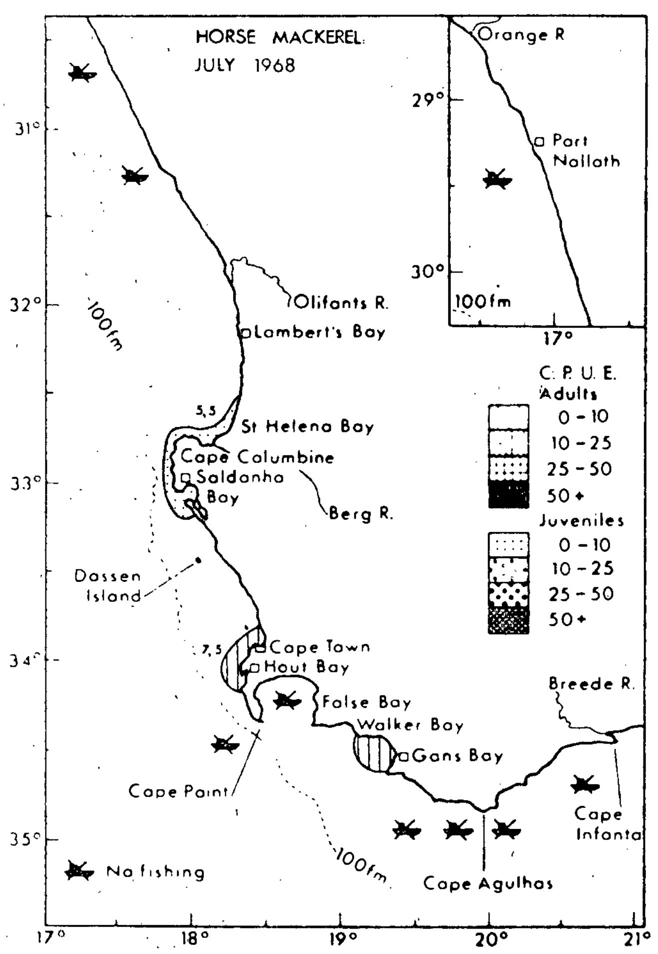
HORSE MACKEREL
JULY 1968
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Olifants R.
Lambert's Bay
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Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
7,5
Cape Town
Hout Bay
False Bay
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Cape Point
Cape Infanta
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Cape Agulhas
No fishing
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Juveniles
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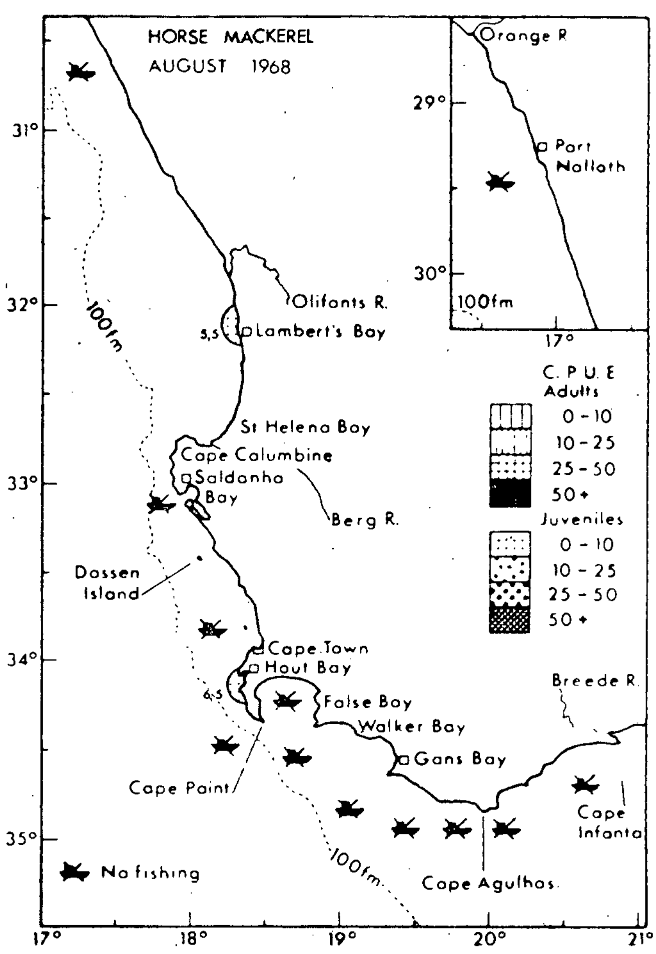
HORSE MACKEREL
AUGUST 1968
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Port Nolloth
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Olifants R.
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Lambert's Bay
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St Helena Bay
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Saldanha Bay
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Dassen Island
Cape Town
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Juveniles
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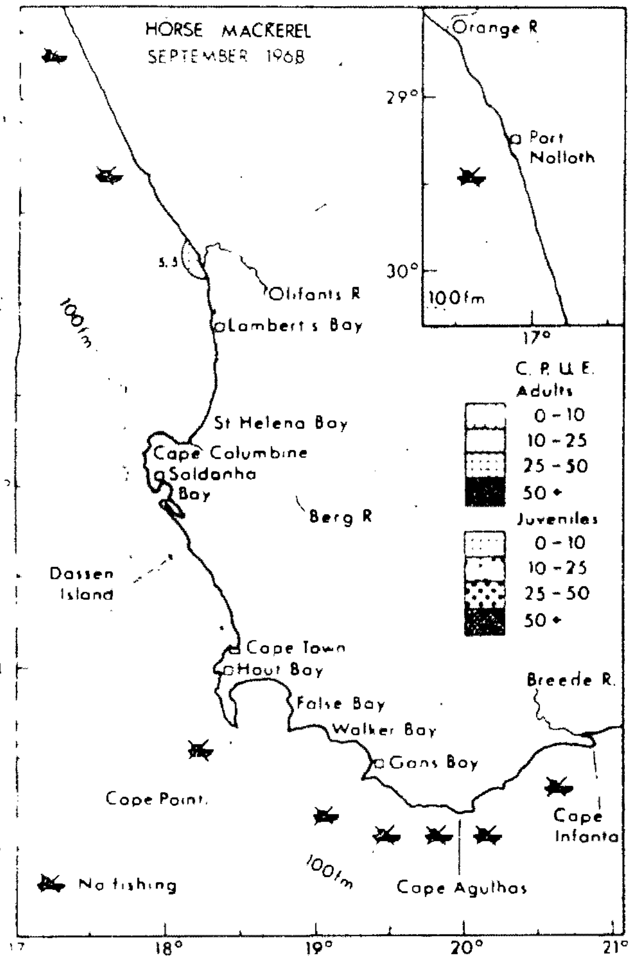
HORSE MACKEREL
SEPTEMBER 1968
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Port
Nolloth
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Olifants R
Lambert's Bay
100fm
C. P. U. E.
Adults
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St Helena Bay
Cape Columbine
Saldanha
Bay
Berg R
Juveniles
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25 - 50
50 +
Dassen
Island
Cape Town
Hout Bay
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False Bay
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Cape Point
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Infanta
No fishing
100fm
Cape Agulhas
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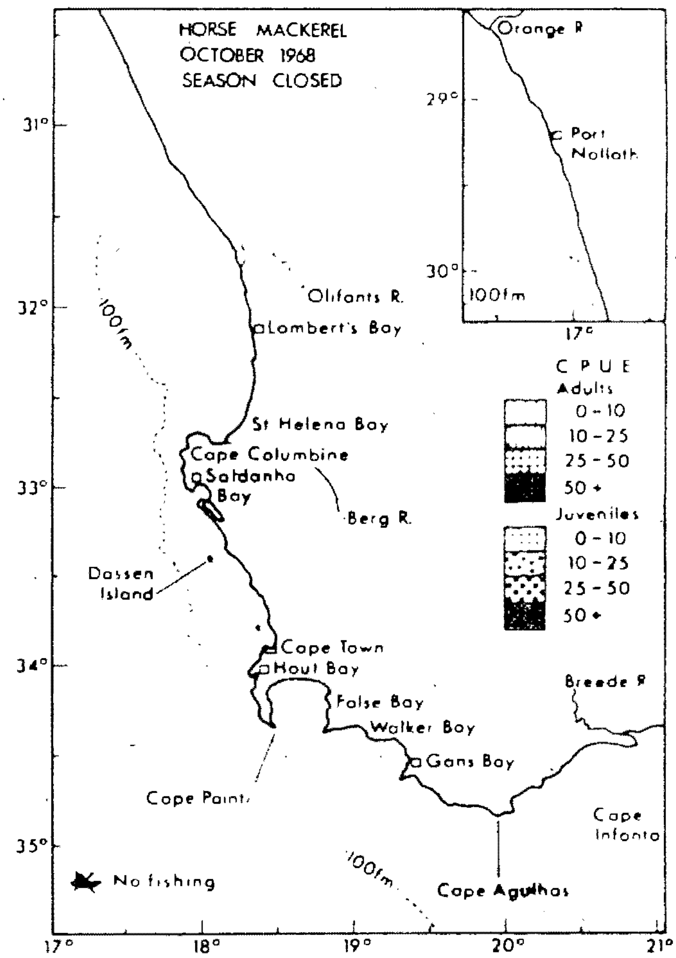
HORSE MACKEREL
OCTOBER 1968
SEASON CLOSED
Orange R
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Port
Nolloth
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100fm
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Olifants R.
Lambert's Bay
100fm
C P U E
Adults
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Bay
Berg R.
33°
Juveniles
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50 +
Dassen
Island
Cape Town
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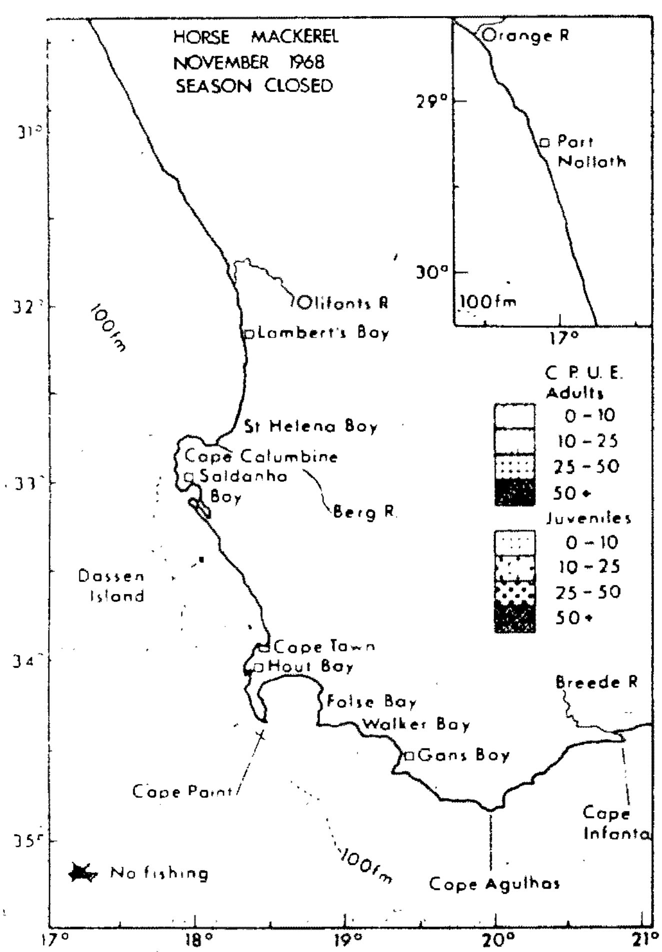
HORSE MACKEREL
NOVEMBER 1968
SEASON CLOSED
Orange R
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Port
Nolloth
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Olifants R
Lambert's Bay
100fm
C. P. U. E.
Adults
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St Helena Bay
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Bay
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Walker Bay
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Cape Point
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Infanta
No fishing
100fm
Cape Agulhas
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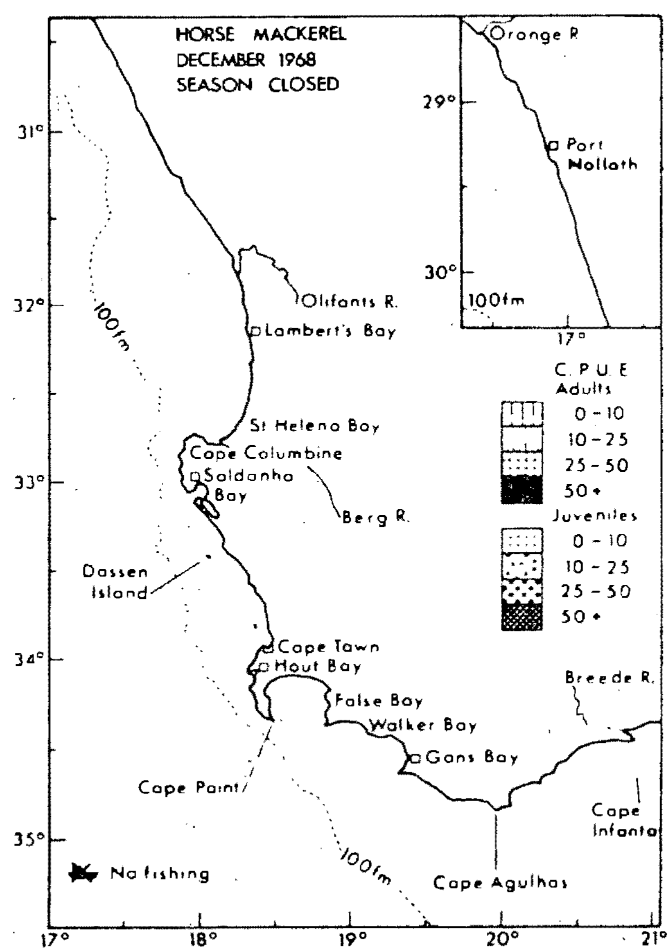
HORSE MACKEREL
DECEMBER 1968
SEASON CLOSED
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Port
Nolloth
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Olifants R.
Lambert's Bay
100fm
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Juveniles
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Cape Town
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Breede R.
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Cape
Infanta
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No fishing
100fm
Cape Agulhas
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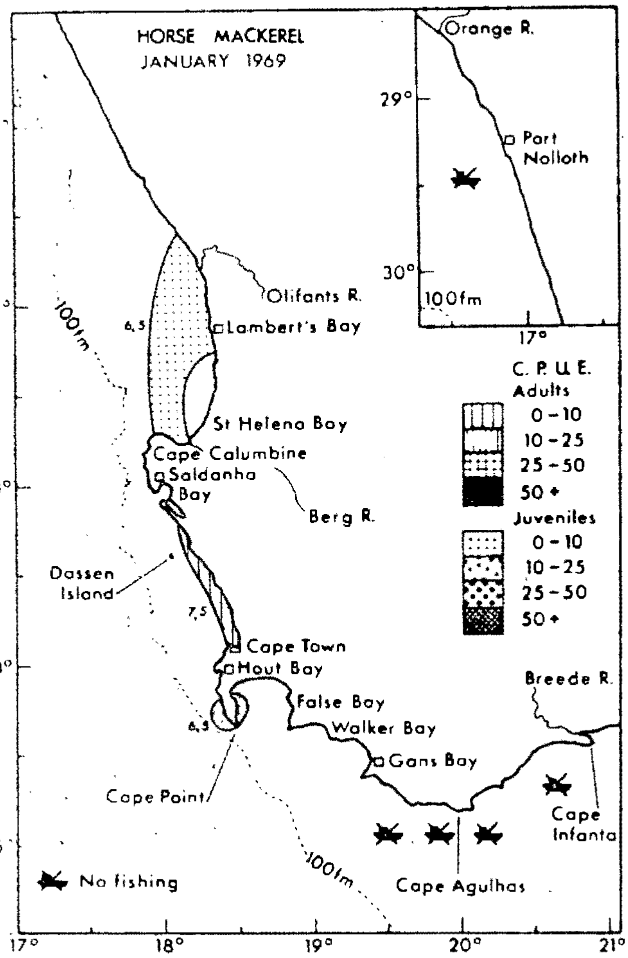
HORSE MACKEREL
JANUARY 1969
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Port Nolloth
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100fm
17°
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
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No fishing
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Juveniles
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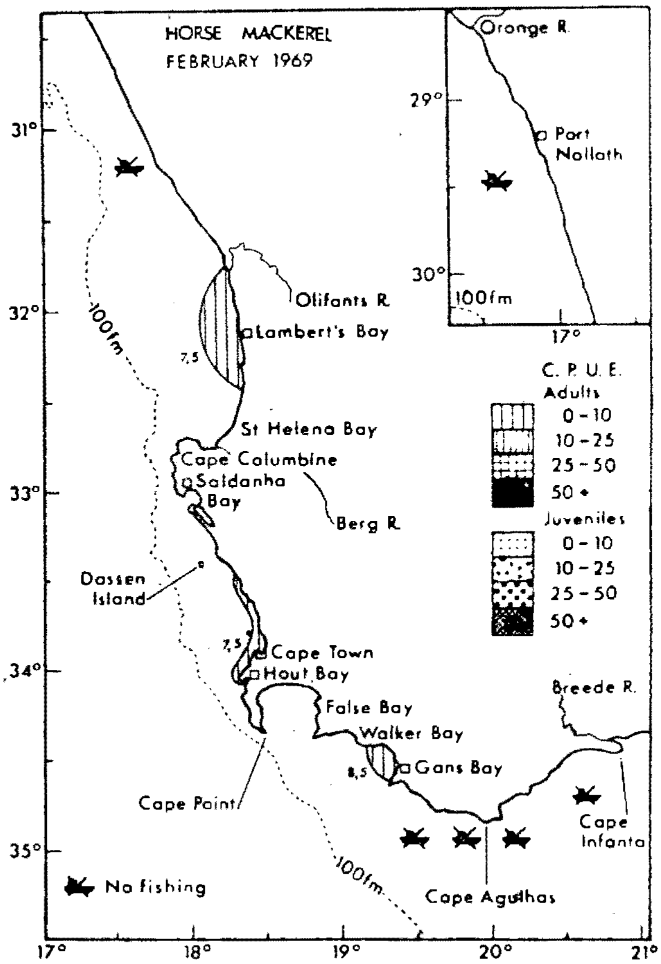
HORSE MACKEREL
FEBRUARY 1969
Orange R.
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Port Nolloth
30°
100fm
17°
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
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Breede R.
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Juveniles
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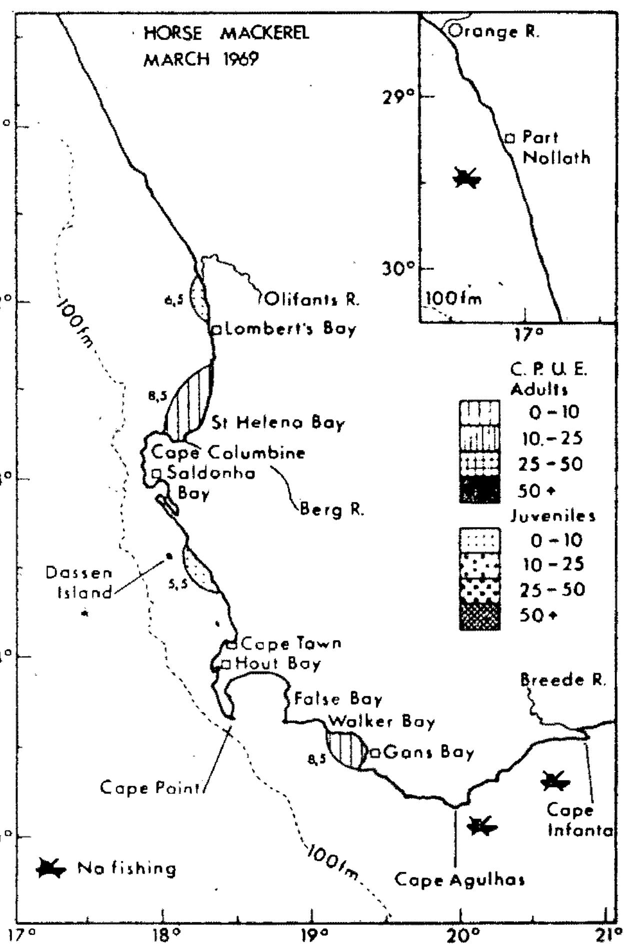
HORSE MACKEREL
MARCH 1969
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Port Nolloth
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100fm
17°
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
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Juveniles
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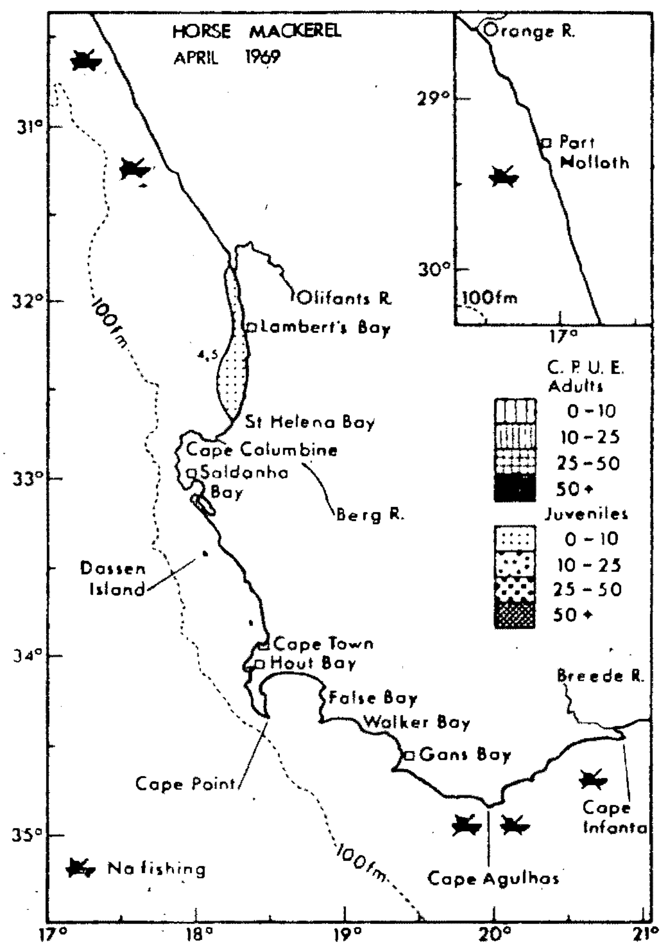
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Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
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Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
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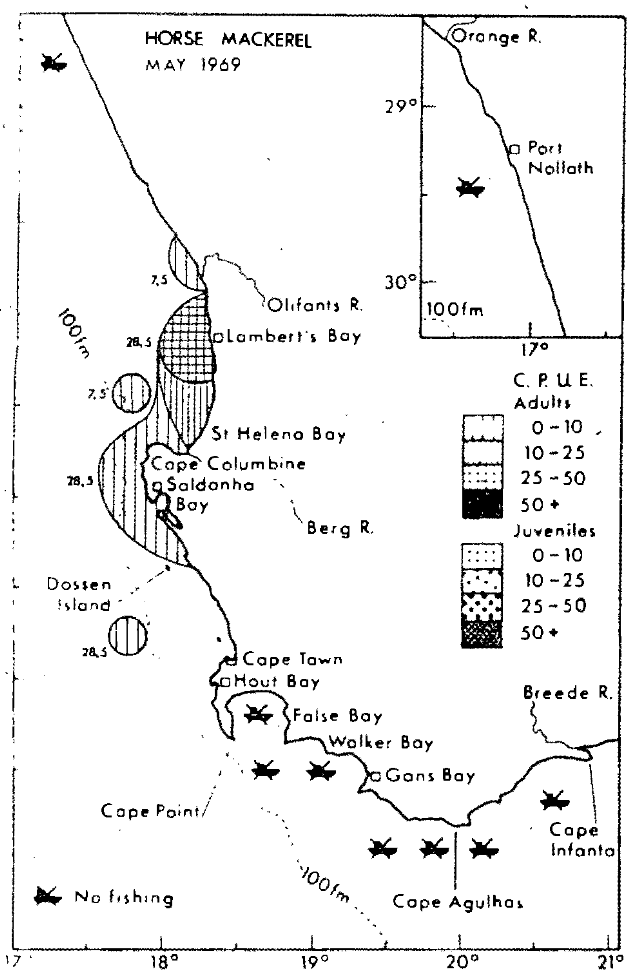
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Berg R.
Dossen Island
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Cape Point
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No fishing
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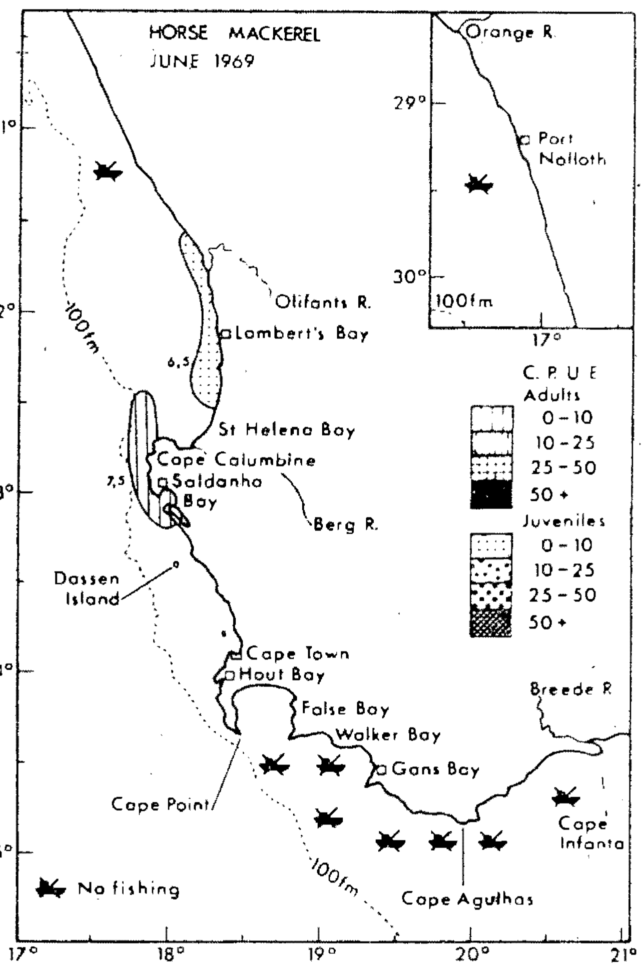
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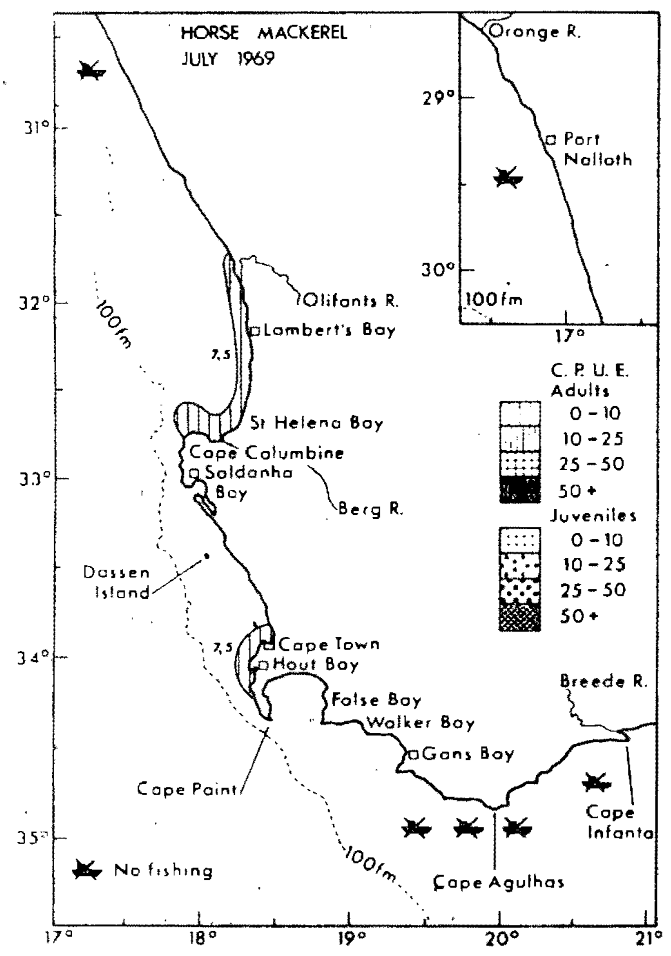
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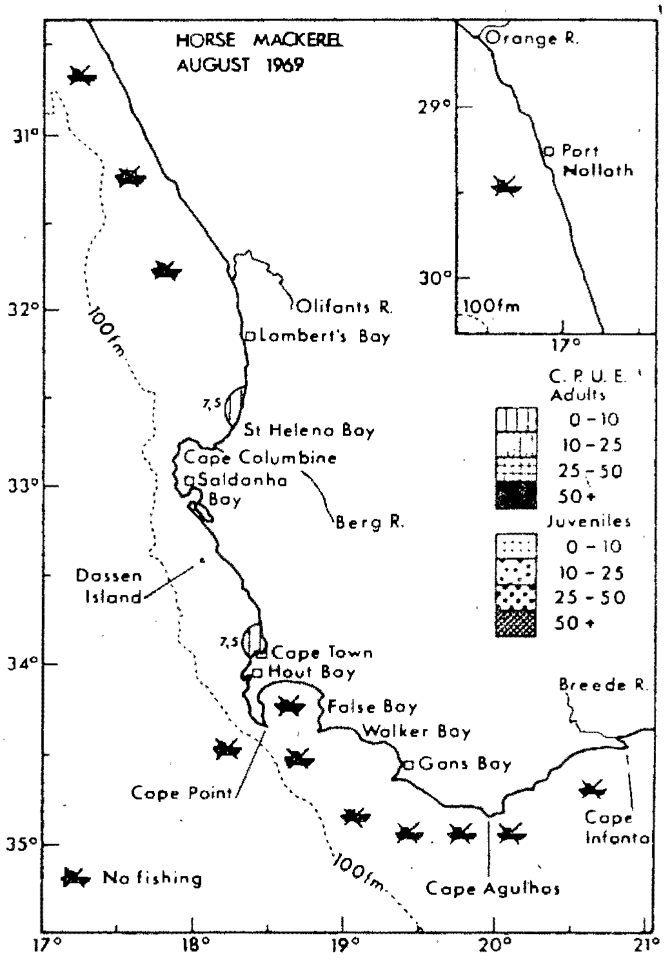
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Lambert's Bay
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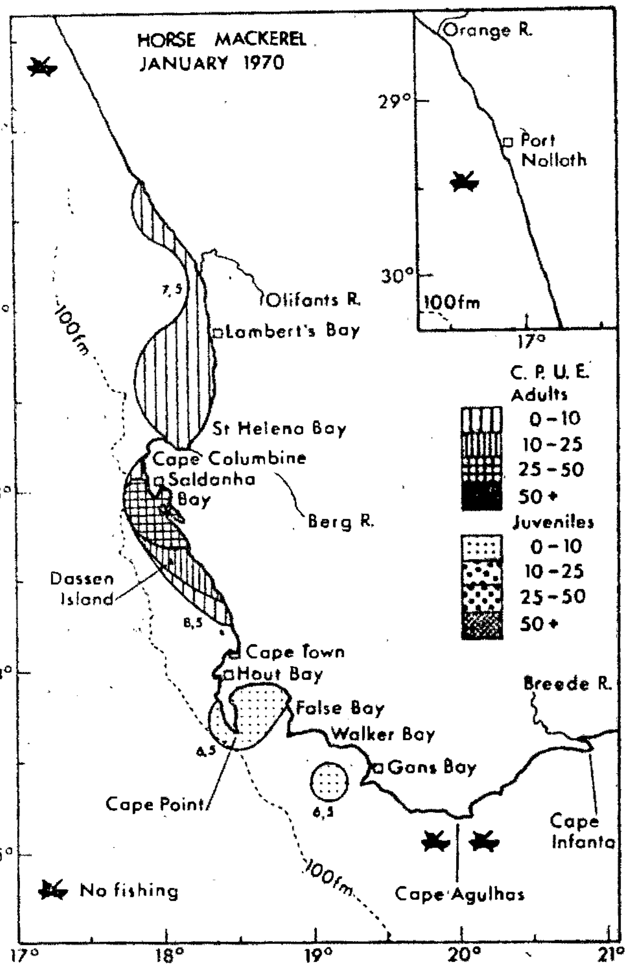
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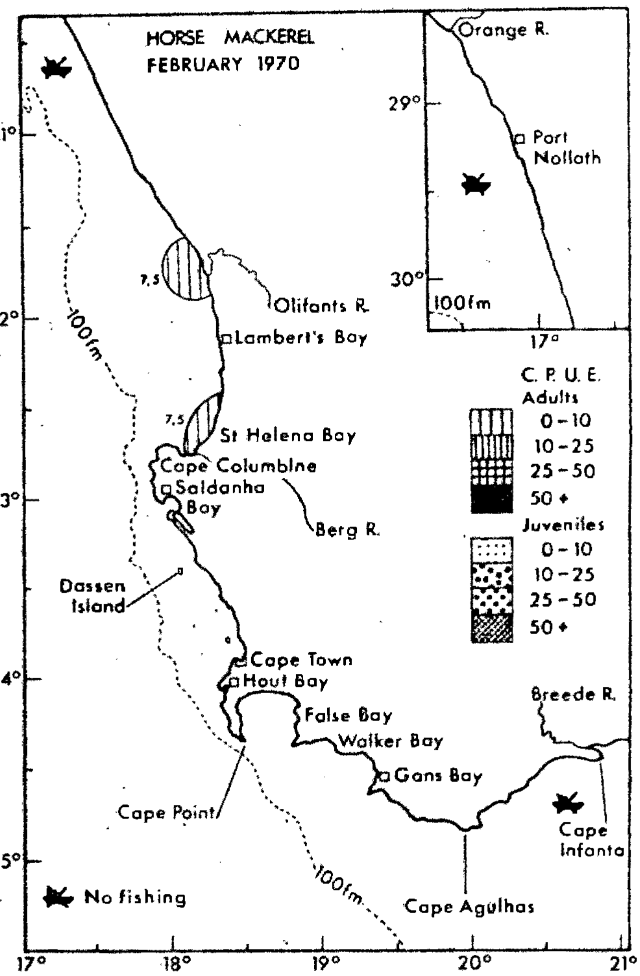
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FEBRUARY 1970
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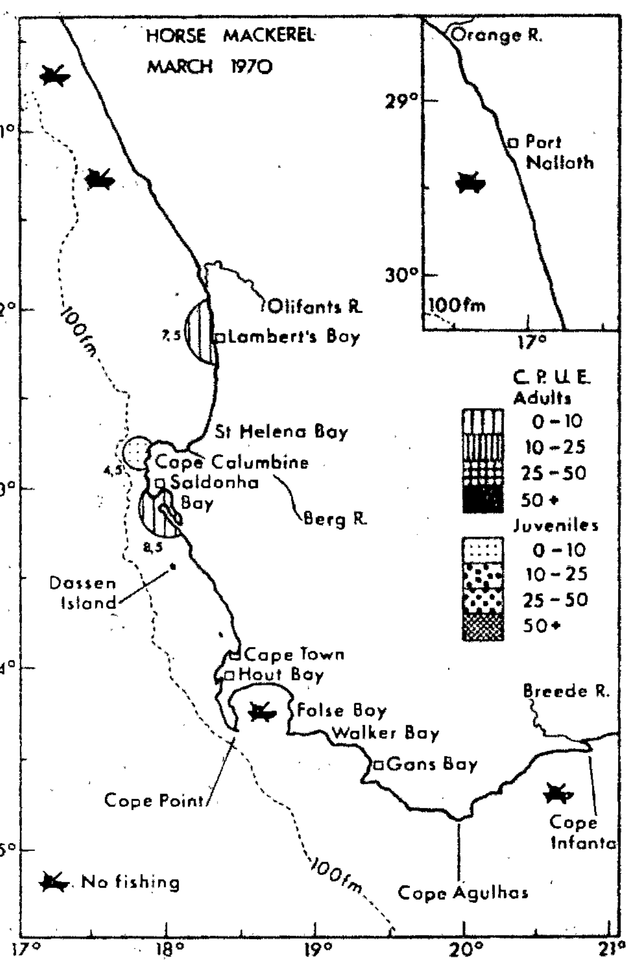
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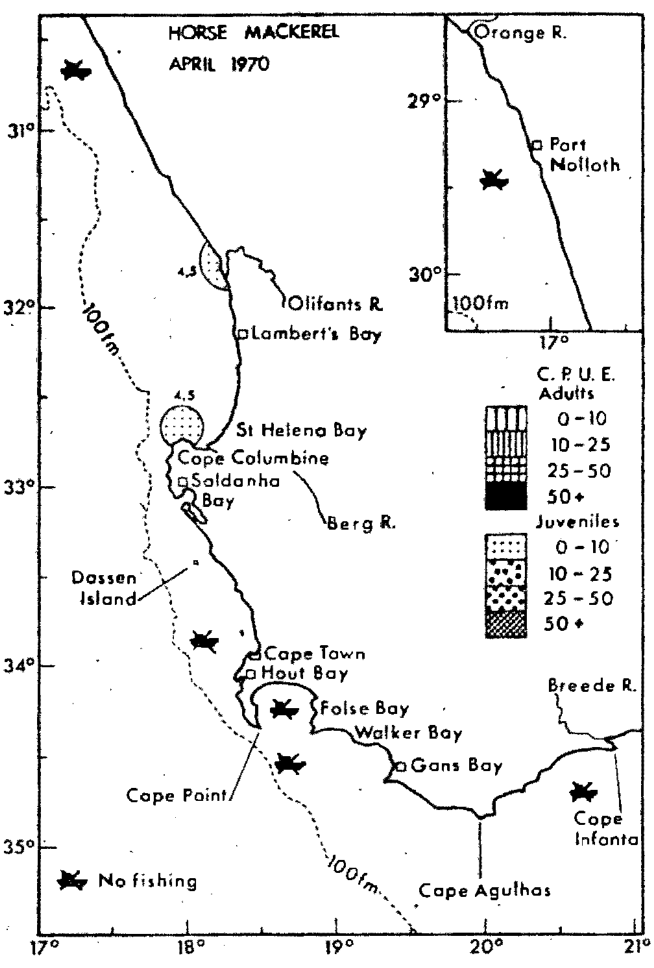
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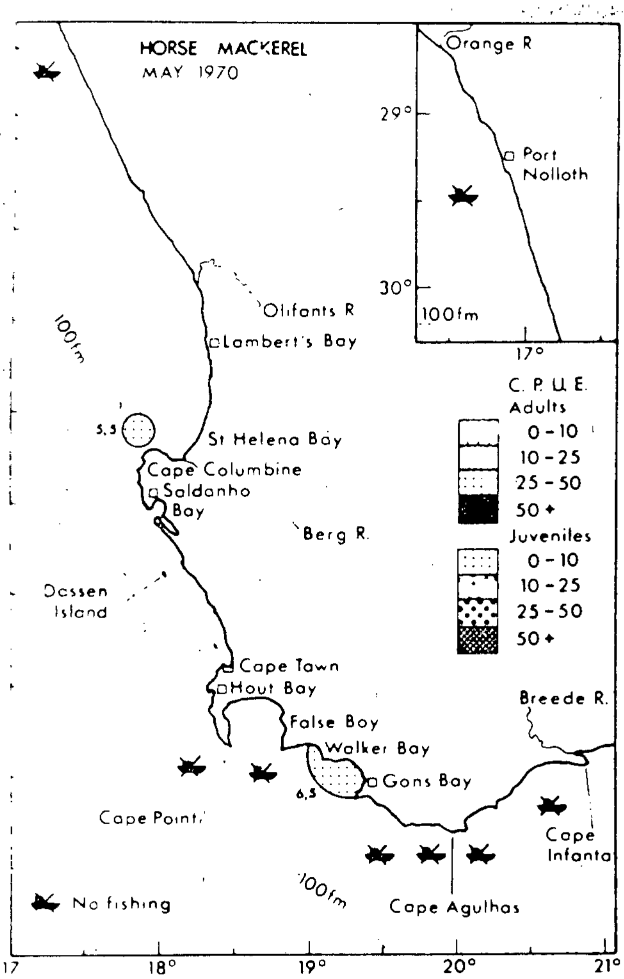
HORSE MACKEREL
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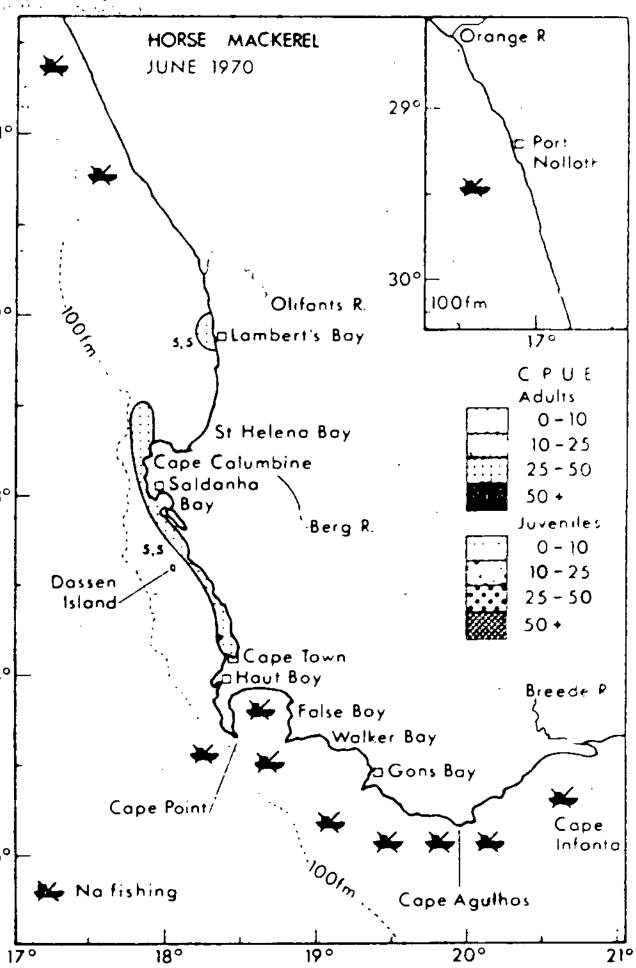
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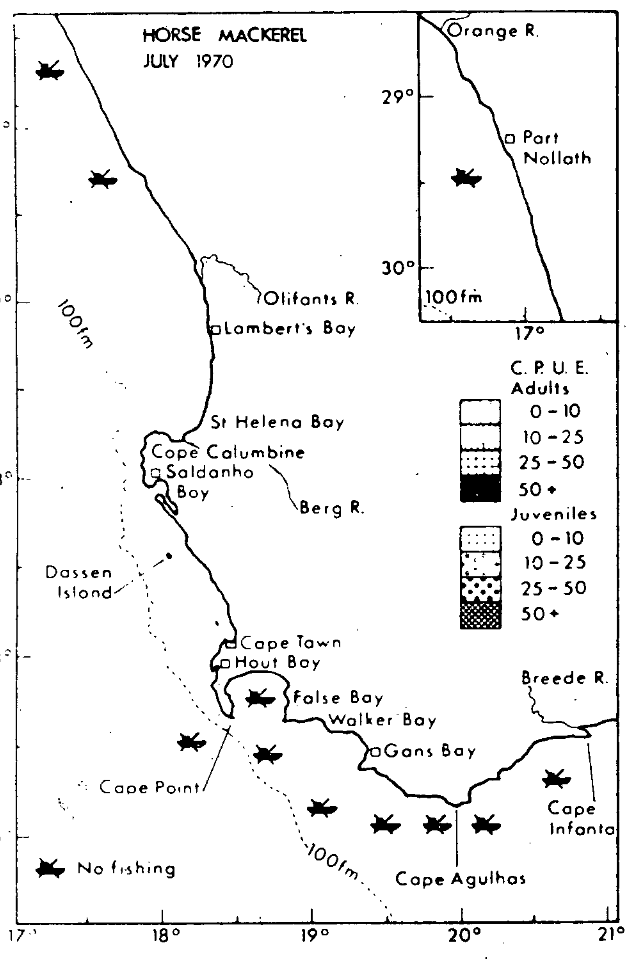
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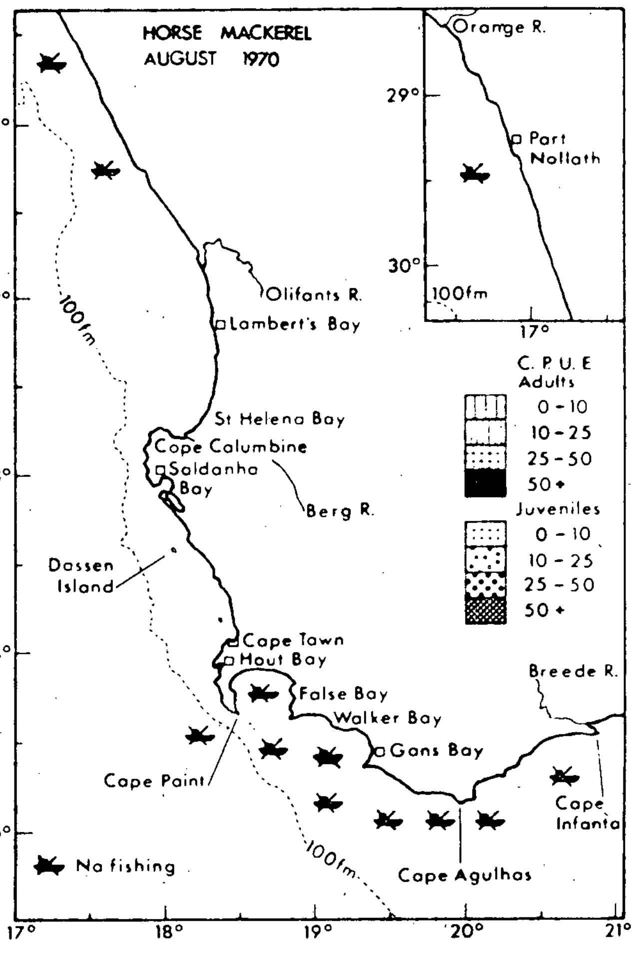
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AUGUST 1970
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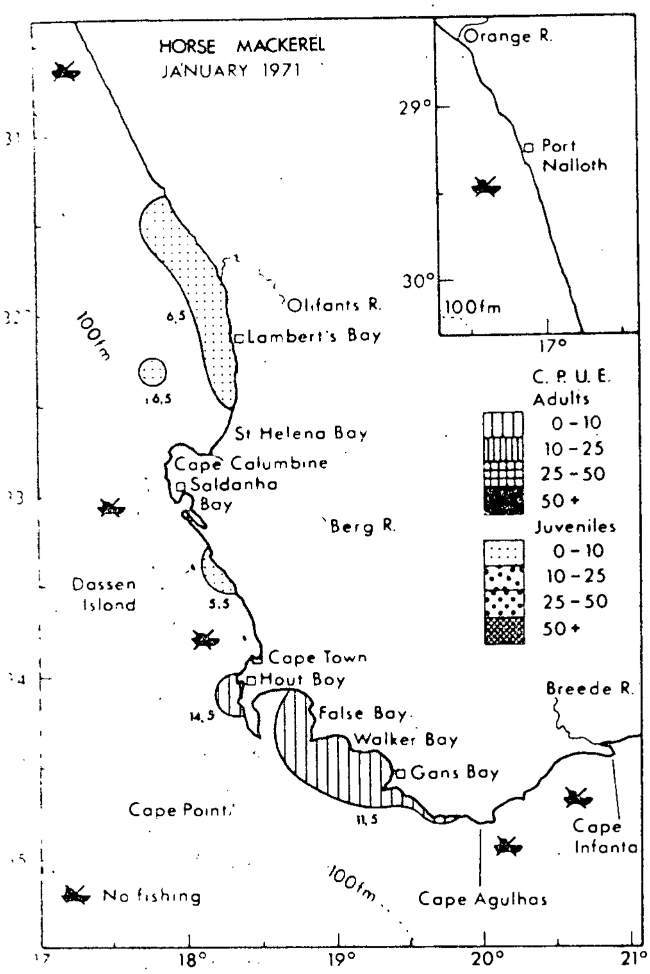
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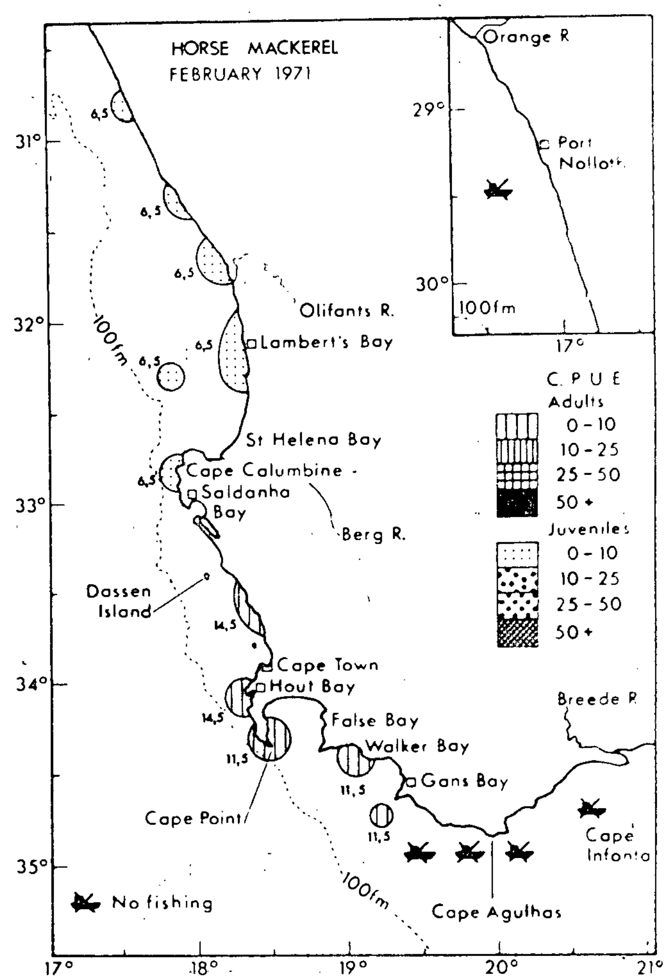
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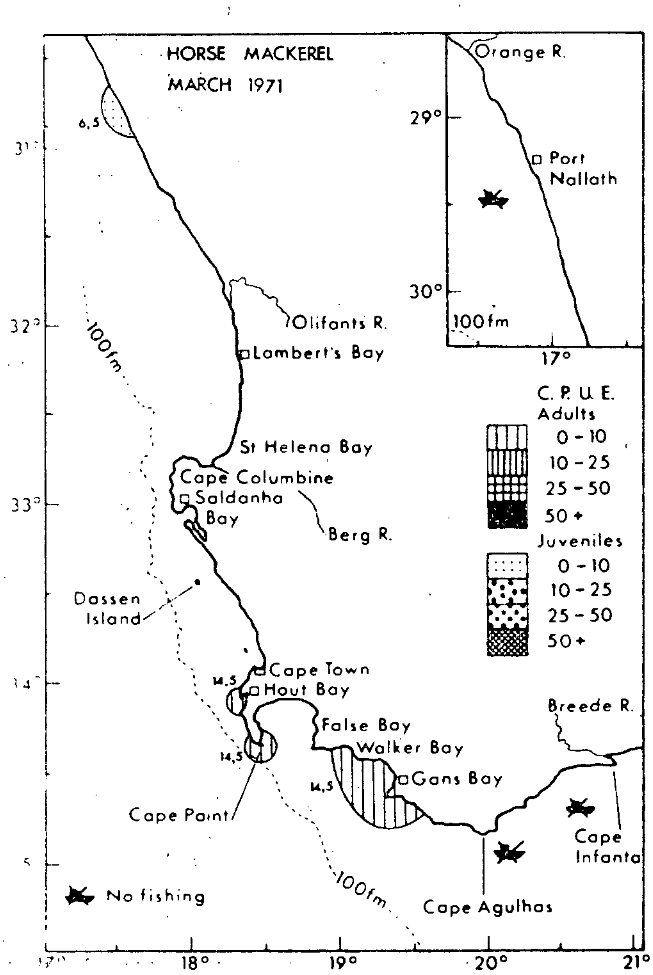
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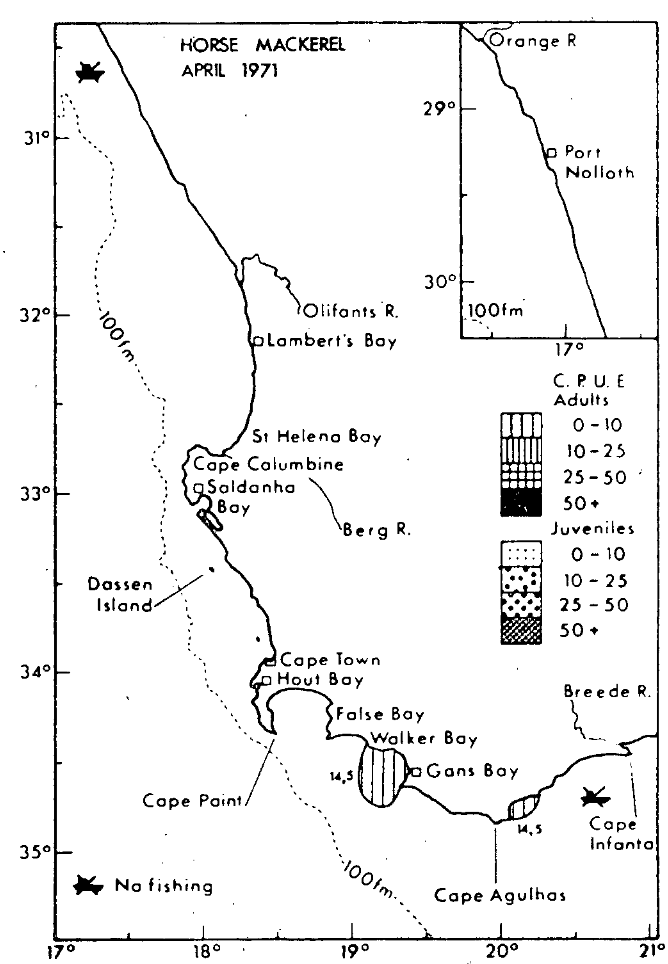
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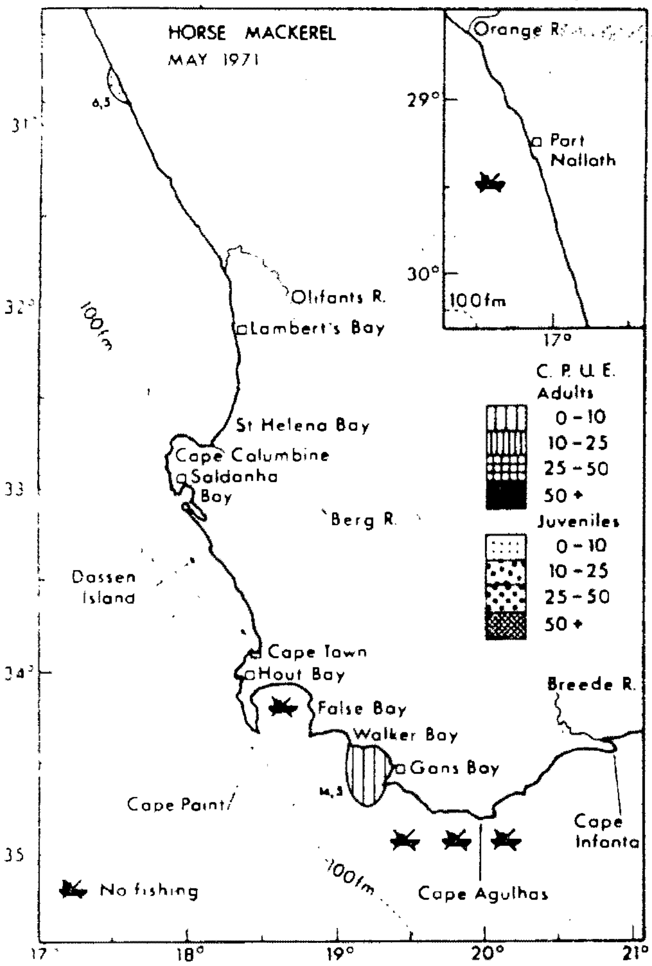
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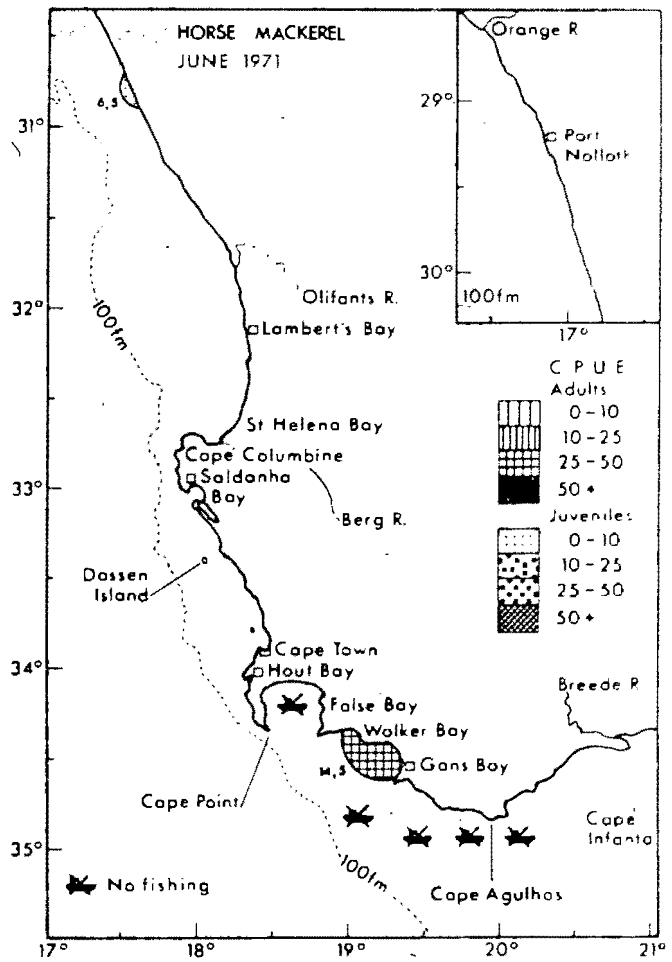
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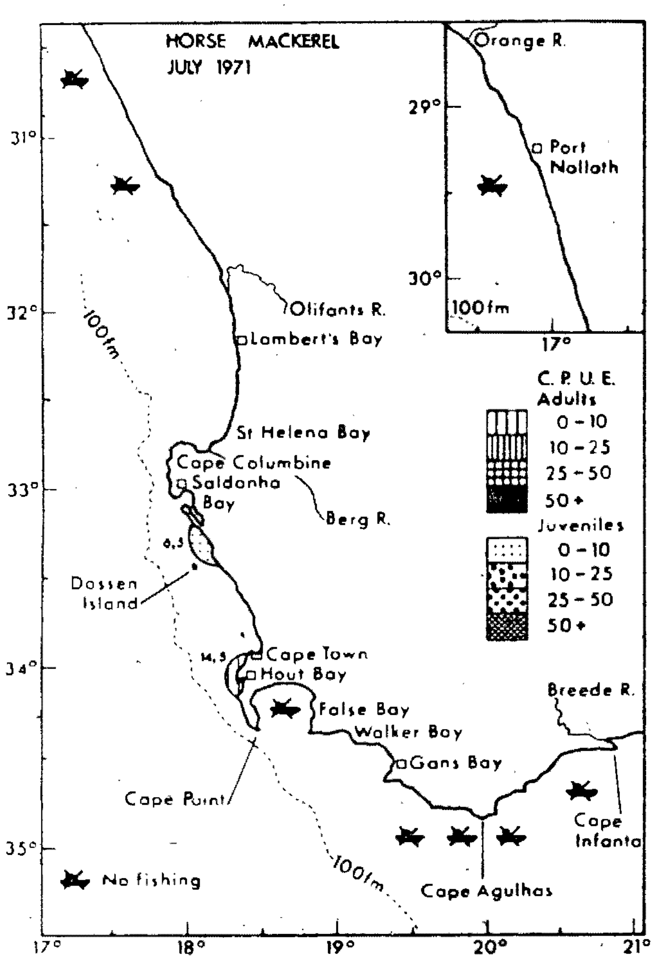
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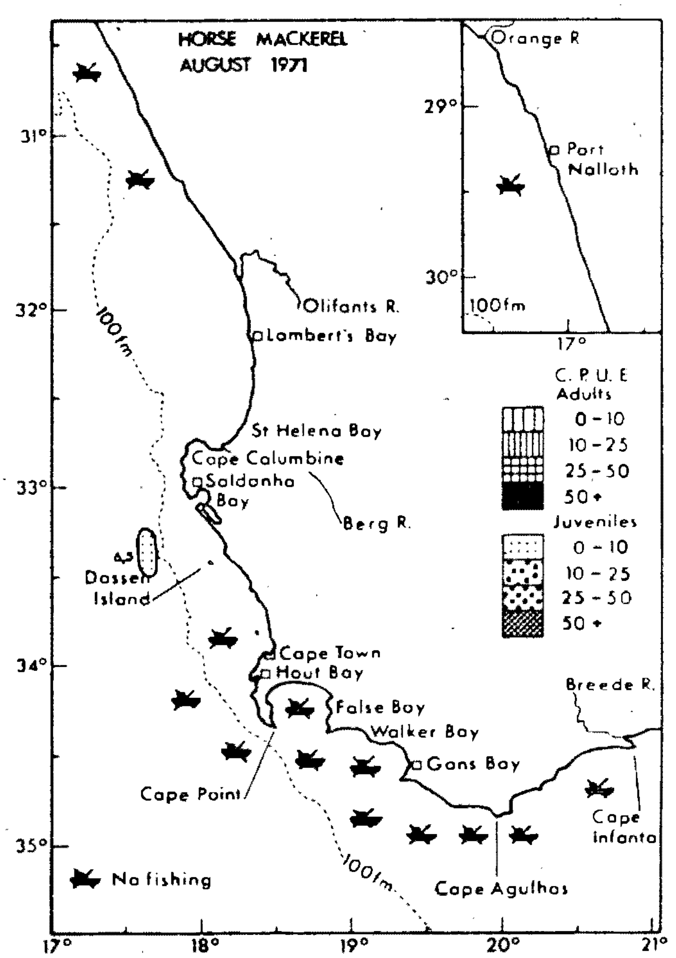
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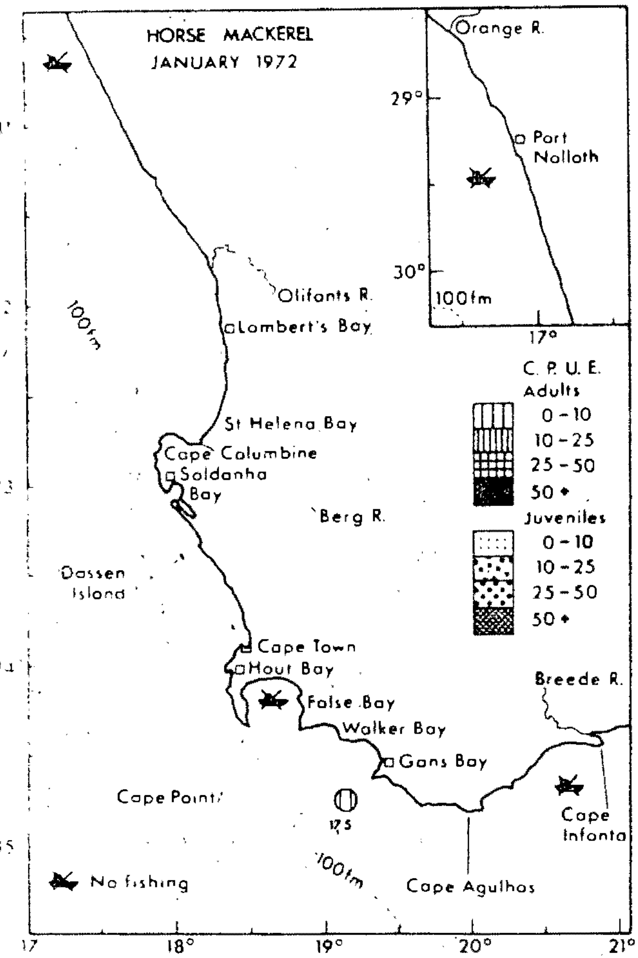
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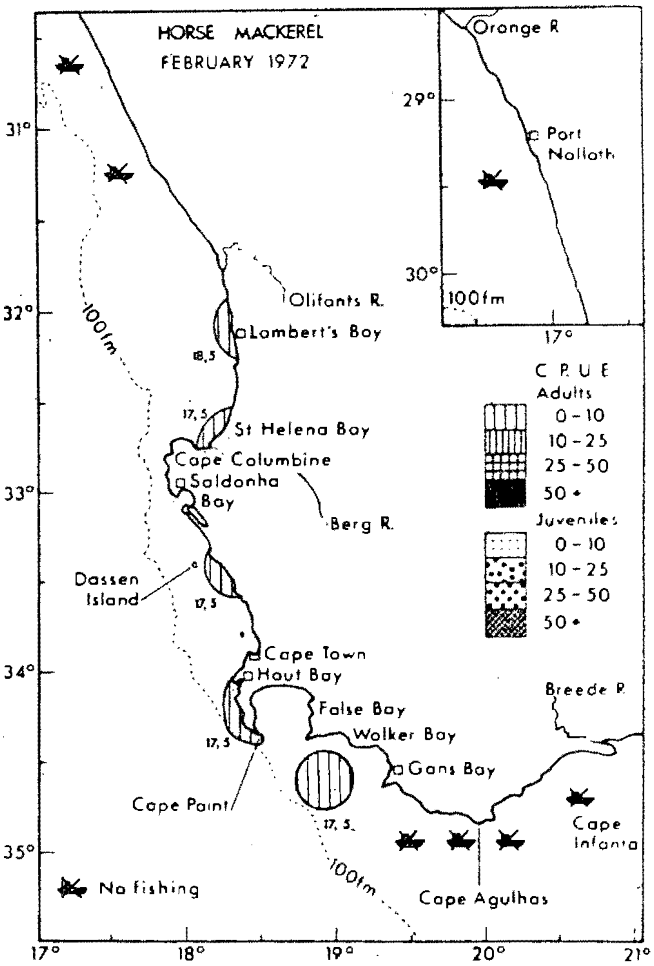
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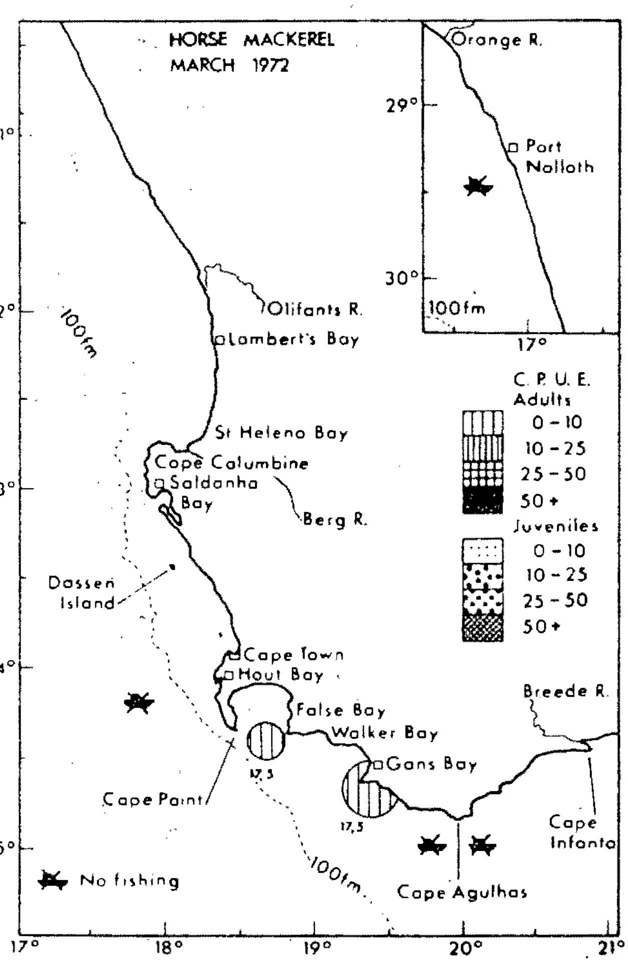
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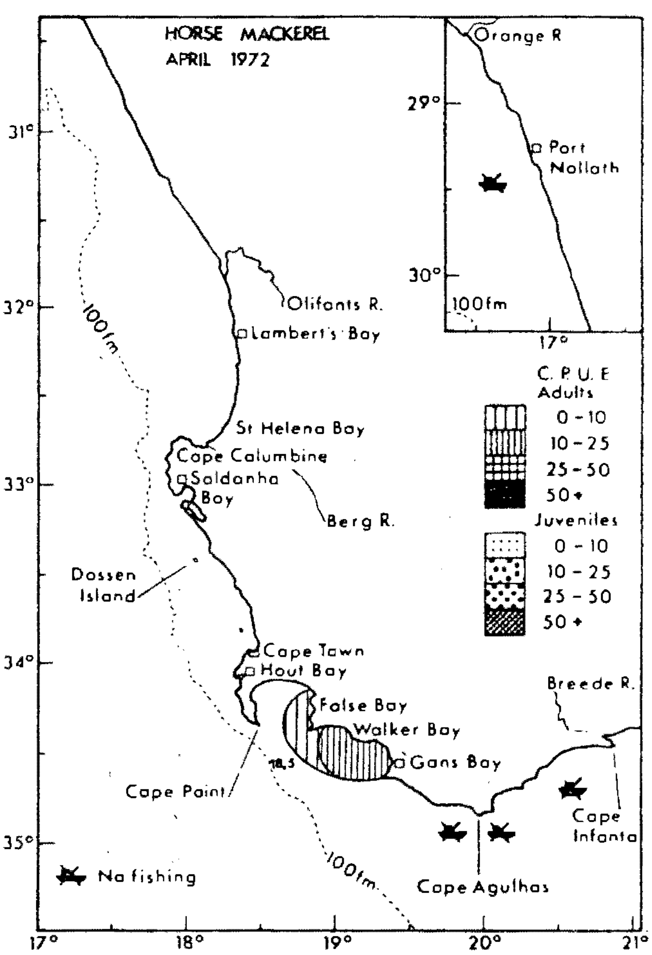
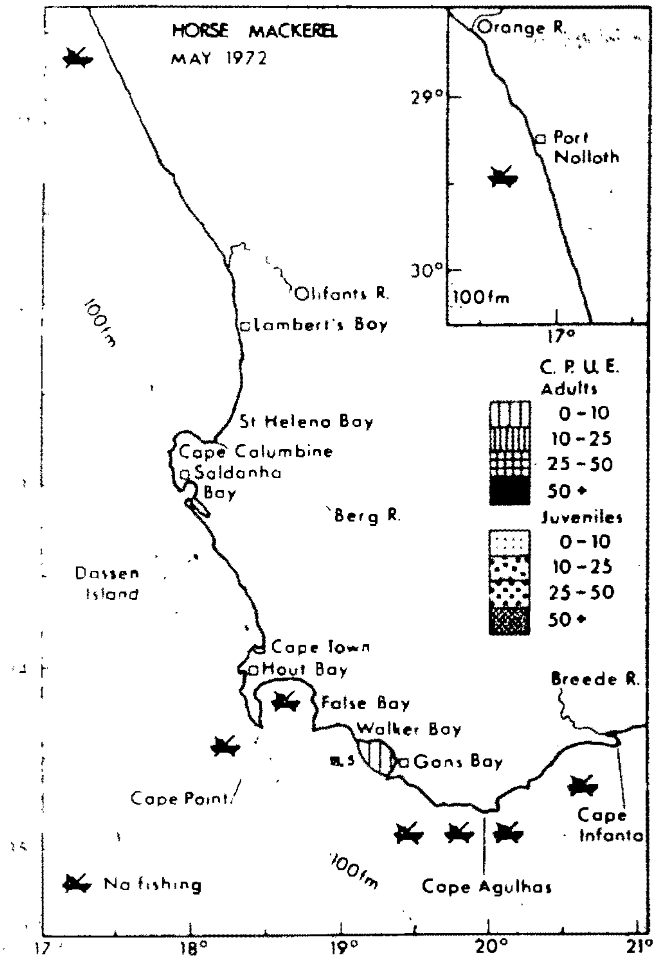
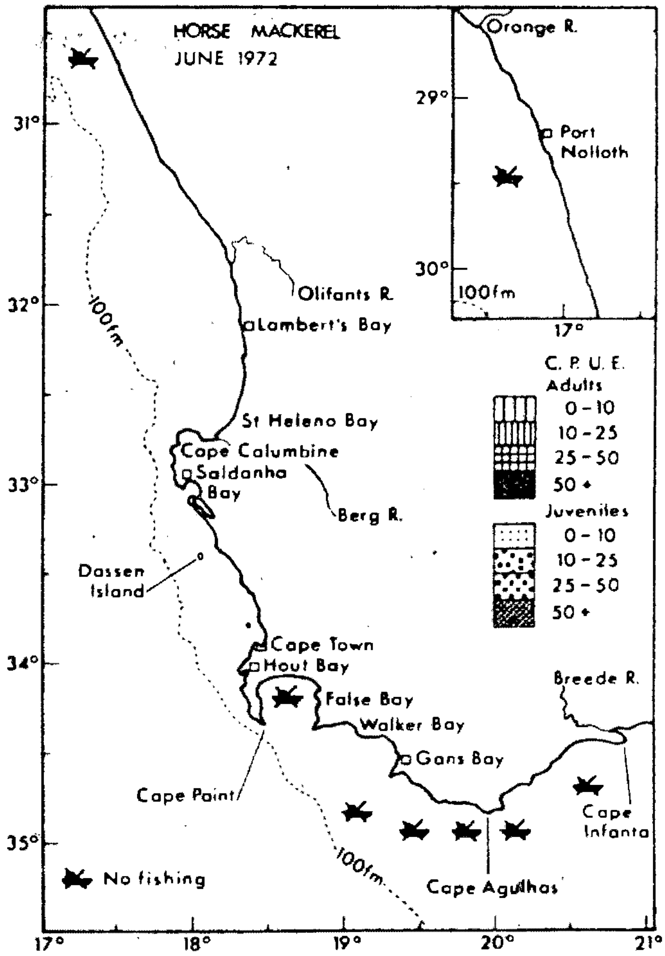
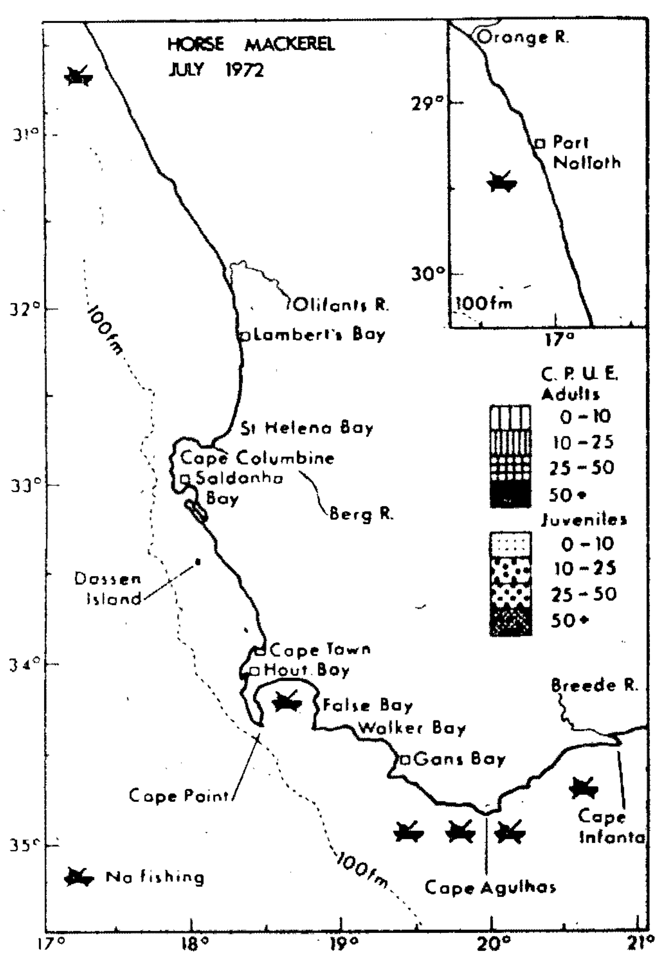
Dassen Island
Cape Town
34°
Hout Bay
Breede R.
False Bay
Walker Bay
Gans Bay
17,5
Cape Point
17,5
Cape Infanta
35°
No fishing
100fm
Cape Agulhas
17°
18°
19°
20°
21°


HORSE MACKEREL
APRIL 1972
Orange R
29°
Port Nolloth
31°
30°
100fm
17°
32°
Olifants R.
Lambert's Bay
100fm
C. P. U. E
Adults
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
33°
Saldanha Bay
Berg R.
Juveniles
0 - 10
10 - 25
25 - 50
50 +
Dassen Island
Cape Town
34°
Hout Bay
Breede R.
False Bay
Walker Bay
18,5
Gans Bay
Cape Point
Cape Infanta
35°
No fishing
100fm
Cape Agulhas
17°
18°
19°
20°
21°


HORSE MACKEREL
MAY 1972
Orange R.
29°
Port Nolloth
30°
100fm
17°
Olifants R.
Lambert's Bay
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
100fm
Cape Agulhas
No fishing
17°
18°
19°
20°
21°


HORSE MACKEREL
JUNE 1972
Orange R.
29°
Port Nolloth
30°
100fm
17°
31°
32°
33°
34°
35°
Olifants R.
Lambert's Bay
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
100fm
Cape Agulhas
No fishing
17°
18°
19°
20°
21°


HORSE MACKEREL
JULY 1972
Orange R.
29°
Port Nolloth
30°
100fm
17°
31°
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35°
Olifants R.
Lambert's Bay
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
100fm
Cape Agulhas
No fishing
17°
18°
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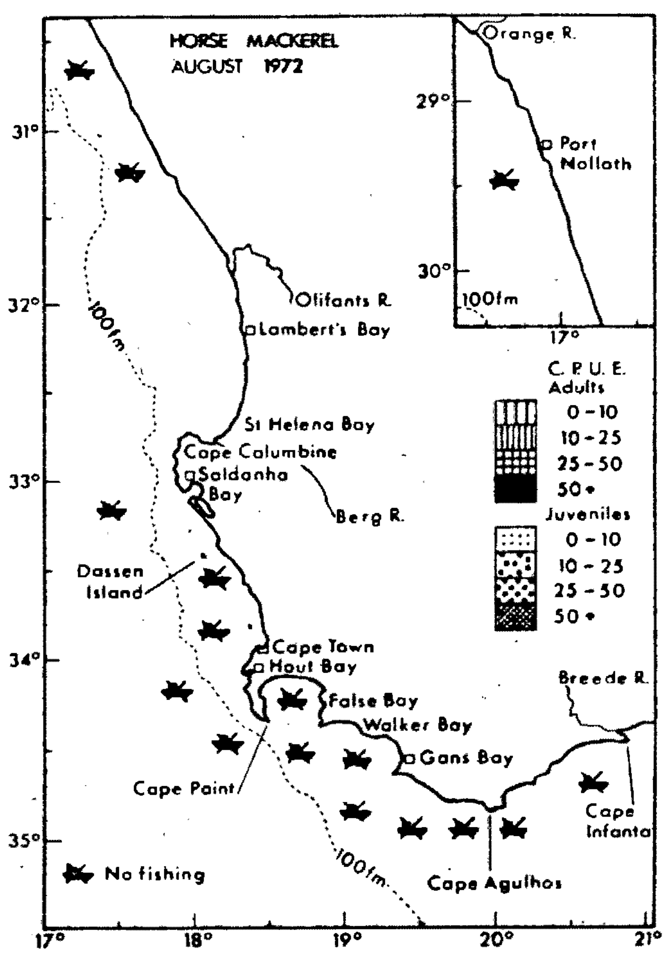
21°


HORSE MACKEREL
AUGUST 1972
Orange R.
29°
Port Nolloth
30°
100fm
17°
31°
32°
33°
34°
35°
Olifants R.
Lambert's Bay
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
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25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
100fm
Cape Agulhas
No fishing
17°
18°
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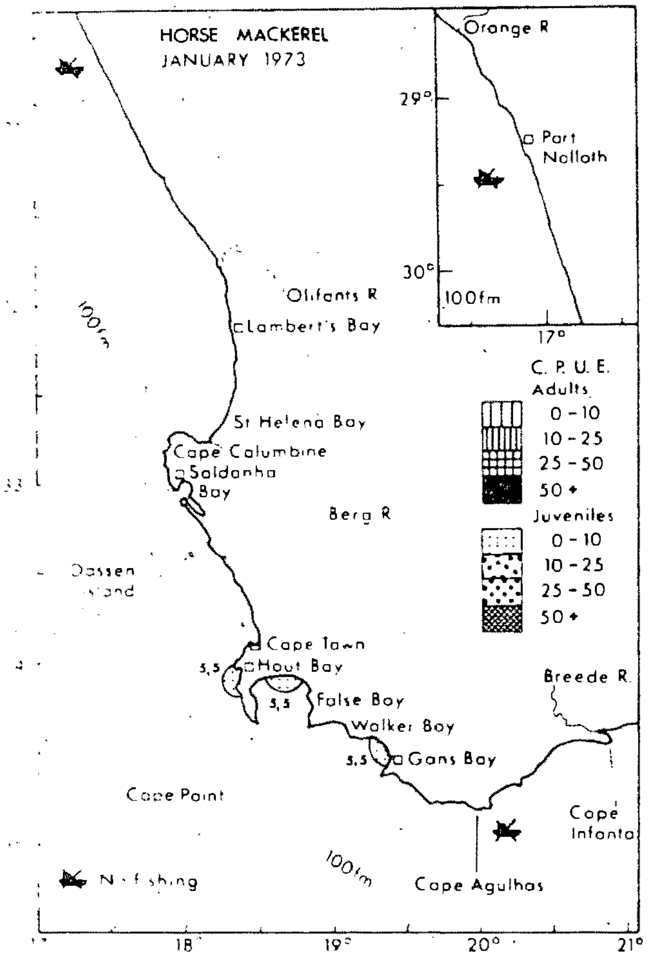
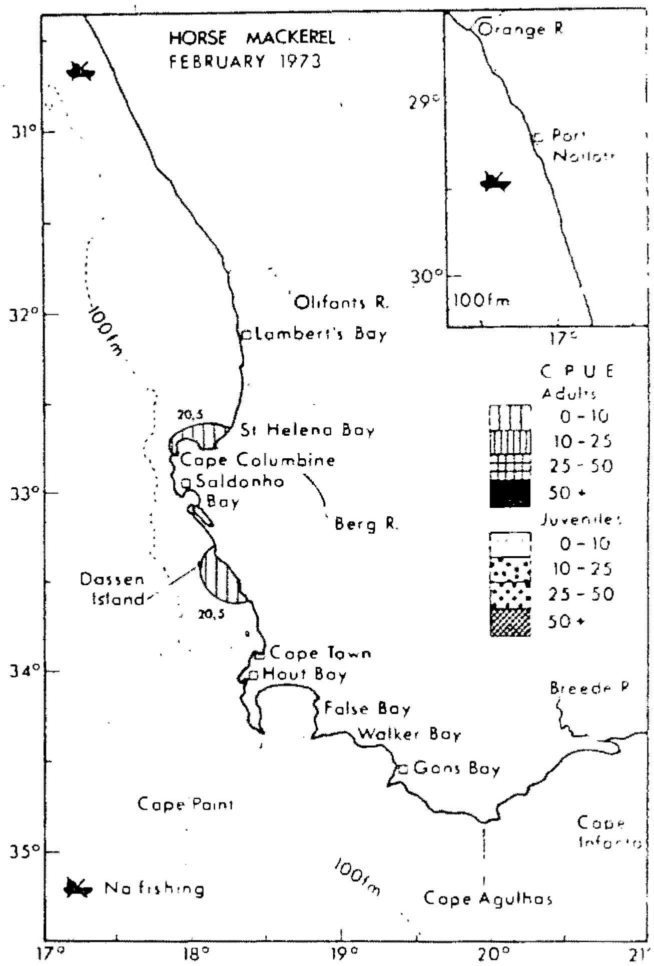

HORSE MACKEREL
JANUARY 1973
Orange R
29°
Port Nolloth
30°
100fm
17°
Olifants R
Lambert's Bay
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R
Dassen Island
Cape Town
Hout Bay
5,5
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
100fm
Cape Agulhas
18°
19°
20°
21°


HORSE MACKEREL
FEBRUARY 1973
Orange R
29°
30°
100fm
17°
31°
Olifants R.
32°
Lambert's Bay
100fm
C P U E
Adults
0 - 10
10 - 25
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50 +
Juveniles
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25 - 50
50 +
20,5
St Helena Bay
Cape Columbine
Saldanha Bay
33°
Berg R.
Dassen Island
20,5
34°
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Cape Point
35°
No fishing
100fm
Cape Agulhas
17°
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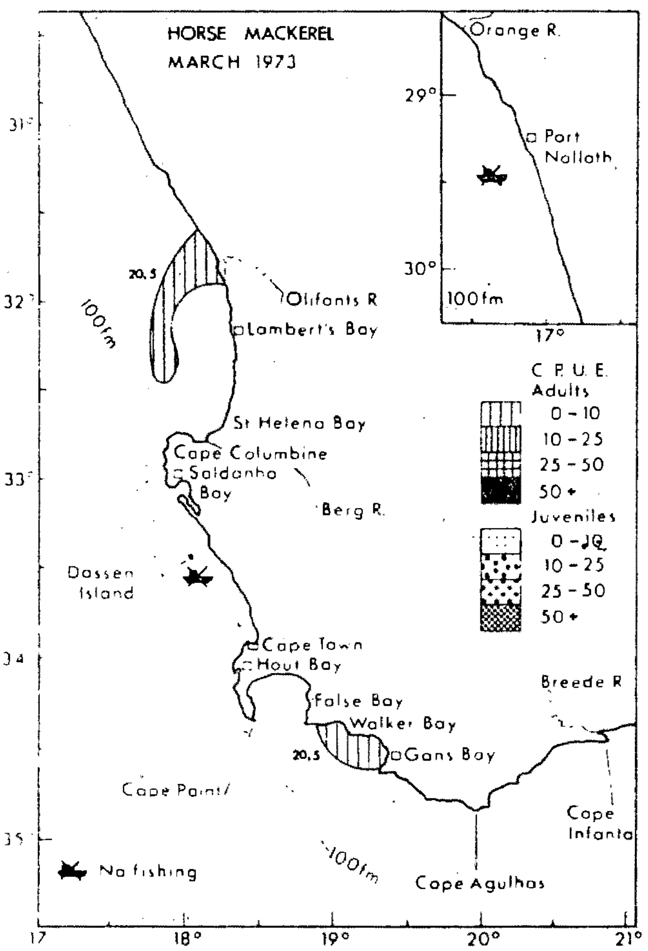
HORSE MACKEREL
MARCH 1973
Orange R.
29°
Port Nolloth
30°
100fm
17°
20,5
Olifants R
Lambert's Bay
100fm
C P U E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
Breede R
False Bay
Walker Bay
20,5
Gans Bay
Cape Point
Cape Infanta
No fishing
100fm
Cape Agulhas
17
18°
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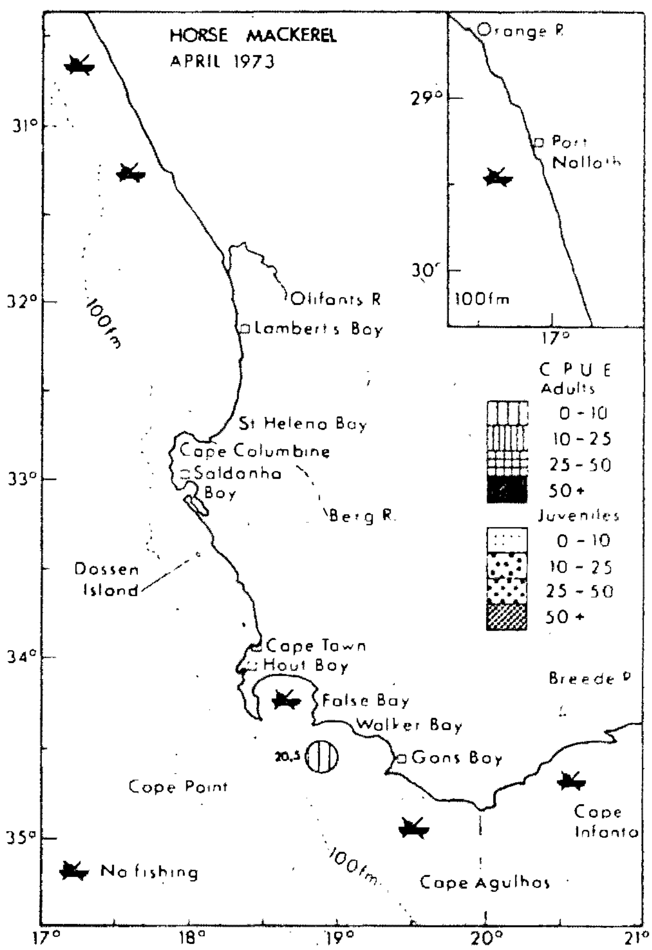
HORSE MACKEREL
APRIL 1973
Orange R
29°
Port Nolloth
30°
100fm
17°
31°
Olifants R
32°
Lambert's Bay
100fm
C P U E
Adults
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10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
33°
Berg R.
Dassen Island
34°
Cape Town
Hout Bay
False Bay
Walker Bay
20,5
Gans Bay
Cape Point
Cape Infanta
35°
No fishing
100fm
Cape Agulhas
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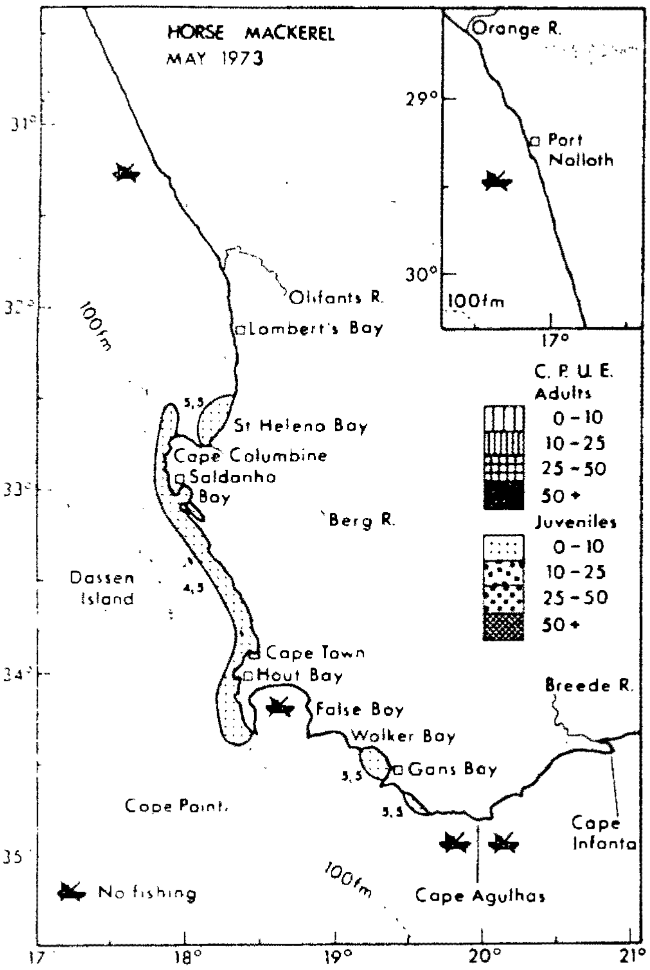
HORSE MACKEREL
MAY 1973
Orange R.
Port Nolloth
29°
30°
100fm
17°
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
31°
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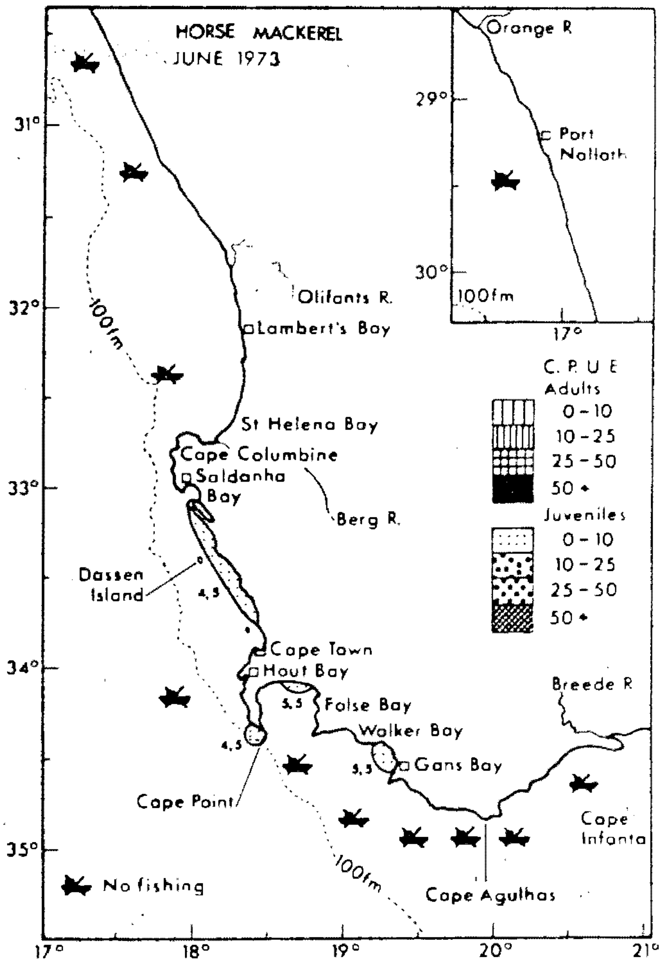
HORSE MACKEREL
JUNE 1973
Orange R
Port Nolloth
29°
30°
100fm
17°
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
31°
32°
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35°
17°
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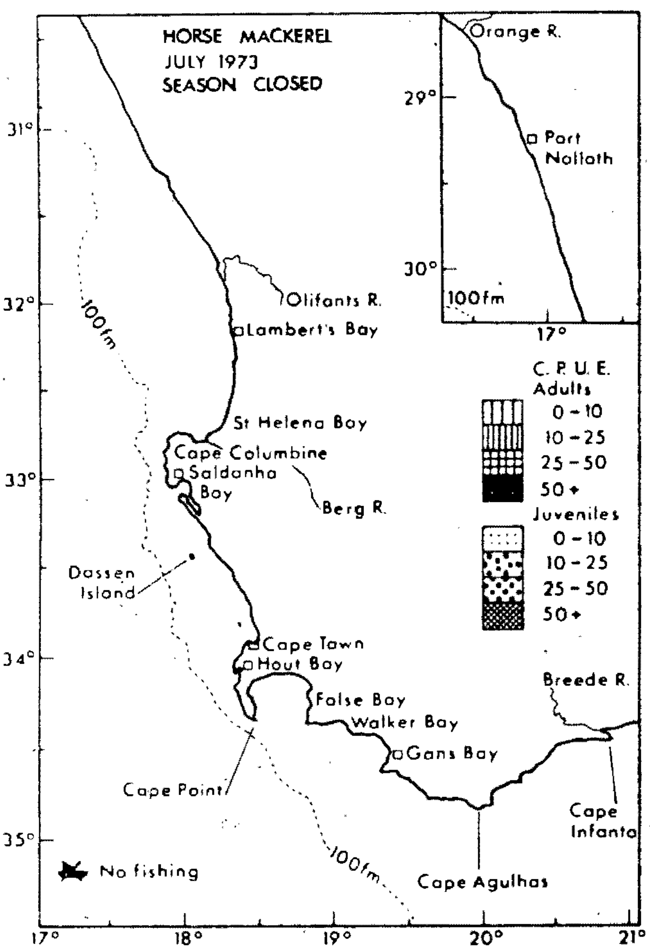
21°


HORSE MACKEREL
JULY 1973
SEASON CLOSED
Orange R.
Port Nolloth
29°
30°
100fm
17°
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
31°
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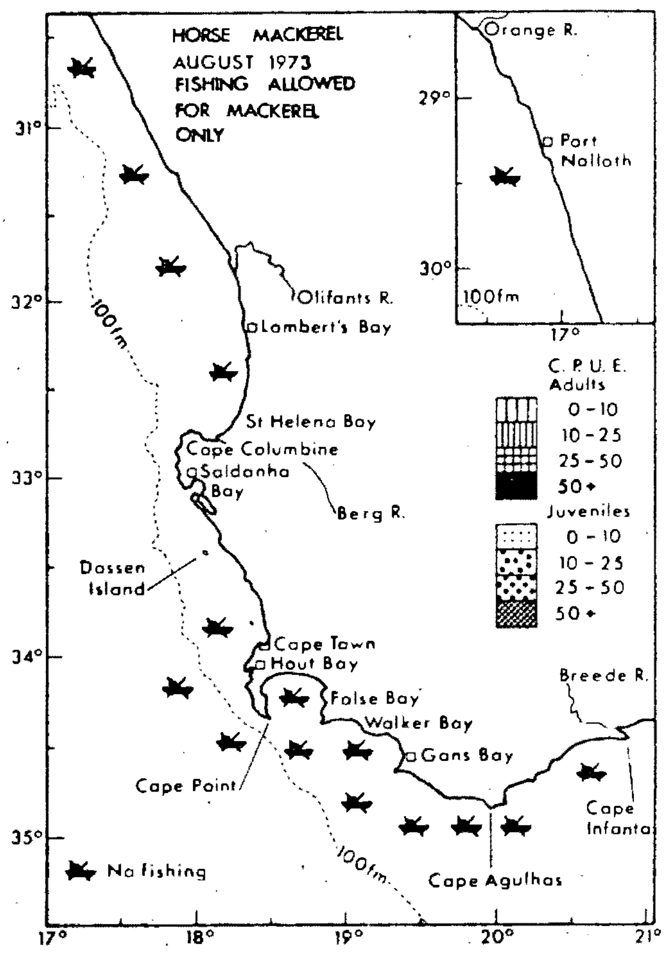
21°


HORSE MACKEREL
AUGUST 1973
FISHING ALLOWED
FOR MACKEREL
ONLY
Orange R.
Port Nolloth
29°
30°
100fm
17°
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
31°
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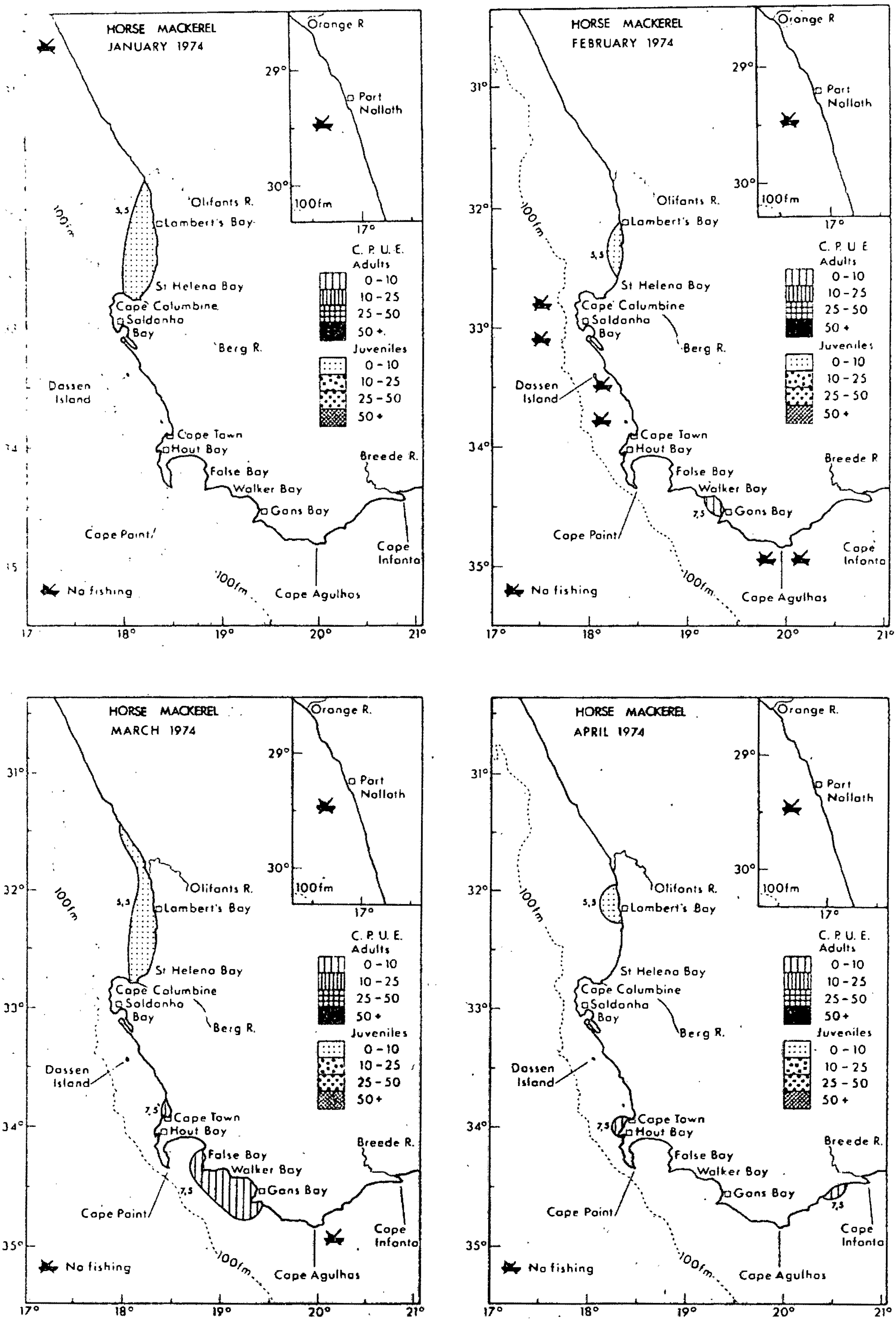
HORSE MACKEREL
JANUARY 1974
FEBRUARY 1974
MARCH 1974
APRIL 1974
Orange R
Port Nolloth
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
5,5
7,5
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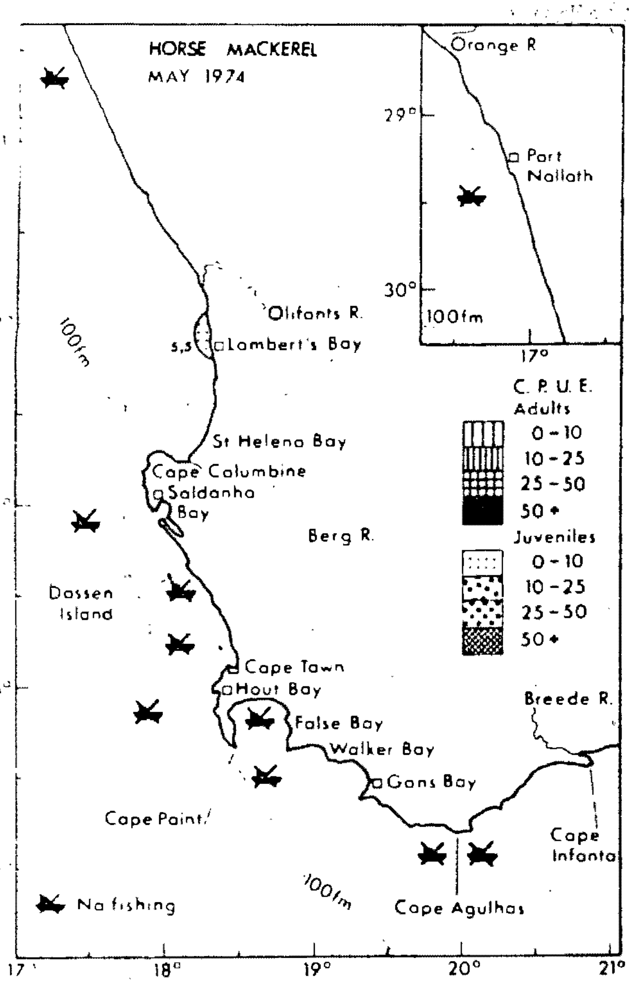
35°


HORSE MACKEREL
MAY 1974
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29°
Port
Nollath
30°
100fm
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33°
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Olifants R.
5,5
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha
Bay
Berg R.
Dassen
Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape
Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
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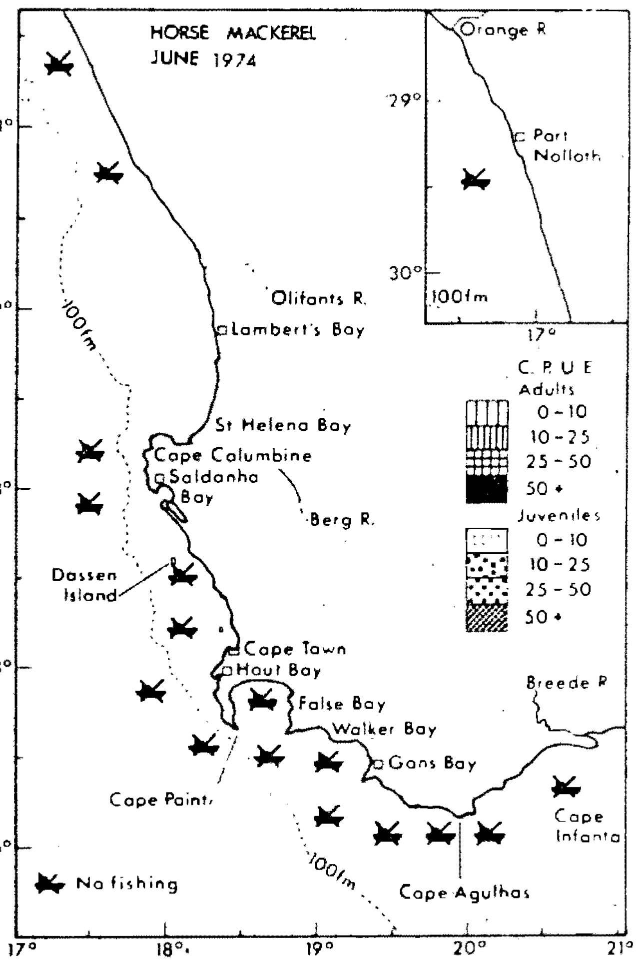
HORSE MACKEREL
JUNE 1974
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Port
Nolloth
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100fm
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35°
Olifants R.
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha
Bay
Berg R.
Dassen
Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape
Infanta
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100fm
No fishing
C. P. U. E.
Adults
0 - 10
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25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
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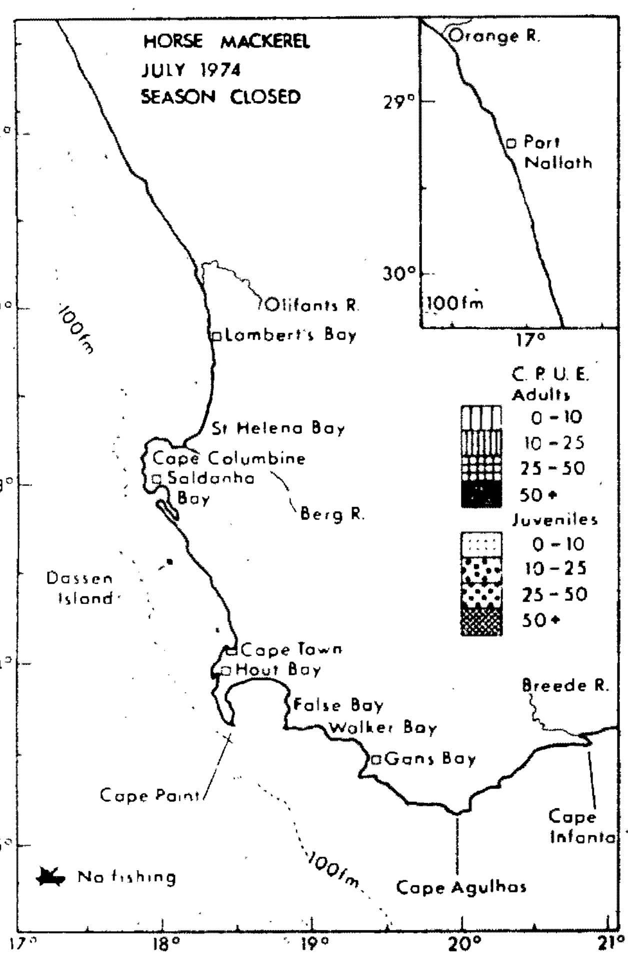
HORSE MACKEREL
JULY 1974
SEASON CLOSED
Orange R.
29°
Port
Nollath
30°
100fm
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35°
Olifants R.
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha
Bay
Berg R.
Dassen
Island
Cape Town
Hout Bay
False Bay
Walker Bay
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Breede R.
Cape Point
Cape
Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
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50 +
Juveniles
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50 +
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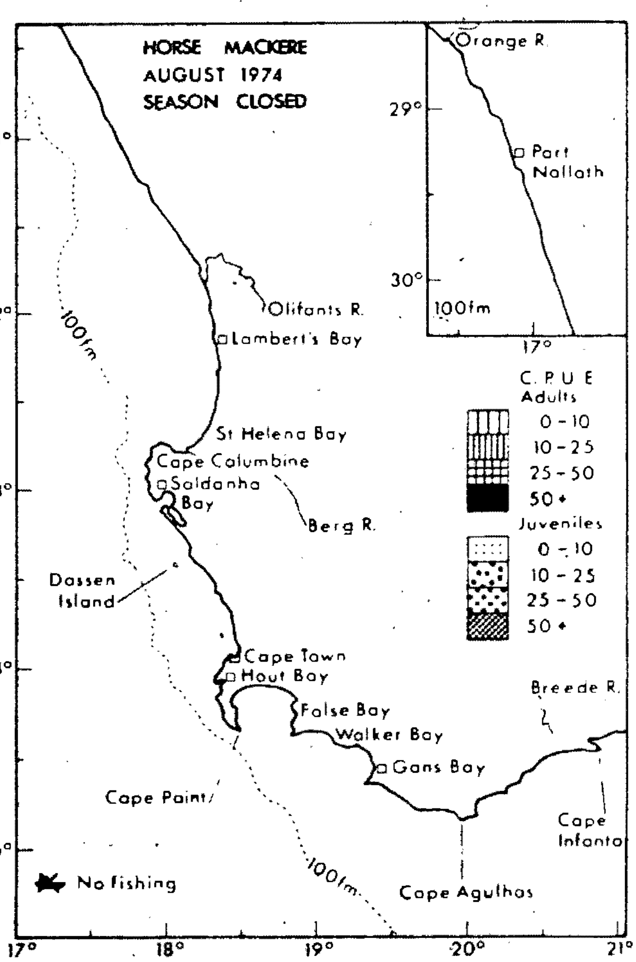
HORSE MACKERE
AUGUST 1974
SEASON CLOSED
Orange R.
29°
Port
Nolloth
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100fm
17°
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35°
Olifants R.
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha
Bay
Berg R.
Dassen
Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape
Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
0 - 10
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Juveniles
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50 +
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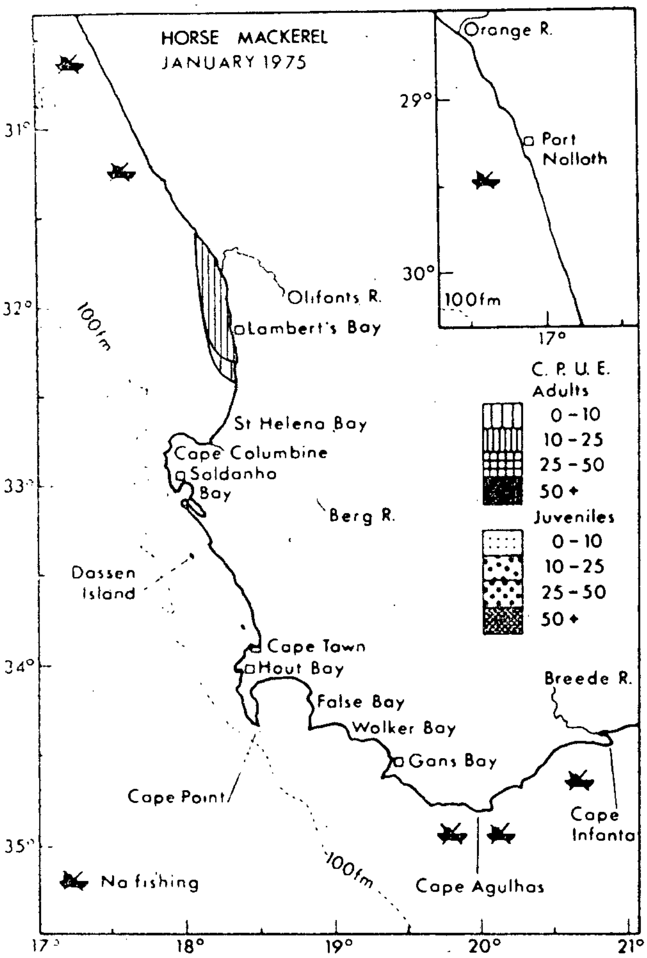
HORSE MACKEREL
JANUARY 1975
Orange R.
29°
Port Nolloth
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100fm
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100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dossen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
0 - 10
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Juveniles
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25 - 50
50 +
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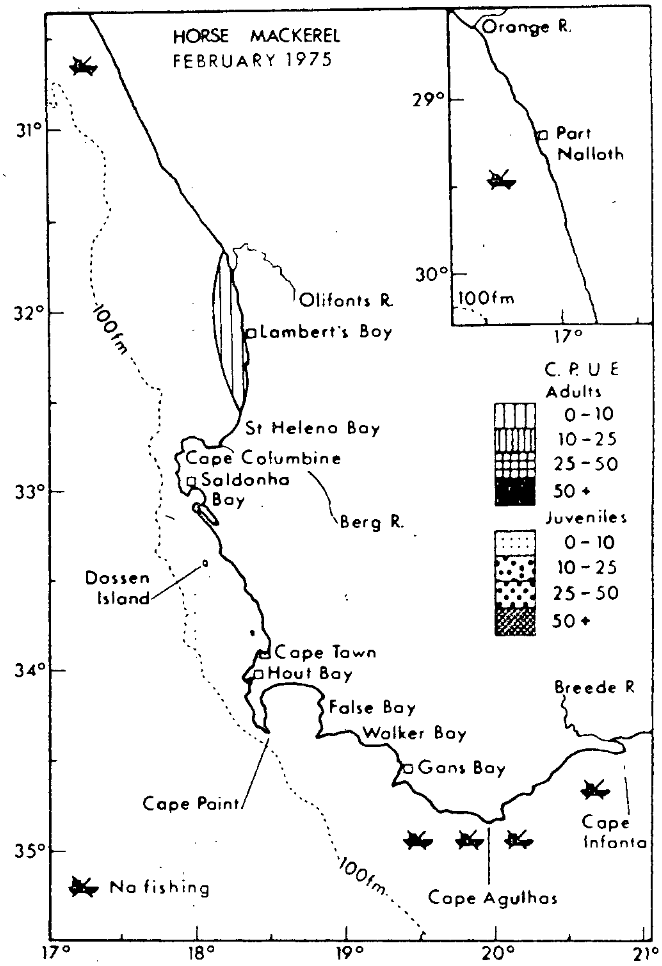
HORSE MACKEREL
FEBRUARY 1975
Orange R.
29°
Port Nolloth
30°
100fm
17°
31°
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34°
35°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
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Cape Town
Hout Bay
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Gans Bay
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No fishing
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Adults
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Juveniles
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50 +
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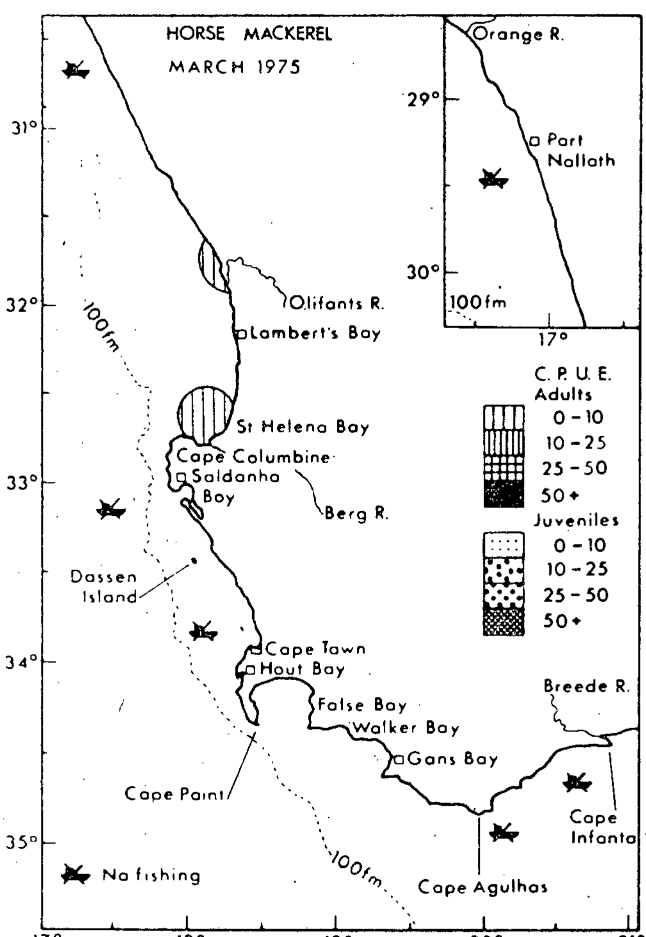
HORSE MACKEREL
MARCH 1975
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Port Nolloth
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100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
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Dassen Island
Cape Town
Hout Bay
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Gans Bay
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Cape Point
Cape Infanta
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100fm
No fishing
C. P. U. E.
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Juveniles
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25 - 50
50 +
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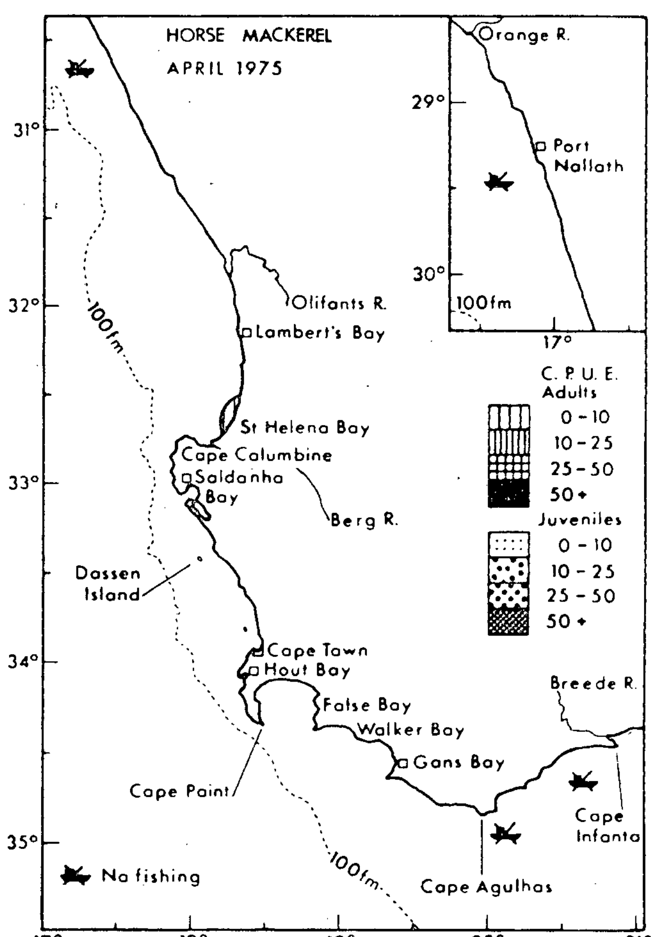
HORSE MACKEREL
APRIL 1975
Orange R.
29°
Port Nolloth
30°
100fm
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100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
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Juveniles
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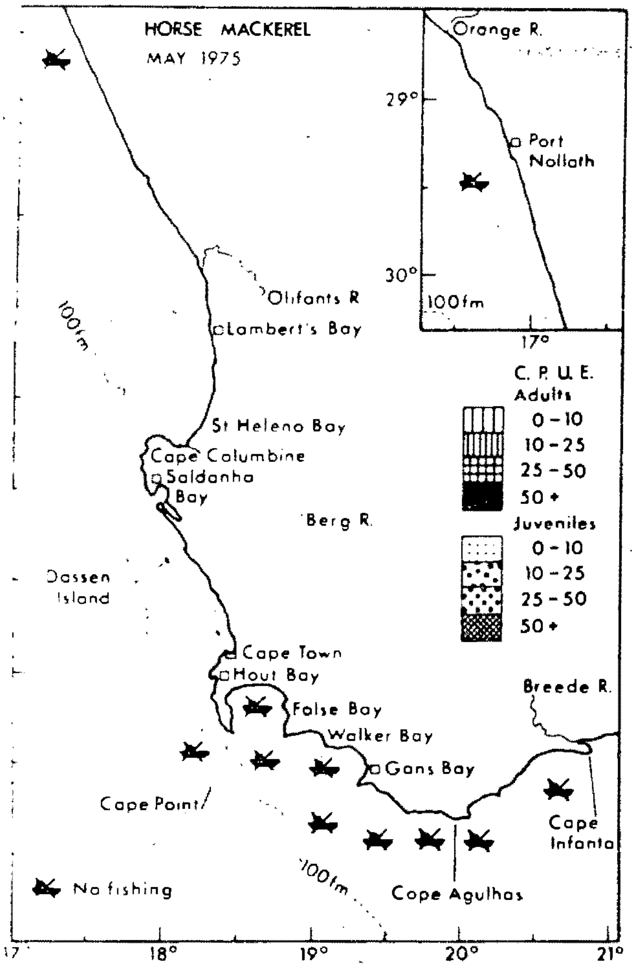
HORSE MACKEREL
MAY 1975
Orange R.
29°
Port Nolloth
30°
100fm
17°
Olifants R
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
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Cape Infanta
Cape Agulhas
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50 +
Juveniles
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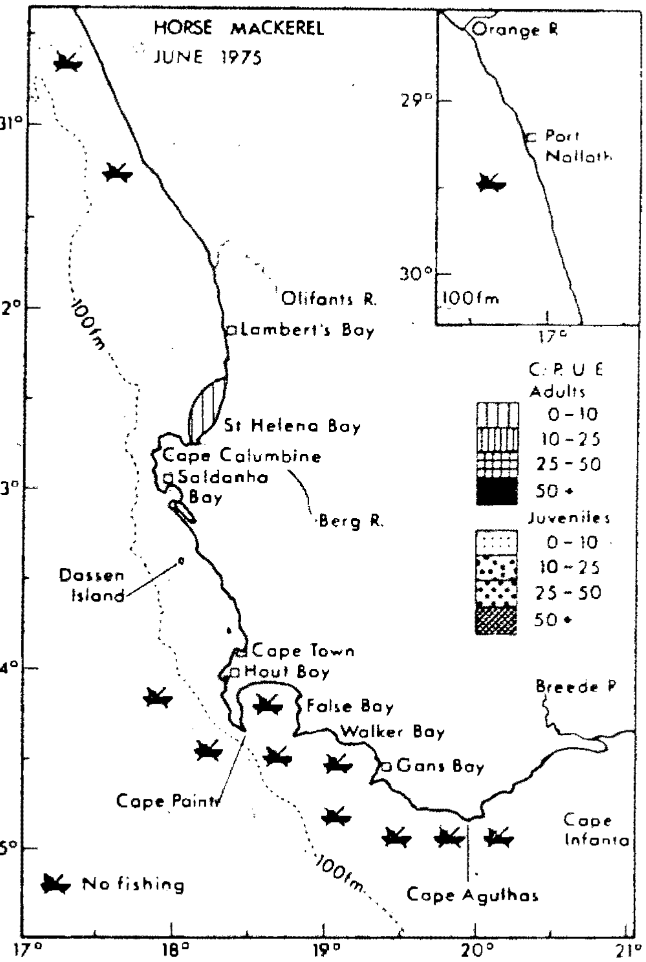
HORSE MACKEREL
JUNE 1975
Orange R
29°
Port Nolloth
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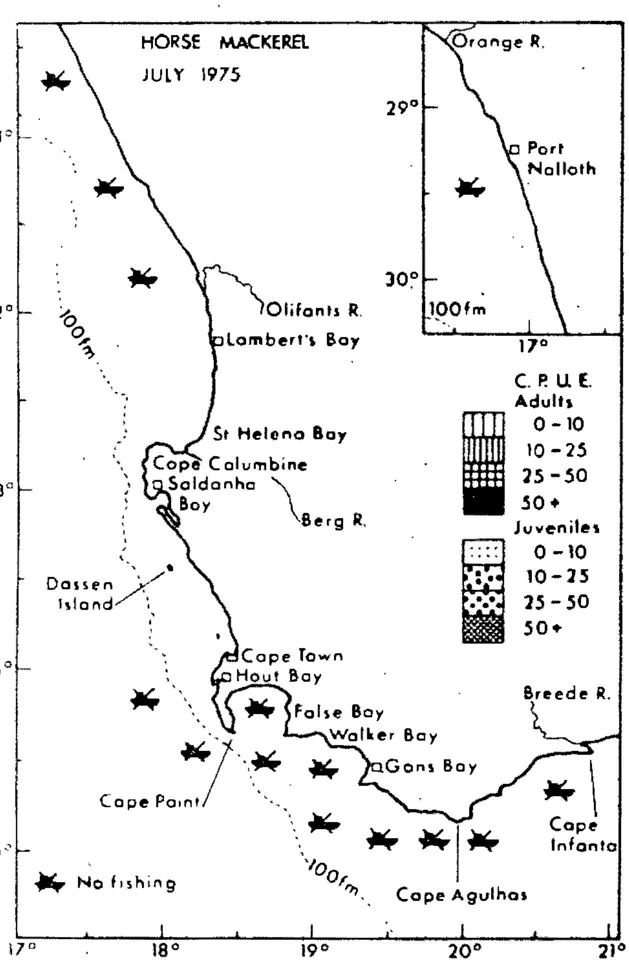
Olifants R.
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
19°
20°
21°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JULY 1975
Orange R.
29°
Port Nolloth
30°
100fm
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32°
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34°
35°
Olifants R.
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm.
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
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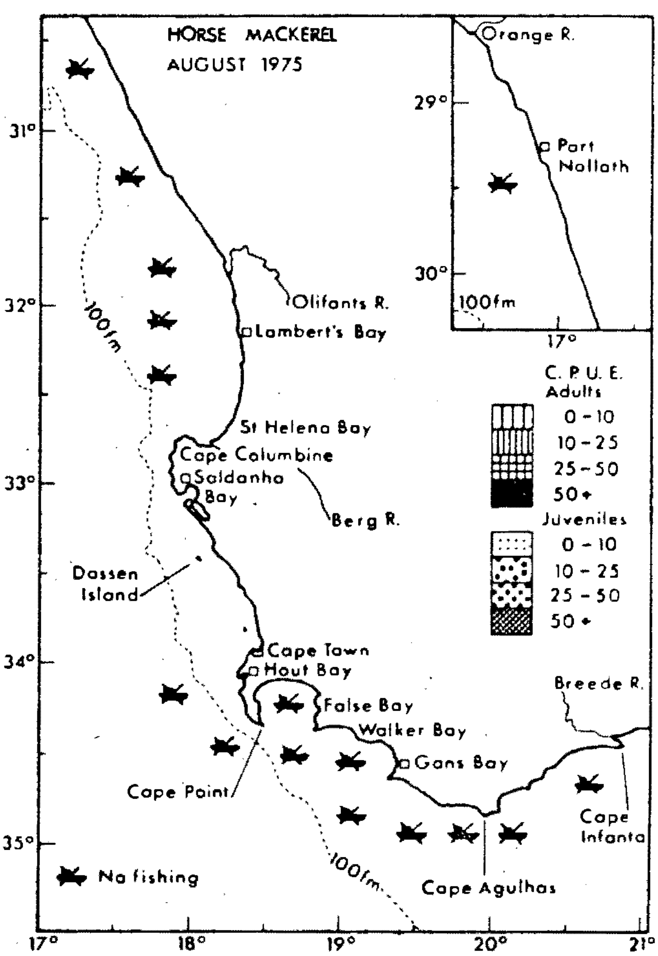
HORSE MACKEREL
AUGUST 1975
Orange R.
29°
Port Nolloth
30°
100fm
17°
31°
32°
33°
34°
35°
Olifants R.
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm.
No fishing
C. P. U. E.
Adults
0 - 10
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25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
19°
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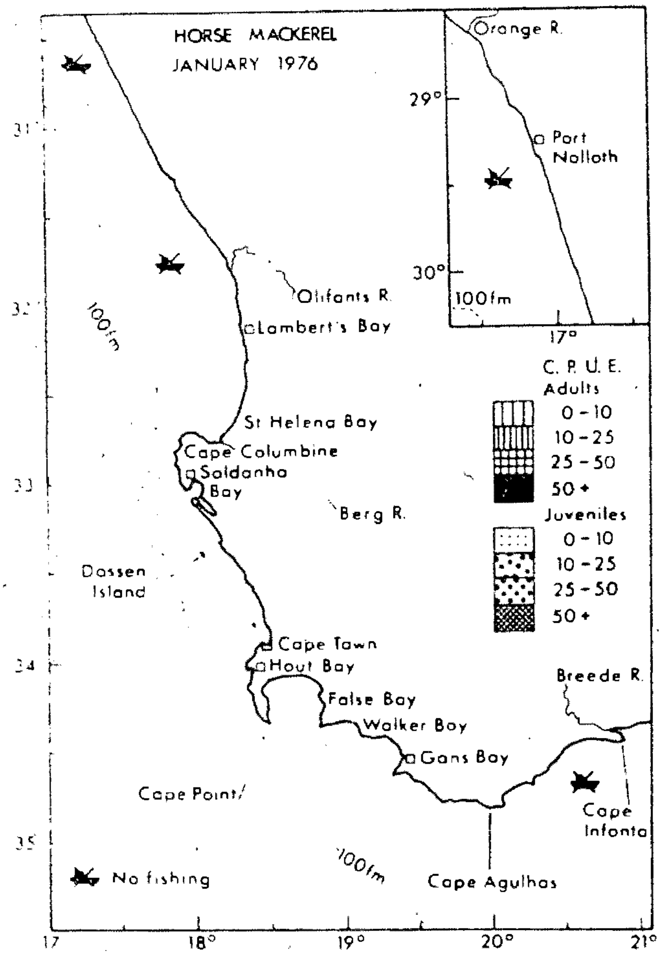
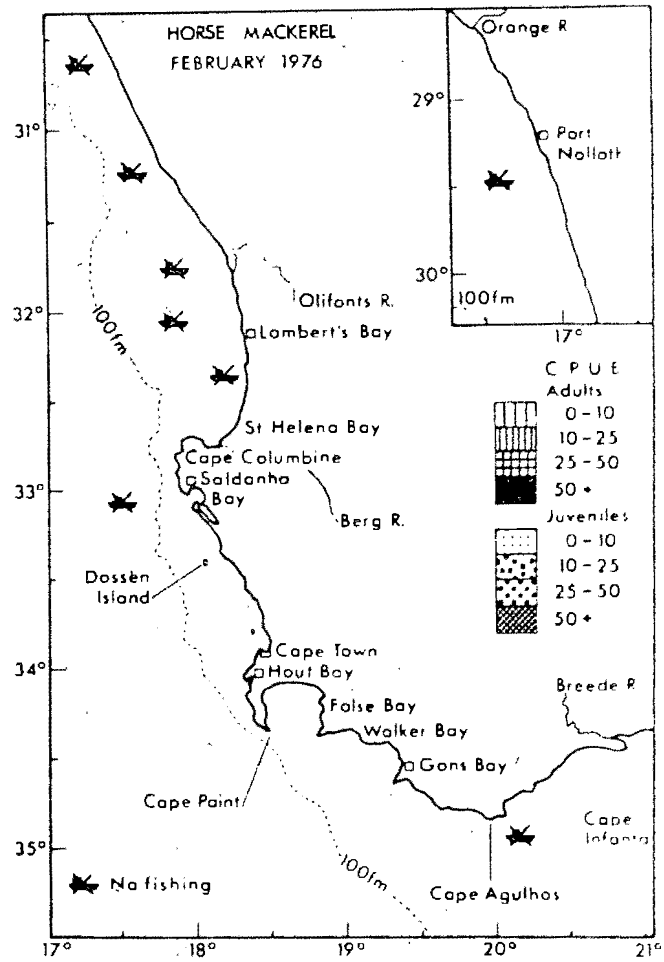

HORSE MACKEREL
JANUARY 1976
Orange R.
29°
Port Nolloth
30°
100fm
17°
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
Olifants R.
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
17
18°
19°
20°
21°


HORSE MACKEREL
FEBRUARY 1976
Orange R
29°
Port Nolloth
30°
100fm
17°
C P U E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
31°
32°
33°
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35°
Olifants R.
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
17°
18°
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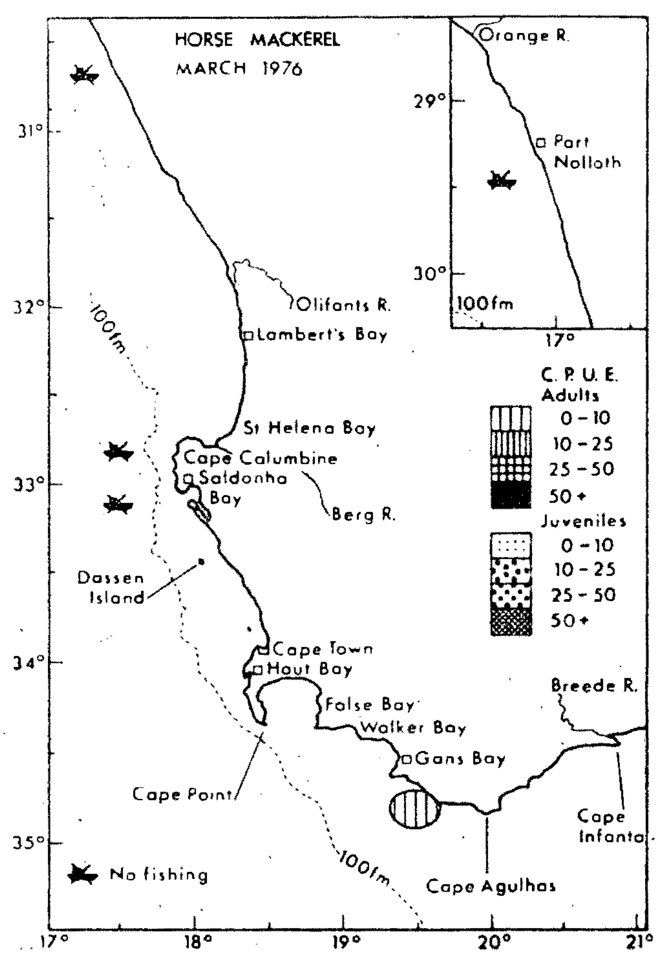
HORSE MACKEREL
MARCH 1976
Orange R.
29°
Port Nolloth
30°
100fm
17°
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
31°
32°
33°
34°
35°
Olifants R.
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
17°
18°
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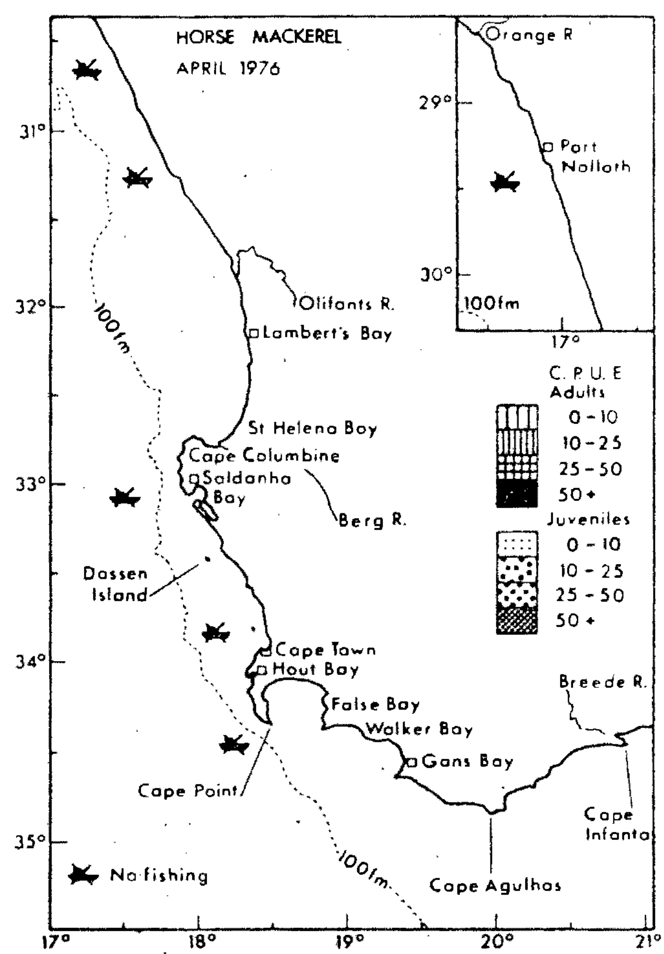
HORSE MACKEREL
APRIL 1976
Orange R
29°
Port Nolloth
30°
100fm
17°
C. P. U. E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
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25 - 50
50 +
31°
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Olifants R.
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
17°
18°
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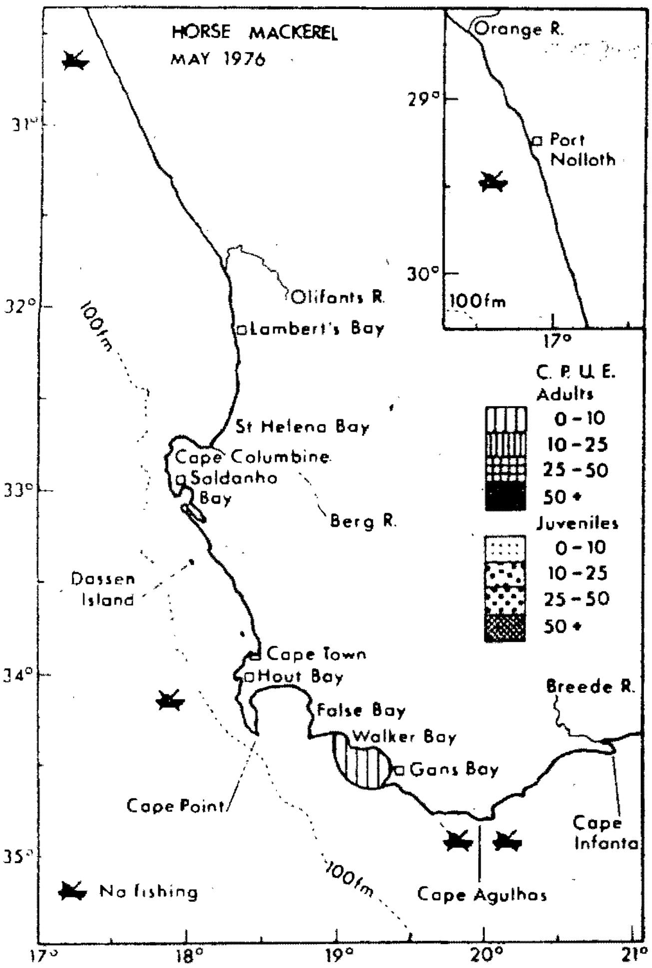
20°
21°


HORSE MACKEREL
MAY 1976
Orange R.
Port Nolloth
100fm
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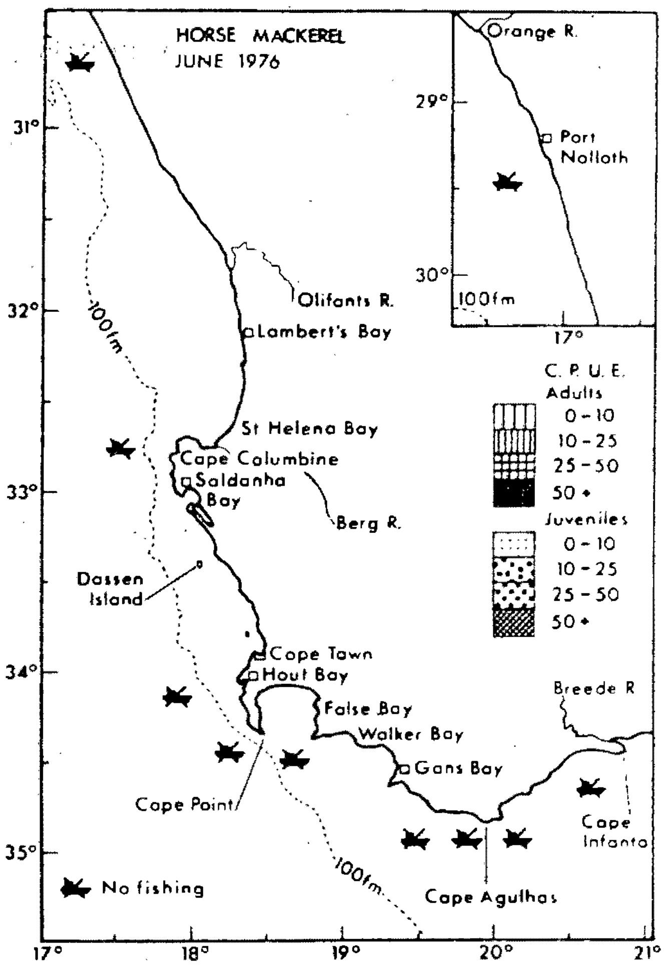
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +


HORSE MACKEREL
JUNE 1976
Orange R.
Port Nolloth
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Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
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25 - 50
50 +
Juveniles
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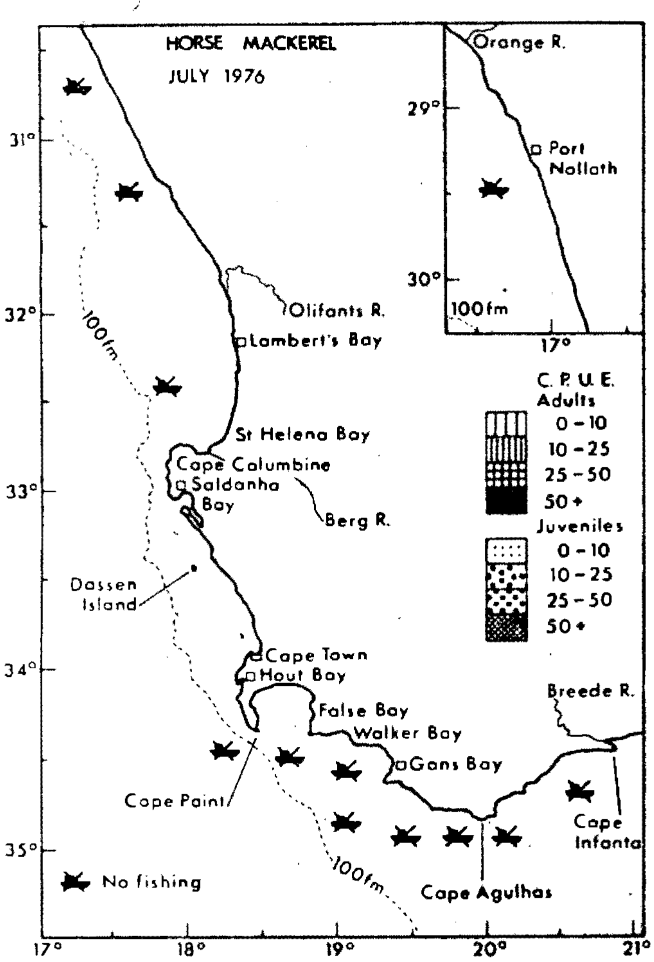
10 - 25
25 - 50
50 +


HORSE MACKEREL
JULY 1976
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
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10 - 25
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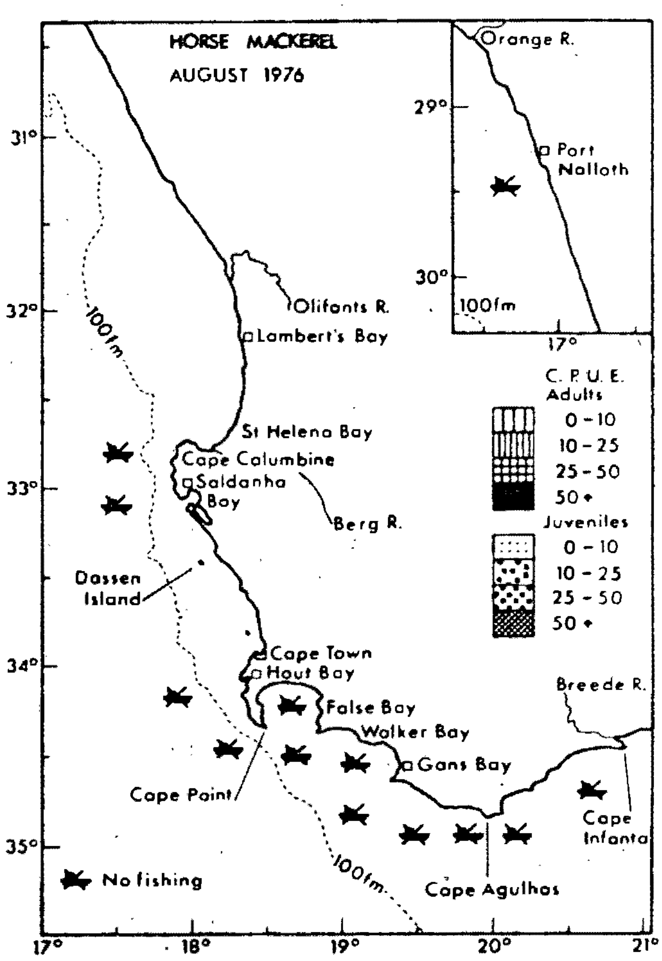
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +


HORSE MACKEREL
AUGUST 1976
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
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Adults
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50 +
Juveniles
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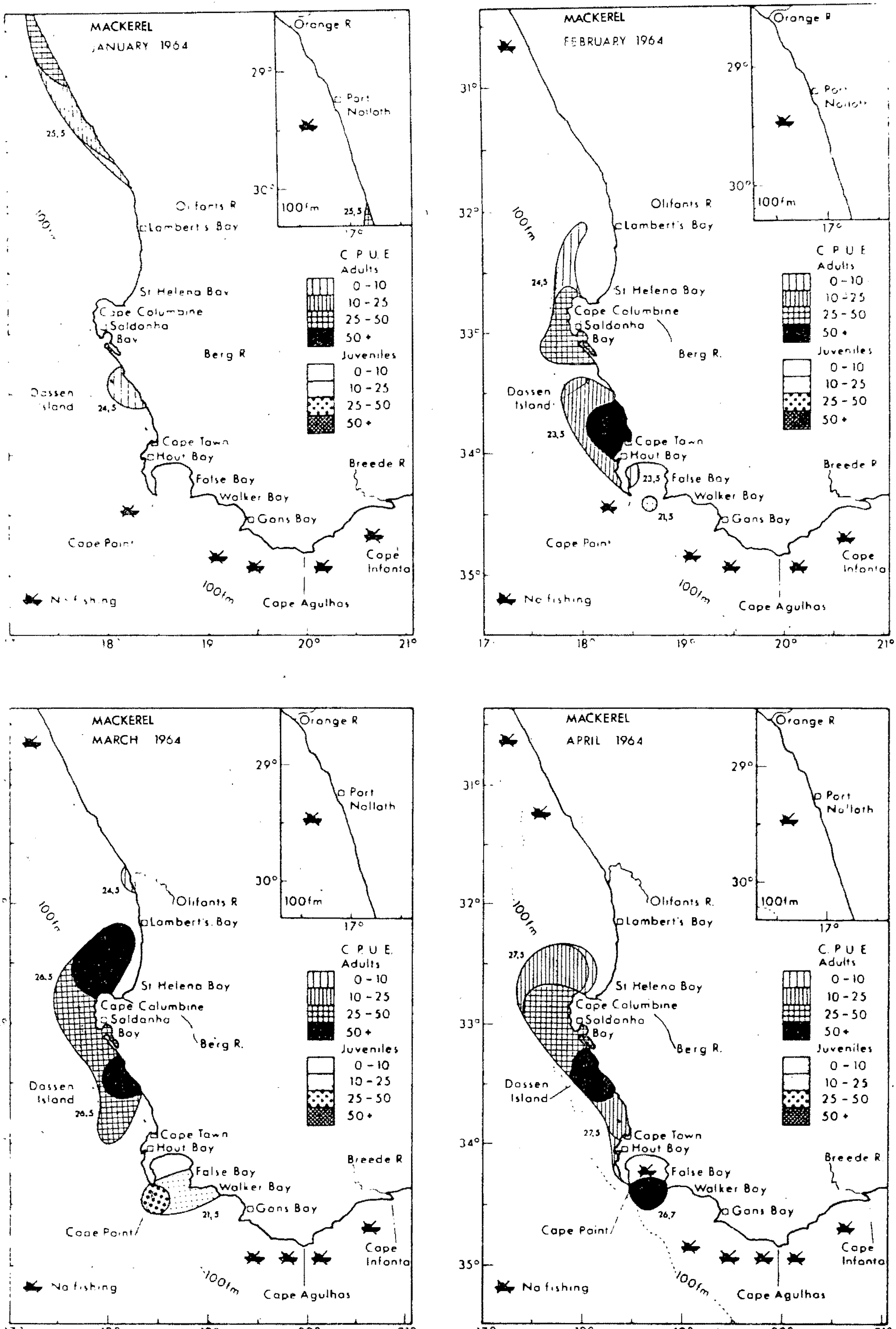
10 - 25
25 - 50
50 +


MACKEREL
JANUARY 1964
Orange R
Port Nolloth
100fm
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C P U E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
MACKEREL
FEBRUARY 1964
MACKEREL
MARCH 1964
MACKEREL
APRIL 1964
17°
18°
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31°
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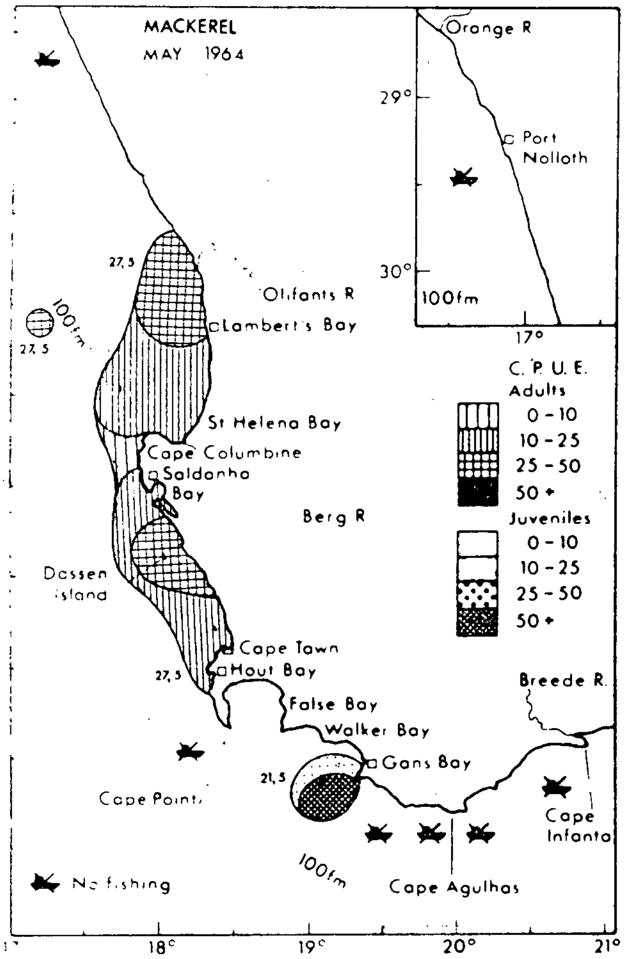
MACKEREL
MAY 1964
Orange R
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Port Nolloth
30°
100fm
17°
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
27,5
21,5
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
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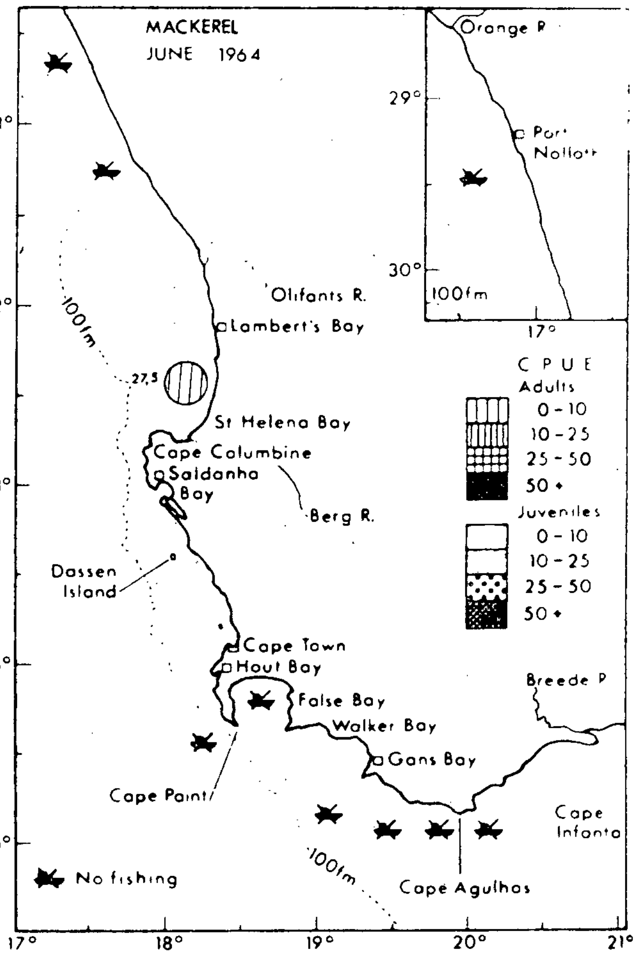
10 - 25
25 - 50
50 +
No fishing
18°
19°
20°
21°


MACKEREL
JUNE 1964
Orange R
29°
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100fm
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31°
32°
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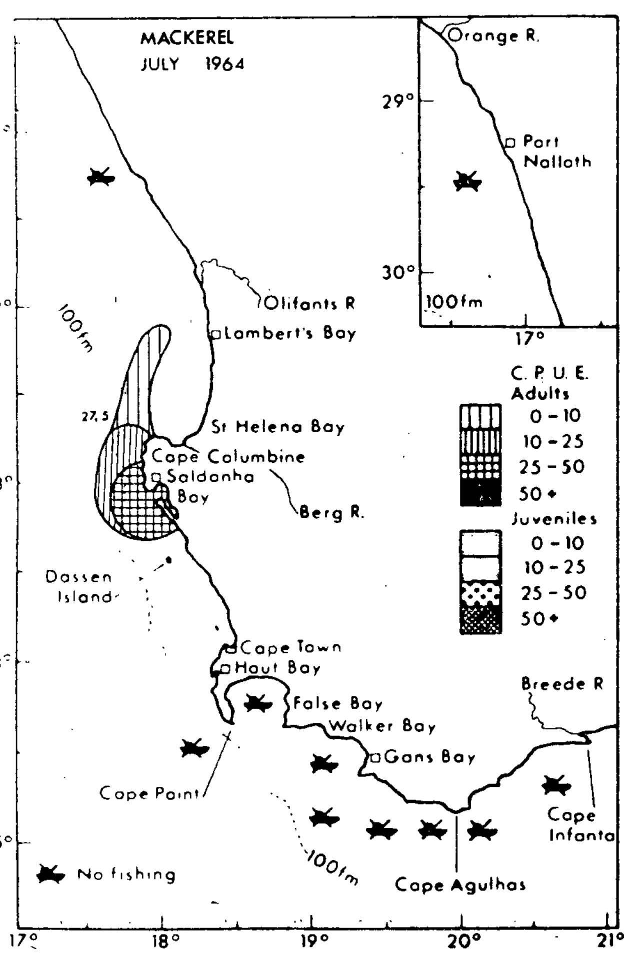
35°
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
27,5
100fm
C P U E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
No fishing
17°
18°
19°
20°
21°


MACKEREL
JULY 1964
Orange R.
29°
Port Nolloth
30°
100fm
17°
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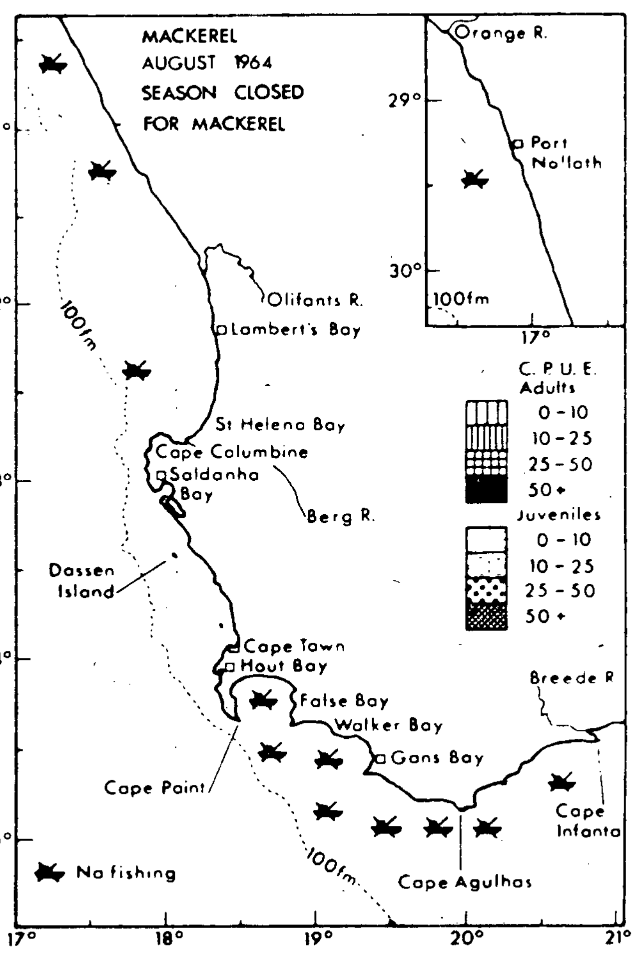
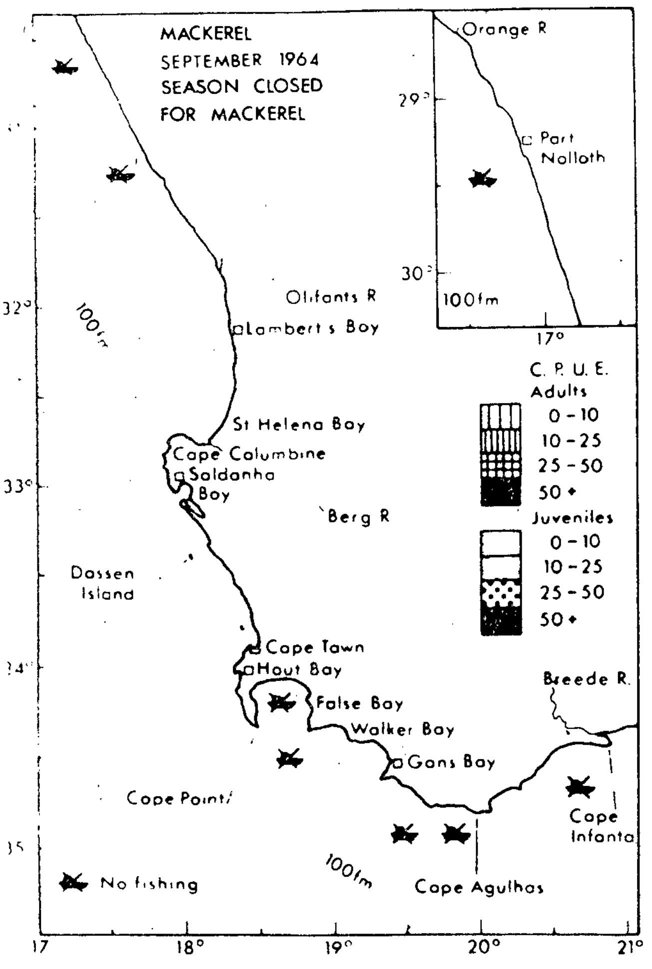
33°
34°
35°
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
27,5
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
No fishing
18°
19°
20°
21°


MACKEREL
AUGUST 1964
SEASON CLOSED
FOR MACKEREL
Orange R.
29°
Port No'loth
30°
100fm
17°
31°
32°
33°
34°
35°
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
No fishing
17°
18°
19°
20°
21°


MACKEREL
SEPTEMBER 1964
SEASON CLOSED
FOR MACKEREL
Orange R
Port Nolloth
100fm
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
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10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
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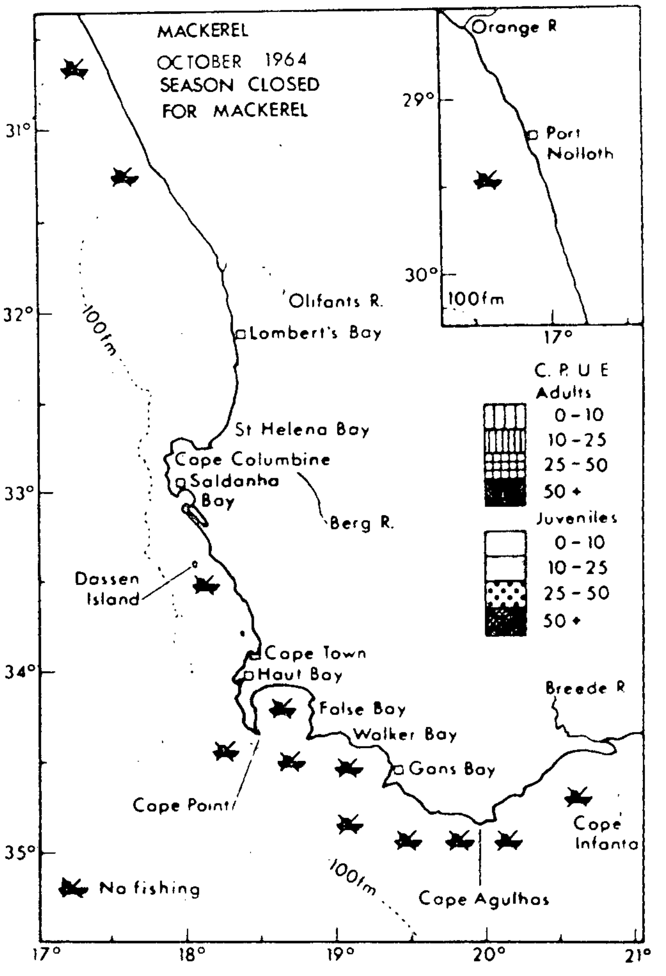
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OCTOBER 1964
SEASON CLOSED
FOR MACKEREL
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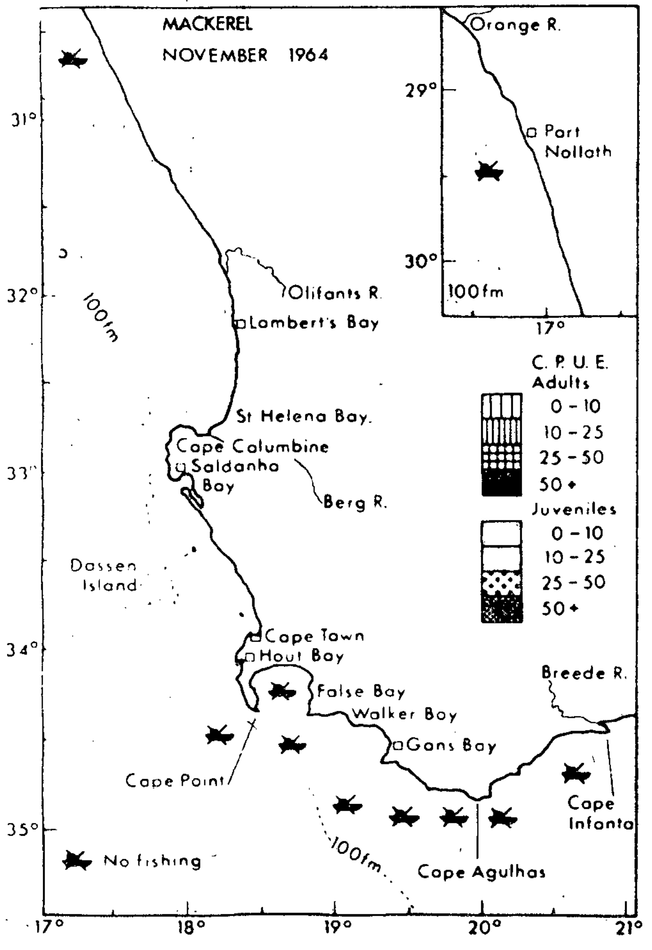
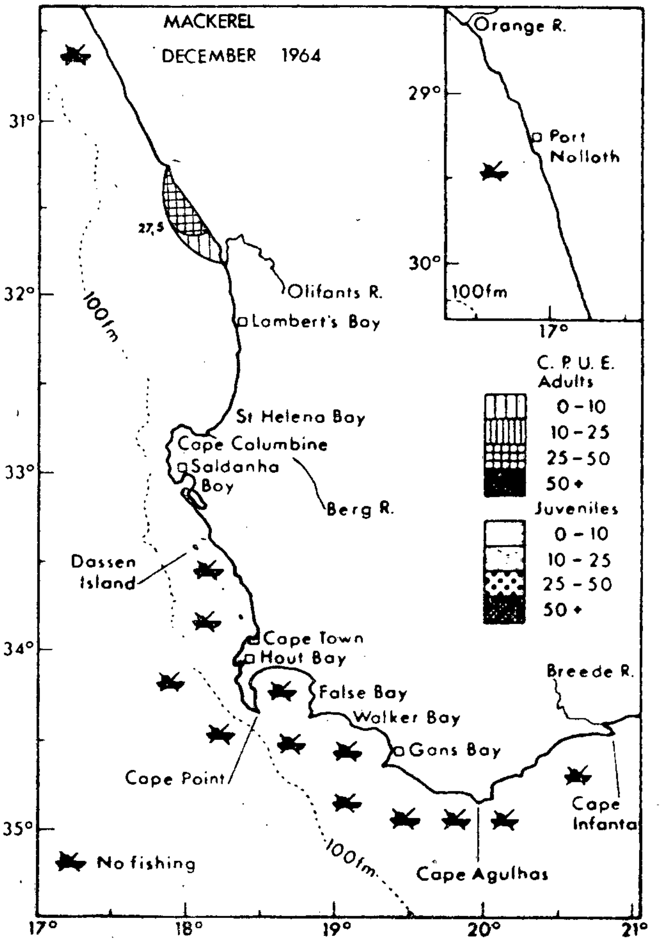
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +


MACKEREL
NOVEMBER 1964
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay.
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +


MACKEREL
DECEMBER 1964
Orange R.
Port Nolloth
100fm
27,5
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
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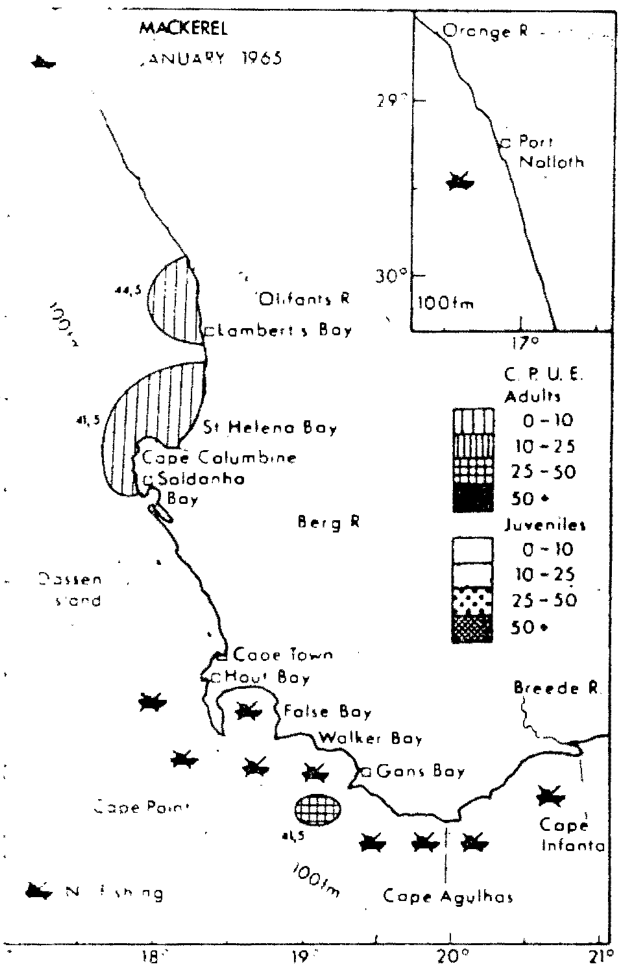
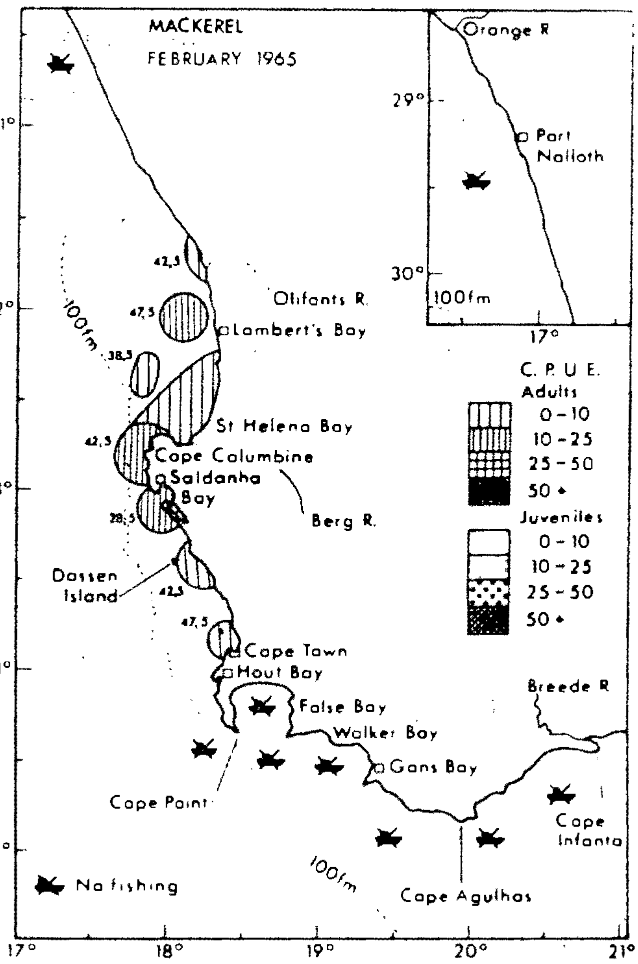
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +


MACKEREL
JANUARY 1965
Orange R
29°
Port Nolloth
30°
100fm
17°
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
100fm
44,5
41,5
41,5
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
18°
19°
20°
21°


MACKEREL
FEBRUARY 1965
Orange R
29°
Port Nolloth
30°
100fm
17°
31°
32°
33°
34°
35°
100fm
42,5
47,5
38,5
42,5
28,5
42,5
47,5
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
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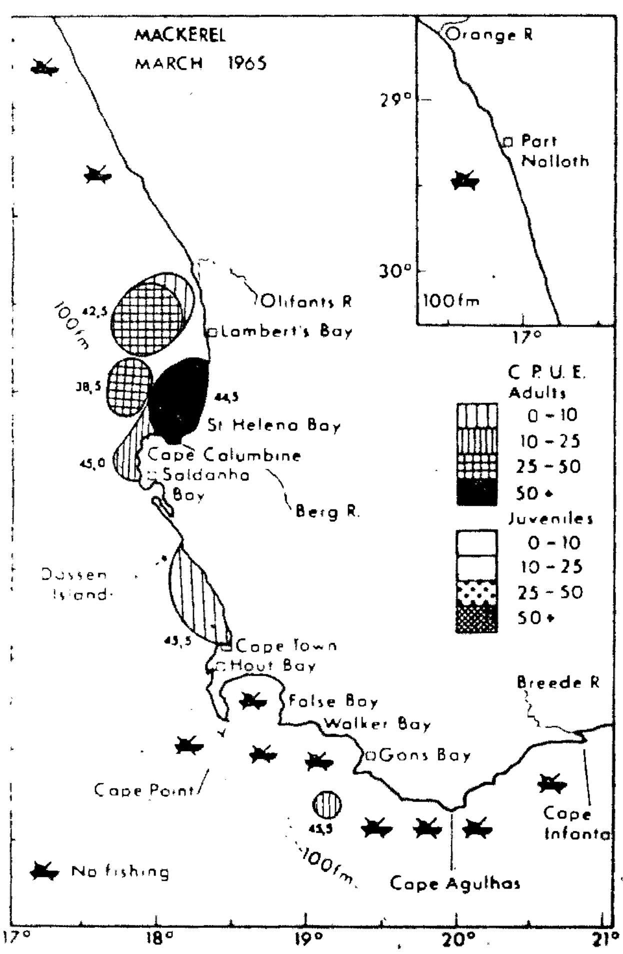
MACKEREL
MARCH 1965
Orange R
29°
Port Nolloth
30°
100fm
17°
100fm
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38,5
44,5
45,0
45,5
45,5
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
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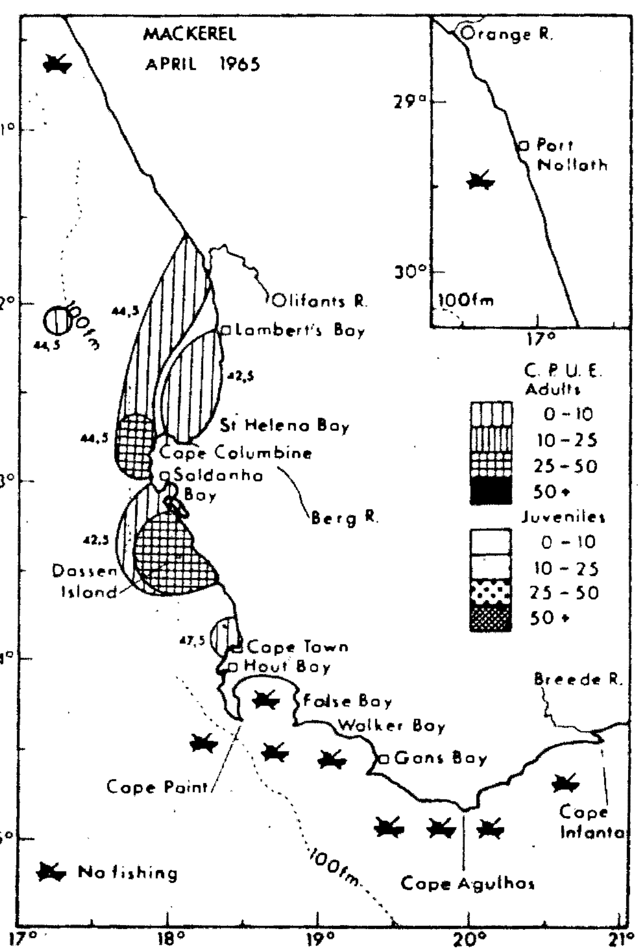
21°


MACKEREL
APRIL 1965
Orange R.
29°
Port Nolloth
30°
100fm
17°
31°
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33°
34°
35°
100fm
44,5
44,5
42,5
44,5
42,5
47,5
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
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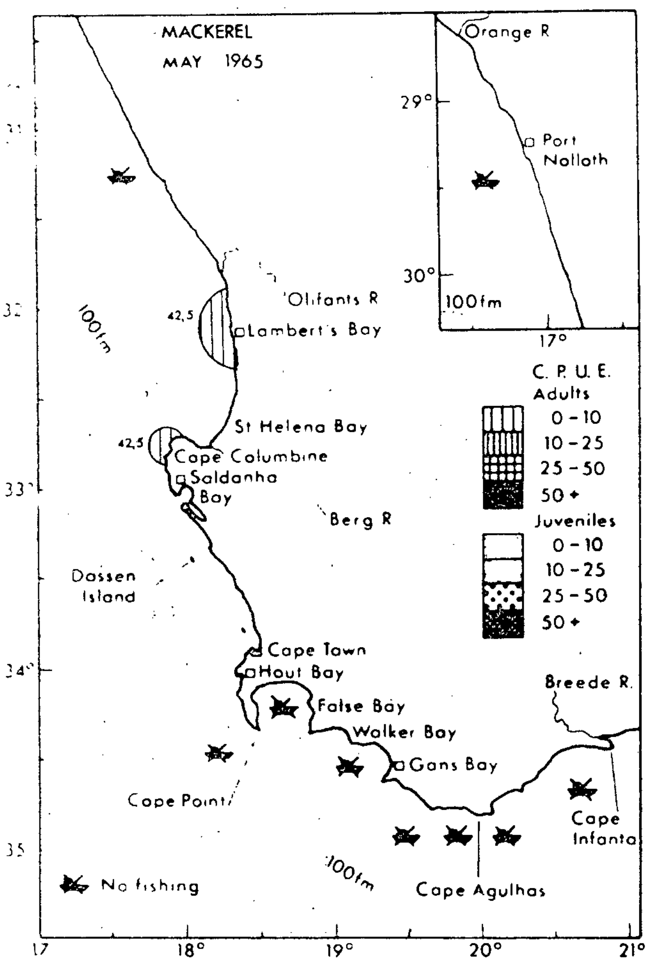
MACKEREL
MAY 1965
Orange R
29°
Port Nolloth
30°
100fm
17°
Olifants R
Lambert's Bay
100fm
42,5
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
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18°
19°
20°
21°
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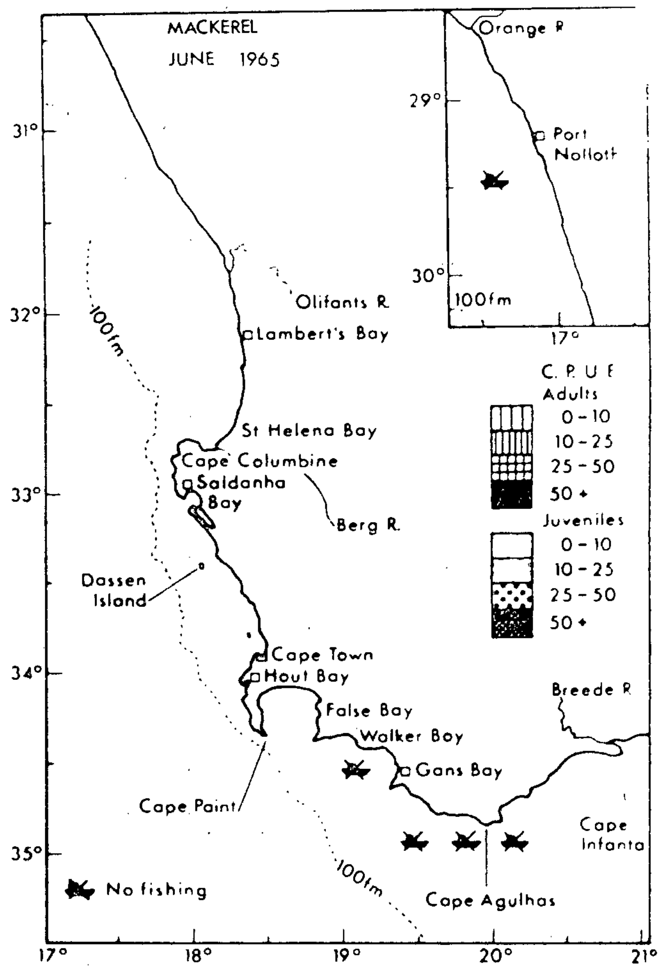
MACKEREL
JUNE 1965
Orange R
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Port Nolloth
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100fm
17°
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33°
34°
35°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
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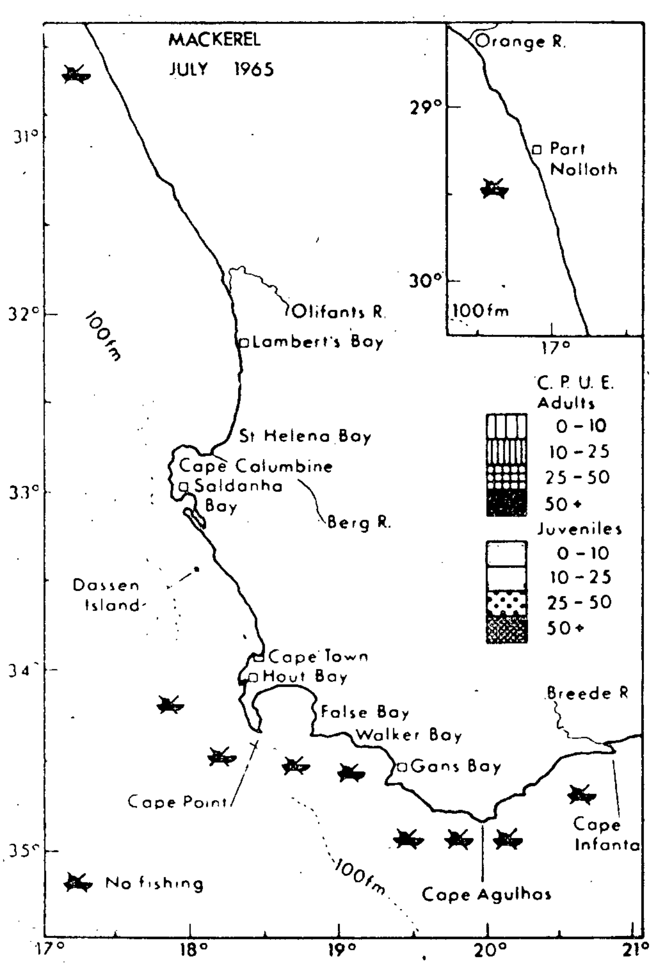
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JULY 1965
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29°
Port Nolloth
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100fm
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35°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
0 - 10
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Juveniles
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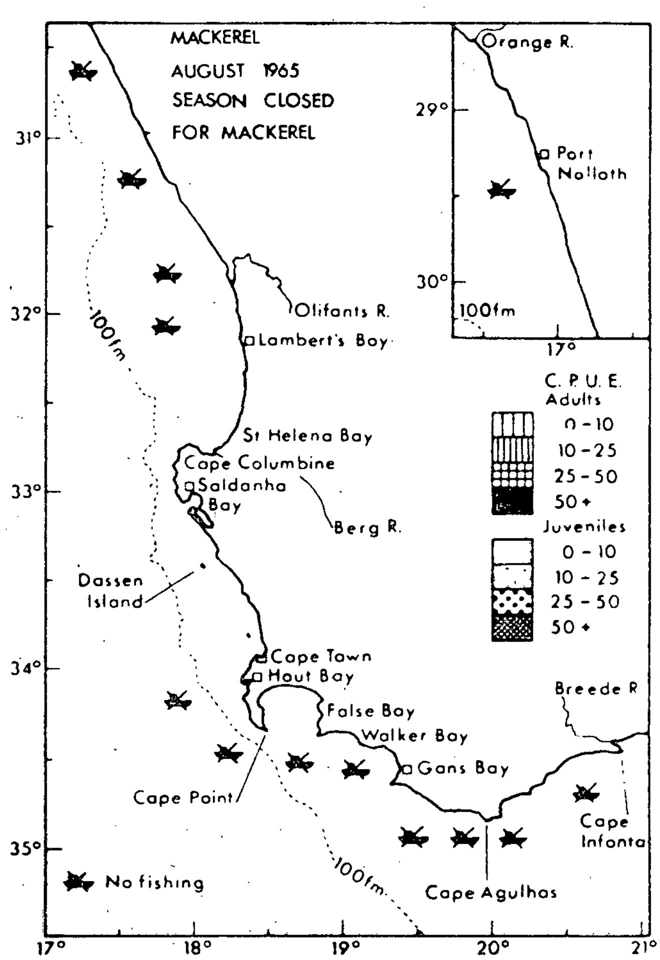
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AUGUST 1965
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FOR MACKEREL
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Port Nolloth
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100fm
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100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
0 - 10
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50 +
Juveniles
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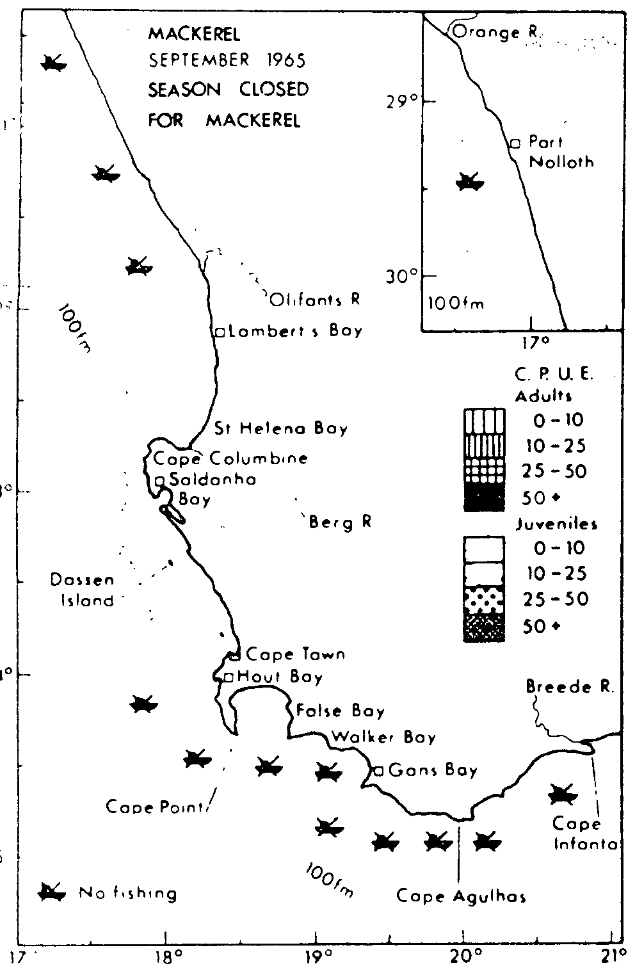
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SEPTEMBER 1965
SEASON CLOSED
FOR MACKEREL
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29°
Port
Nolloth
30°
100fm
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Olifants R
Lambert's Bay
100fm
C. P. U. E.
Adults
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Juveniles
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St Helena Bay
Cape Columbine
Saldanha
Bay
Berg R
Dassen
Island
Cape Town
Hout Bay
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Walker Bay
Gans Bay
Breede R.
Cape Point
Cape
Infanta
100fm
Cape Agulhas
No fishing
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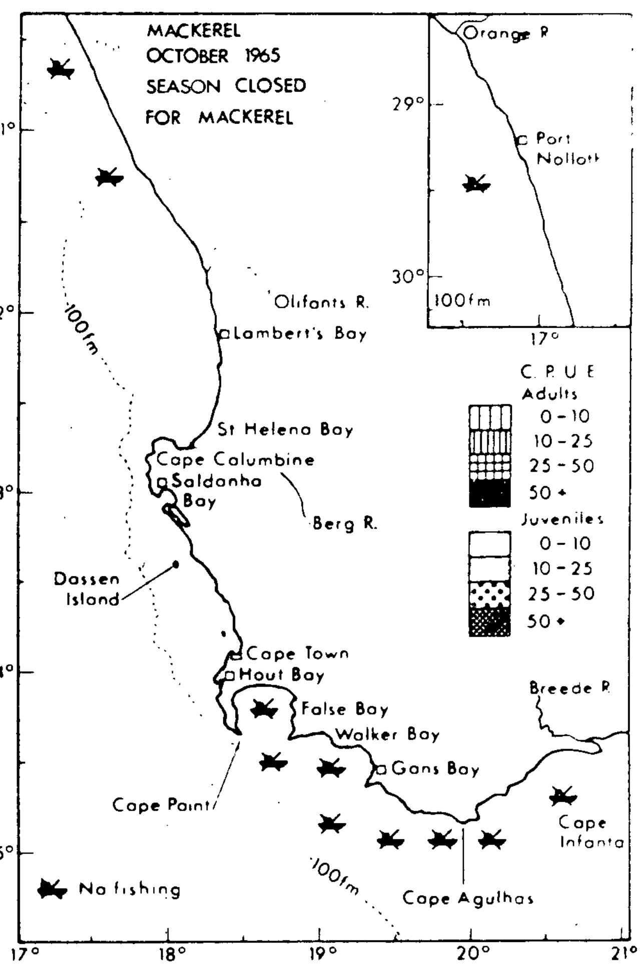
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OCTOBER 1965
SEASON CLOSED
FOR MACKEREL
Orange R
29°
Port
Nolloth
30°
100fm
17°
Olifants R.
Lambert's Bay
100fm
C. P. U. E.
Adults
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50 +
Juveniles
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50 +
St Helena Bay
Cape Columbine
Saldanha
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Berg R.
Dassen
Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape
Infanta
100fm
Cape Agulhas
No fishing
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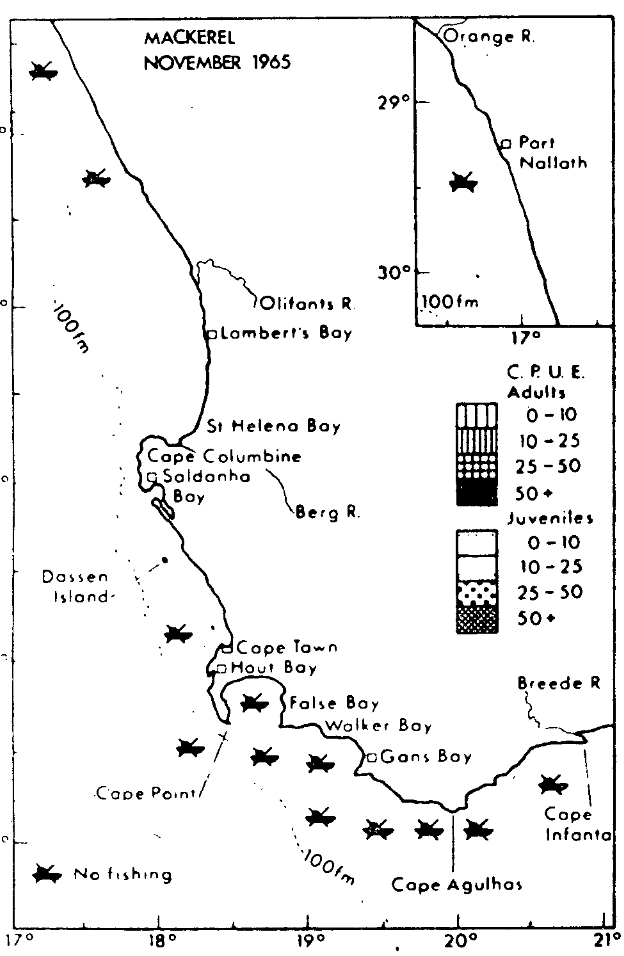
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NOVEMBER 1965
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Port
Nolloth
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Olifants R.
Lambert's Bay
100fm
C. P. U. E.
Adults
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50 +
Juveniles
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50 +
St Helena Bay
Cape Columbine
Saldanha
Bay
Berg R.
Dassen
Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
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100fm
Cape Agulhas
No fishing
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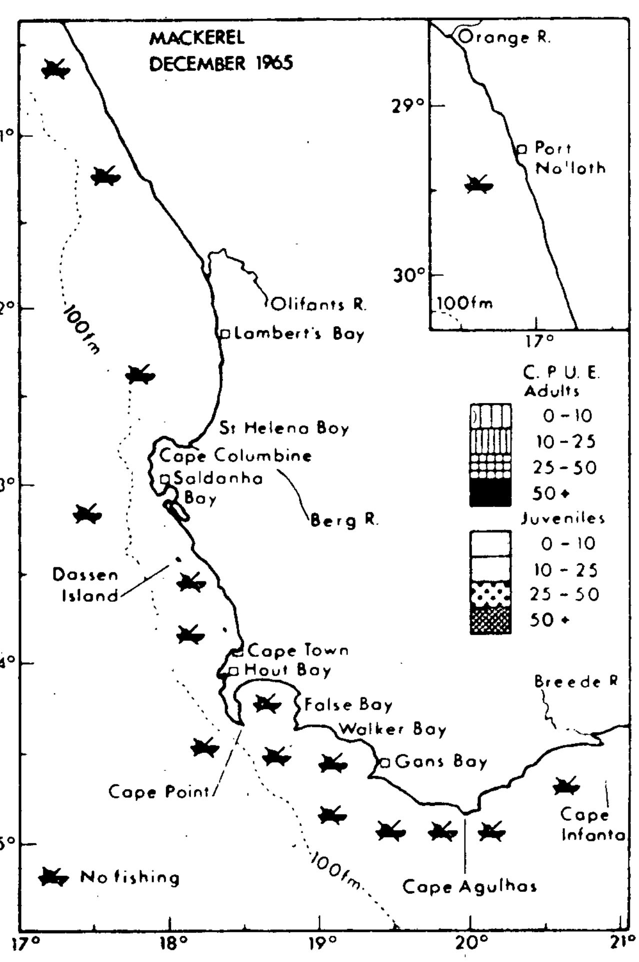
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DECEMBER 1965
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Port
Nolloth
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Olifants R.
Lambert's Bay
100fm
C. P. U. E.
Adults
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Juveniles
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Saldanha
Bay
Berg R.
Dassen
Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape
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No fishing
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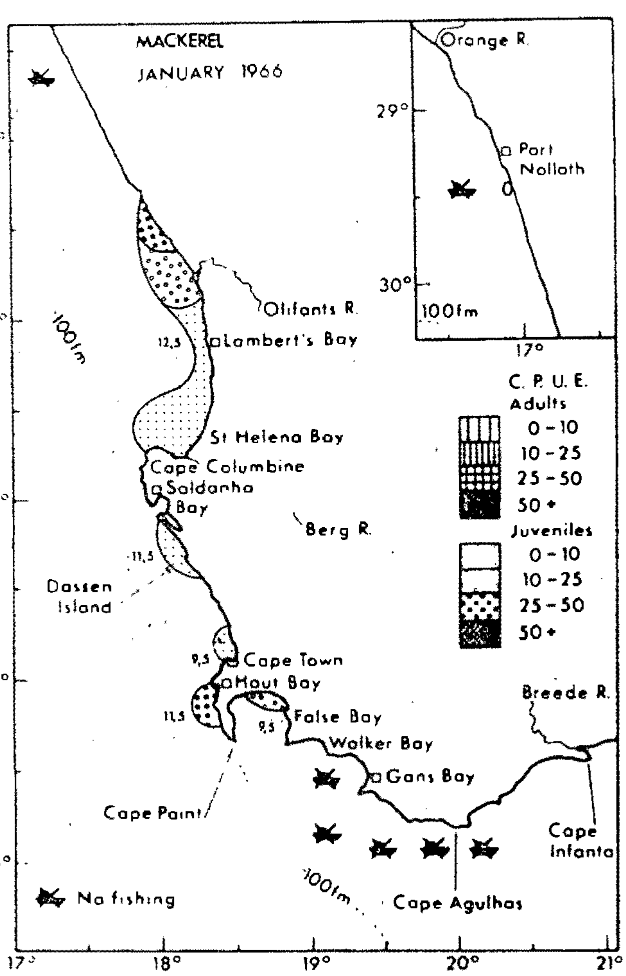
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JANUARY 1966
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Port Nolloth
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Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
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50 +
Juveniles
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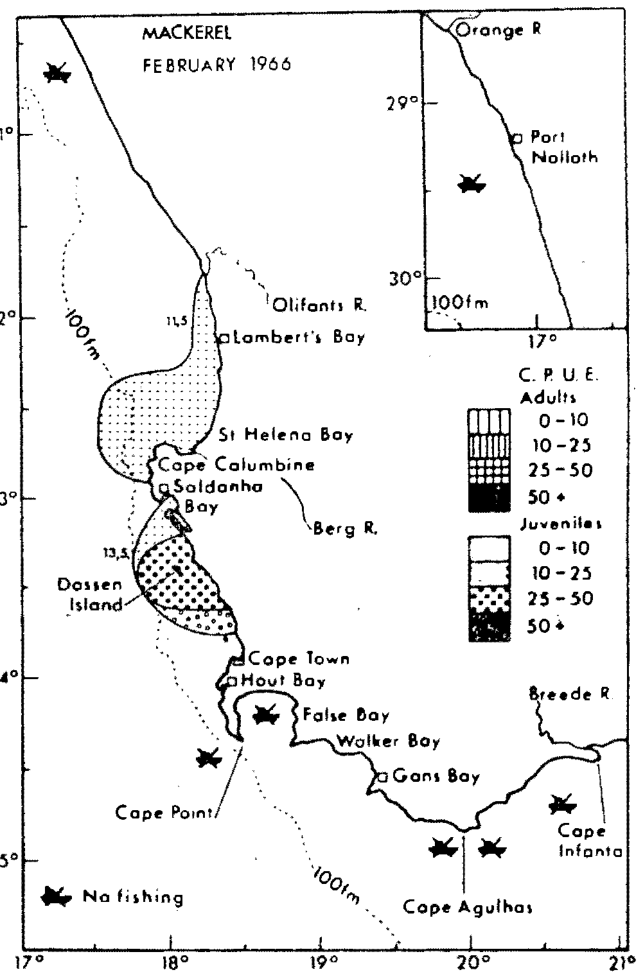
MACKEREL
FEBRUARY 1966
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Port Nolloth
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Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
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Juveniles
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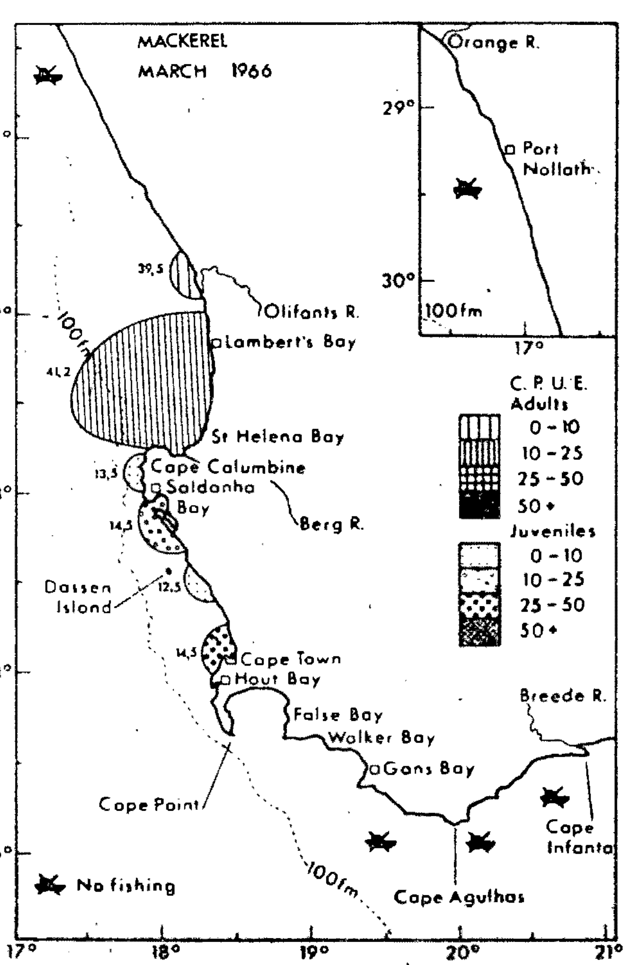
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MARCH 1966
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Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
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50 +
Juveniles
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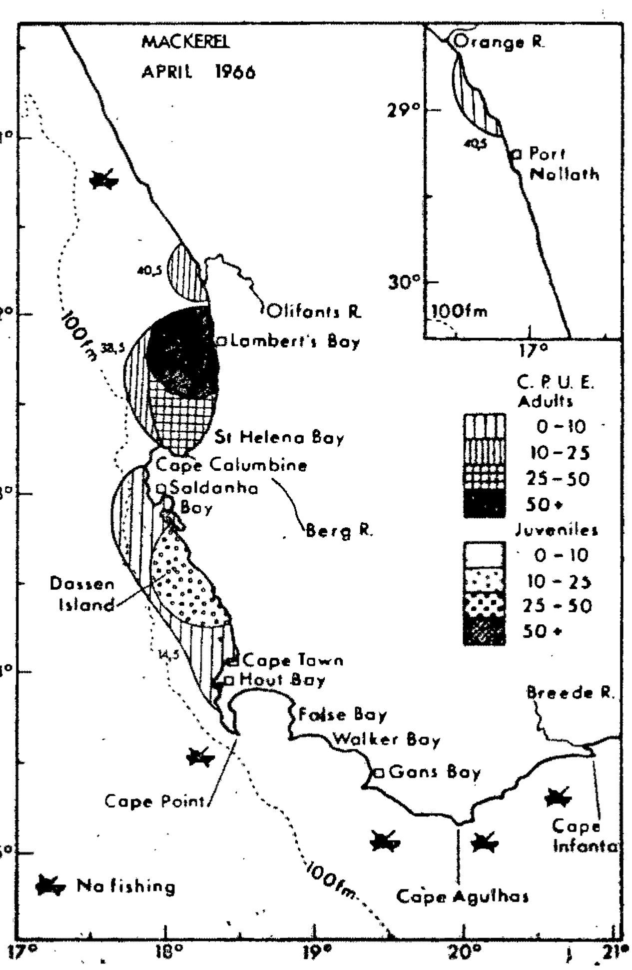
MACKEREL
APRIL 1966
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Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
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Juveniles
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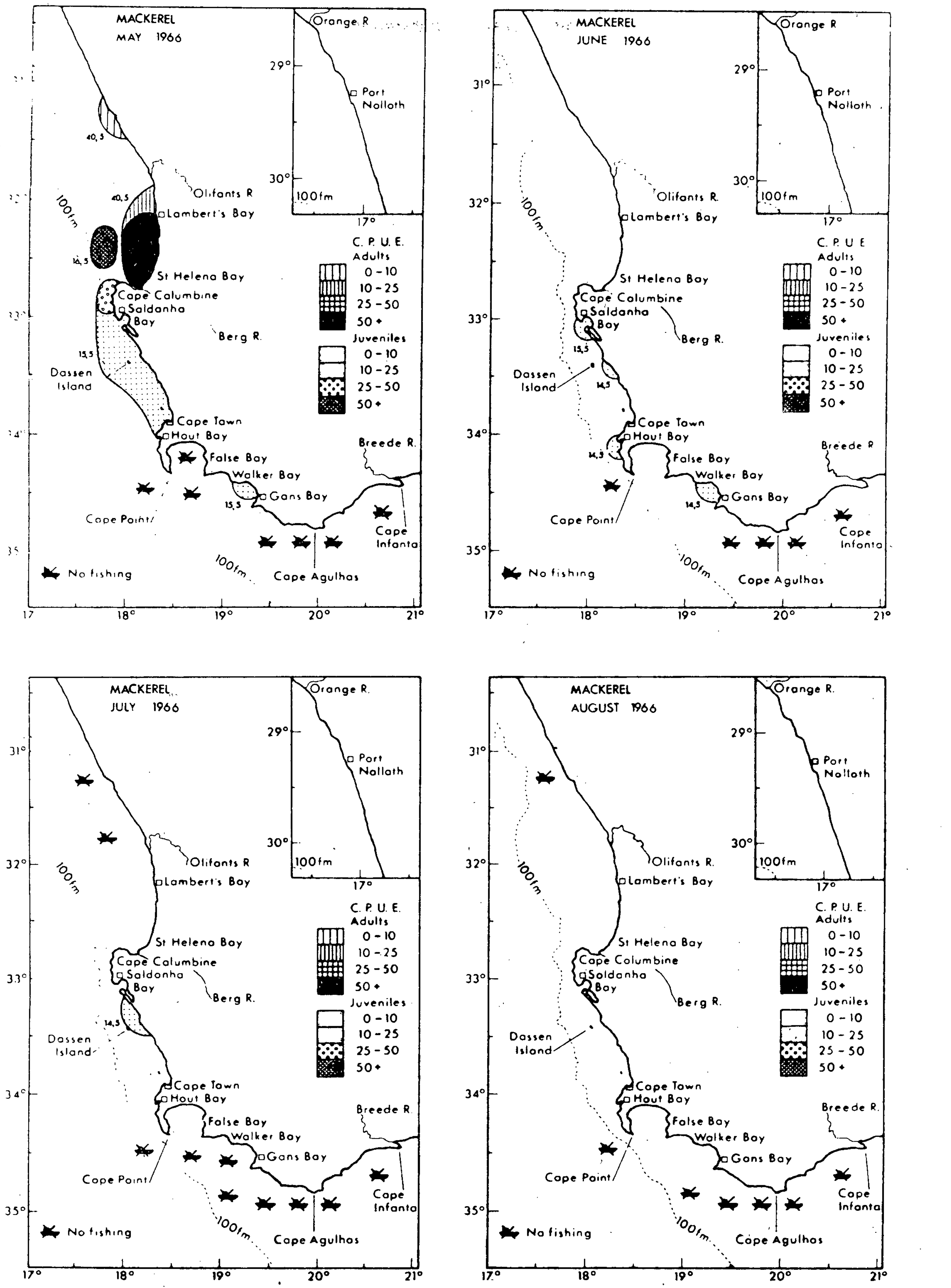
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JUNE 1966
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JULY 1966
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AUGUST 1966
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Port Nolloth
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Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
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Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
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Juveniles
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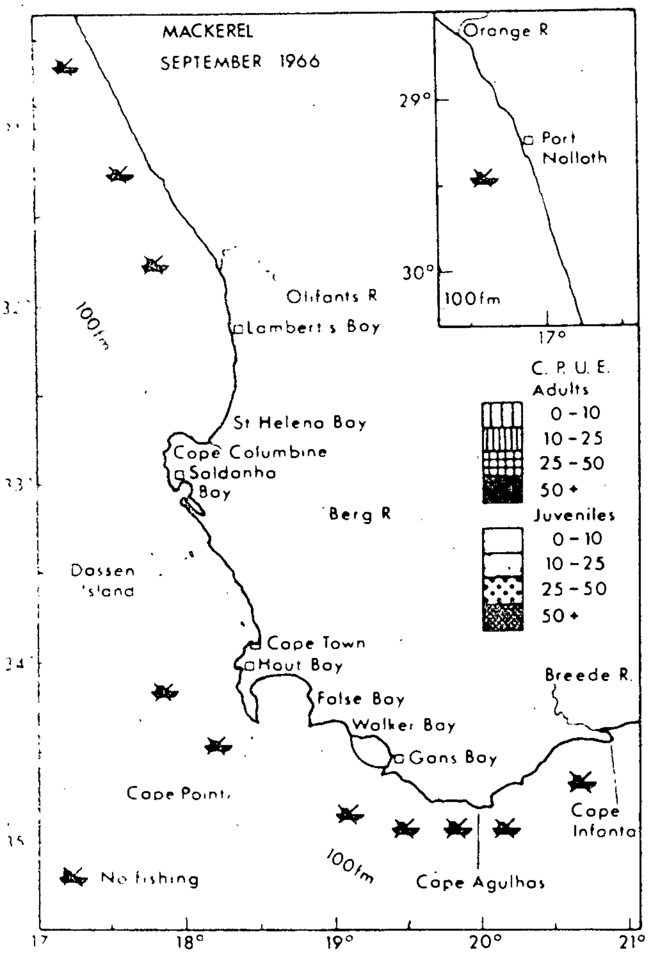
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SEPTEMBER 1966
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Olifants R
Lambert's Bay
100fm
C. P. U. E.
Adults
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St Helena Bay
Cape Columbine
Saldanha Bay
Berg R
Juveniles
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Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
100fm
Cape Agulhas
No fishing
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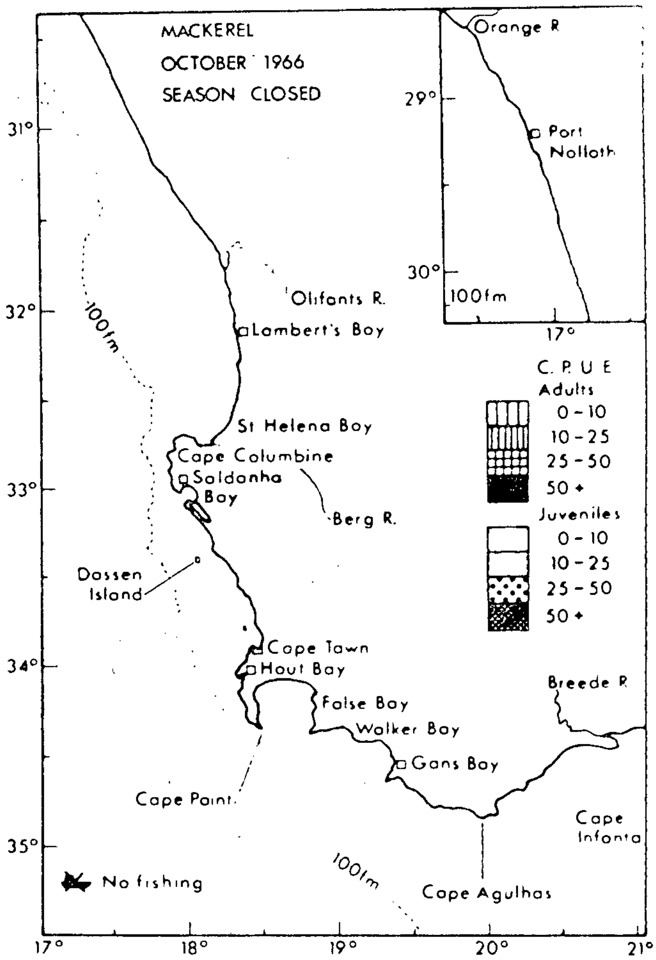
MACKEREL
OCTOBER 1966
SEASON CLOSED
Orange R
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Port Nolloth
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100fm
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Olifants R.
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Lambert's Bay
100fm
C. P. U. E.
Adults
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50 +
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
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Juveniles
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50 +
Dassen Island
Cape Town
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False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
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Cape Agulhas
No fishing
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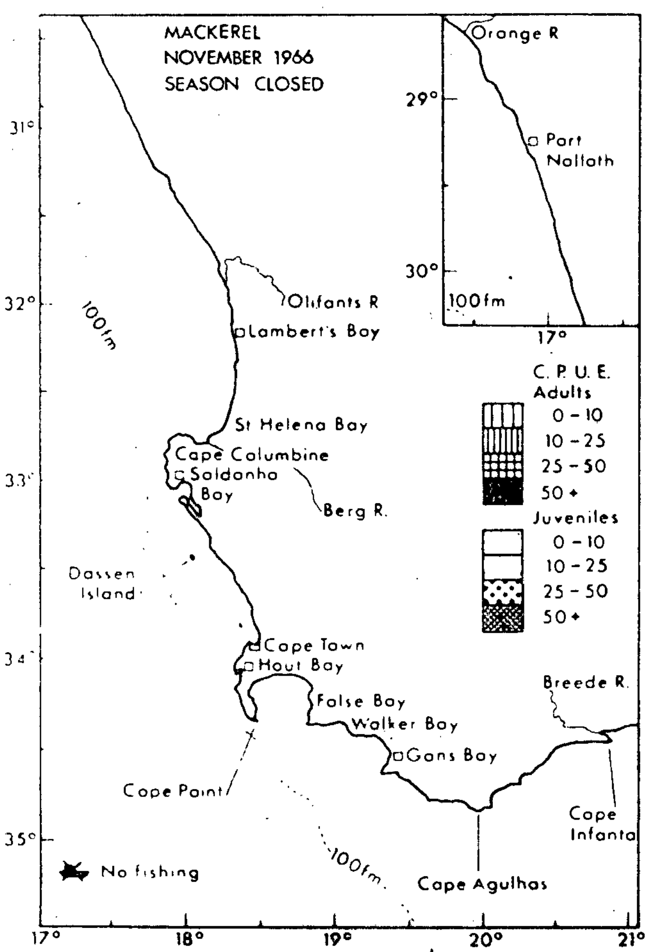
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NOVEMBER 1966
SEASON CLOSED
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29°
Port Nolloth
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100fm
Lambert's Bay
C. P. U. E.
Adults
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St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
33°
Juveniles
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50 +
Dassen Island
Cape Town
Hout Bay
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False Bay
Walker Bay
Gans Bay
Breede R.
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Cape Agulhas
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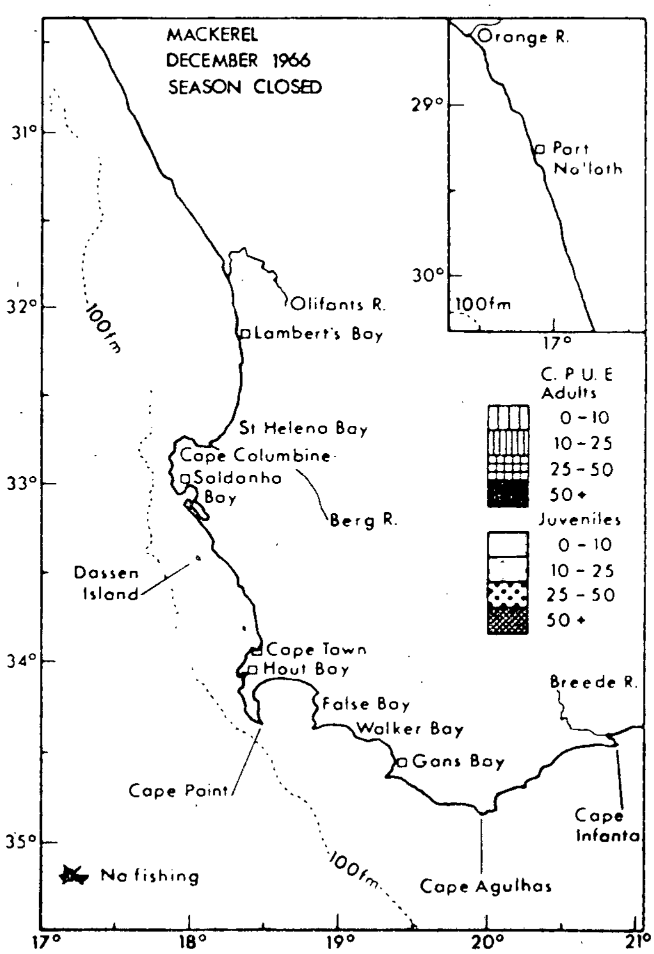
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Port Nolloth
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Lambert's Bay
C. P. U. E
Adults
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Cape Columbine
Saldanha Bay
Berg R.
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Juveniles
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Dassen Island
Cape Town
Hout Bay
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False Bay
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Gans Bay
Breede R.
Cape Point
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Cape Agulhas
No fishing
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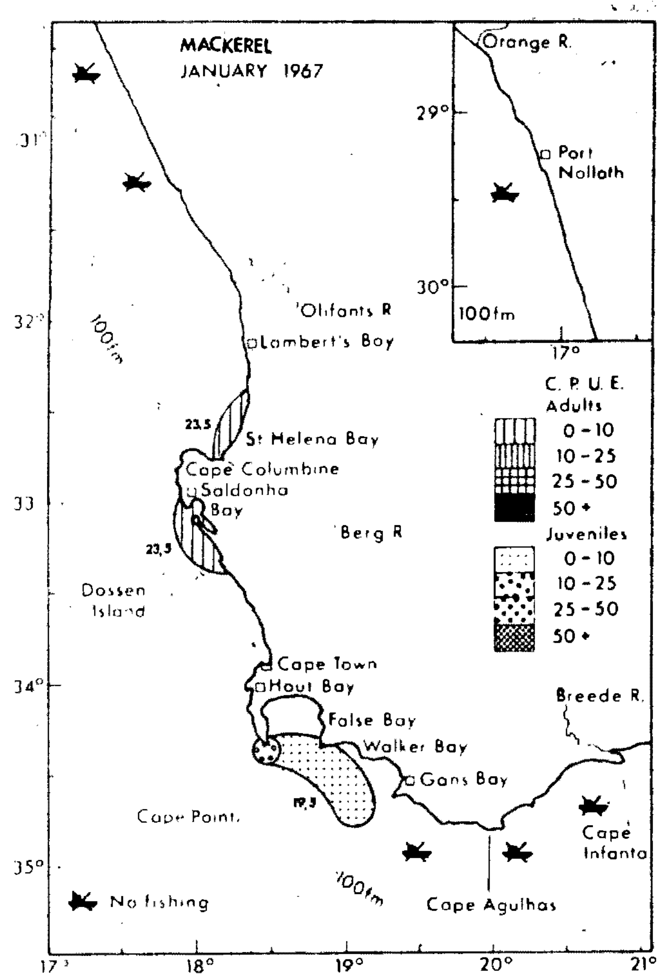
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Port Nolloth
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Lambert's Bay
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St Helena Bay
Cape Columbine
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Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
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Cape Point
Cape Infanta
100fm
Cape Agulhas
No fishing
C. P. U. E.
Adults
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Juveniles
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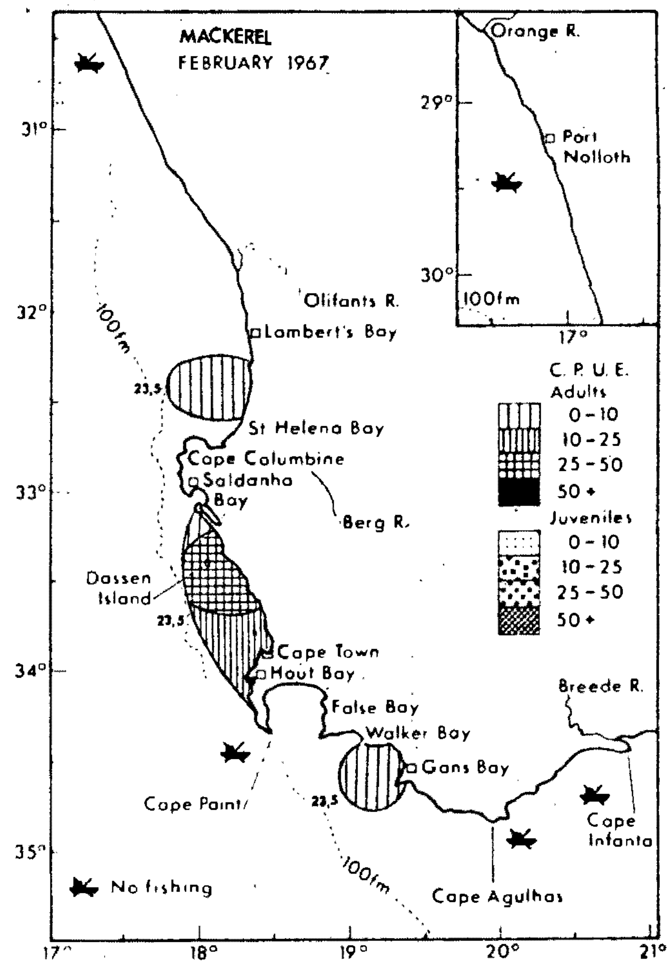
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FEBRUARY 1967
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Port Nolloth
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Olifants R.
Lambert's Bay
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St Helena Bay
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Saldanha Bay
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Dassen Island
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Gans Bay
Breede R.
Cape Point
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Cape Infanta
100fm
Cape Agulhas
No fishing
C. P. U. E.
Adults
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Juveniles
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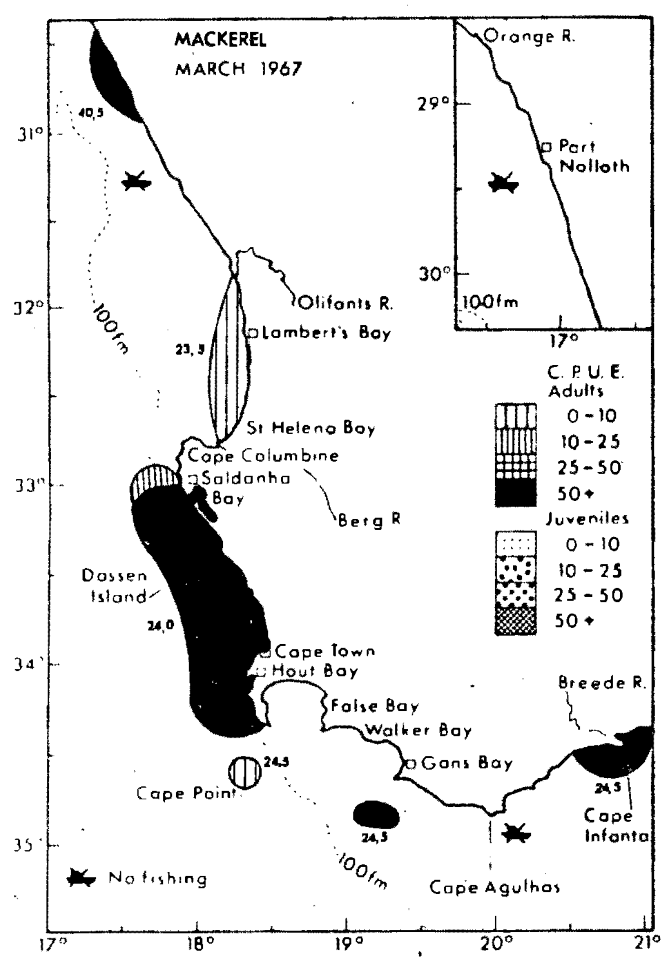
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Port Nolloth
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Olifants R.
Lambert's Bay
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Saldanha Bay
Berg R
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Gans Bay
Breede R.
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100fm
Cape Agulhas
No fishing
C. P. U. E.
Adults
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Juveniles
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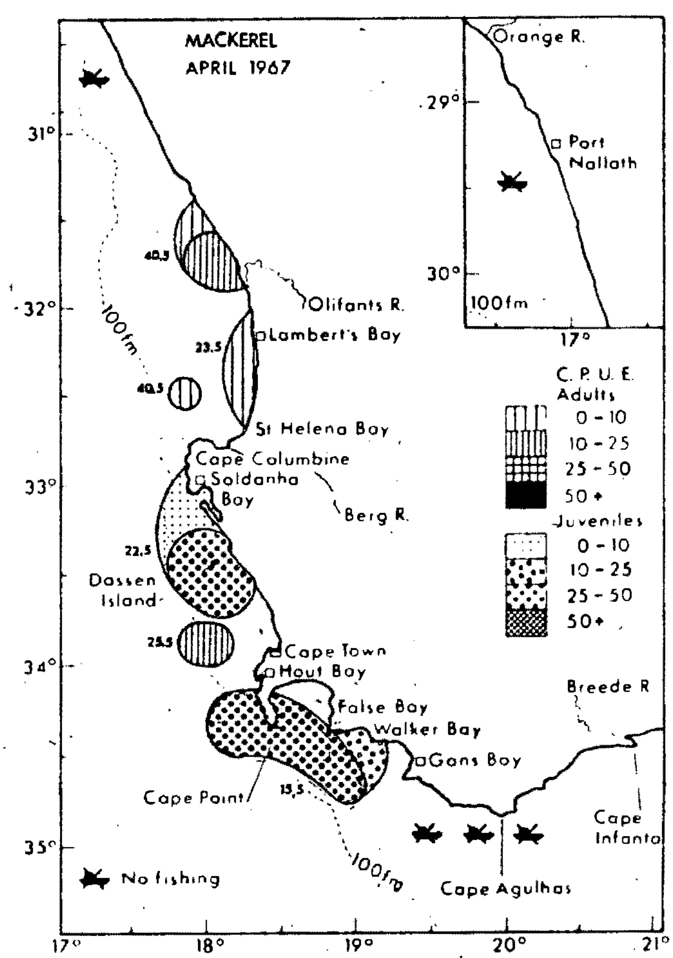
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Breede R
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100fm
Cape Agulhas
No fishing
C. P. U. E.
Adults
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Juveniles
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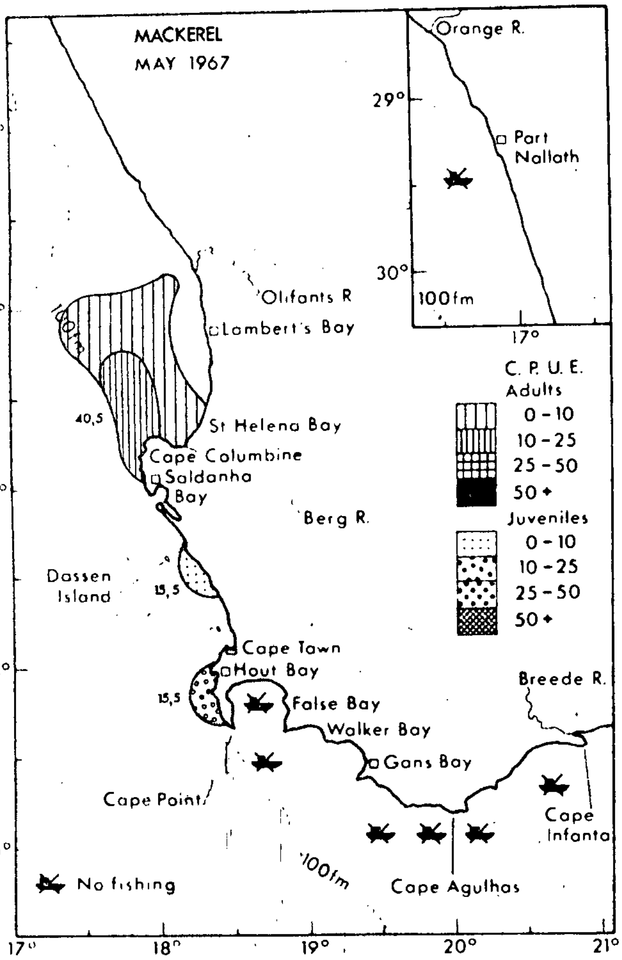
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MAY 1967
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Dassen Island
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Juveniles
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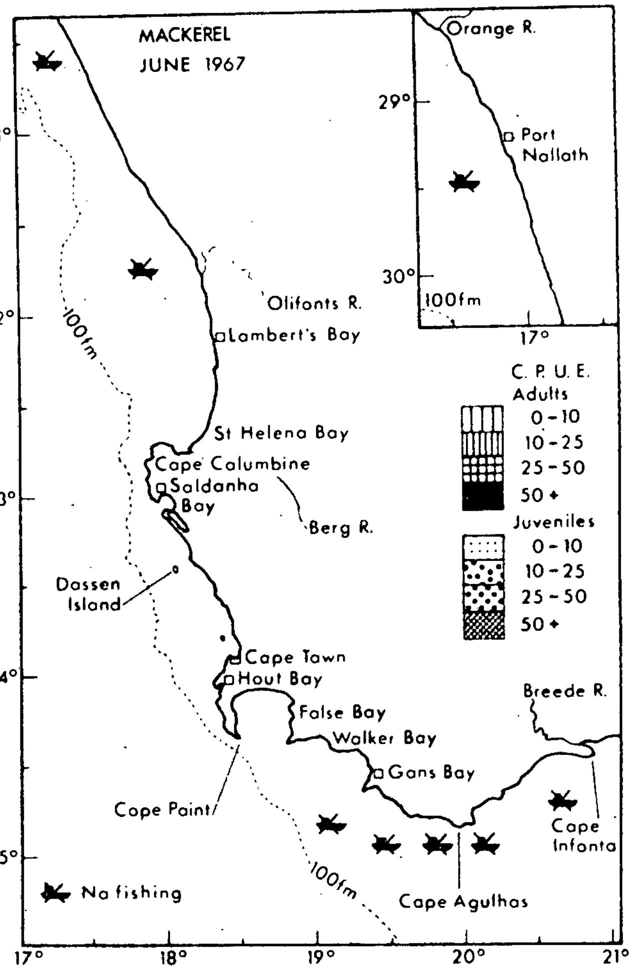
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JUNE 1967
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Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
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Breede R.
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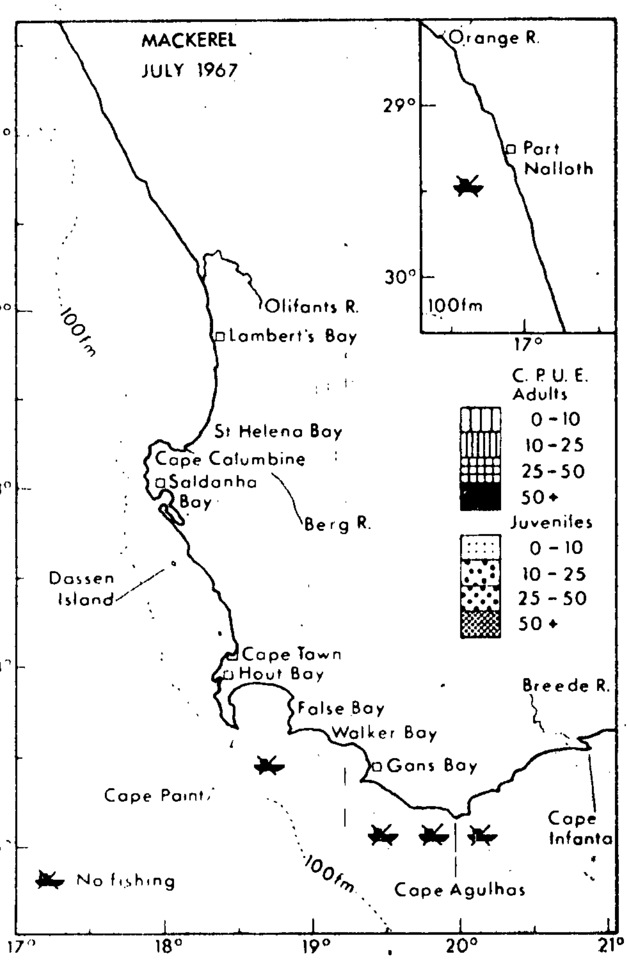
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JULY 1967
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Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
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Juveniles
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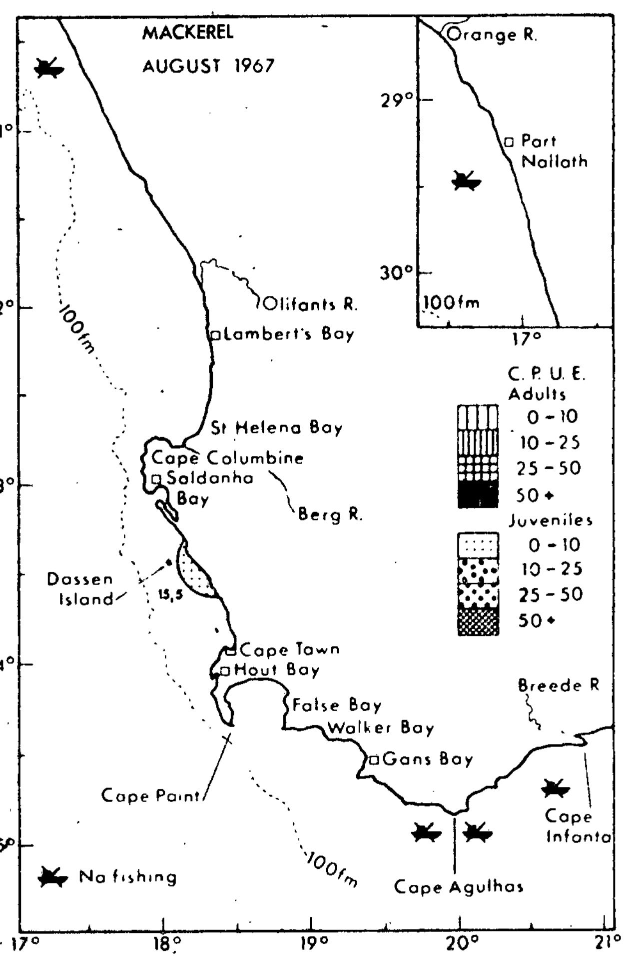
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AUGUST 1967
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Port Nolloth
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100fm
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100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
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Cape Town
Hout Bay
False Bay
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Gans Bay
Breede R
Cape Point
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100fm
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
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50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
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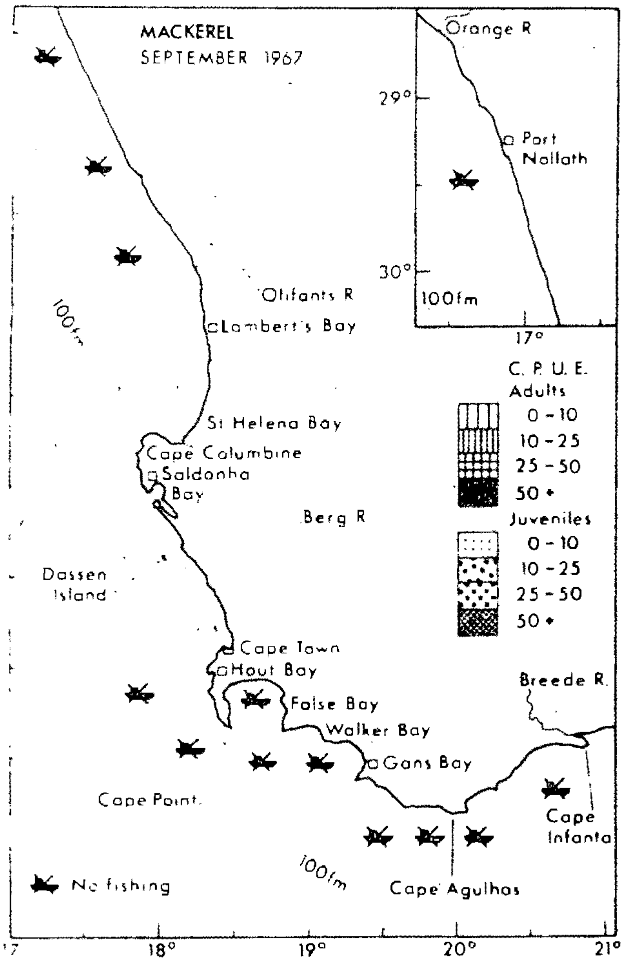
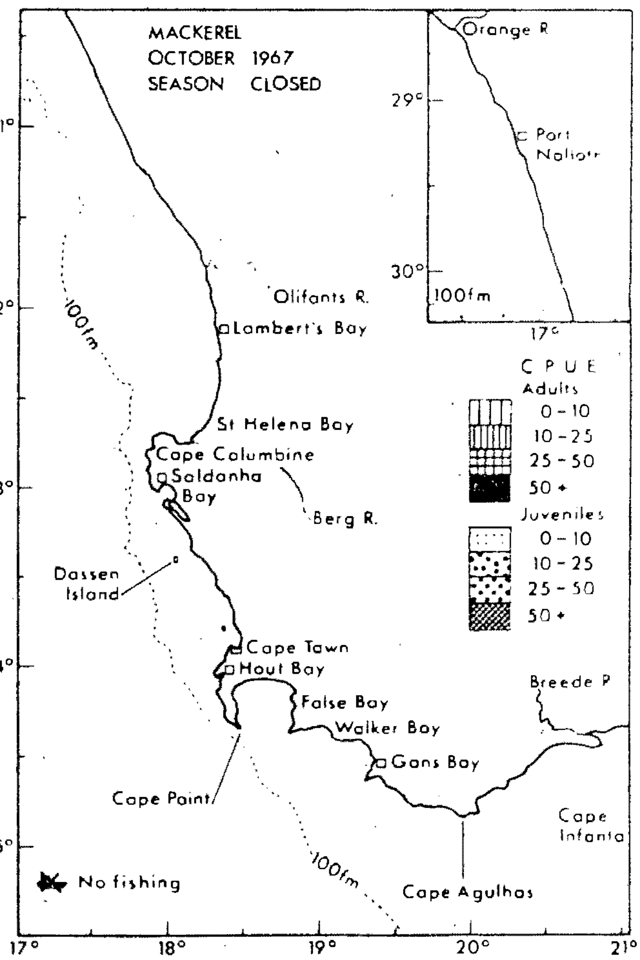
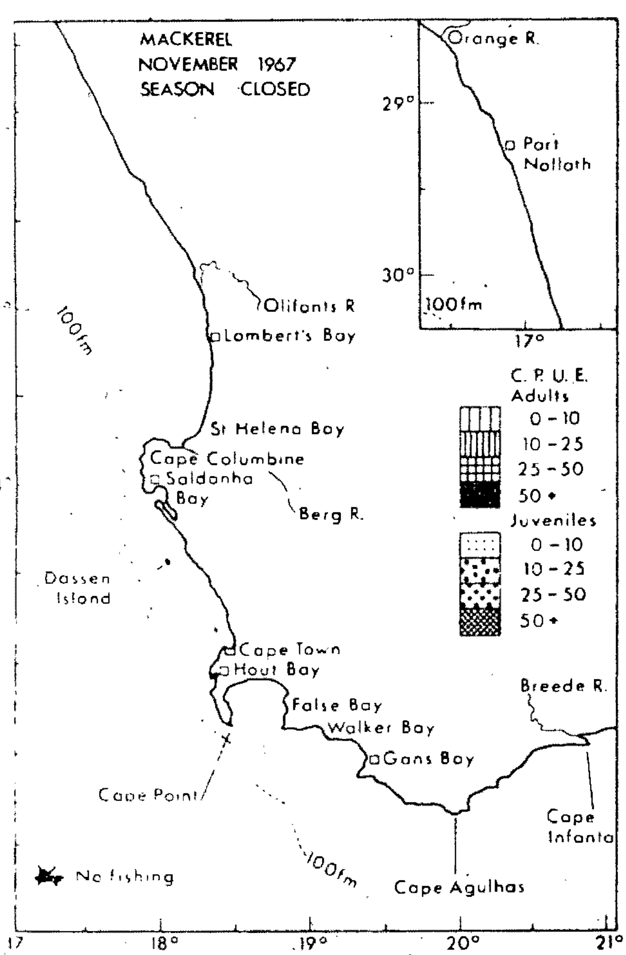
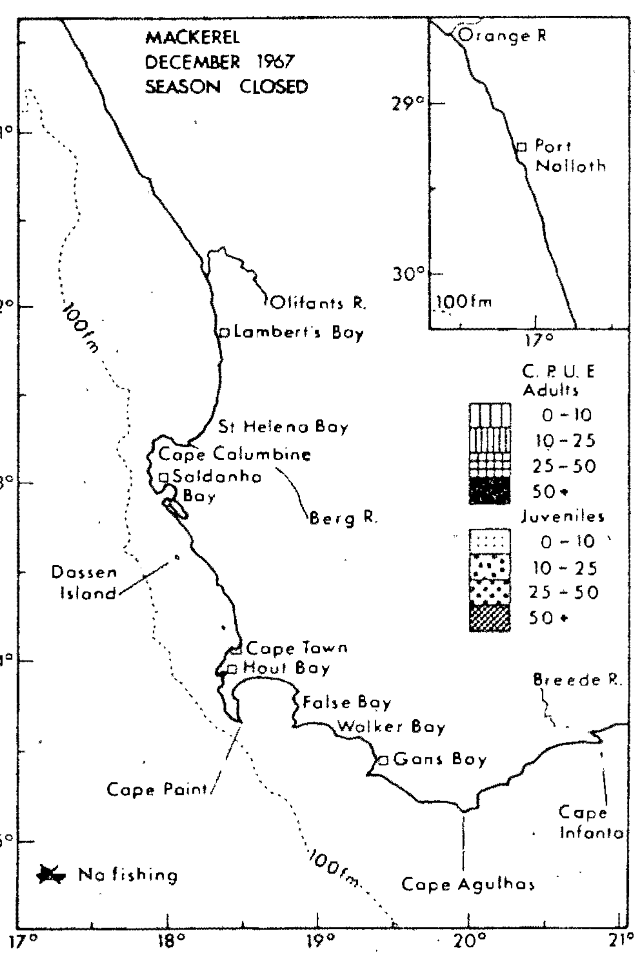
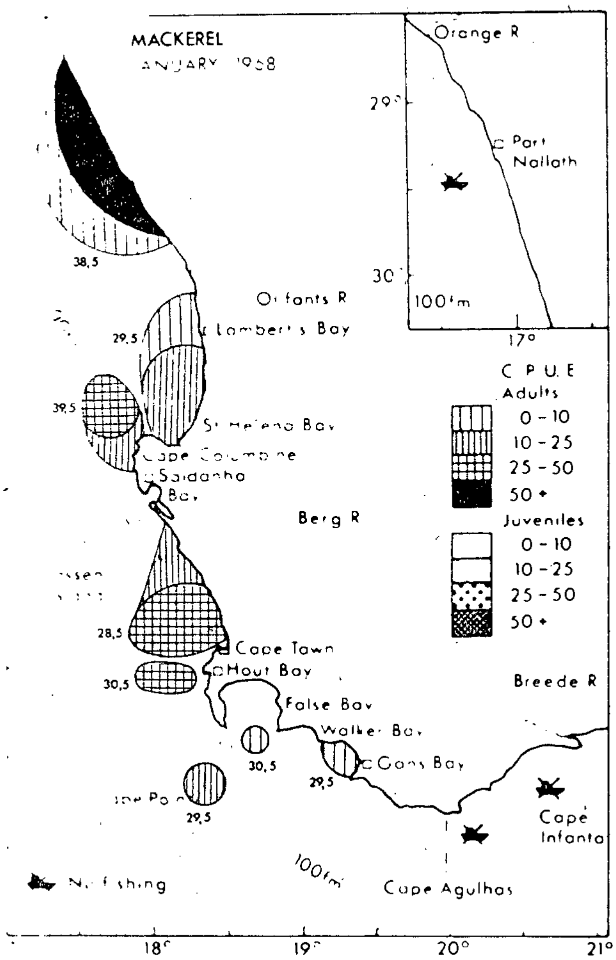
19°
20°
21°


MACKEREL
SEPTEMBER 1967
Orange R
29°
Port Nolloth
30°
100fm
17°
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
100fm
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
17
18°
19°
20°
21°


MACKEREL
OCTOBER 1967
SEASON CLOSED
Orange R
29°
Port Nolloth
30°
100fm
17°
C P U E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
31°
32°
33°
34°
35°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
100fm
Cape Agulhas
No fishing
17°
18°
19°
20°
21°


MACKEREL
NOVEMBER 1967
SEASON CLOSED
Orange R.
29°
Port Nolloth
30°
100fm
17°
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
32°
33°
34
100fm
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
100fm
Cape Agulhas
No fishing
17
18°
19°
20°
21°


MACKEREL
DECEMBER 1967
SEASON CLOSED
Orange R
29°
Port Nolloth
30°
100fm
17°
C. P. U. E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
31°
32°
33°
34°
35°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
100fm
Cape Agulhas
No fishing
17°
18°
19°
20°
21°


MACKEREL
Orange R
29°
Port
Nolloth
30°
100fm
17°
38,5
Lambert's Bay
29,5
39,5
Cape Columbine
Saldanha
Bay
Berg R
28,5
Cape Town
30,5
Hout Bay
Breede R
False Bay
Walker Bay
30,5
29,5
Gans Bay
29,5
Cape
Infanta
100fm
Cape Agulhas
C P U E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
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25 - 50
50 +
18°
19°
20°
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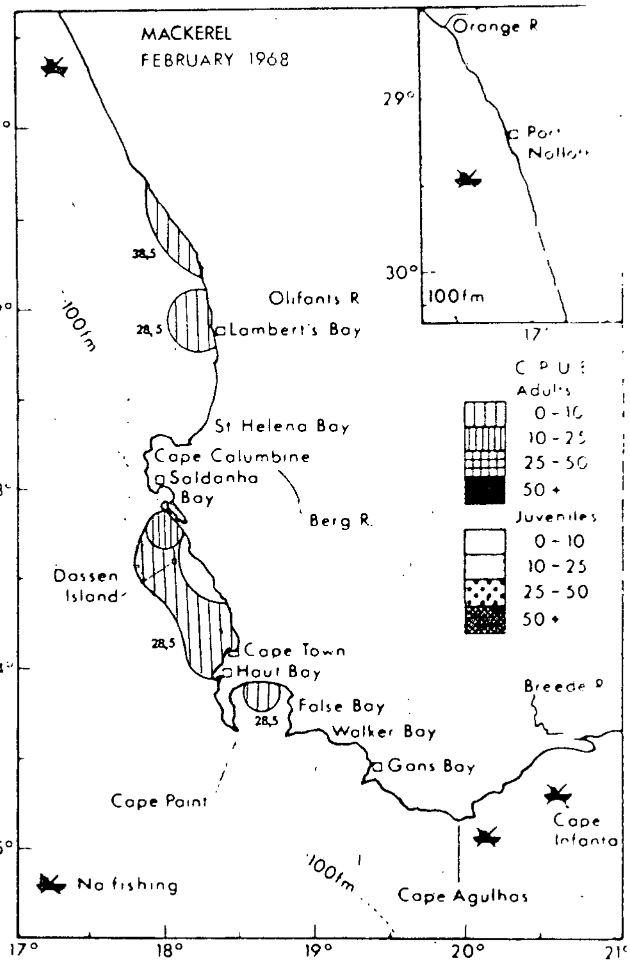
MACKEREL
FEBRUARY 1968
Orange R
29°
30°
100fm
31°
32°
33°
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35°
38,5
Olifants R
28,5
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha
Bay
Berg R.
Dassen
Island
28,5
Cape Town
Hout Bay
False Bay
28,5
Walker Bay
Gans Bay
Cape Point
Cape
Infanta
No fishing
100fm
Cape Agulhas
Juveniles
0 - 10
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25 - 50
50 +
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18°
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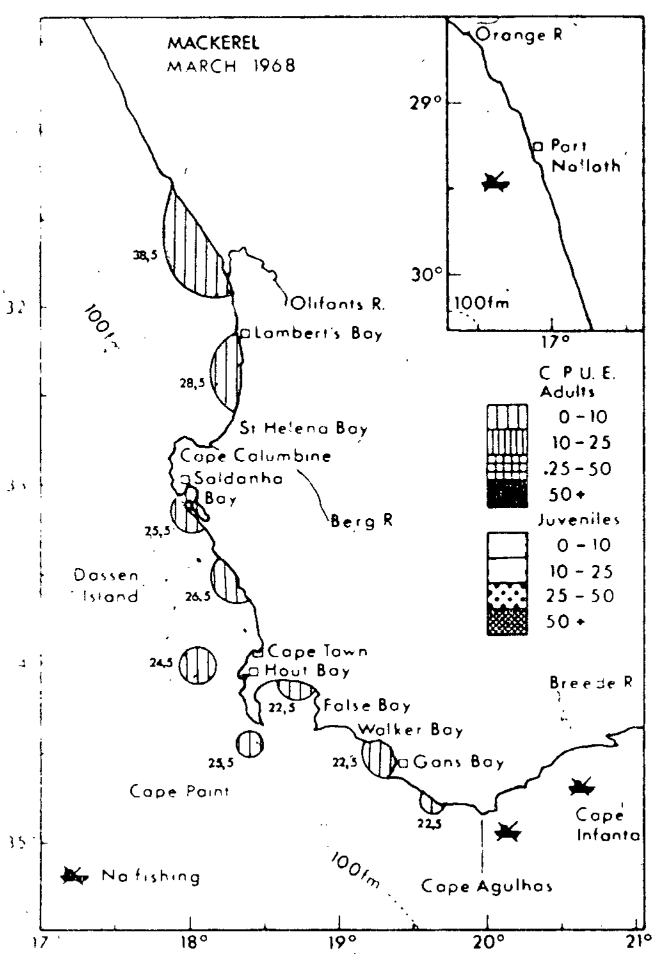
20°


MACKEREL
MARCH 1968
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29°
Port
Nolloth
30°
100fm
17°
38,5
Olifants R.
Lambert's Bay
28,5
St Helena Bay
Cape Columbine
Saldanha
Bay
Berg R
25,5
Dassen
Island
26,5
Cape Town
Hout Bay
24,5
22,5
False Bay
Walker Bay
25,5
22,5
Gans Bay
22,5
Cape Point
Breede R
Cape
Infanta
No fishing
100fm
Cape Agulhas
C P U E
Adults
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10 - 25
25 - 50
50 +
Juveniles
0 - 10
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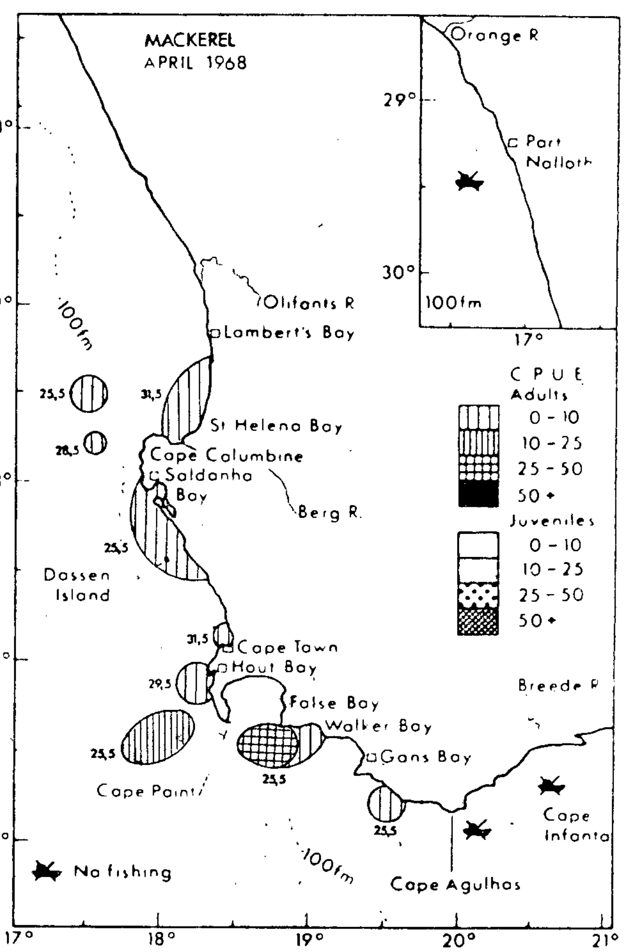
19°
20°
21°


MACKEREL
APRIL 1968
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29°
Port
Nolloth
30°
100fm
17°
31°
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33°
34°
35°
Olifants R
Lambert's Bay
100fm
25,5
31,5
28,5
St Helena Bay
Cape Columbine
Saldanha
Bay
Berg R.
25,5
Dassen
Island
31,5
Cape Town
Hout Bay
29,5
Breede R
False Bay
Walker Bay
25,5
Gans Bay
25,5
Cape Point
25,5
Cape
Infanta
No fishing
100fm
Cape Agulhas
C P U E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
19°
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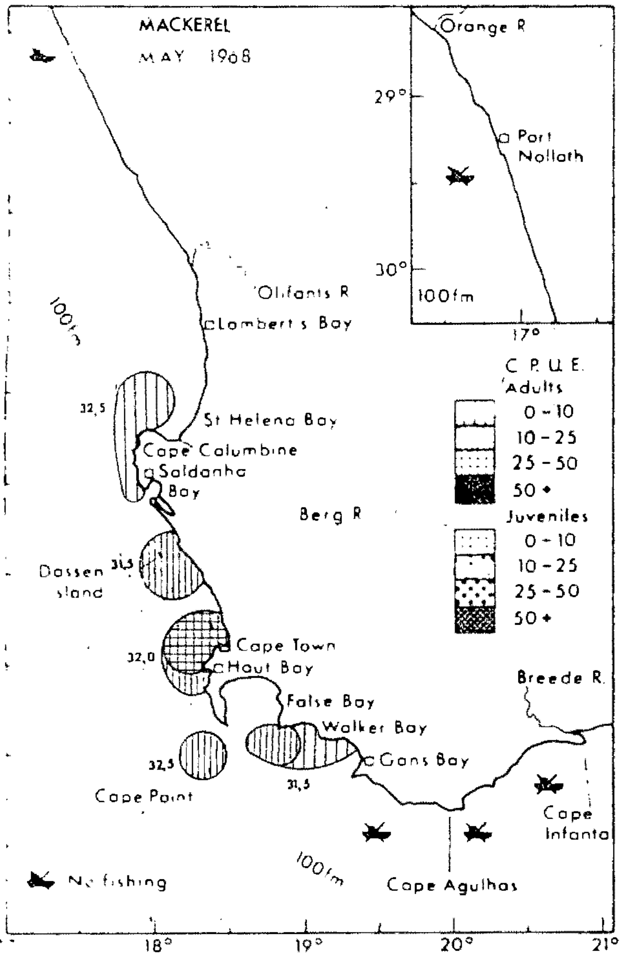
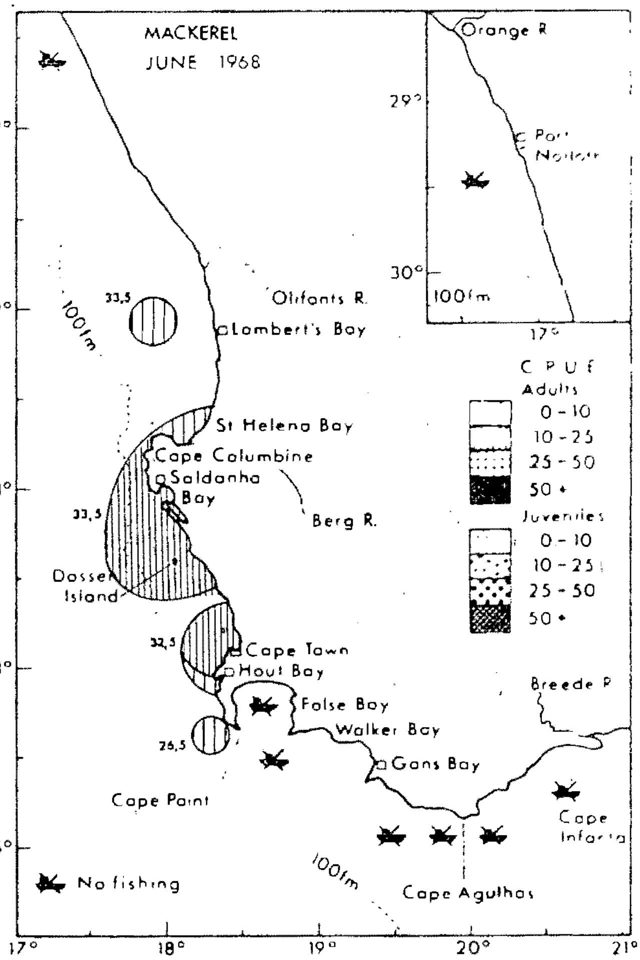
21°


MACKEREL
MAY 1968
Orange R
29°
Port Nollath
30°
100fm
17°
Olifants R
Lambert's Bay
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
32,5
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R
Dassen Island
31,5
32,0
Cape Town
Hout Bay
Breede R.
False Bay
Walker Bay
Gans Bay
32,5
31,5
Cape Point
Cape Infanta
No fishing
100fm
Cape Agulhas
18°
19°
20°
21°


MACKEREL
JUNE 1968
Orange R
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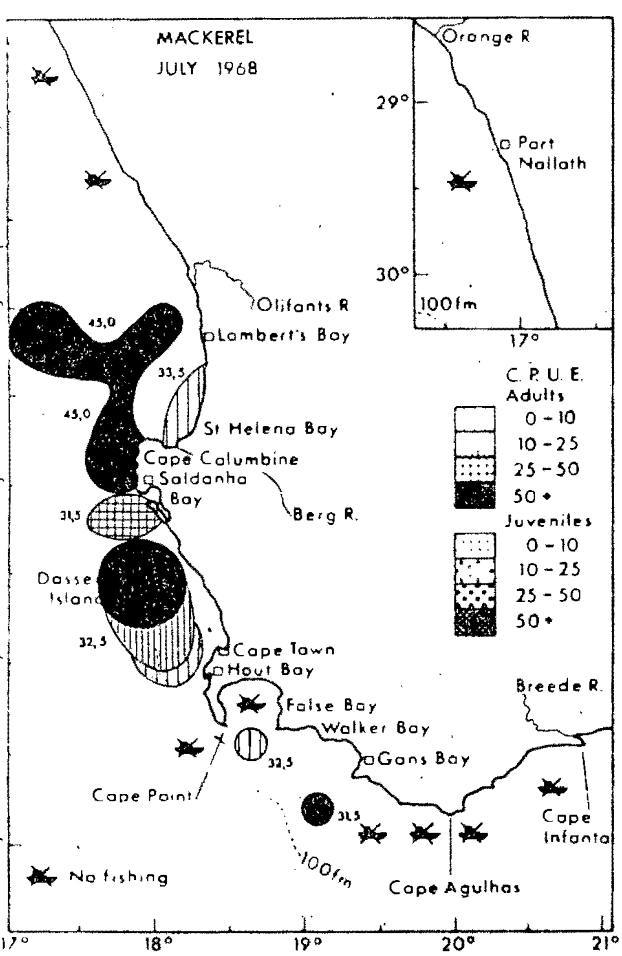
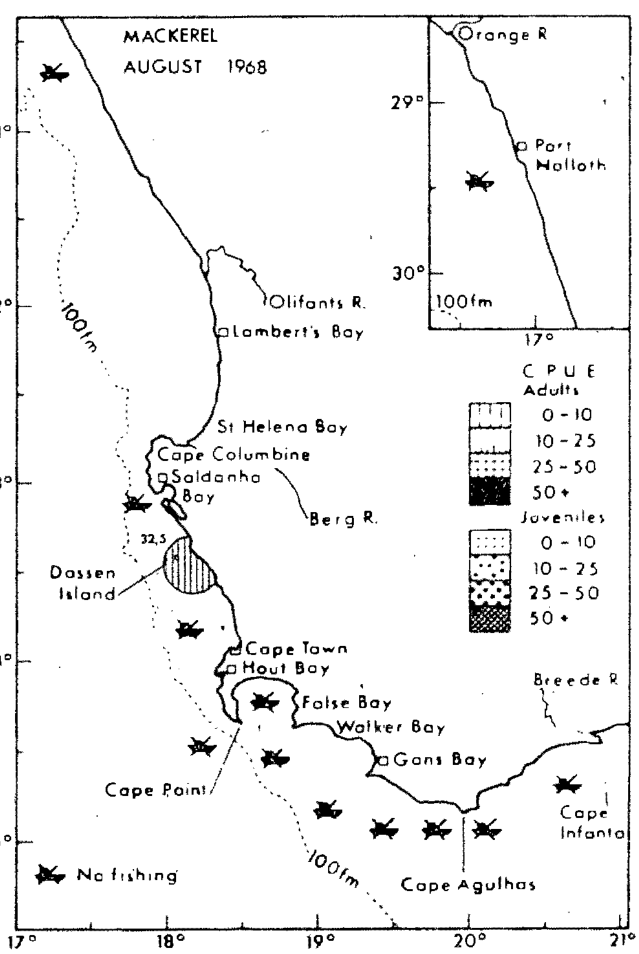
31°
30°
100fm
17°
Olifants R.
32°
33,5
100fm
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
33°
33,5
Dassen Island
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
25 - 50
50 +
32,5
Cape Town
Hout Bay
34°
Breede R
False Bay
Walker Bay
26,5
Gans Bay
Cape Point
Cape
35°
No fishing
100fm
Cape Agulhas
17°
18°
19°
20°
21°


MACKEREL
JULY 1968
Orange R
29°
Port Nollath
30°
100fm
17°
Olifants R
32°
45,0
Lambert's Bay
33,5
45,0
St Helena Bay
Cape Columbine
Saldanha Bay
33°
Berg R.
31,5
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
32,5
Cape Town
Hout Bay
34°
Breede R.
False Bay
Walker Bay
32,5
Gans Bay
Cape Point
Cape Infanta
31,5
35°
No fishing
100fm
Cape Agulhas
17°
18°
19°
20°
21°


MACKEREL
AUGUST 1968
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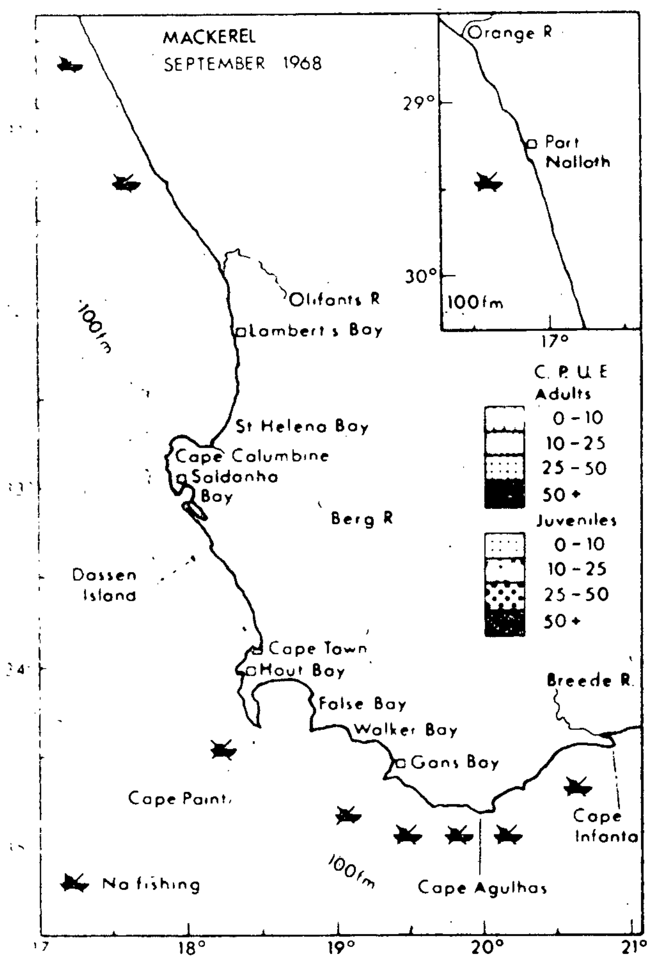
Port Nolloth
31°
30°
100fm
17°
Olifants R.
32°
100fm
Lambert's Bay
C P U E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
33°
Berg R.
32,5
Dassen Island
34°
Cape Town
Hout Bay
Breede R
False Bay
Walker Bay
Gans Bay
Cape Point
Cape Infanta
35°
No fishing
100fm
Cape Agulhas
17°
18°
19°
20°
21°


MACKEREL
SEPTEMBER 1968
Orange R
29°
Port Nolloth
30°
100fm
17°
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E
Adults
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10 - 25
25 - 50
50 +
Juveniles
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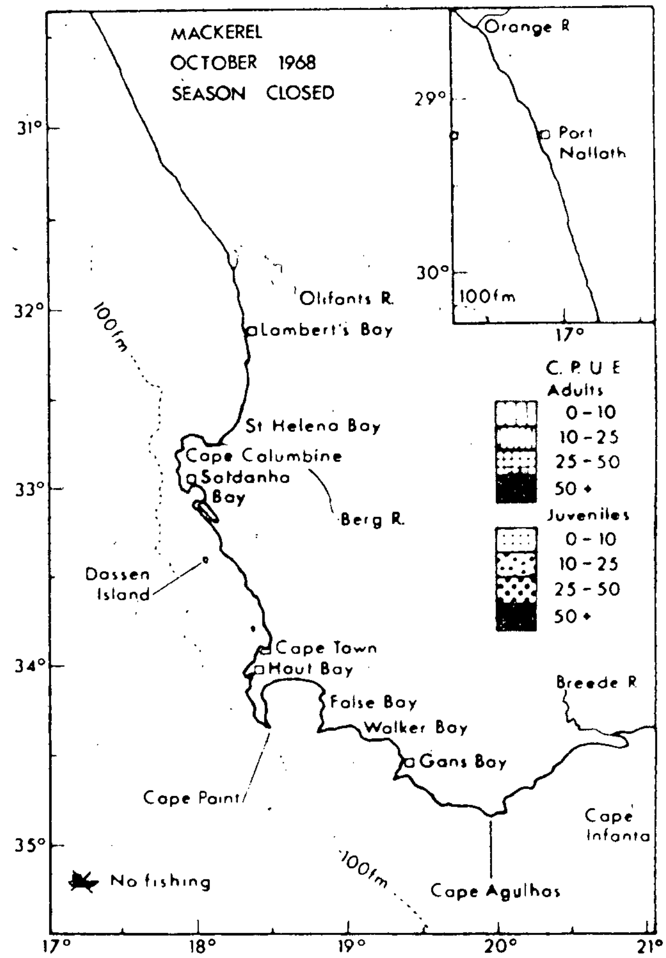
18°
19°
20°
21°


MACKEREL
OCTOBER 1968
SEASON CLOSED
Orange R
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Port Nolloth
30°
100fm
17°
31°
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34°
35°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E
Adults
0 - 10
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50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
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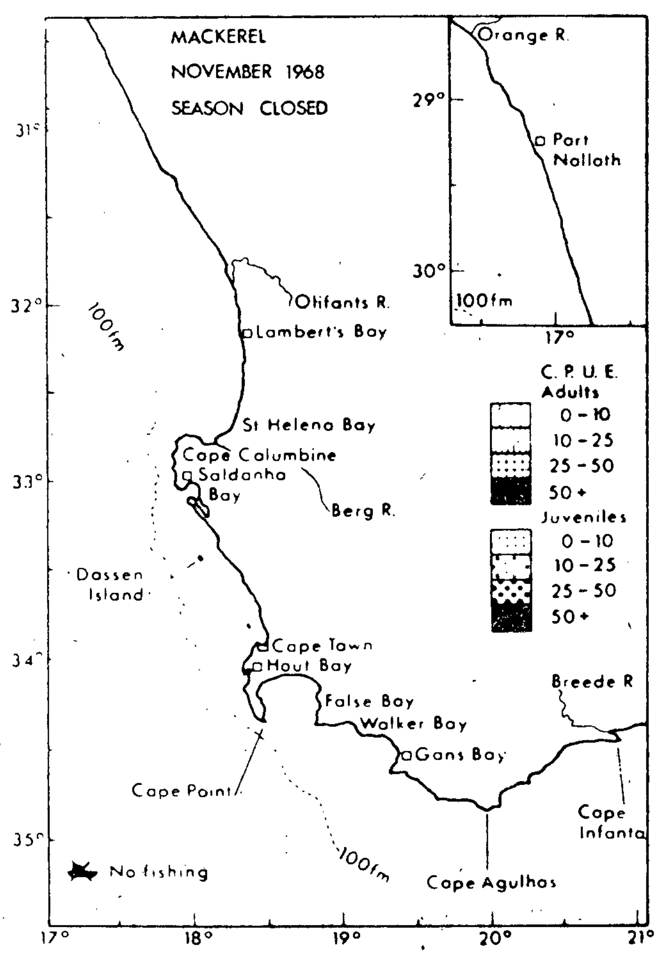
18°
19°
20°
21°


MACKEREL
NOVEMBER 1968
SEASON CLOSED
Orange R.
29°
Port Nolloth
30°
100fm
17°
31°
32°
33°
34°
35°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
0 - 10
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25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
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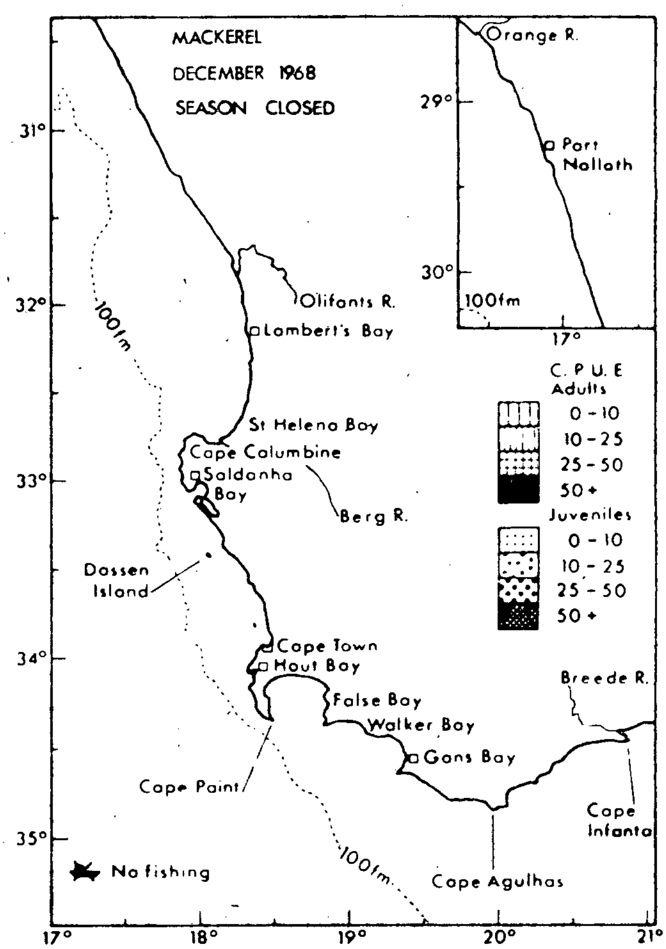
MACKEREL
DECEMBER 1968
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Port Nolloth
30°
100fm
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34°
35°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E
Adults
0 - 10
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50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
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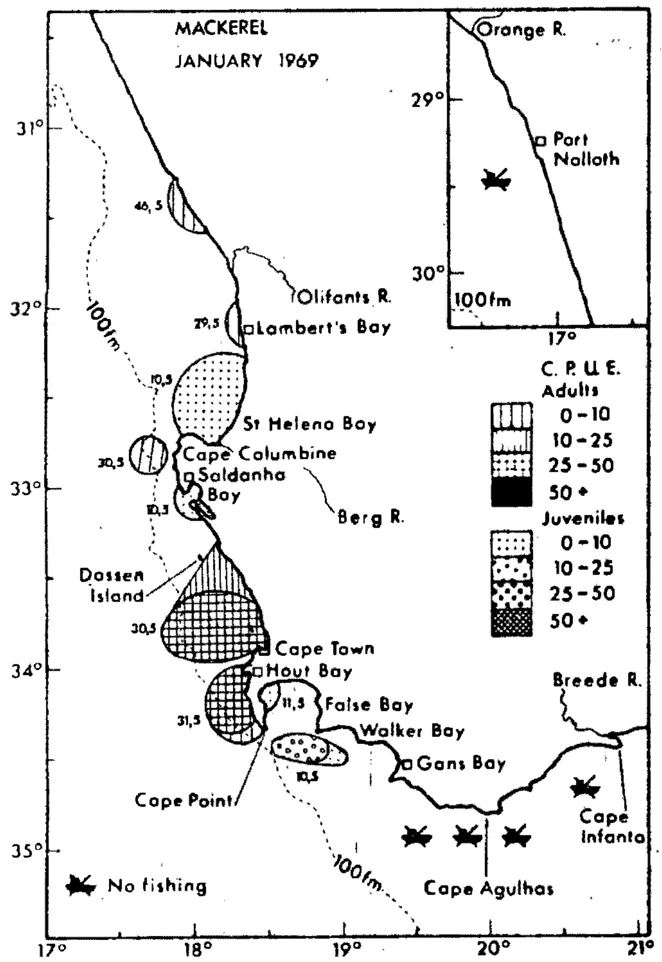
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JANUARY 1969
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100fm
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34°
35°
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Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
46,5
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10,5
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31,5
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10,5
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19°
20°
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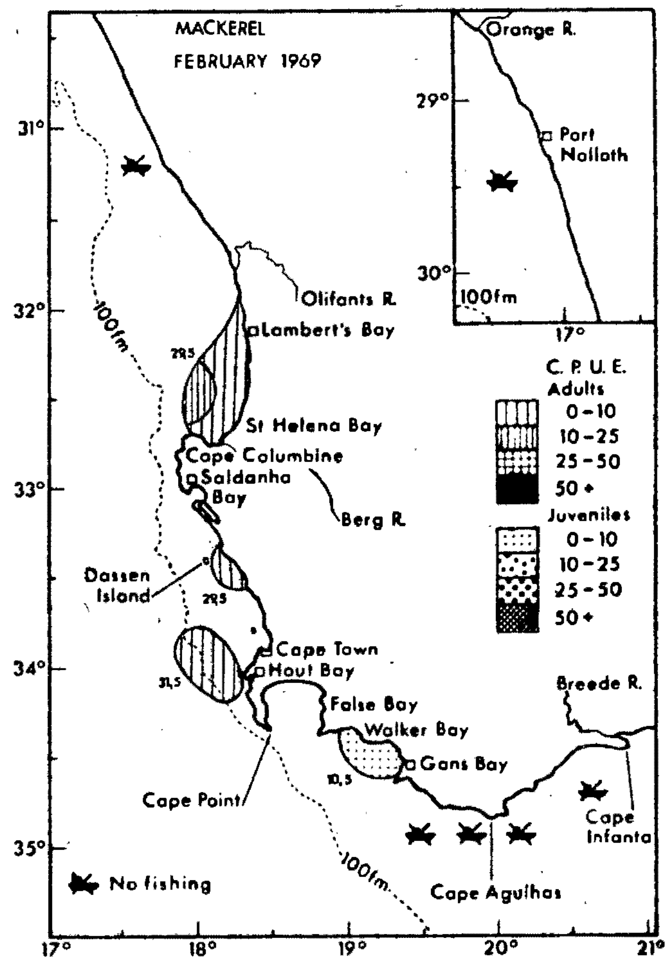
MACKEREL
FEBRUARY 1969
Orange R.
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Port Nolloth
30°
100fm
17°
31°
32°
33°
34°
35°
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
29,5
29,5
31,5
10,5
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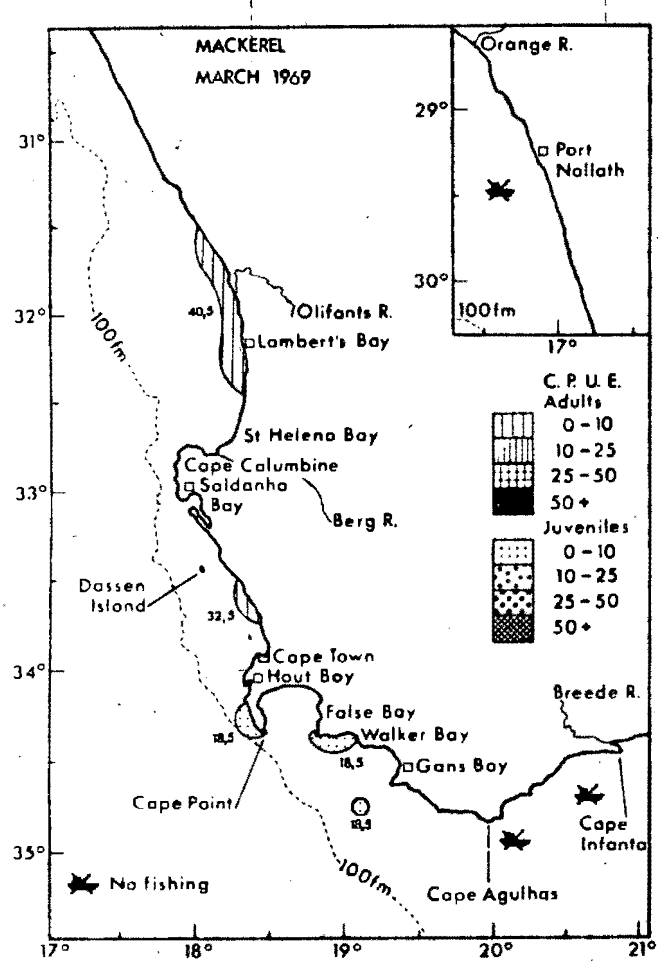
20°
21°


MACKEREL
MARCH 1969
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Port Nolloth
30°
100fm
17°
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32°
33°
34°
35°
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
40,5
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18,5
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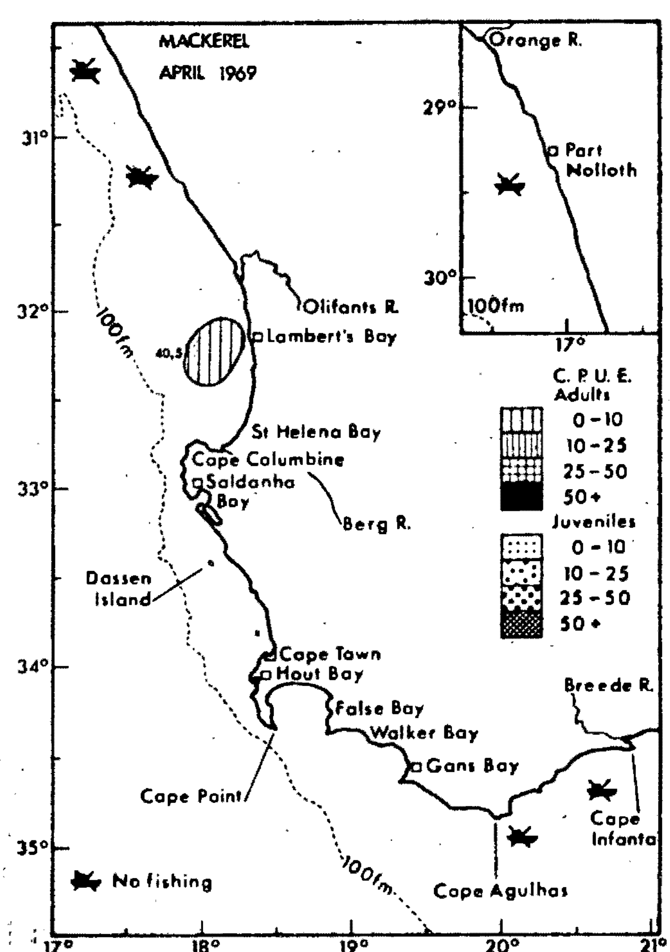
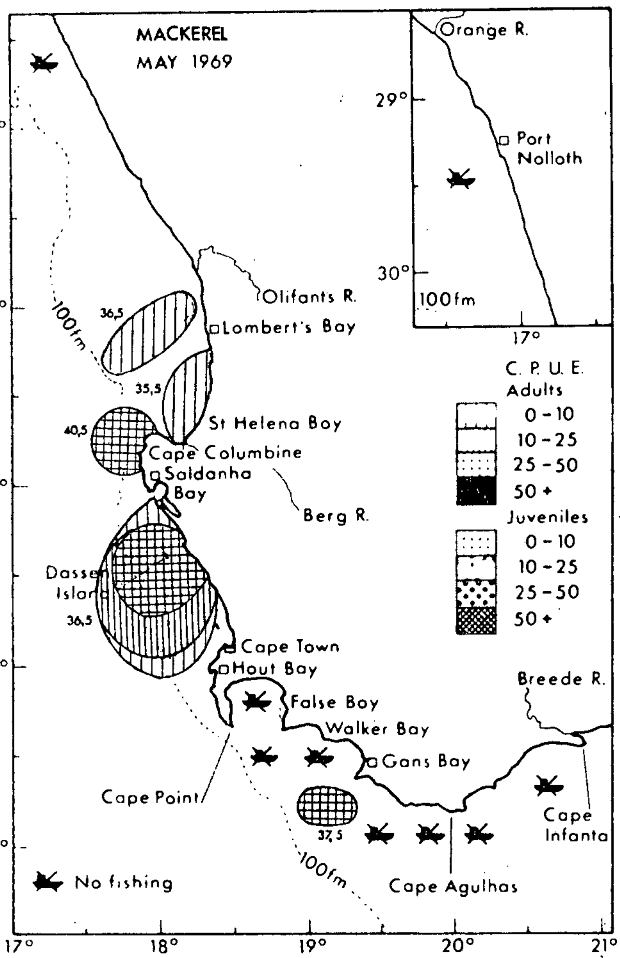
18,5
17°
18°
19°
20°
21°


MACKEREL
APRIL 1969
Orange R.
29°
Port Nolloth
30°
100fm
17°
31°
32°
33°
34°
35°
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
40,5
17°
18°
19°
20°
21°


MACKEREL
MAY 1969
Orange R.
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Port Nolloth
30°
100fm
17°
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32°
33°
34°
35°
100fm
Olifants R.
Lambert's Bay
36,5
35,5
St Helena Bay
40,5
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
36,5
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
37,5
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
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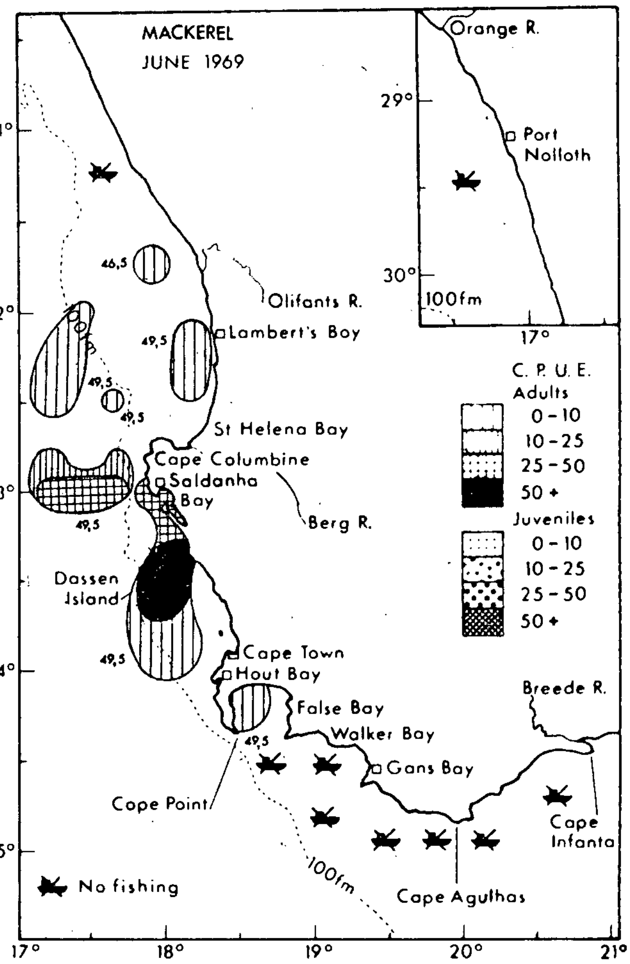
21°


MACKEREL
JUNE 1969
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Port Nolloth
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100fm
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33°
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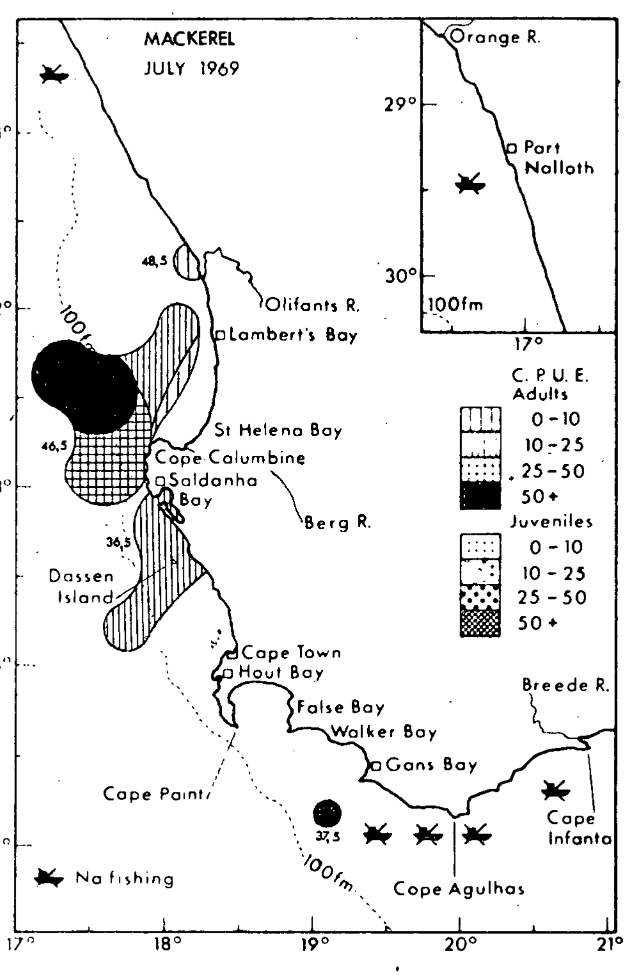
35°
46,5
Olifants R.
49,5
Lambert's Bay
49,5
49,5
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
49,5
Dassen Island
49,5
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
49,5
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
19°
20°
21°


MACKEREL
JULY 1969
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Port Nolloth
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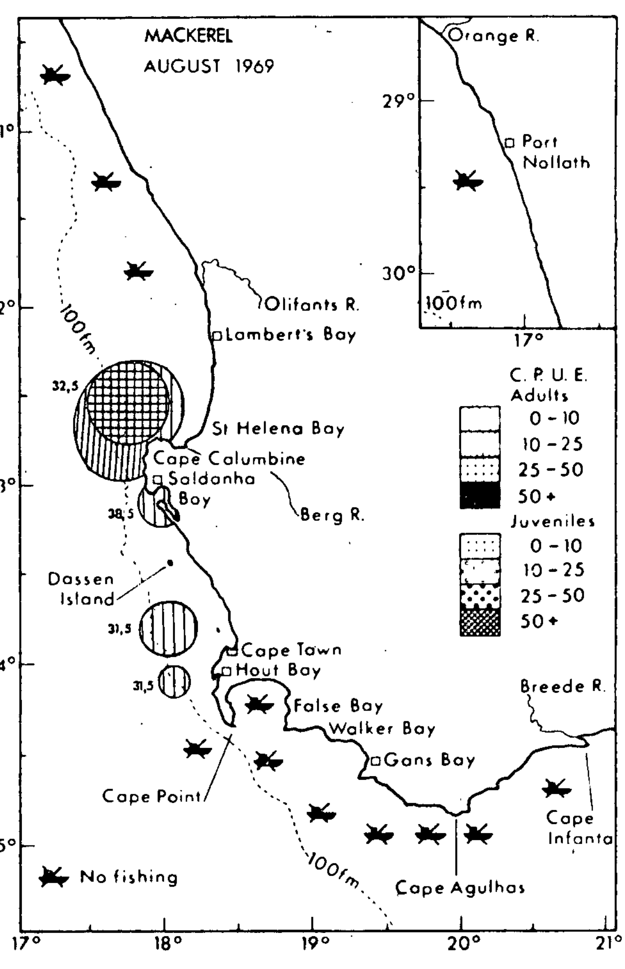
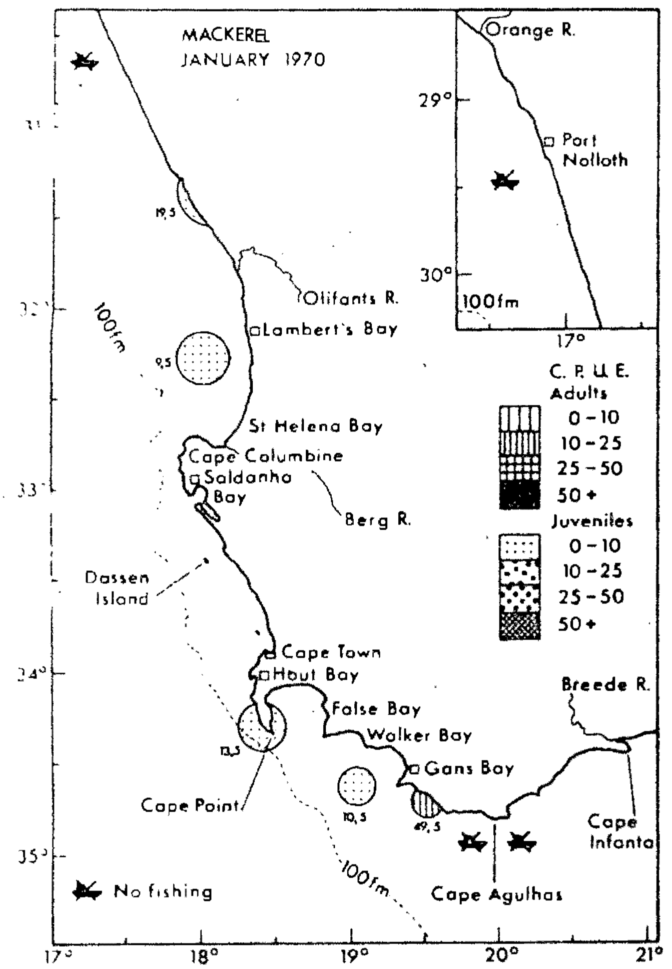
35°
48,5
Olifants R.
Lambert's Bay
100fm
St Helena Bay
46,5
Cape Columbine
Saldanha Bay
Berg R.
36,5
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
37,5
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
19°
20°
21°


MACKEREL
AUGUST 1969
Orange R.
29°
Port Nollath
30°
100fm
17°
31°
32°
33°
34°
35°
100fm
Olifants R.
Lambert's Bay
32,5
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
38,5
Dassen Island
31,5
31,5
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
19°
20°
21°


MACKEREL
JANUARY 1970
Orange R.
29°
Port
Nolloth
30°
100fm
17°
Olifants R.
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha
Bay
Berg R.
Dassen
Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape
Infanta
Cape Agulhas
No fishing
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
19,5
9,5
13,5
10,5
49,5
32°
33°
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35°
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19°
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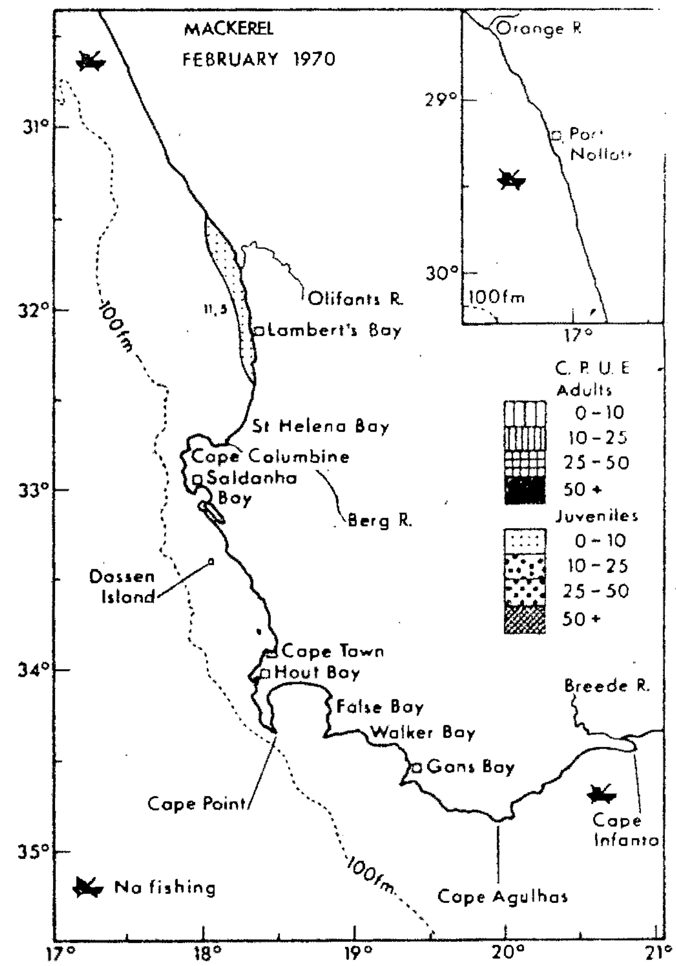
21°


MACKEREL
FEBRUARY 1970
Orange R.
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Port
Nolloth
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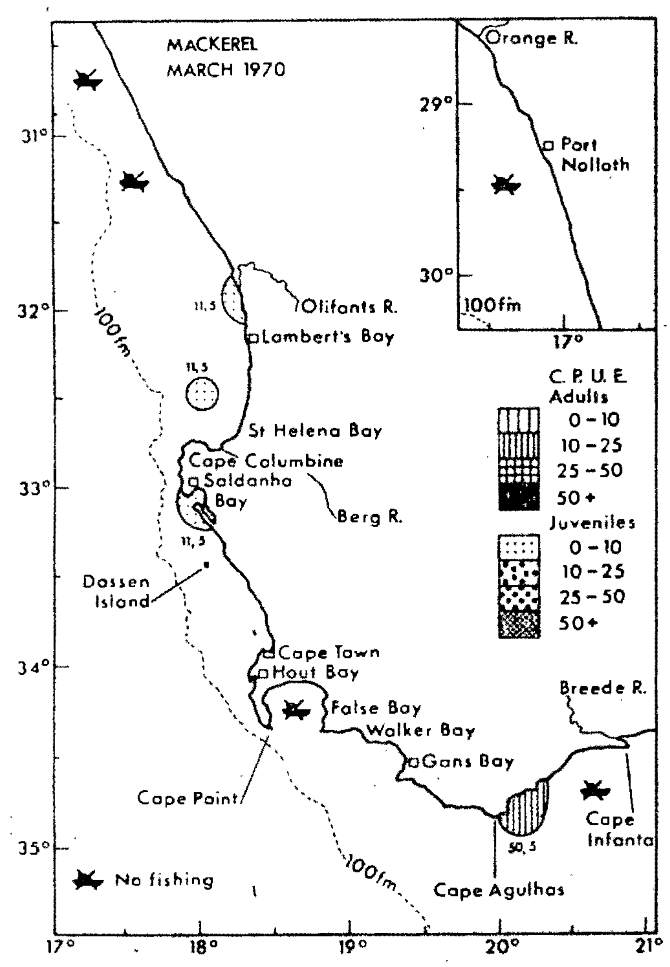
100fm
17°
31°
32°
11,5
Olifants R.
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha
Bay
33°
Berg R.
Dassen
Island
34°
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape
Infanta
35°
No fishing
100fm
Cape Agulhas
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
19°
20°
21°


MACKEREL
MARCH 1970
Orange R.
29°
Port
Nolloth
30°
100fm
17°
31°
32°
11,5
Olifants R.
Lambert's Bay
100fm
11,5
St Helena Bay
Cape Columbine
Saldanha
Bay
33°
Berg R.
11,5
Dassen
Island
34°
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape
Infanta
50,5
35°
No fishing
100fm
Cape Agulhas
C. P. U. E.
Adults
0 - 10
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25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
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19°
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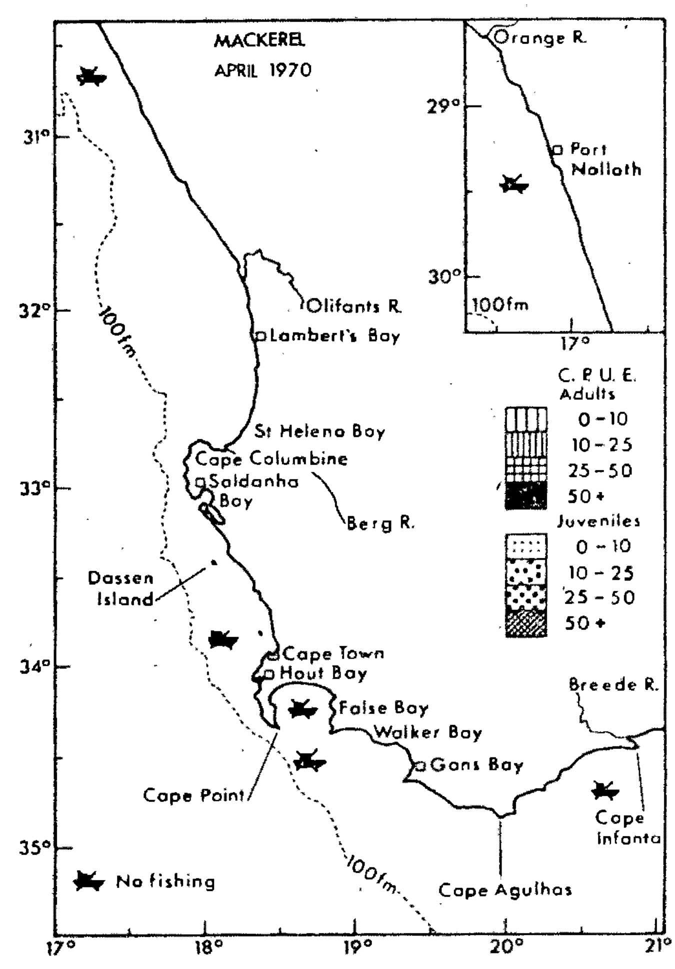
21°


MACKEREL
APRIL 1970
Orange R.
29°
Port
Nolloth
30°
100fm
17°
31°
32°
Olifants R.
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha
Bay
33°
Berg R.
Dassen
Island
34°
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape
Infanta
35°
No fishing
100fm
Cape Agulhas
C. P. U. E.
Adults
0 - 10
10 - 25
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50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
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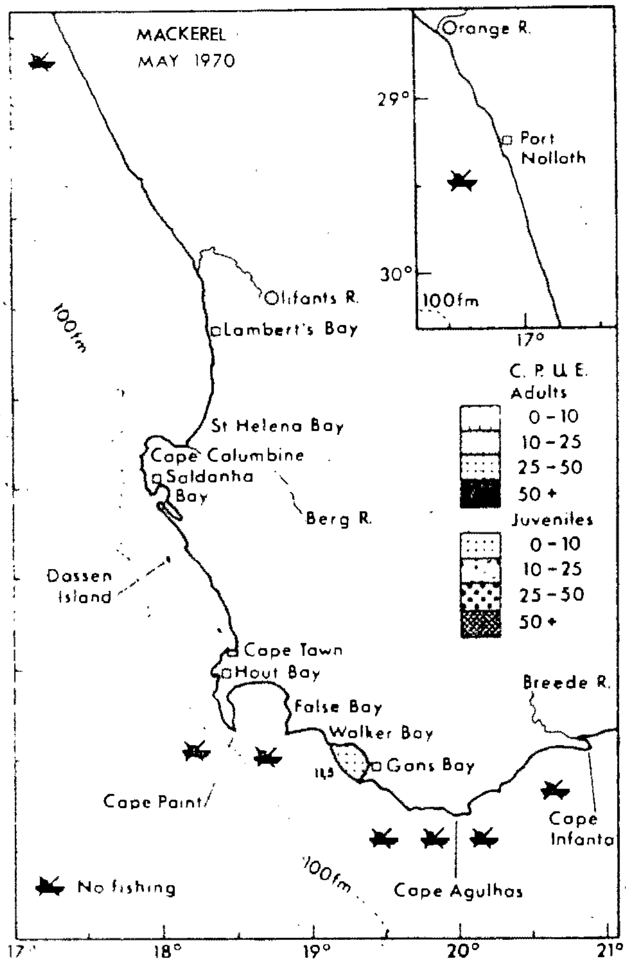
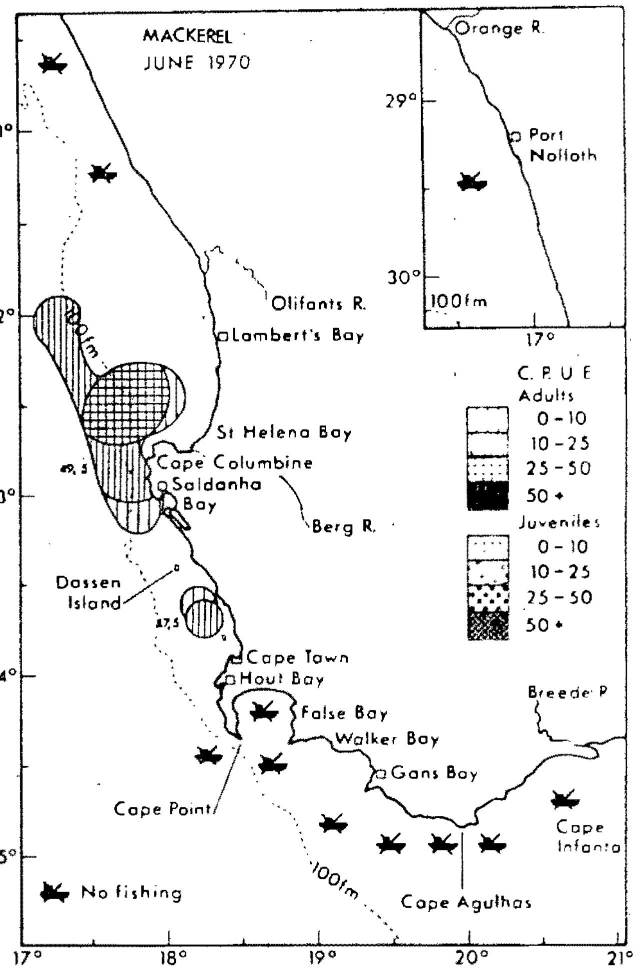
19°
20°
21°


MACKEREL
MAY 1970
Orange R.
29°
Port Nolloth
30°
100fm
17°
Olifants R.
Lambert's Bay
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
Breede R.
False Bay
Walker Bay
Gans Bay
11,5
Cape Point
Cape Infanta
100fm
No fishing
Cape Agulhas
18°
19°
20°
21°


MACKEREL
JUNE 1970
Orange R.
29°
Port Nolloth
30°
100fm
17°
31°
32°
Olifants R.
Lambert's Bay
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
49,5
33°
Berg R.
Dassen Island
47,5
Cape Town
34°
Hout Bay
Breede R.
False Bay
Walker Bay
Gans Bay
Cape Point
Cape Infanta
35°
100fm
No fishing
Cape Agulhas
17°
18°
19°
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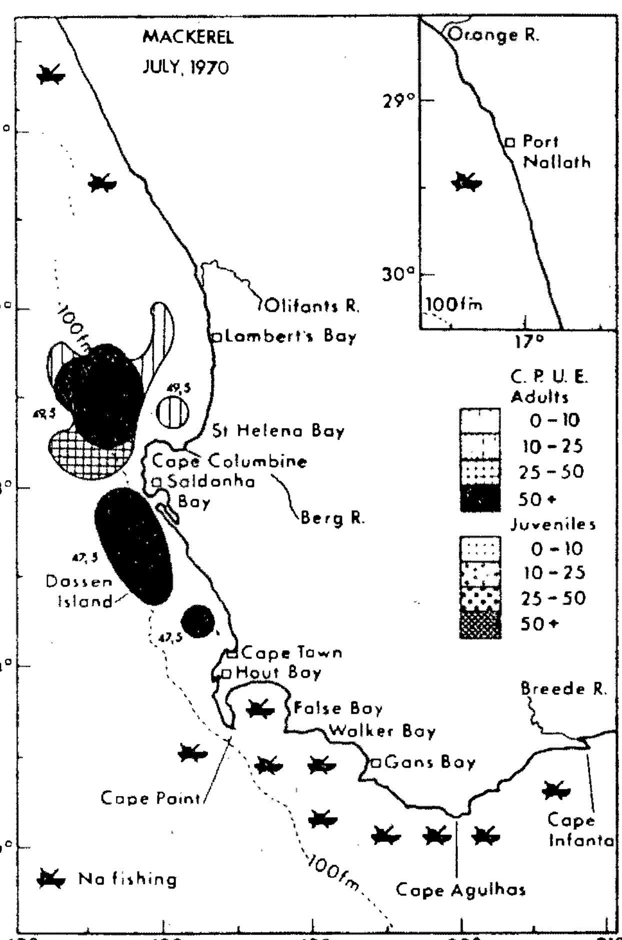
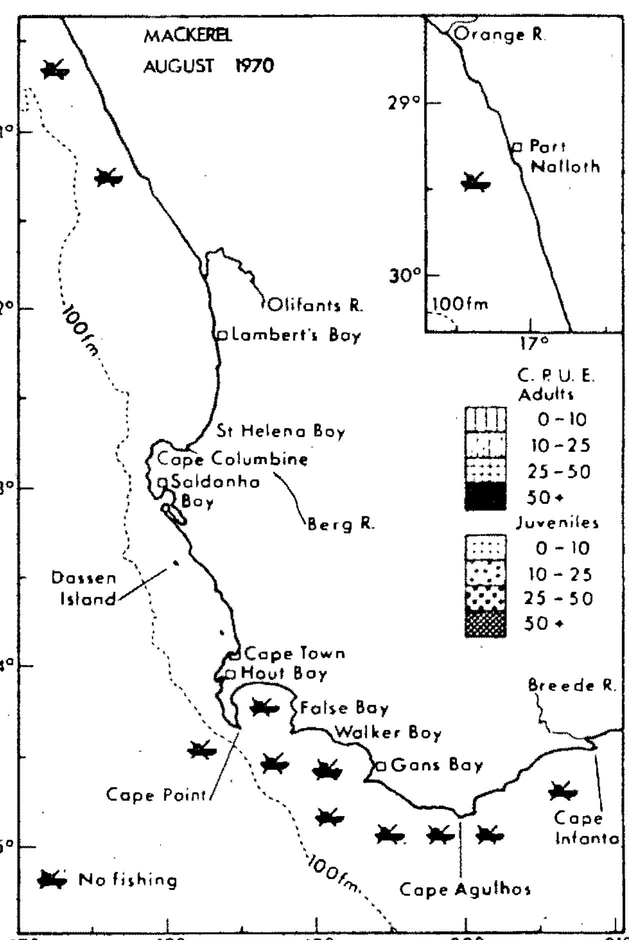
21°


MACKEREL
JULY, 1970
Orange R.
29°
Port Nollath
31°
30°
100fm
17°
32°
Olifants R.
Lambert's Bay
100fm
49,5
49,5
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
33°
Berg R.
47,5
Dassen Island
47,5
Cape Town
34°
Hout Bay
Breede R.
False Bay
Walker Bay
Gans Bay
Cape Point
Cape Infanta
35°
No fishing
100fm
Cape Agulhas
17°
18°
19°
20°
21°


MACKEREL
AUGUST 1970
Orange R.
29°
Port Nolloth
31°
30°
100fm
17°
32°
Olifants R.
Lambert's Bay
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
33°
Berg R.
Dassen Island
Cape Town
34°
Hout Bay
Breede R.
False Bay
Walker Bay
Gans Bay
Cape Point
Cape Infanta
35°
No fishing
100fm
Cape Agulhas
17°
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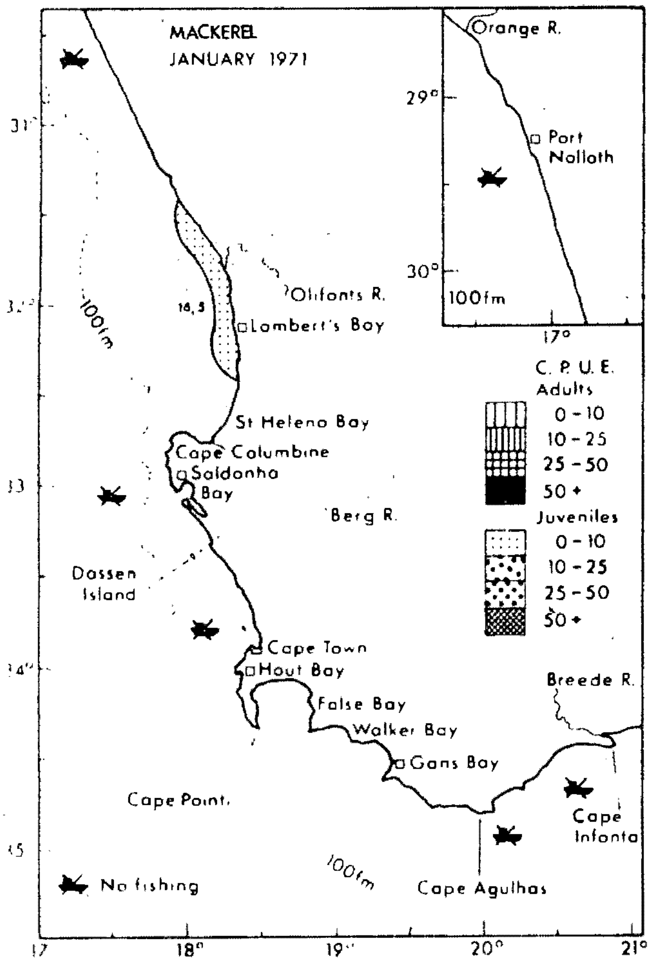
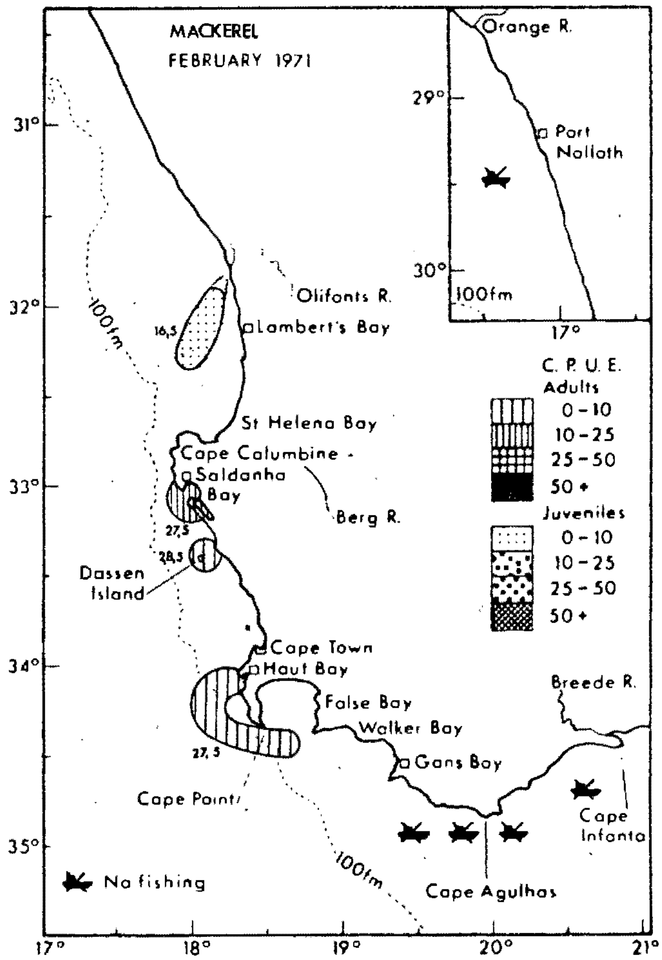
21°


MACKEREL
JANUARY 1971
Orange R.
29°
Port Nolloth
30°
100fm
17°
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
16,5
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
18°
19°
20°
21°


MACKEREL
FEBRUARY 1971
Orange R.
29°
Port Nolloth
30°
100fm
17°
31°
32°
33°
34°
35°
100fm
16,5
27,5
28,5
27,5
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
No fishing
17°
18°
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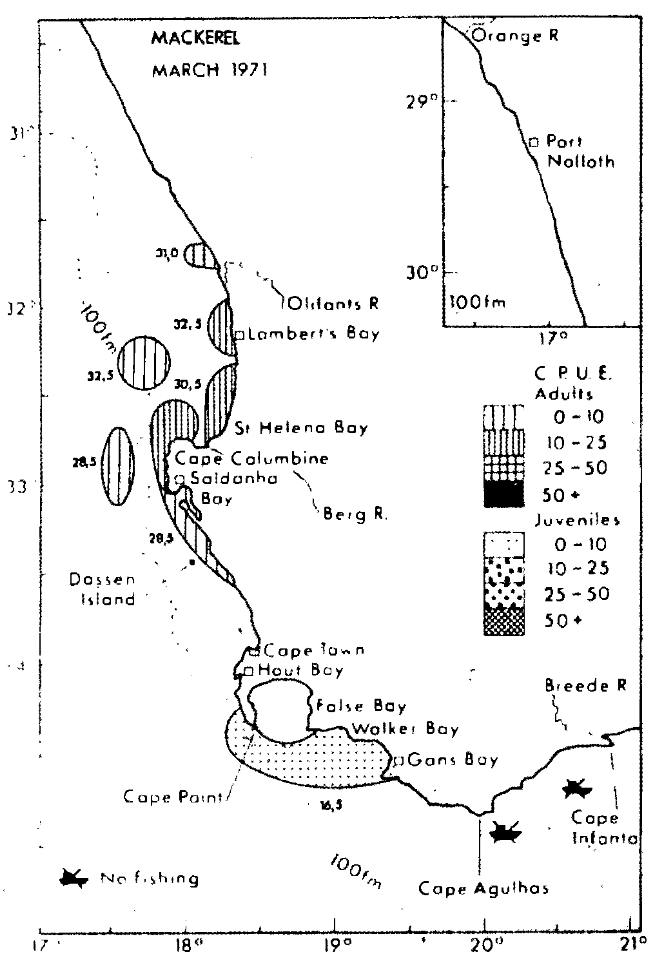
20°
21°


MACKEREL
MARCH 1971
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Port Nolloth
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28,5
16,5
100fm
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
C P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
No fishing
100fm
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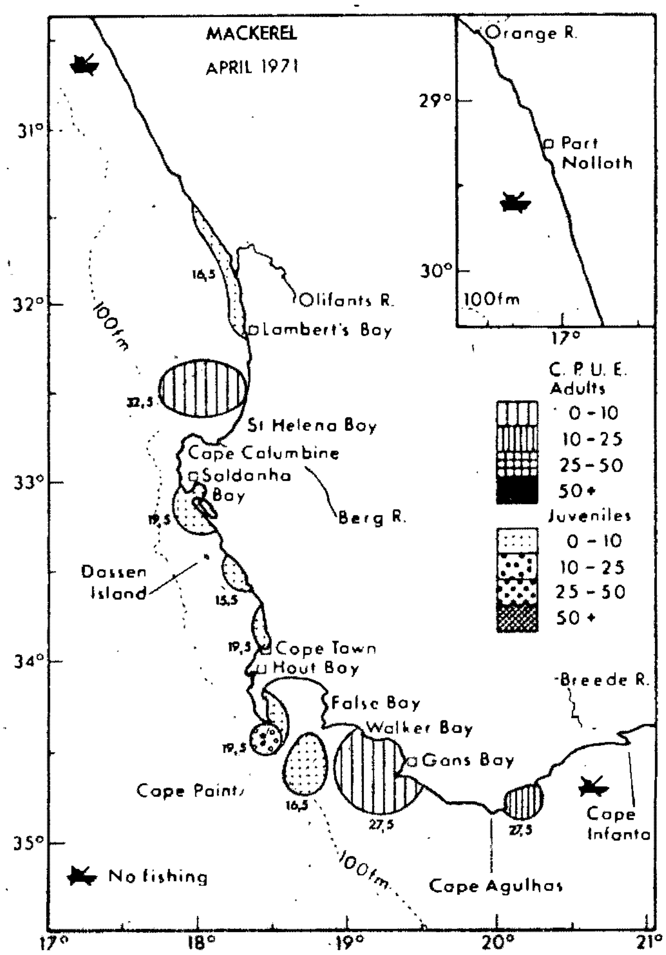
MACKEREL
APRIL 1971
Orange R.
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Port Nolloth
30°
100fm
17°
31°
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33°
34°
35°
100fm
16,5
32,5
19,5
15,5
19,5
19,5
16,5
27,5
27,5
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
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25 - 50
50 +
No fishing
100fm
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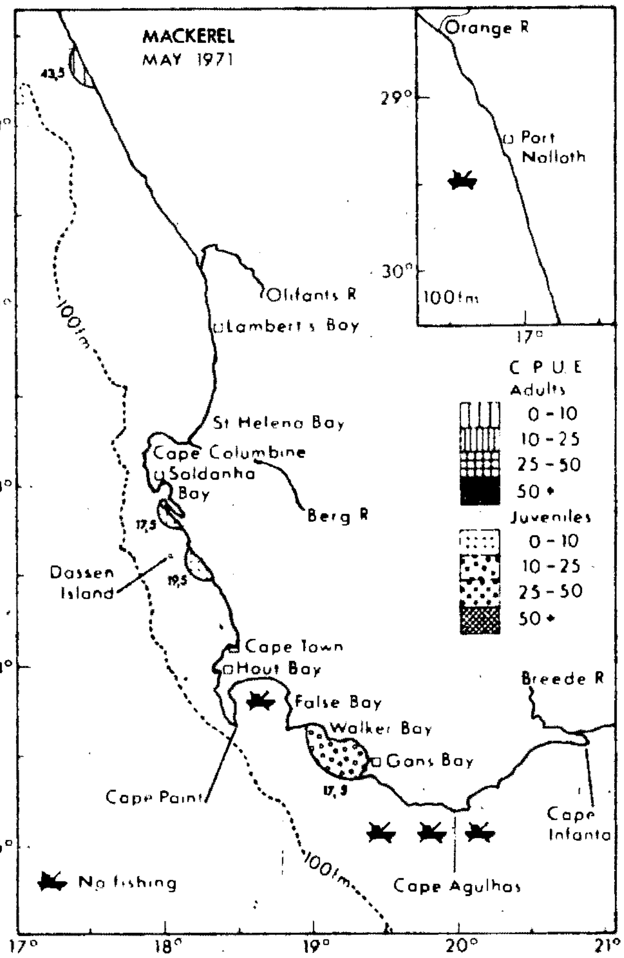
21°


MACKEREL
MAY 1971
Orange R
Port Nolloth
100fm
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C P U E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
43,5
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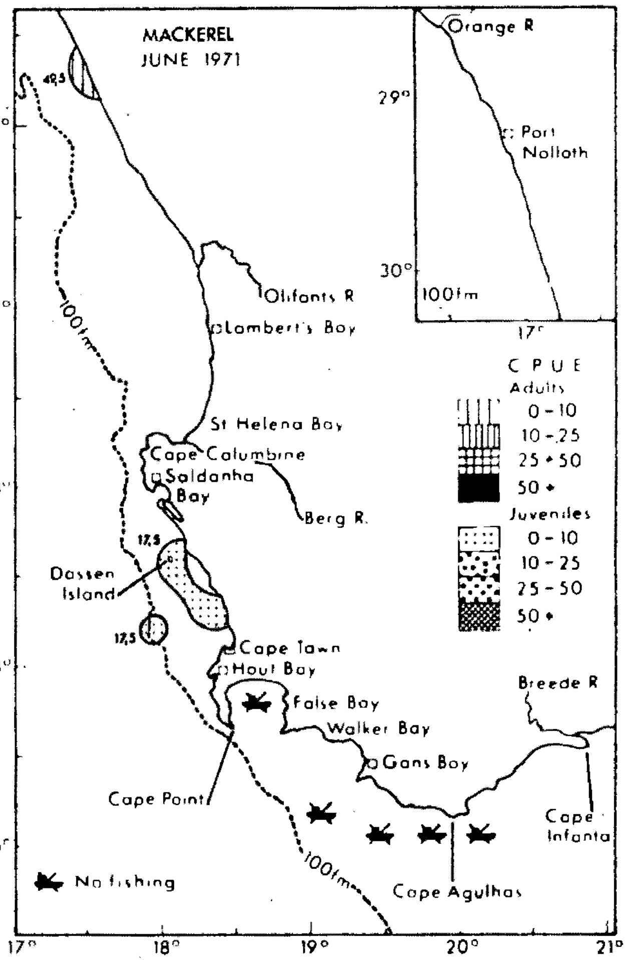
MACKEREL
JUNE 1971
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Port Nolloth
100fm
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C P U E
Adults
0 - 10
10 - 25
25 + 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
49,5
17,5
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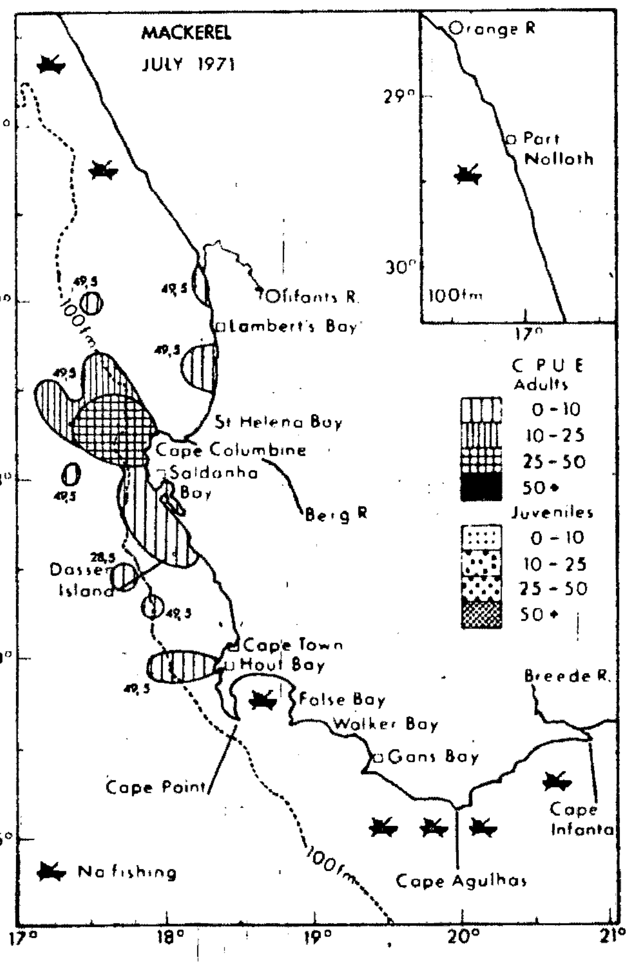
MACKEREL
JULY 1971
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Port Nolloth
100fm
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Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C P U E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
49,5
49,5
49,5
49,5
49,5
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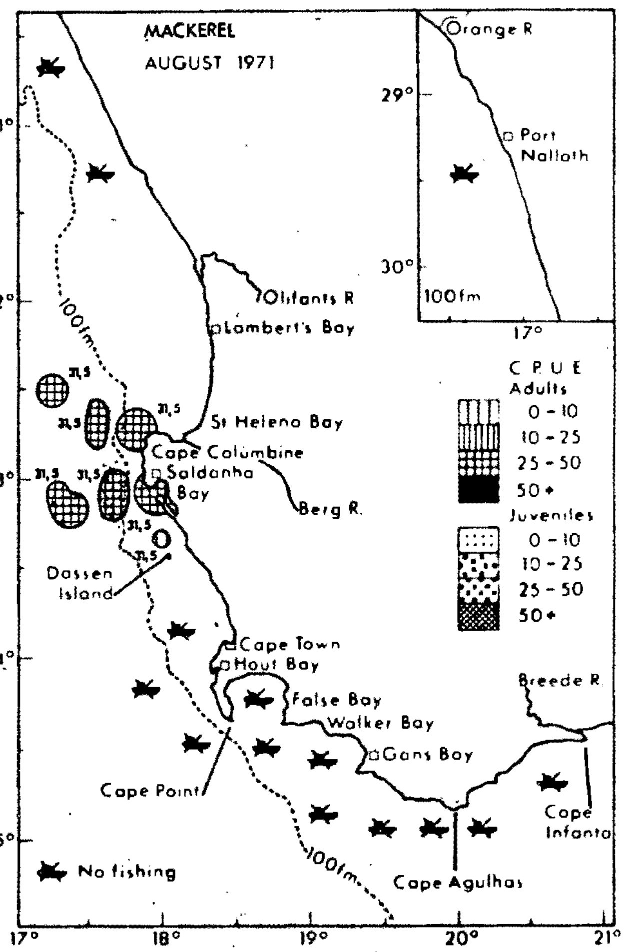
MACKEREL
AUGUST 1971
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Port Nolloth
100fm
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C P U E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
31,5
17°
18°
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20°
21°
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30°
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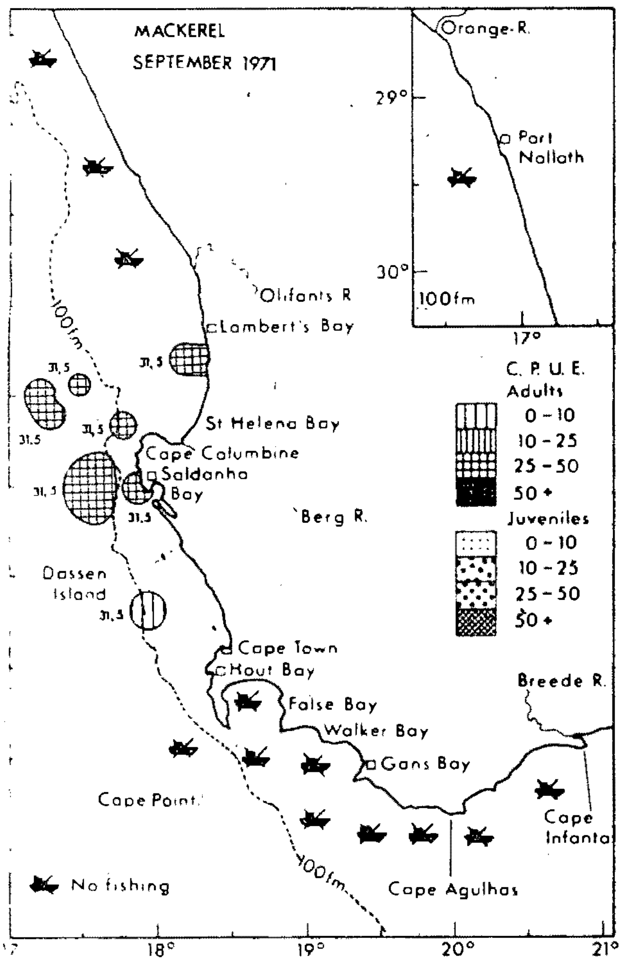
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SEPTEMBER 1971
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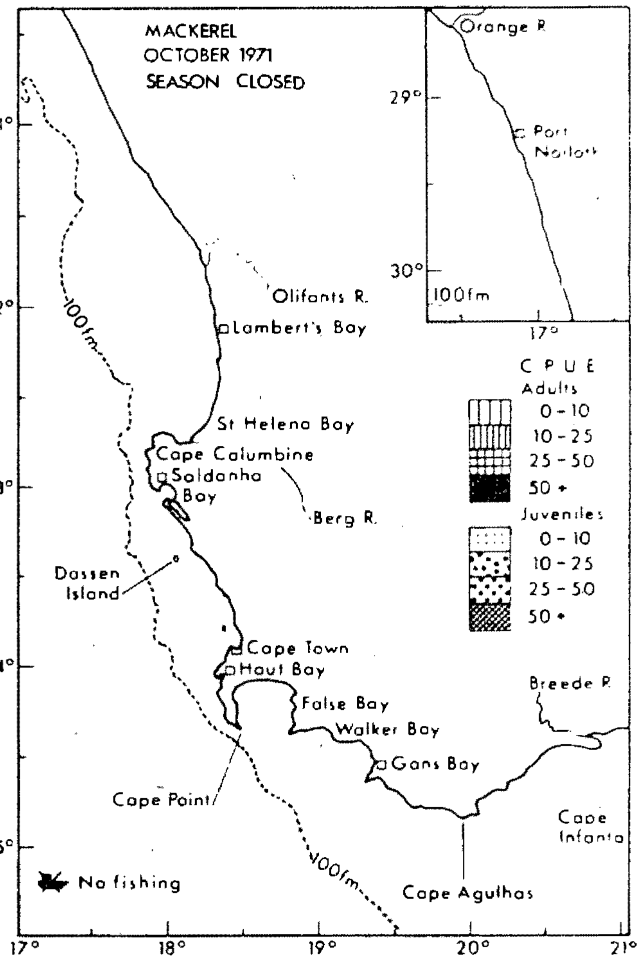
Port Nolloth
30°
100fm
17°
Olifants R.
Lambert's Bay
100fm
31.5
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
18°
19°
20°
21°


MACKEREL
OCTOBER 1971
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Port Nolloth
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100fm
17°
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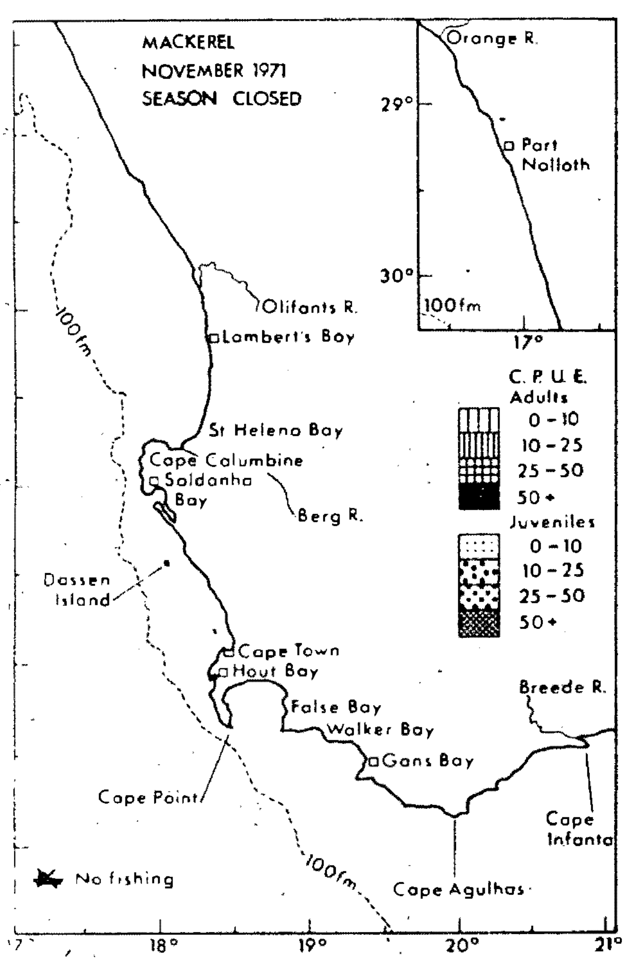
33°
34°
35°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C P U E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
19°
20°
21°


MACKEREL
NOVEMBER 1971
SEASON CLOSED
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29°
Port Nolloth
30°
100fm
17°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
18°
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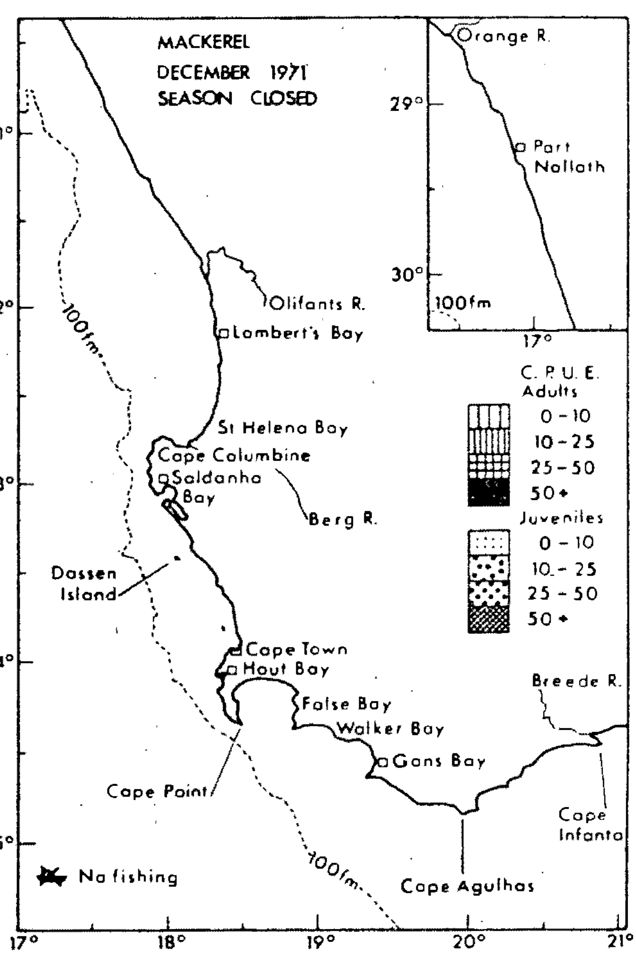
MACKEREL
DECEMBER 1971
SEASON CLOSED
Orange R.
29°
Port Nolloth
30°
100fm
17°
31°
32°
33°
34°
35°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
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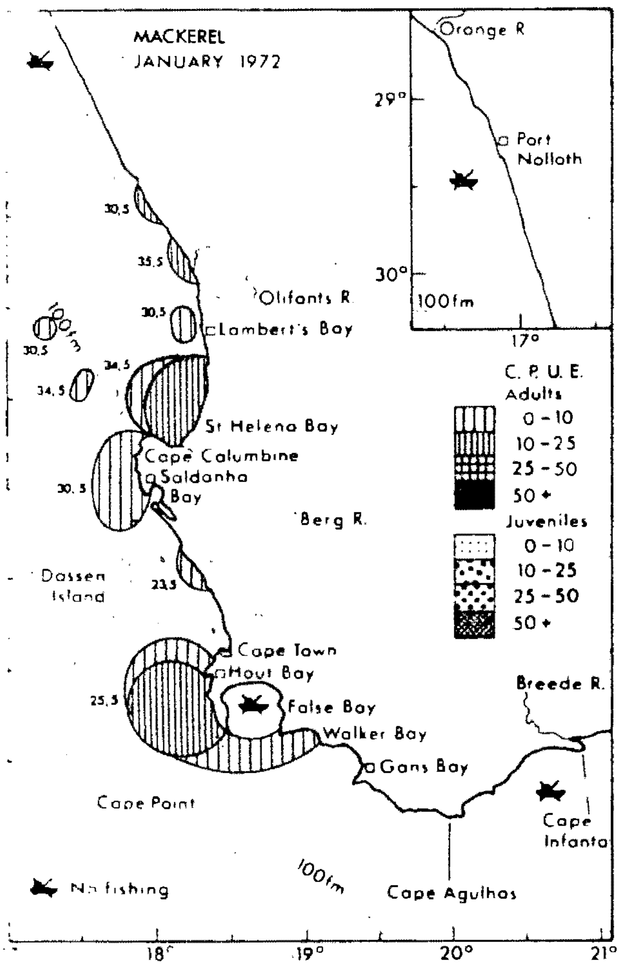
MACKEREL
JANUARY 1972
Orange R
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
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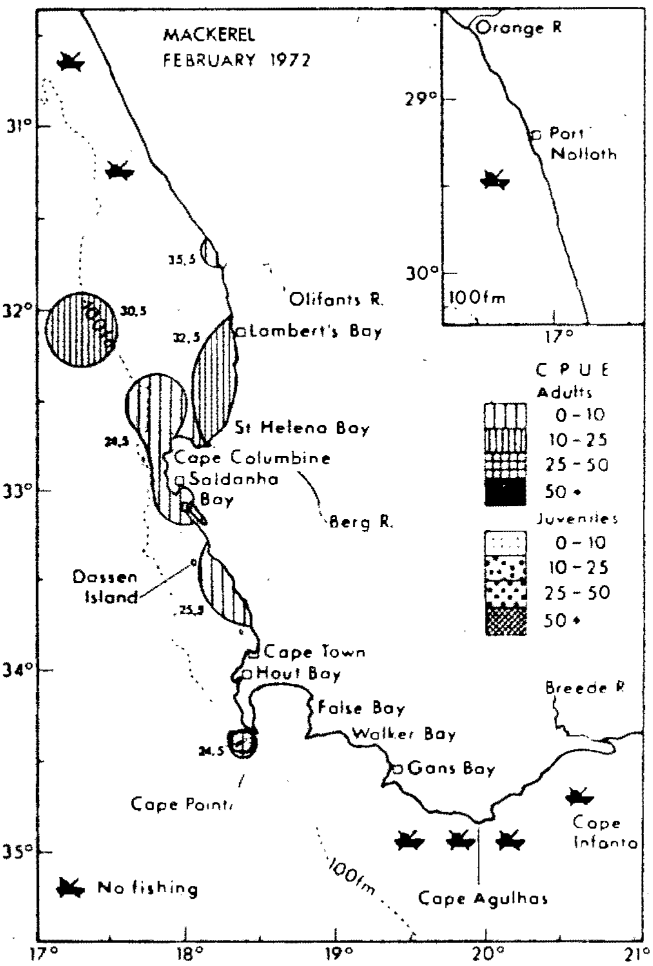
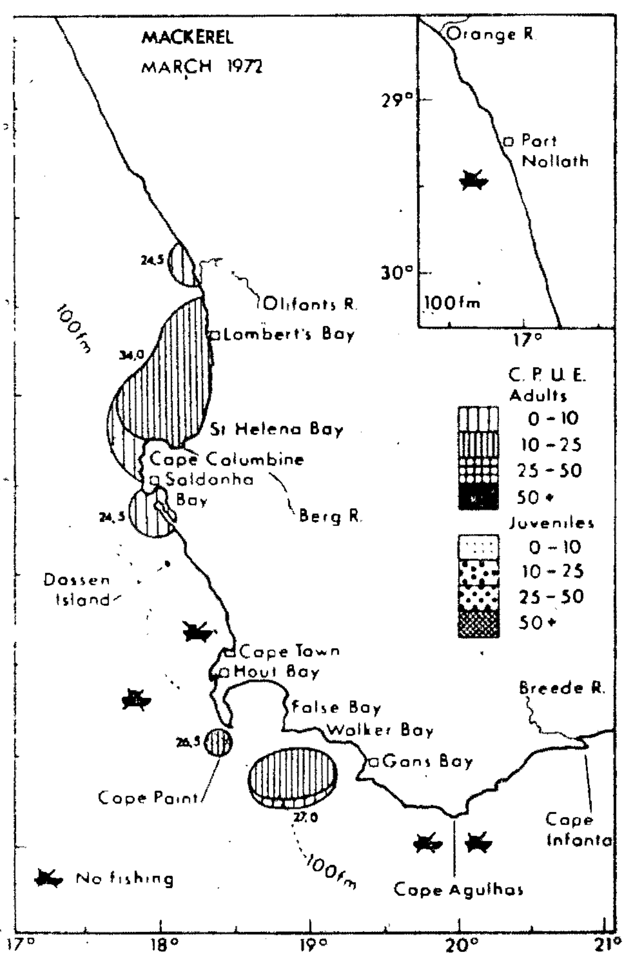
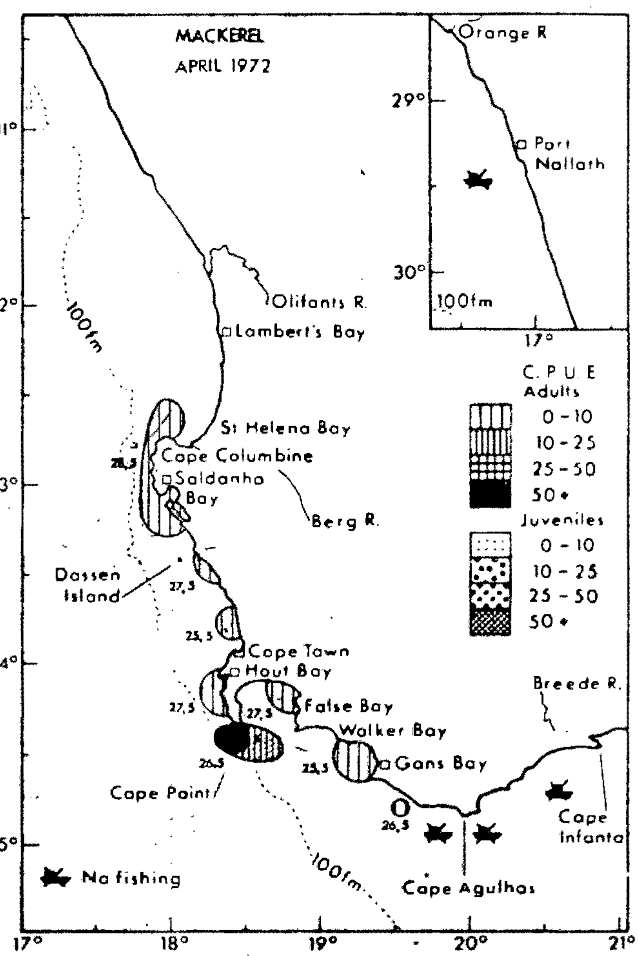
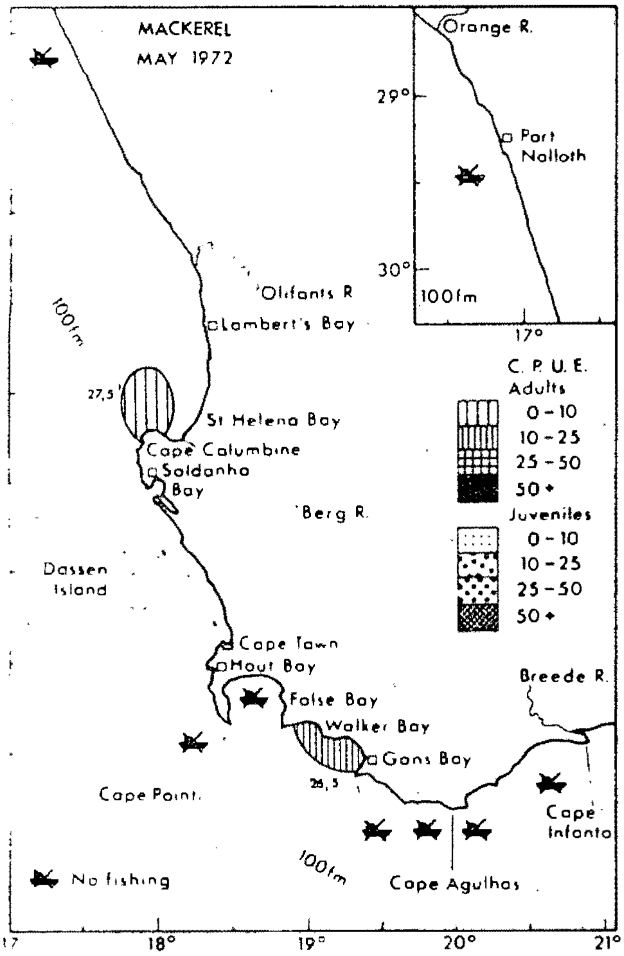
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +


MACKEREL
FEBRUARY 1972
Orange R
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C P U E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +


MACKEREL
MARCH 1972
Orange R
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +


MACKEREL
APRIL 1972
Orange R
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P U E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +


MACKEREL
MAY 1972
Orange R.
29°
Port Nolloth
30°
100fm
17°
Olifants R
Lambert's Bay
100fm
27,5
St Helena Bay
Cape Columbine
Soldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
25,5
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
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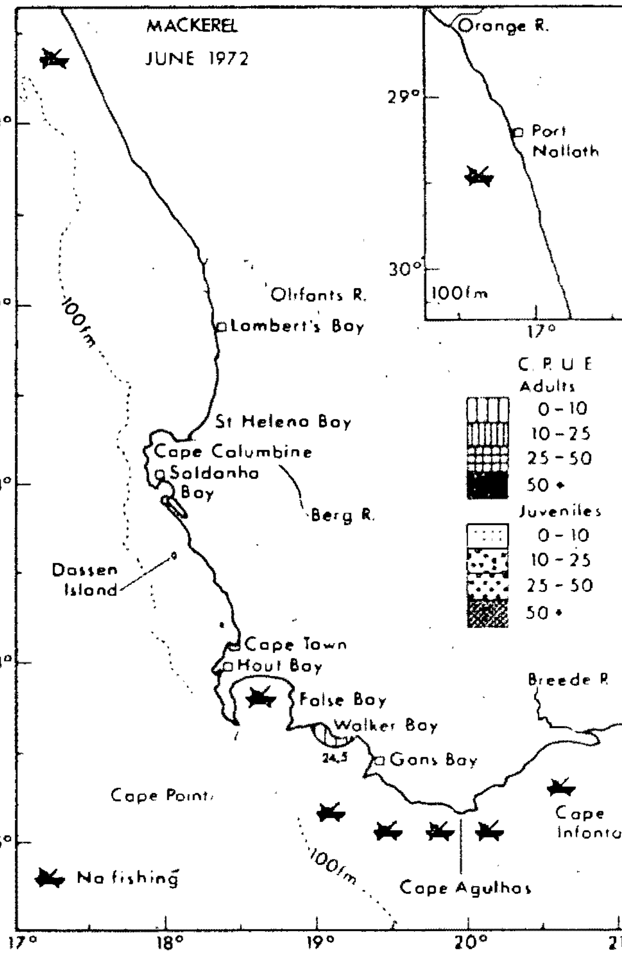
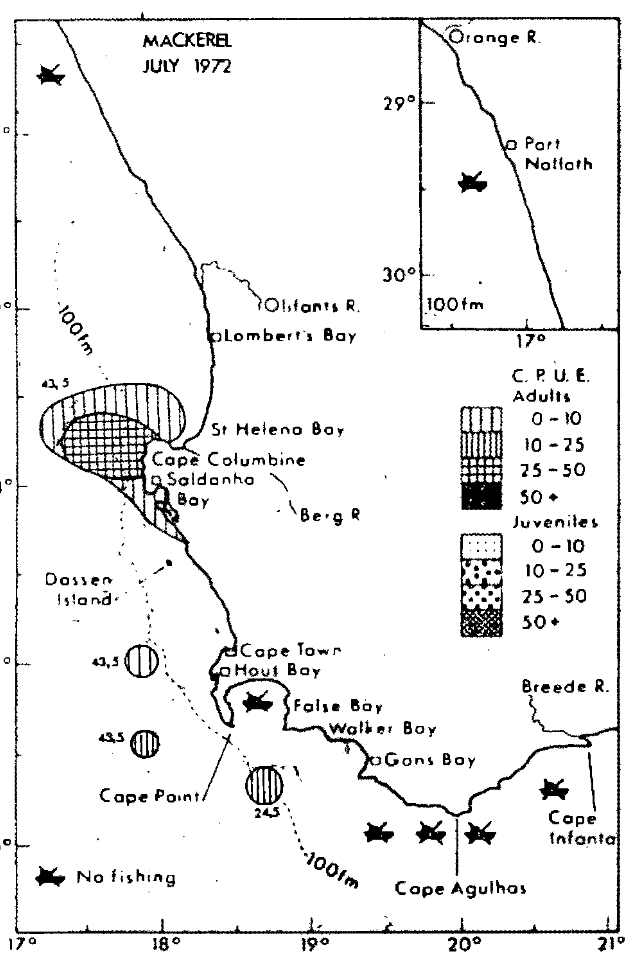
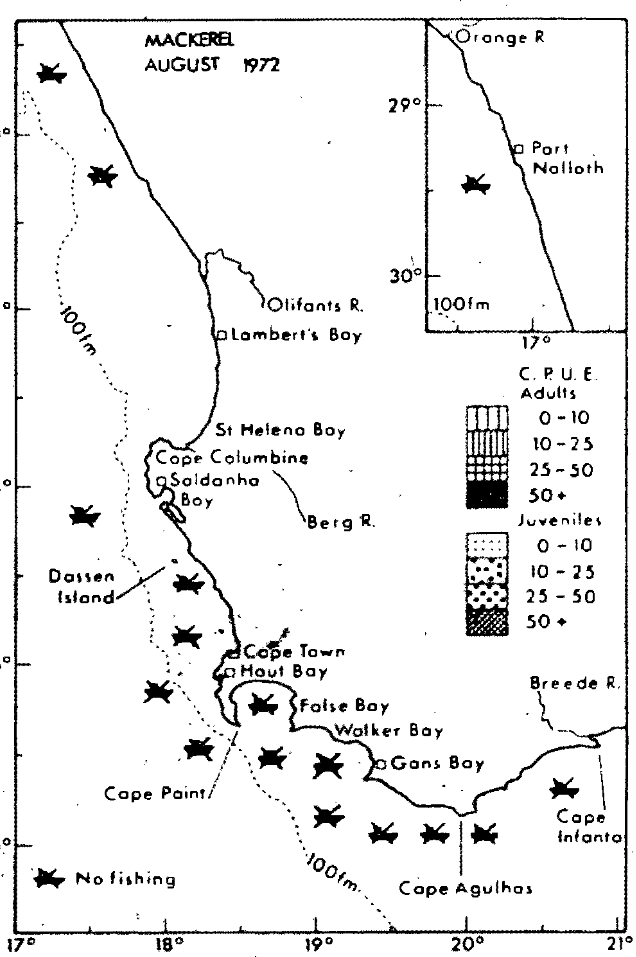
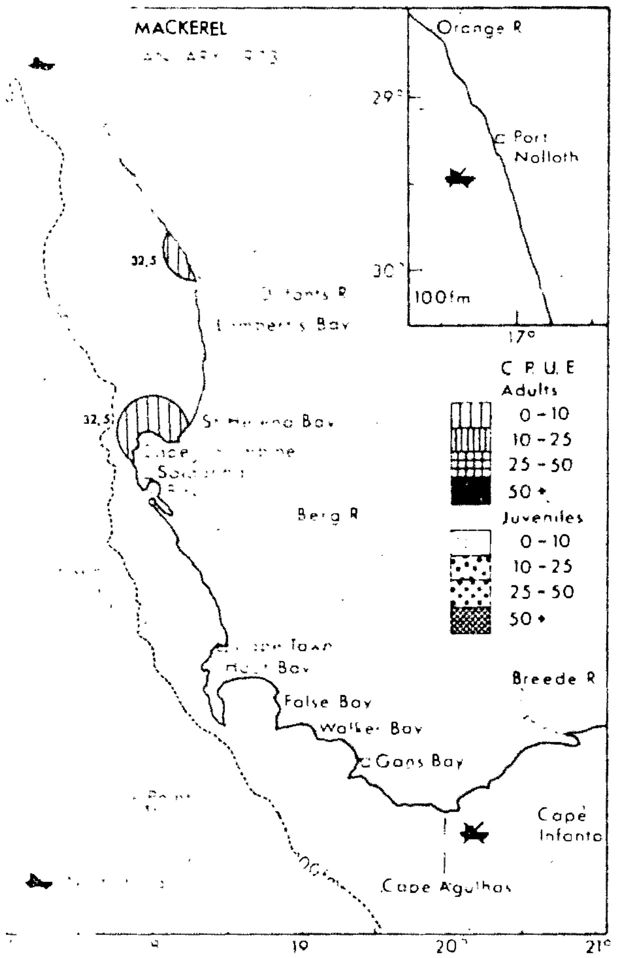
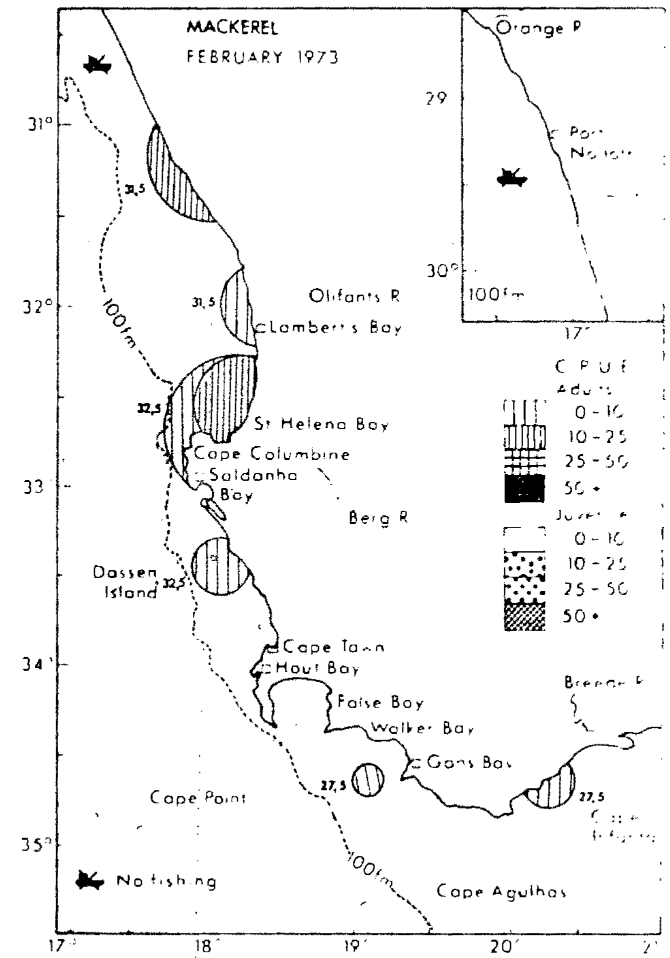
25 - 50
50 +
18°
19°
20°
21°

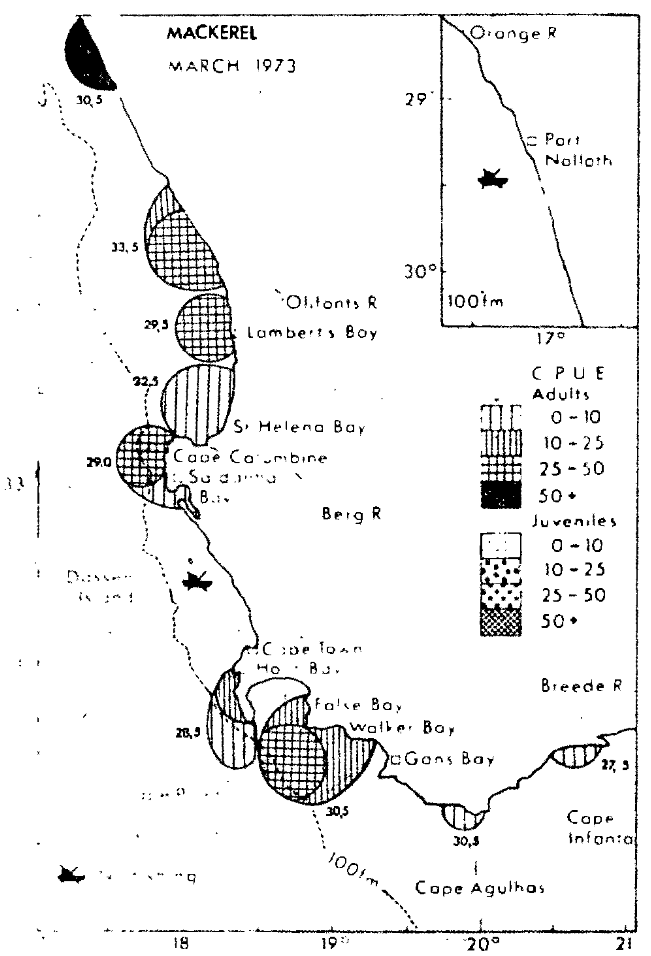

MACKEREL
JUNE 1972
Orange R.
29°
Port Nolloth
30°
100fm
17°
31°
32°
33°
34°
35°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Soldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
24,5
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
19°
20°
21°

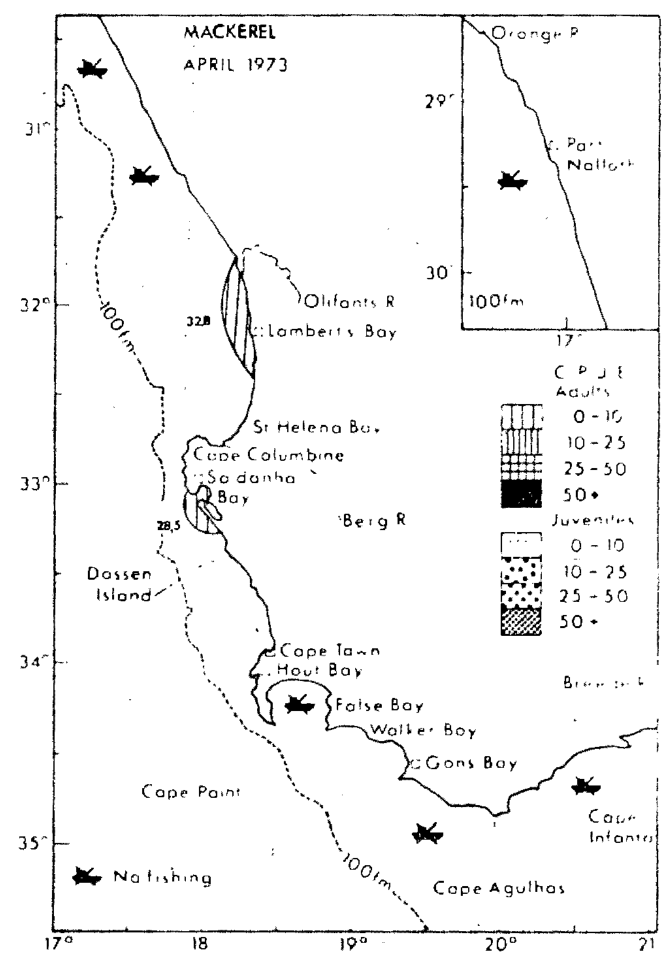

MACKEREL
JULY 1972
Orange R.
29°
Port Nolloth
30°
100fm
17°
31°
32°
33°
34°
35°
100fm
Olifants R.
Lambert's Bay
43,5
St Helena Bay
Cape Columbine
Soldanha Bay
Berg R
Dassen Island
43,5
Cape Town
Hout Bay
False Bay
Walker Bay
43,5
Gans Bay
Breede R.
Cape Point
24,5
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
19°
20°
21°

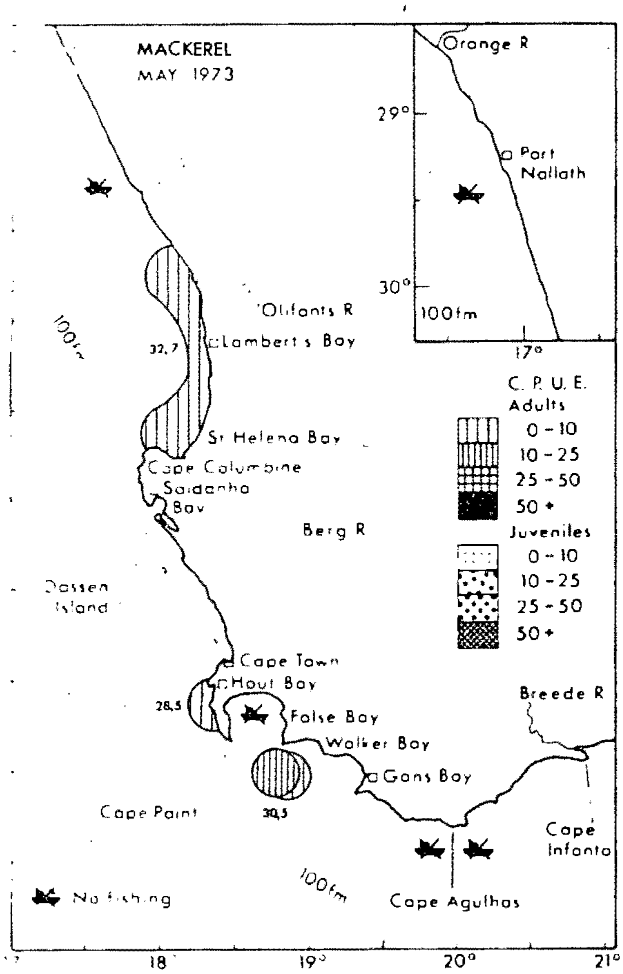

MACKEREL
AUGUST 1972
Orange R
29°
Port Nolloth
30°
100fm
17°
31°
32°
33°
34°
35°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Soldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
19°
20°
21°

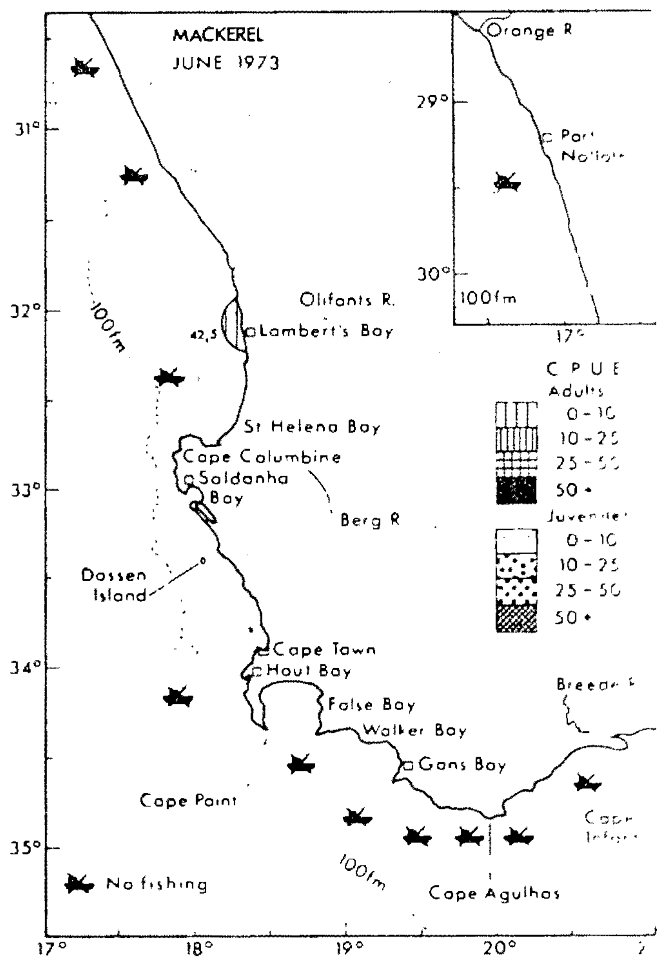

MACKEREL
Orange R
29°
Port
Nolloth
30°
100fm
17°
32,5
32,5
St Helena Bay
Berg R
C P U E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
False Bay
Walker Bay
Gans Bay
Breede R
Cape
Infanta
Cape Agulhas
19
20°
21°

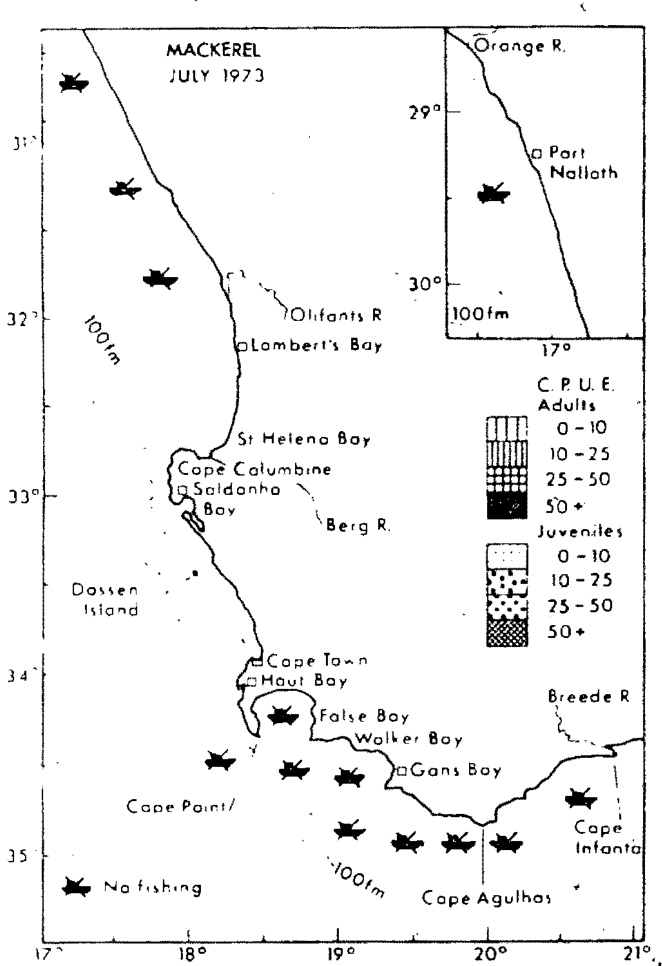

MACKEREL
FEBRUARY 1973
Orange R
29
30°
100fm
17°
31°
31,5
32°
31,5
100fm
Olifants R
Lamberts Bay
32,5
St Helena Bay
Cape Columbine
Saldanha
Bay
33°
Berg R
Dossen
Island
32,5
C P U E
0 - 10
10 - 25
25 - 50
50 +
0 - 10
10 - 25
25 - 50
50 +
34°
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
27,5
27,5
Cape Point
35°
No fishing
100fm
Cape Agulhas
17°
18°
19°
20°

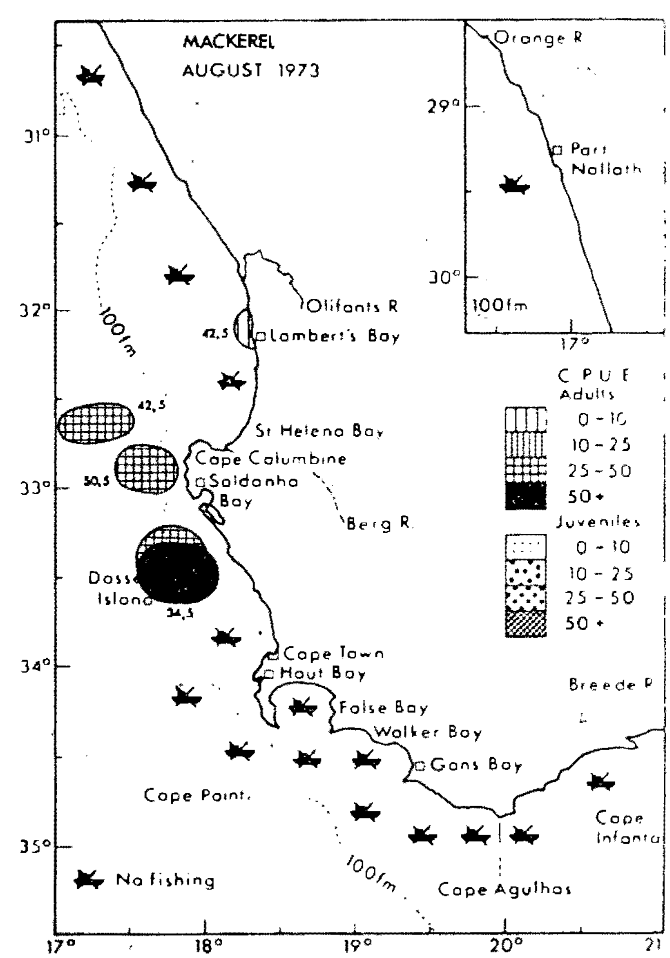

MACKEREL
MARCH 1973
Orange R
29°
Port
Nolloth
30°
100fm
17°
30,5
33,5
Olifants R
29,5
Lamberts Bay
22,5
St Helena Bay
29.0
Cape Columbine
Berg R
C P U E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
Cape Town
Breede R
28,5
False Bay
Walker Bay
Gans Bay
27,5
30,5
30,5
Cape
Infanta
100fm
Cape Agulhas
18
19°
20°
21

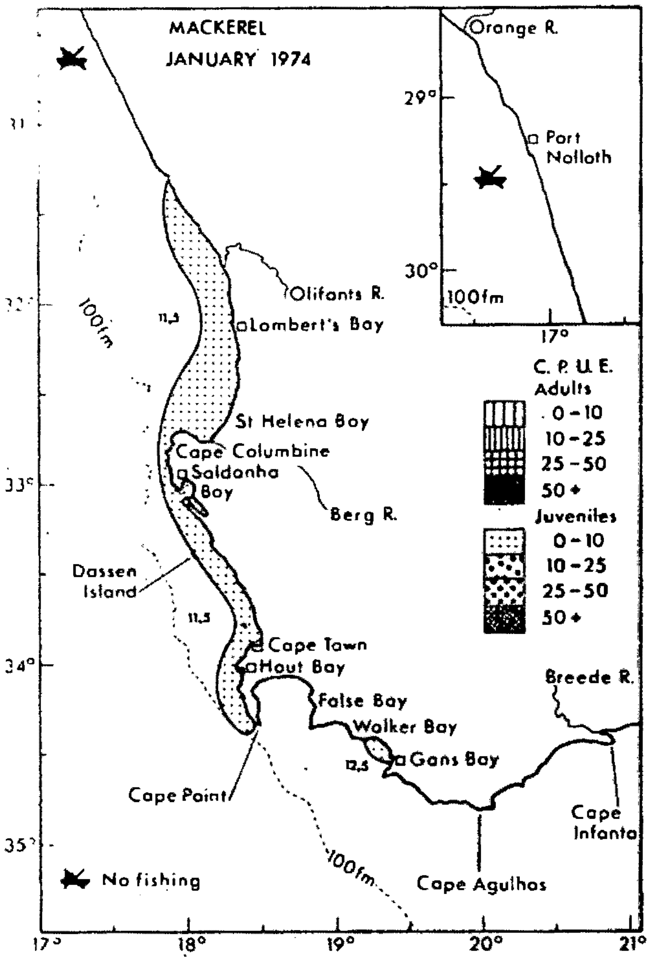

MACKEREL
APRIL 1973
Orange R
29°
30°
100fm
17°
31°
32°
100fm
Olifants R
32,8
Lamberts Bay
St Helena Bay
Cape Columbine
Saldanha
Bay
33°
Berg R
28,5
Dossen
Island
C P U E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
34°
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Cape Point
Cape
Infanta
35°
No fishing
100fm
Cape Agulhas
17°
18
19°
20°
21


MACKEREL
MAY 1973
Orange R
29°
Port
Nolloth
30°
100fm
17°
Olifants R
Lambert's Bay
32,7
St Helena Bay
Cape Columbine
Saldanha
Bay
Berg R
Dassen
Island
Cape Town
Hout Bay
28,5
False Bay
Walker Bay
Gans Bay
30,5
Breede R
Cape Point
Cape
Infanta
100fm
Cape Agulhas
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
No fishing
18°
19°
20°
21°


MACKEREL
JUNE 1973
Orange R
29°
30°
100fm
31°
32°
33°
34°
35°
100fm
Olifants R.
42,5
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha
Bay
Berg R
Dassen
Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Cape Point
100fm
Cape Agulhas
No fishing
17°
18°
19°
20°


MACKEREL
JULY 1973
Orange R.
29°
Port
Nolloth
30°
100fm
17°
32°
33°
34°
35
100fm
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha
Bay
Berg R.
Dassen
Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape
Infanta
100fm
Cape Agulhas
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
No fishing
18°
19°
20°
21°


MACKEREL
AUGUST 1973
Orange R
29°
Port
Nolloth
30°
100fm
17°
31°
32°
33°
34°
35°
100fm
Olifants R
42,5
Lambert's Bay
42,5
50,5
St Helena Bay
Cape Columbine
Saldanha
Bay
Berg R.
Island
34,5
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point.
Cape
100fm
Cape Agulhas
C P U E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
No fishing
17°
18°
19°
20°
21


MACKEREL
JANUARY 1974
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
11,5
12,5
17°
18°
19°
20°
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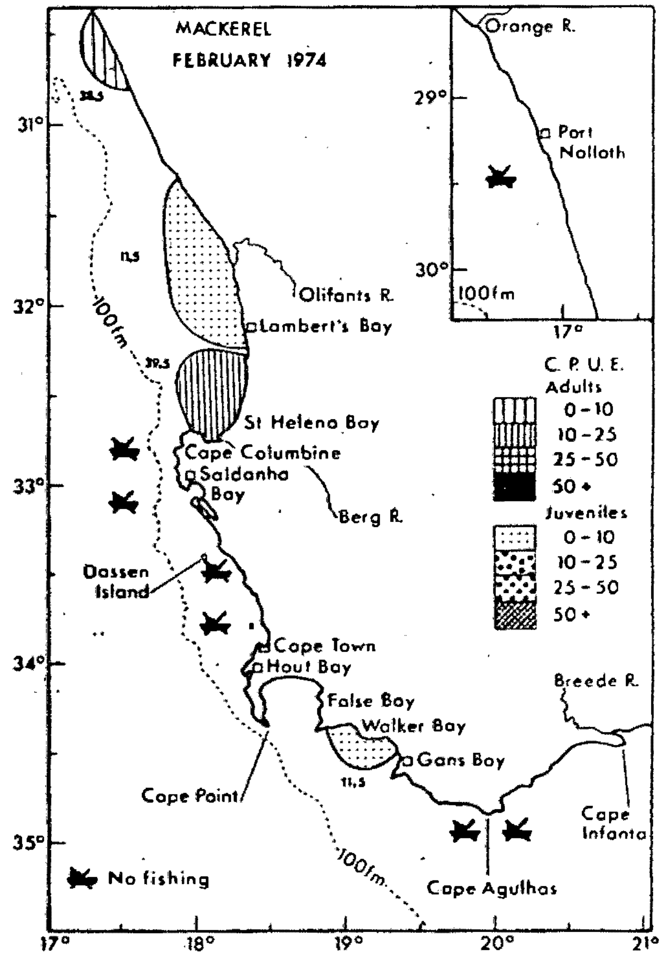
29°
30°
31
33°
34°
35°


MACKEREL
FEBRUARY 1974
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
11,5
39,5
17°
18°
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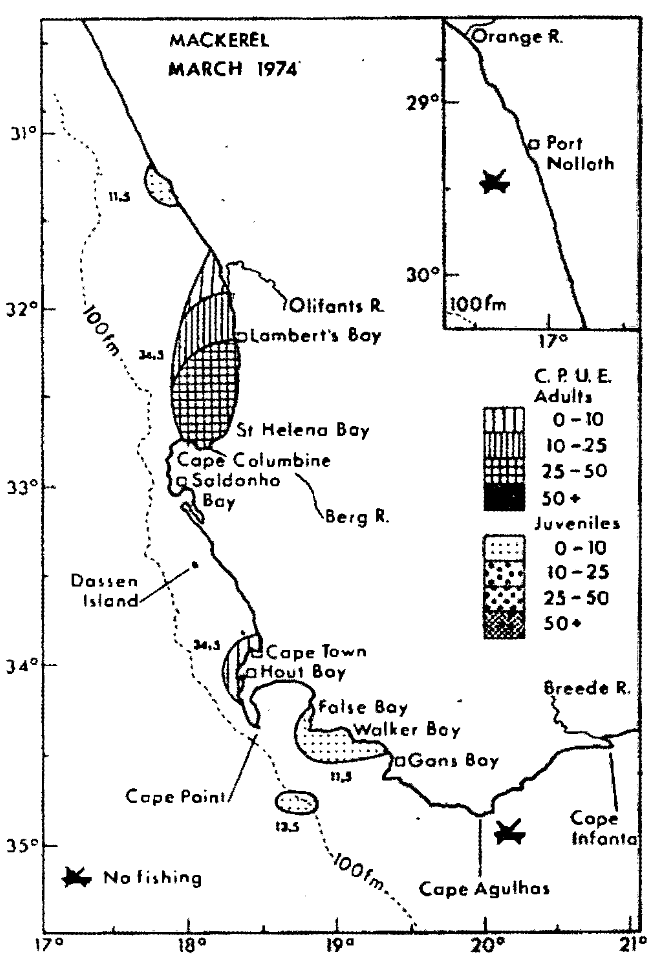
20°
21°
29°
30°
31°
32°
33°
34°
35°


MACKEREL
MARCH 1974
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
11,5
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30°
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34°
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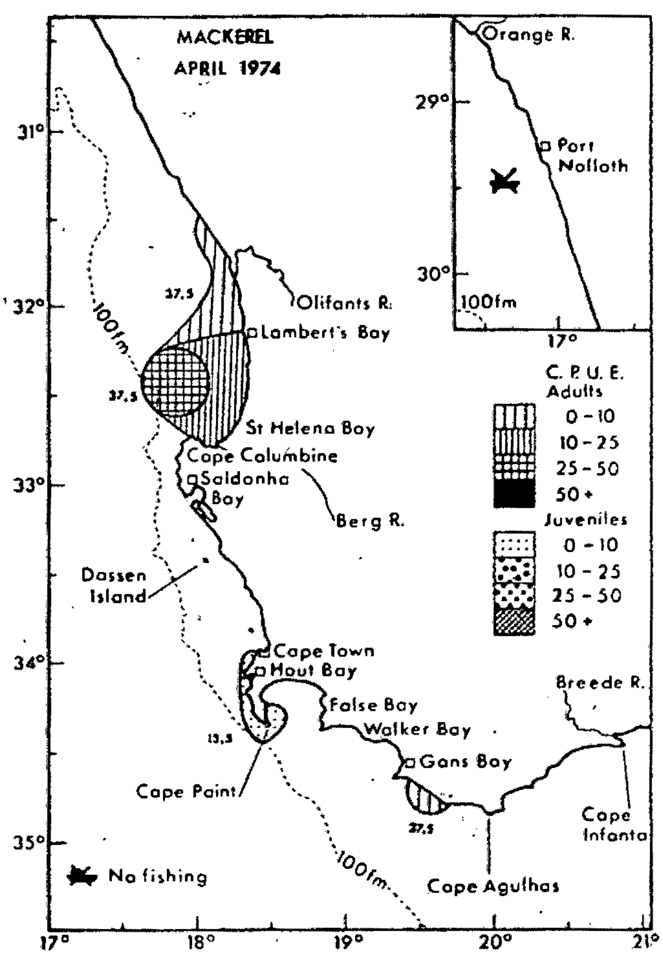
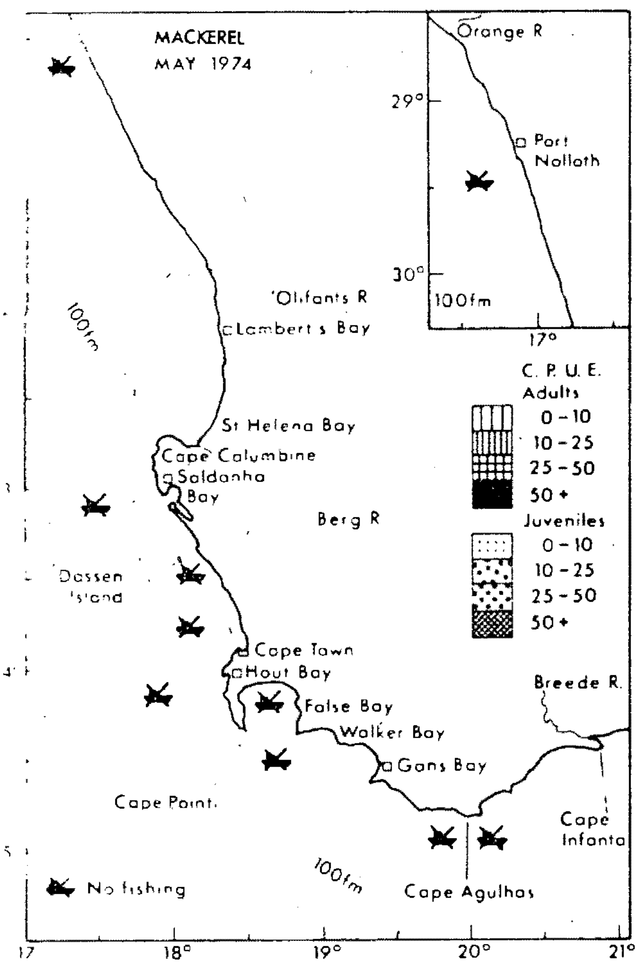
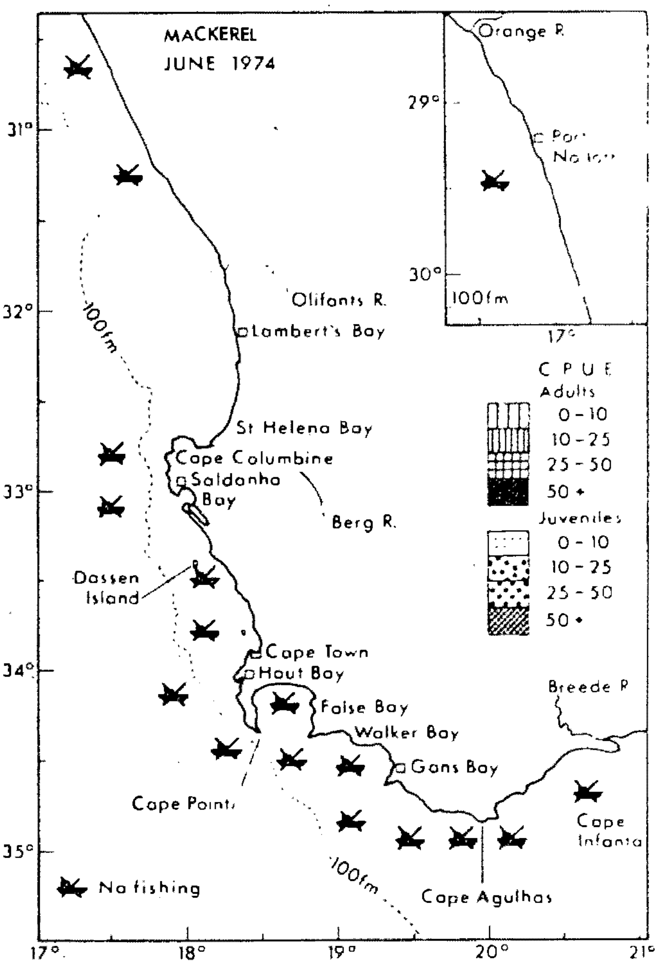
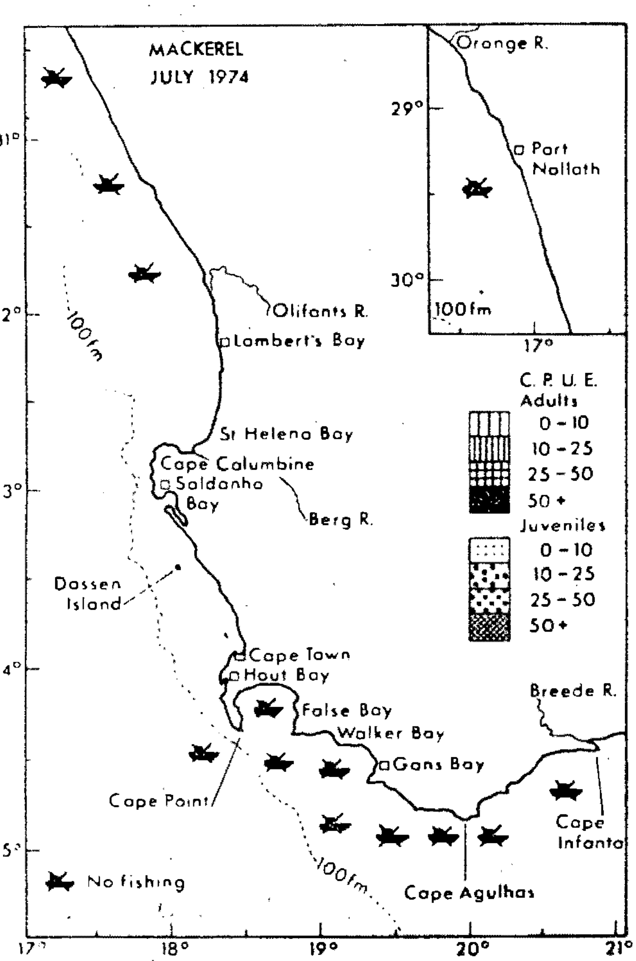
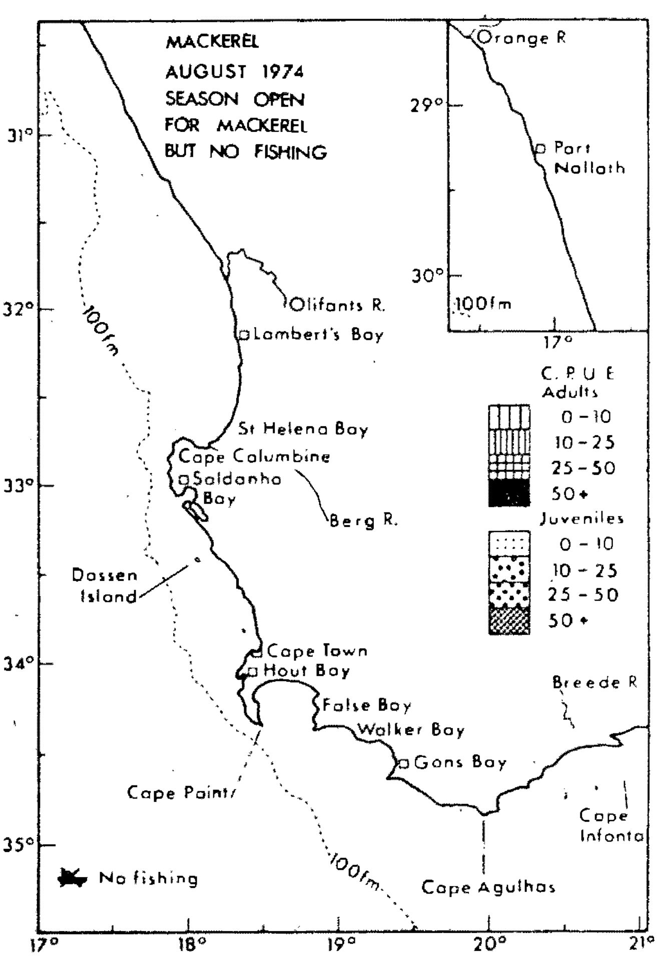
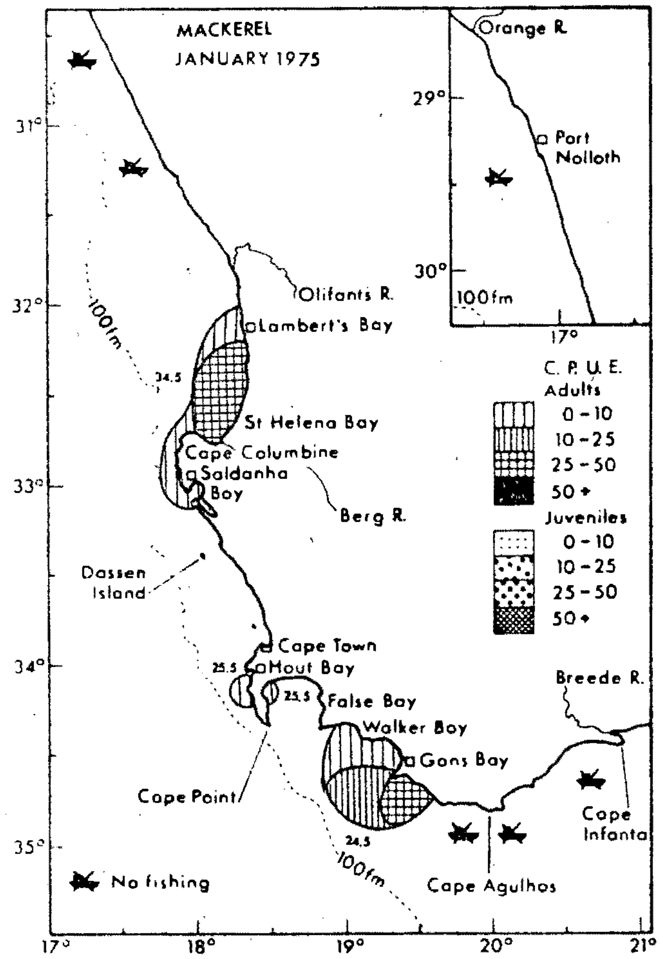

MACKEREL
APRIL 1974
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
37,5
13,5
17°
18°
19°
20°
21°
29°
30°
31°
32°
33°
34°
35°

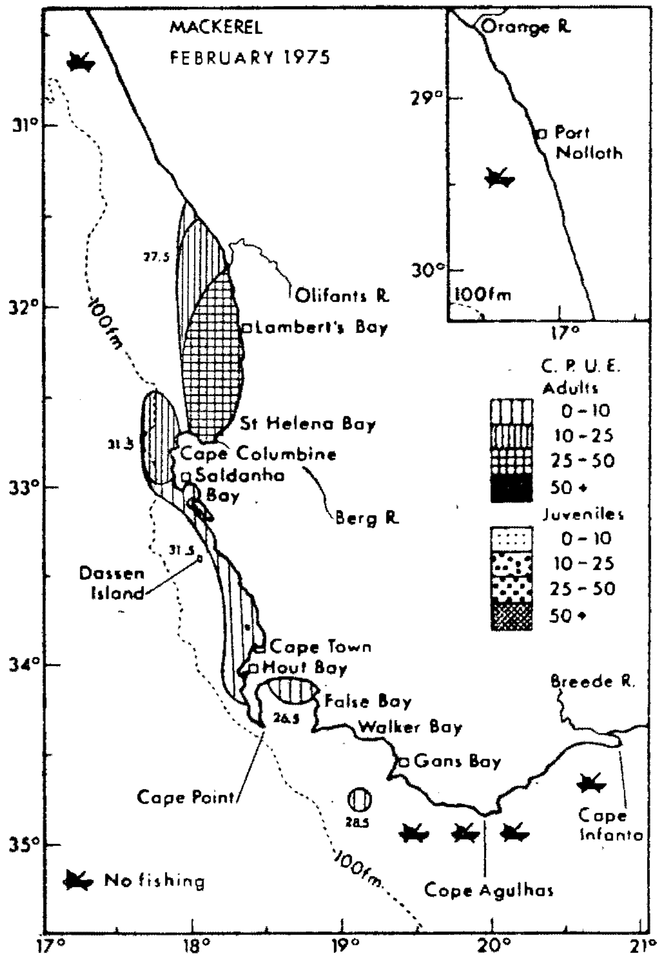

MACKEREL
MAY 1974
Orange R
29°
Port Nolloth
30°
100fm
17°
Olifants R
Lambert's Bay
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R
Dassen Island
Cape Town
Hout Bay
False Bay
Breede R.
Walker Bay
Gans Bay
Cape Point
Cape Infanta
No fishing
100fm
Cape Agulhas
17
18°
19°
20°
21°

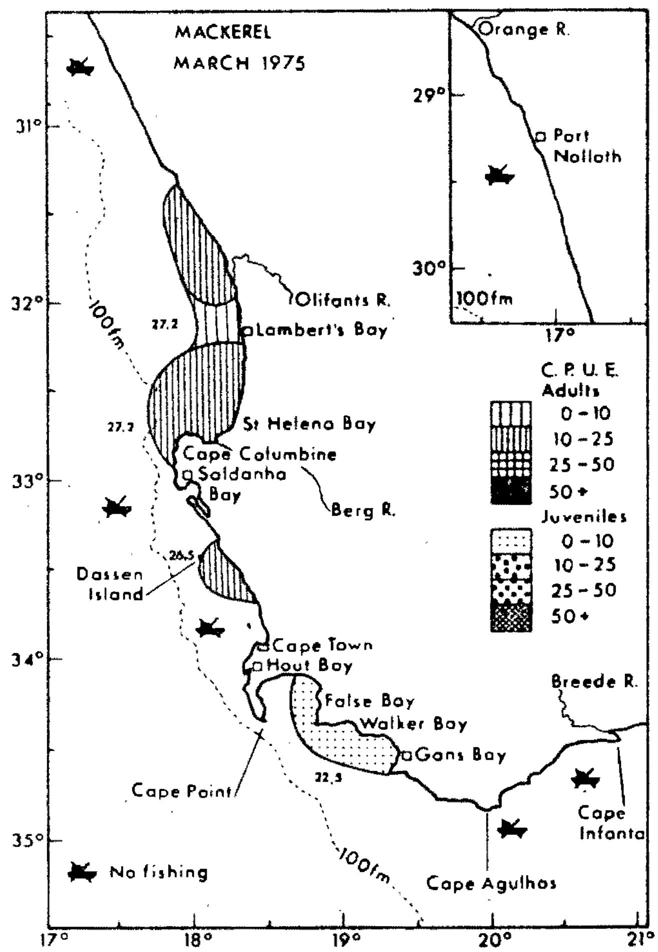

MACKEREL
JUNE 1974
Orange R
29°
30°
100fm
17°
31°
32°
100fm
Olifants R.
Lambert's Bay
C P U E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
33°
Berg R.
Dassen Island
Cape Town
34°
Hout Bay
False Bay
Breede R
Walker Bay
Gans Bay
Cape Point
Cape Infanta
35°
No fishing
100fm
Cape Agulhas
17°
18°
19°
20°
21°

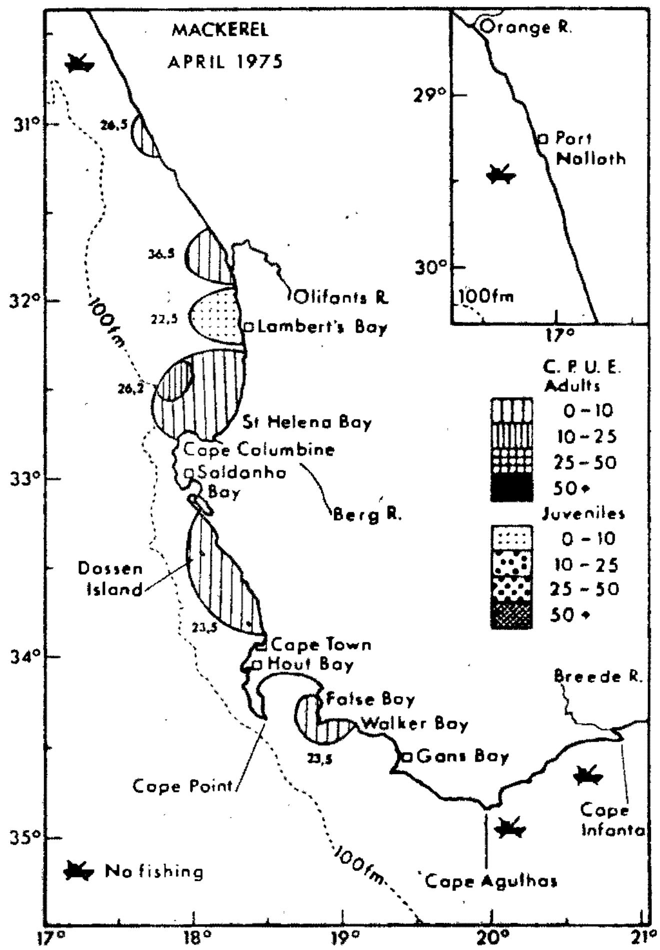

MACKEREL
JULY 1974
Orange R.
29°
Port Nolloth
30°
100fm
17°
31°
Olifants R.
32°
Lambert's Bay
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
33°
Berg R.
Dassen Island
Cape Town
34°
Hout Bay
Breede R.
False Bay
Walker Bay
Gans Bay
Cape Point
Cape Infanta
35°
No fishing
100fm
Cape Agulhas
18°
19°
20°
21°


MACKEREL
AUGUST 1974
SEASON OPEN
FOR MACKEREL
BUT NO FISHING
Orange R
29°
Port Nolloth
31°
30°
100fm
17°
32°
100fm
Olifants R.
Lambert's Bay
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
33°
Berg R.
Dassen Island
Cape Town
34°
Hout Bay
Breede R
False Bay
Walker Bay
Gans Bay
Cape Point
Cape Infanta
35°
No fishing
100fm
Cape Agulhas
17°
18°
19°
20°
21°


MACKEREL
JANUARY 1975
Orange R.
Port Nolloth
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
100fm
34.5
25.5
25.5
24.5
17°
18°
19°
20°
21°
29°
30°
31°
32°
33°
34°
35°


MACKEREL
FEBRUARY 1975
Orange R.
Port Nolloth
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
100fm
27.5
31.5
31.5
26.5
28.5
17°
18°
19°
20°
21°
29°
30°
31°
32°
33°
34°
35°


MACKEREL
MARCH 1975
Orange R.
Port Nolloth
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
100fm
27.2
27.2
26.5
22.5
17°
18°
19°
20°
21°
29°
30°
31°
32°
33°
34°
35°


MACKEREL
APRIL 1975
Orange R.
Port Nolloth
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
100fm
26.5
36.5
22.5
26.2
23.5
23.5
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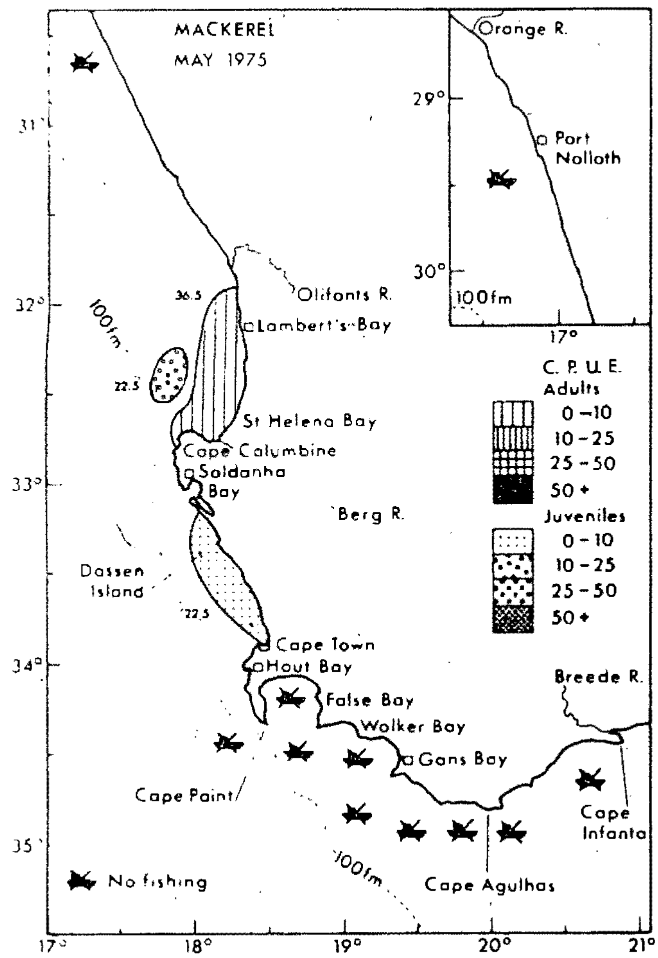
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MAY 1975
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
C. P. U. E.
Adults
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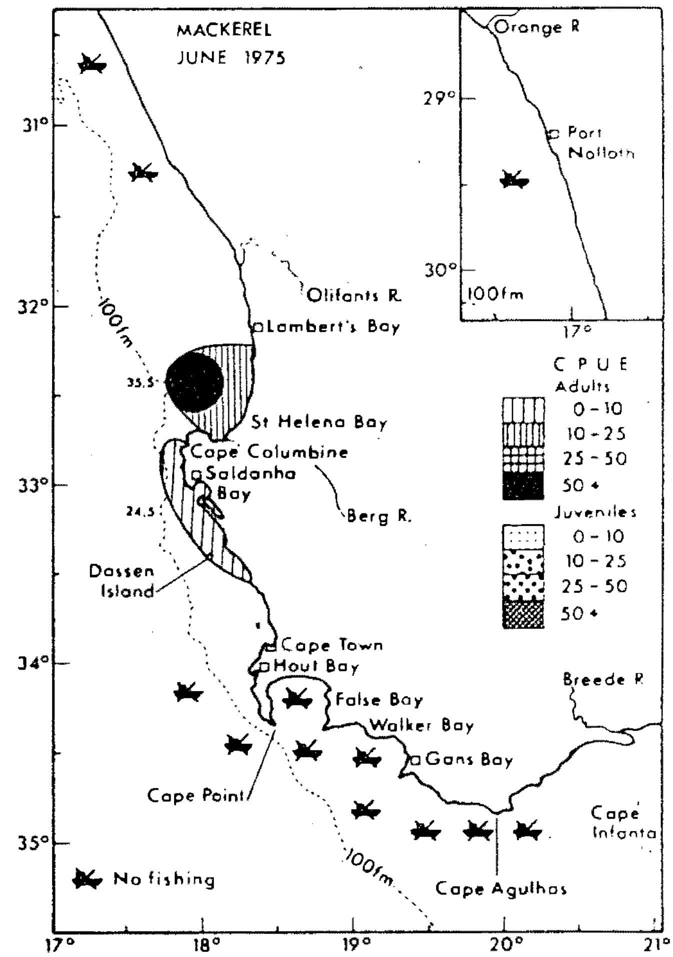
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
No fishing
36.5
22.5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JUNE 1975
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Port Nolloth
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Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
C P U E
Adults
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25 - 50
50 +
Juveniles
0 - 10
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25 - 50
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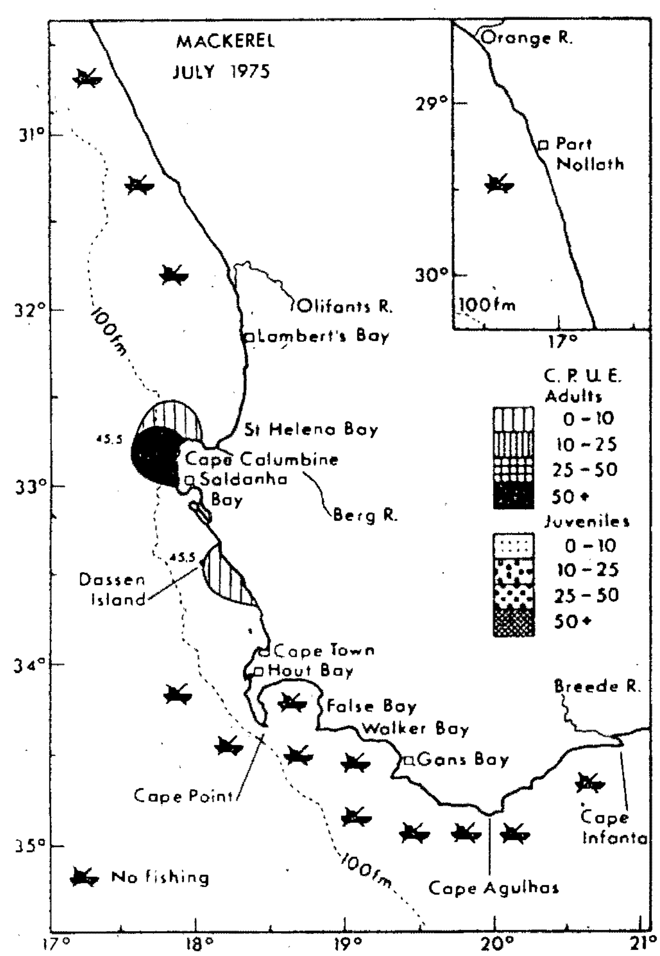
No fishing
35.5
24.5


MACKEREL
JULY 1975
Orange R.
Port Nolloth
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Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
C. P. U. E.
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Juveniles
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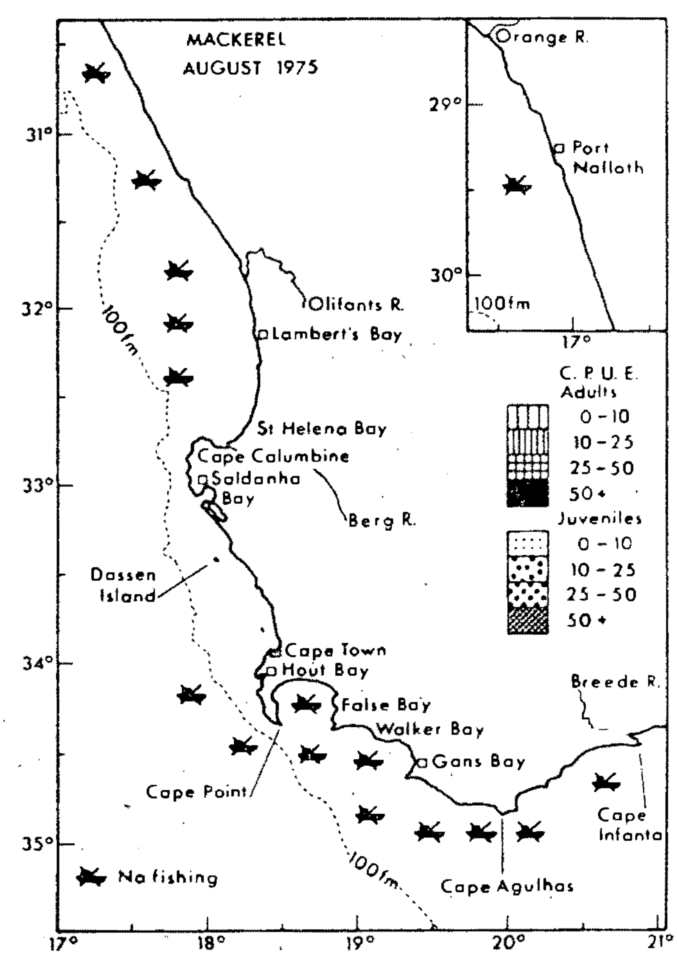
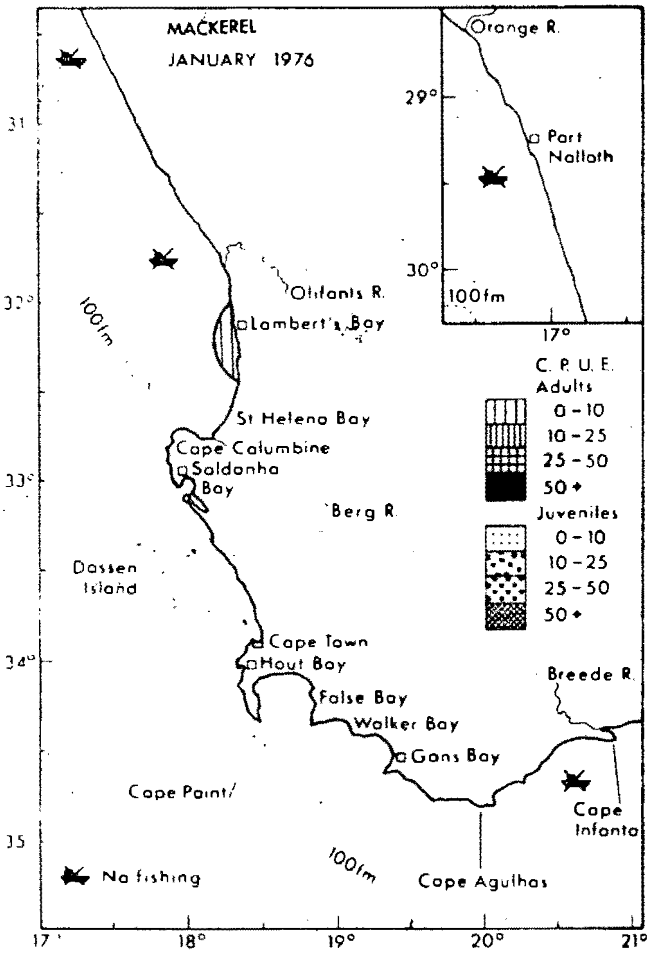
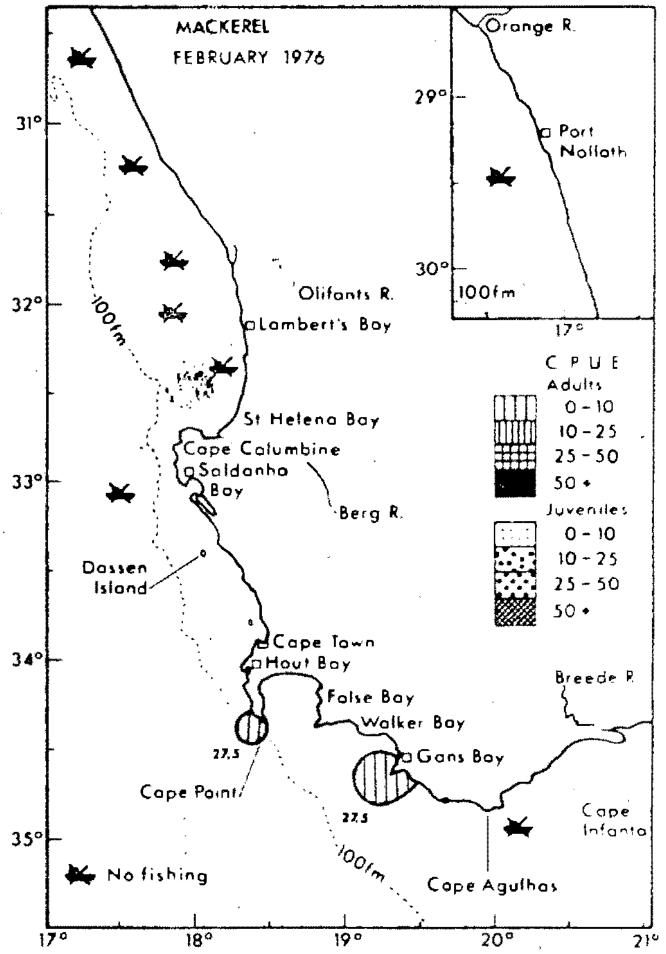

MACKEREL
AUGUST 1975
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
No fishing


MACKEREL
JANUARY 1976
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
No fishing


MACKEREL
FEBRUARY 1976
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
27.5
Cape Point
27.5
Cape Infanta
Cape Agulhas
100fm
C P U E
Adults
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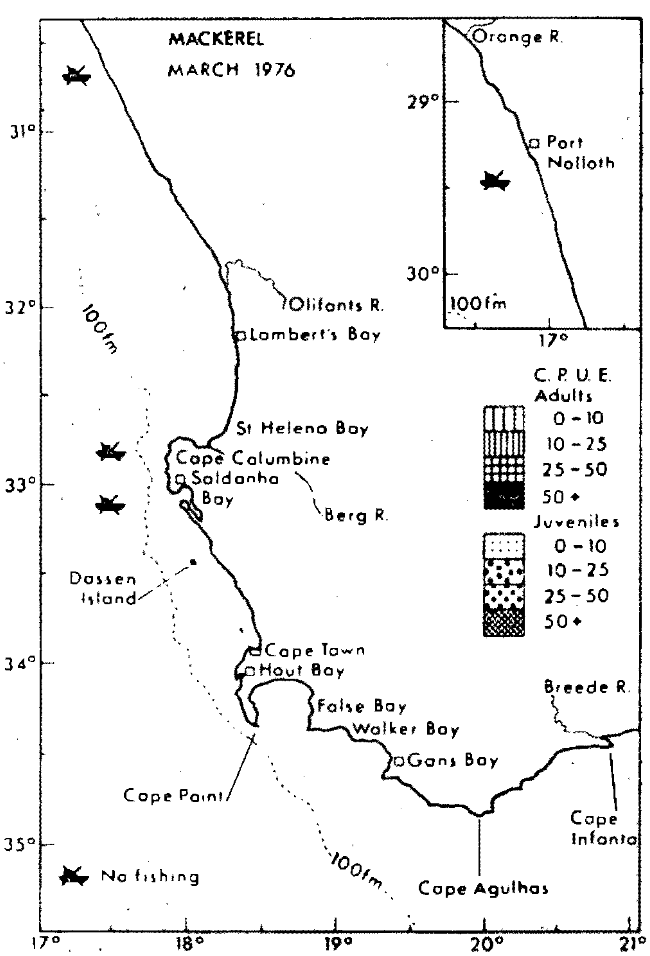
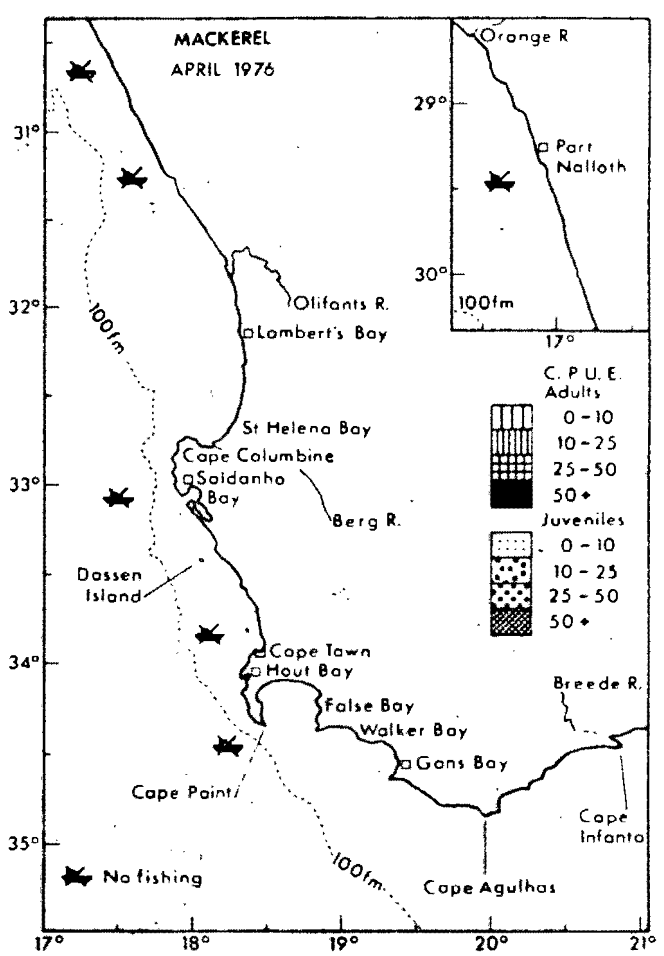
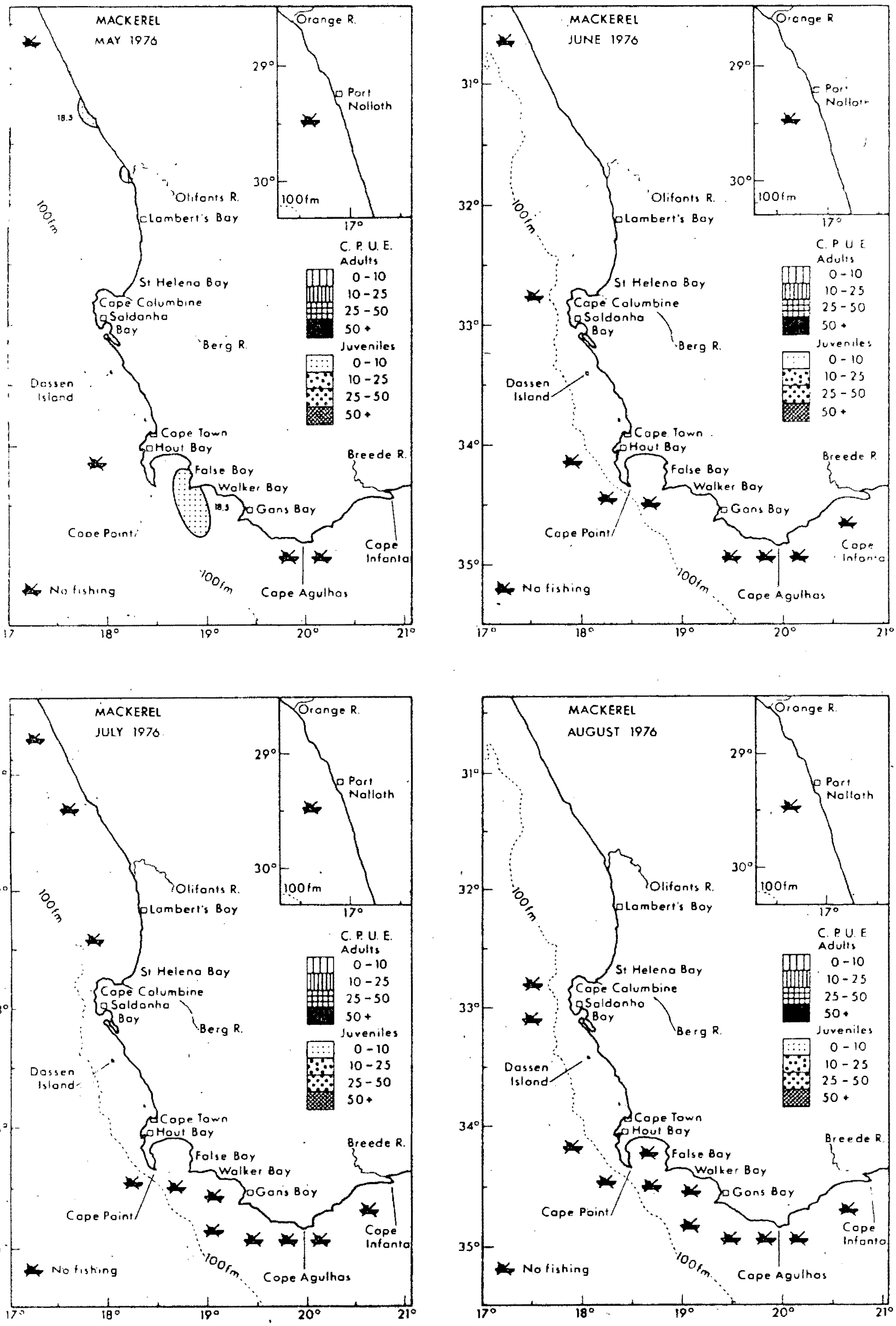
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
No fishing


MACKEREL
MARCH 1976
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
No fishing


MACKEREL
APRIL 1976
Orange R
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm.
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
No fishing


MACKEREL
MAY 1976
JUNE 1976
JULY 1976
AUGUST 1976
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
18.5
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19°
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30°
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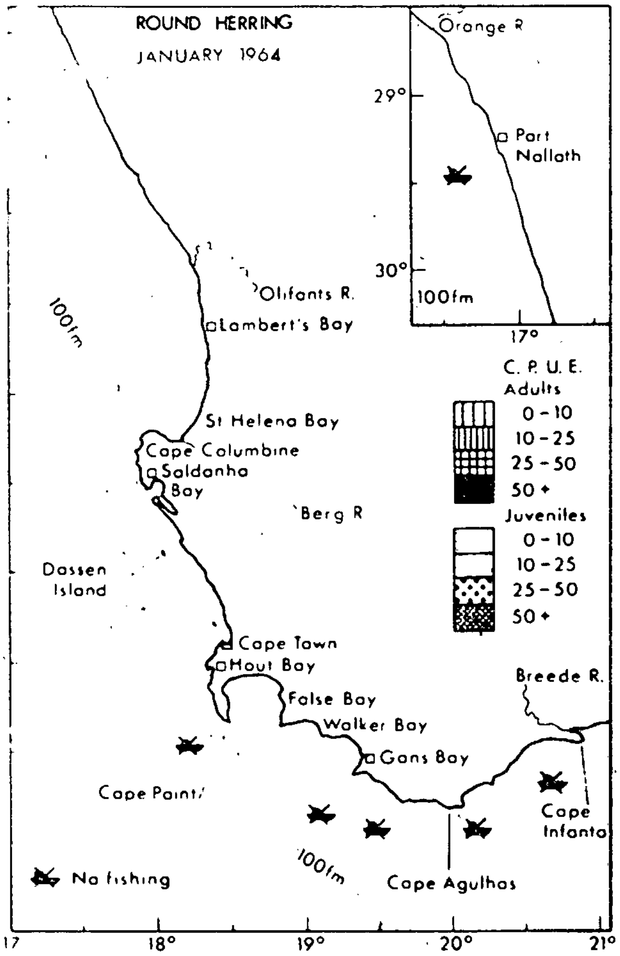
34°
35°


ROUND HERRING
JANUARY 1964
Orange R
29°
Port Nolloth
30°
100fm
17°
Olifants R.
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
33
34
35
17
18°
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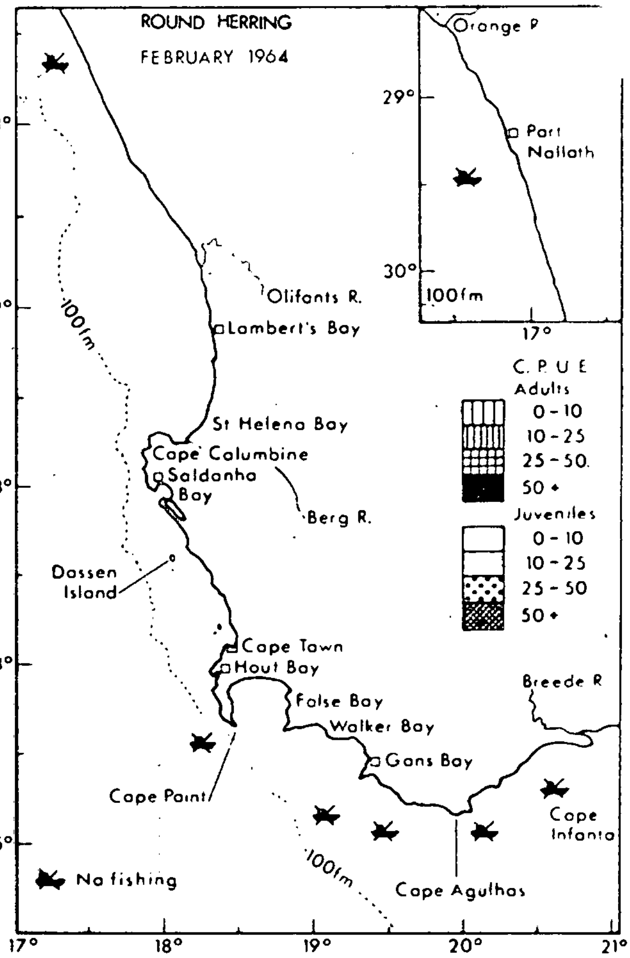
ROUND HERRING
FEBRUARY 1964
Orange R
29°
Port Nolloth
30°
100fm
17°
31°
32°
33°
34°
35°
Olifants R.
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
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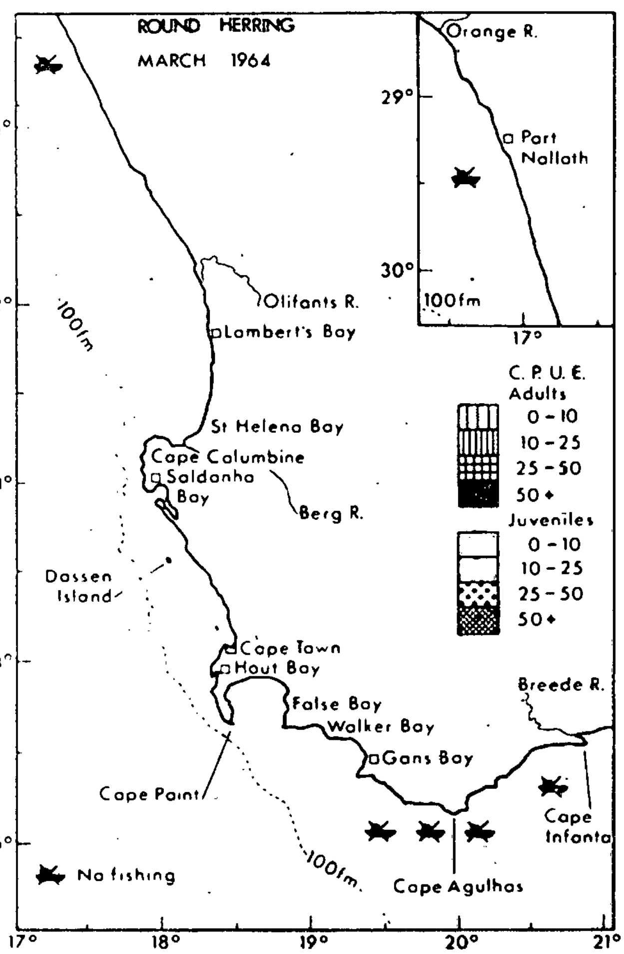
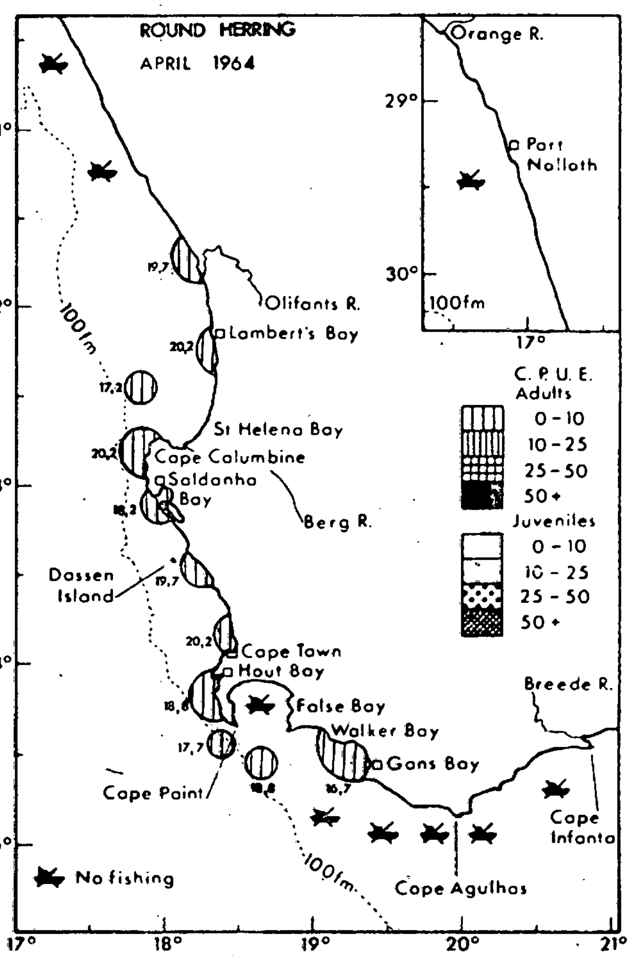
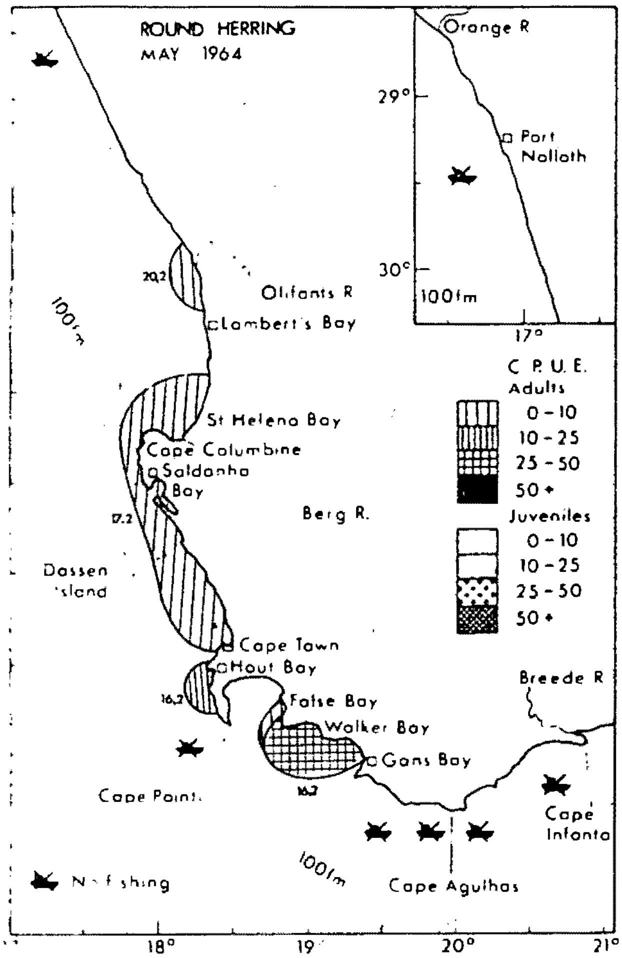
20°
21°


ROUND HERRING
MARCH 1964
Orange R.
29°
Port Nolloth
30°
100fm
17°
31°
32°
33°
34°
35°
Olifants R.
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm.
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
19°
20°
21°


ROUND HERRING
APRIL 1964
Orange R.
29°
Port Nolloth
30°
100fm
17°
31°
32°
33°
34°
35°
Olifants R.
Lambert's Bay
100fm
19,7
20,2
17,2
20,2
18,2
19,7
20,2
18,8
17,7
18,8
16,7
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm.
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
19°
20°
21°


ROUND HERRING
MAY 1964
Orange R
Port Nolloth
29°
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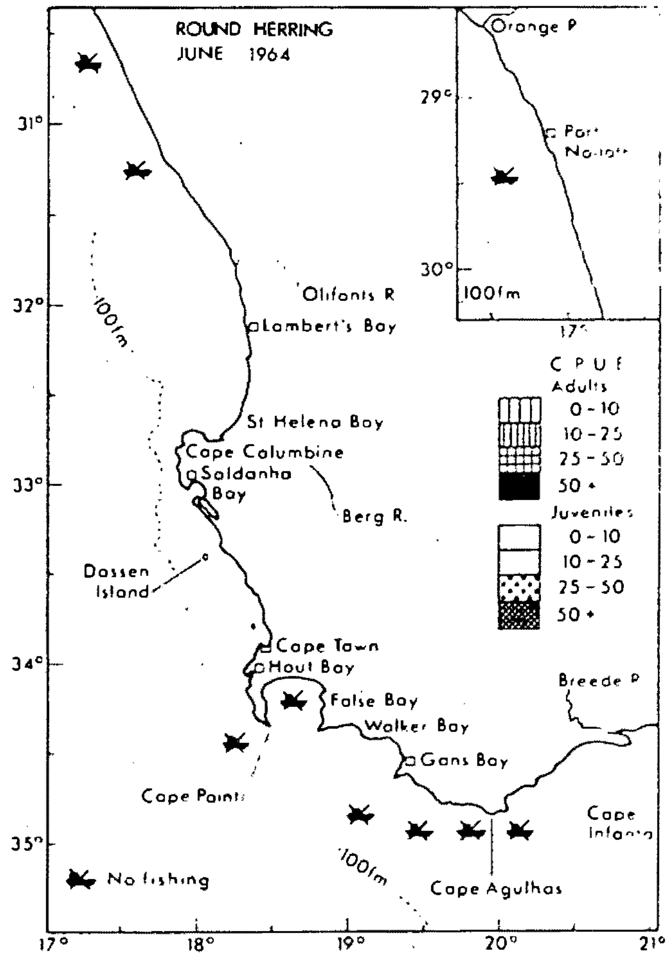
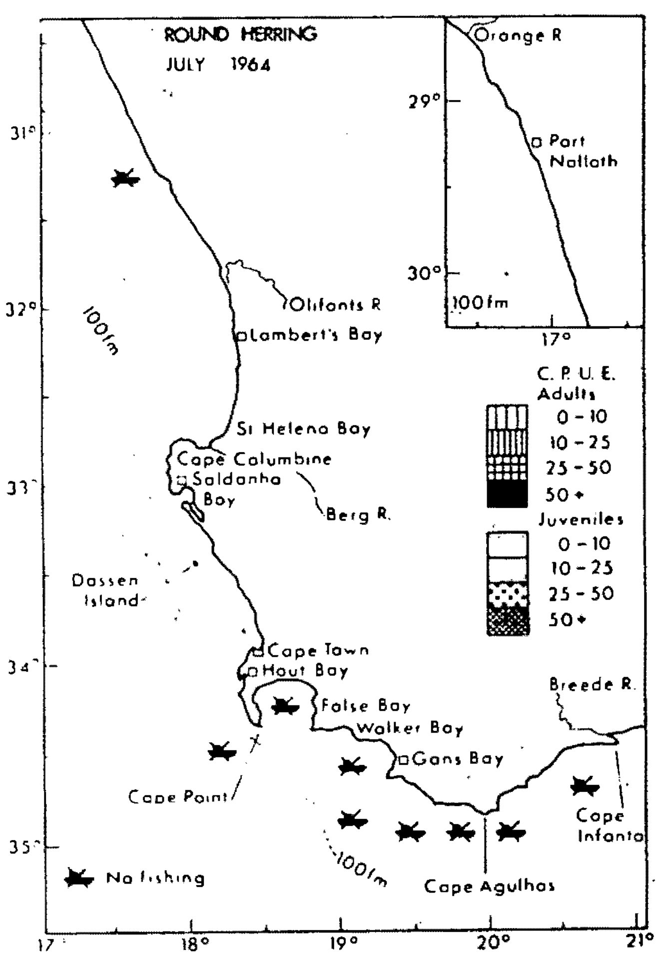
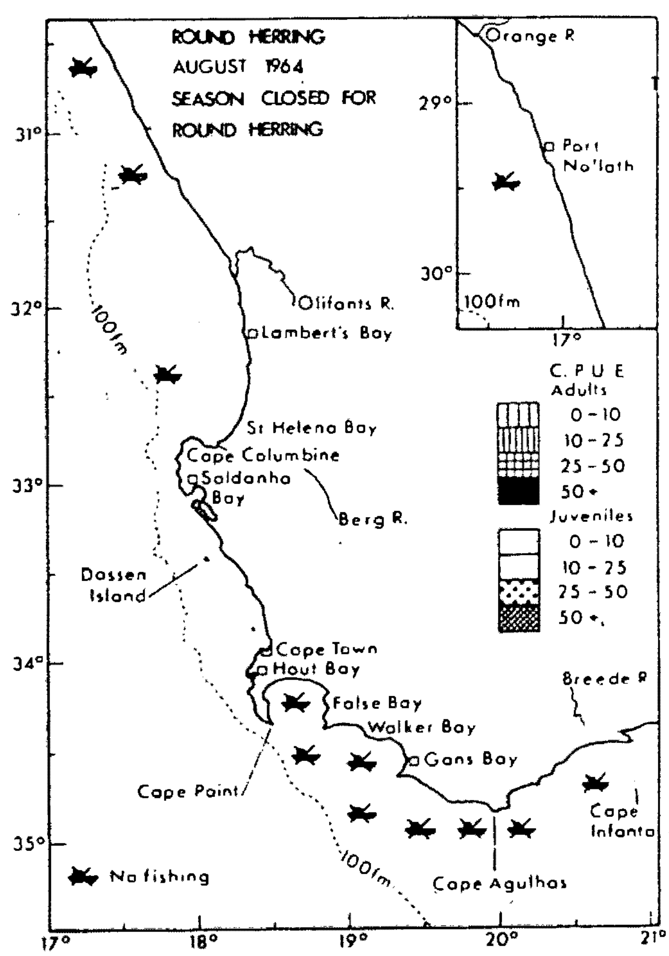
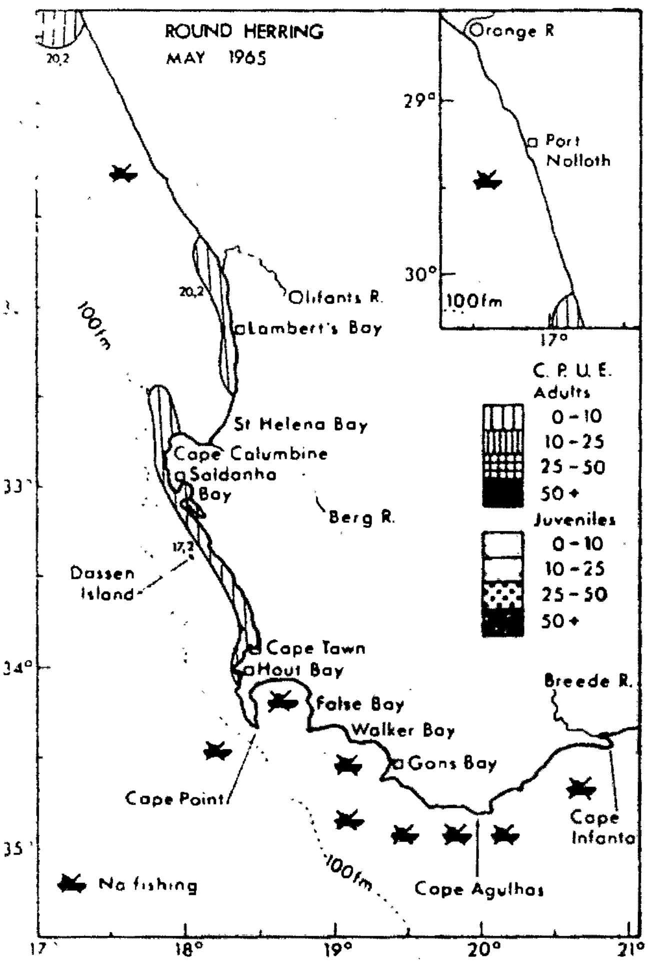
100fm
17°
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
100fm
20.2
17.2
16.2
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
No fishing
18°
19°
20°
21°


ROUND HERRING
JUNE 1964
29°
30°
100fm
31°
32°
33°
34°
35°
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Cape Point
Cape Agulhas
100fm
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
No fishing
17°
18°
19°
20°
21°


ROUND HERRING
JULY 1964
Orange R
Port Nolloth
29°
30°
100fm
17°
31°
32°
34°
35°
100fm
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
No fishing
18°
19°
20°
21°


ROUND HERRING
AUGUST 1964
SEASON CLOSED FOR
ROUND HERRING
Orange R
Port No'loth
29°
30°
100fm
17°
31°
32°
33°
34°
35°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
No fishing
17°
18°
19°
20°
21°


ROUND HERRING
MAY 1965
Orange R
29°
Port Nolloth
30°
100fm
17°
20,2
Olifants R.
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
17,2
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
100fm
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
33°
34°
35°
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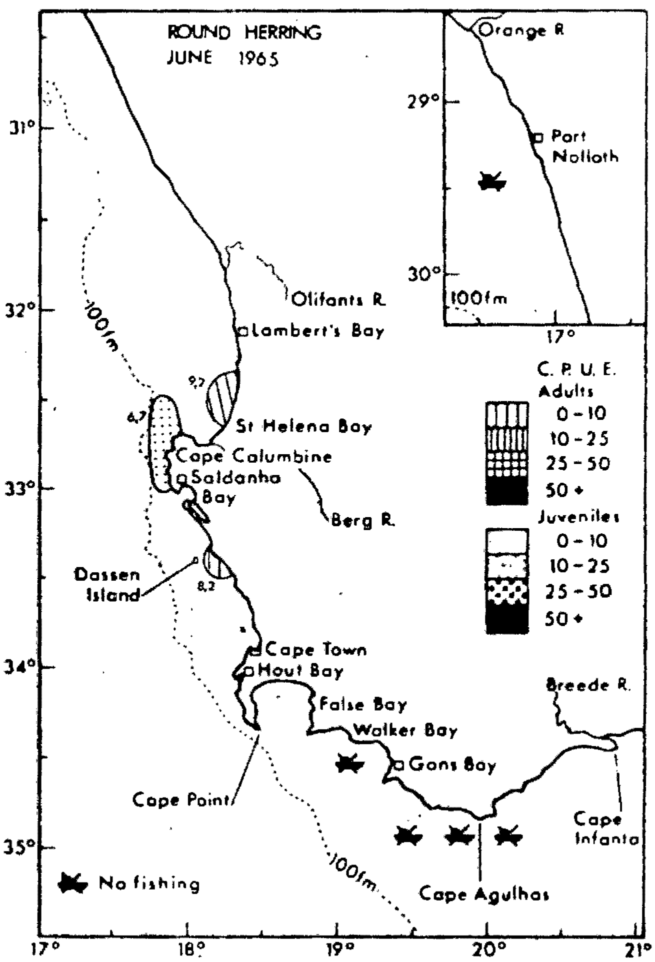
ROUND HERRING
JUNE 1965
Orange R
29°
Port Nolloth
30°
100fm
17°
31°
32°
100fm
Olifants R.
Lambert's Bay
9,2
6,7
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
8,2
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
100fm
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
33°
34°
35°
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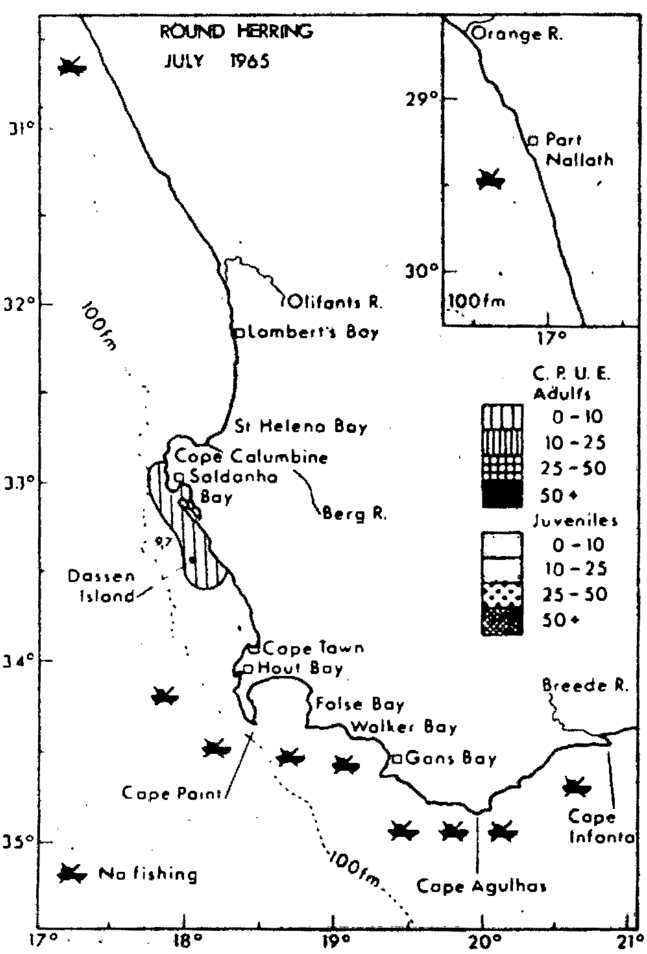
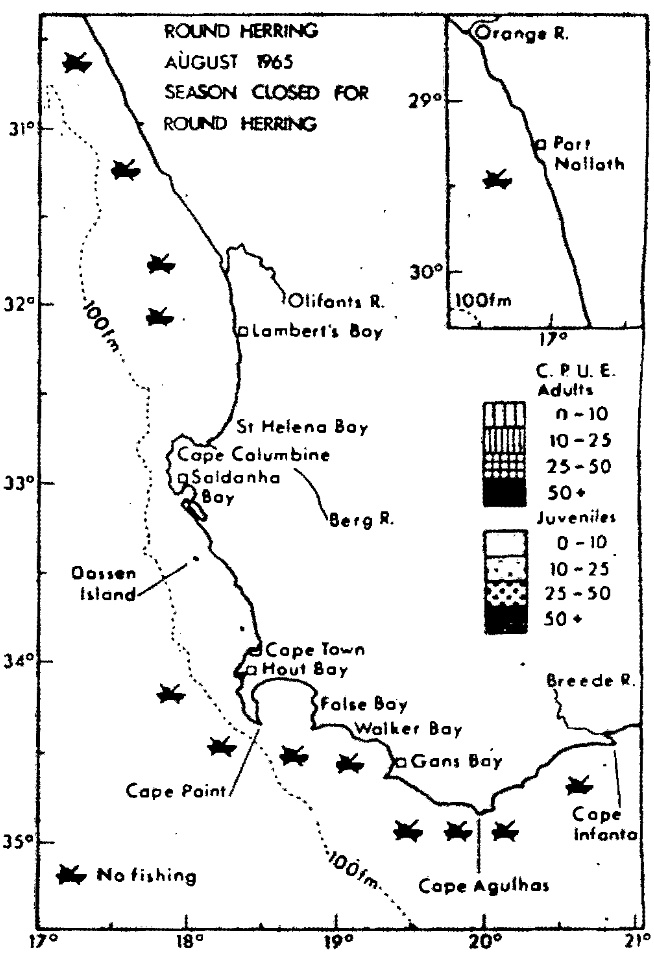

ROUND HERRING
JULY 1965
Orange R.
29°
Port Nolloth
30°
100fm
17°
31°
32°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
9,7
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
100fm
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
33°
34°
35°
17°
18°
19°
20°
21°


ROUND HERRING
AUGUST 1965
SEASON CLOSED FOR
ROUND HERRING
Orange R.
29°
Port Nolloth
30°
100fm
17°
31°
32°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
100fm
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
33°
34°
35°
17°
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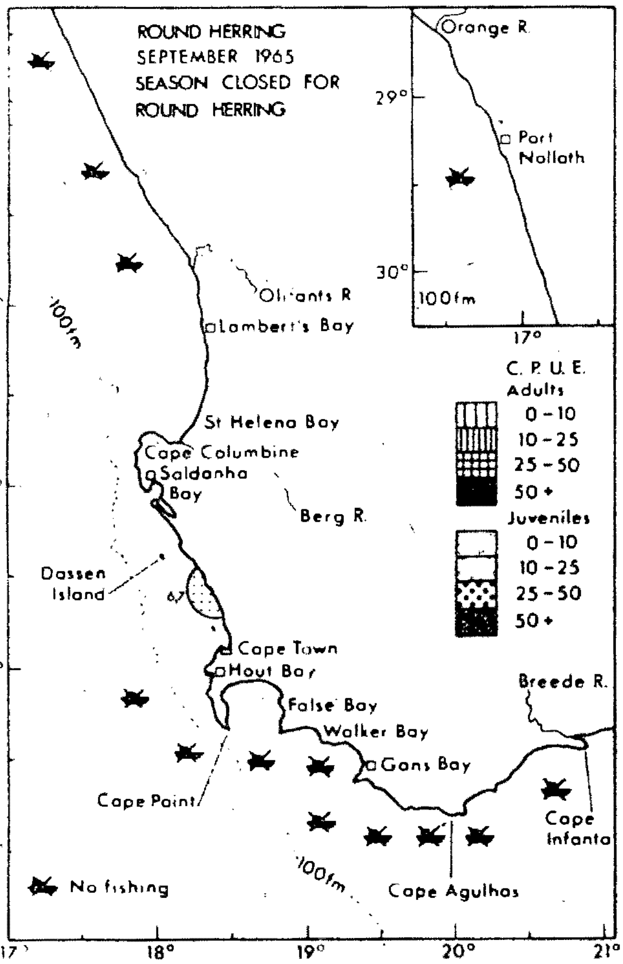
21°


ROUND HERRING
SEPTEMBER 1965
SEASON CLOSED FOR
ROUND HERRING
Orange R.
Port Nolloth
100fm
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
19°
20°
21°
29°
30°
32°
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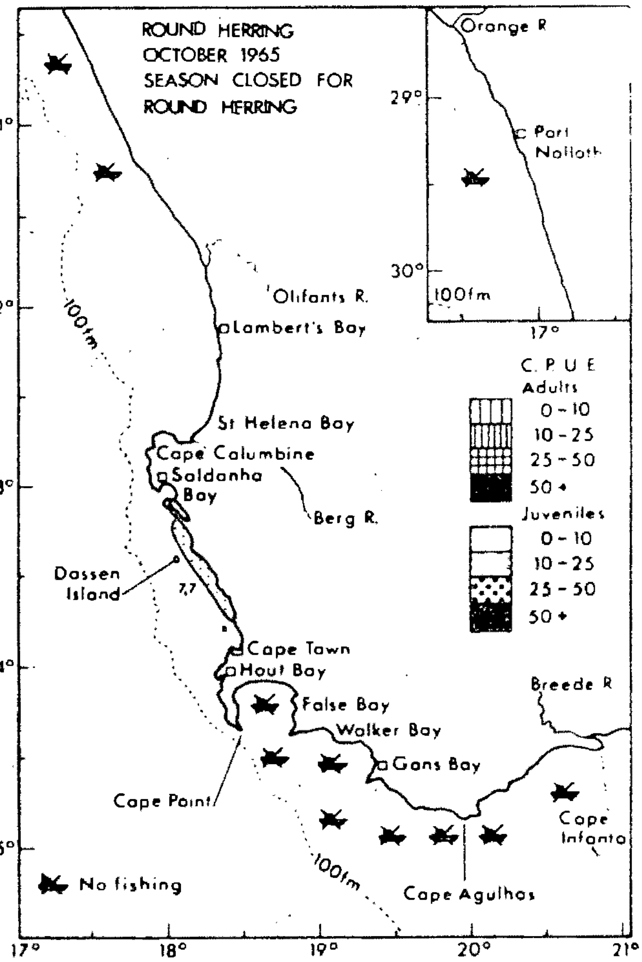
34°
35°


ROUND HERRING
OCTOBER 1965
SEASON CLOSED FOR
ROUND HERRING
Orange R
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
19°
20°
21°
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30°
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34°
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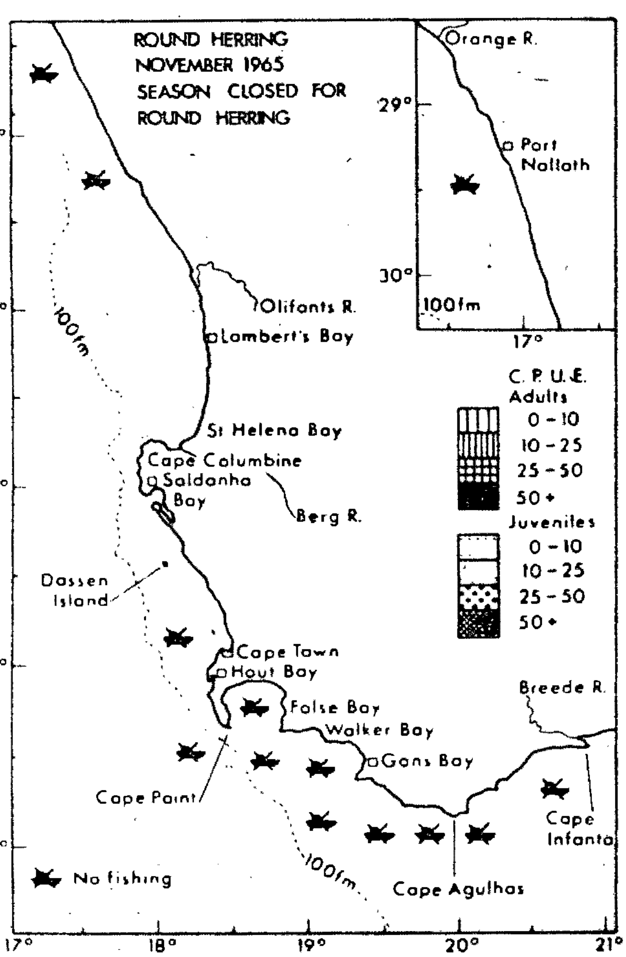
ROUND HERRING
NOVEMBER 1965
SEASON CLOSED FOR
ROUND HERRING
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
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20°
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30°
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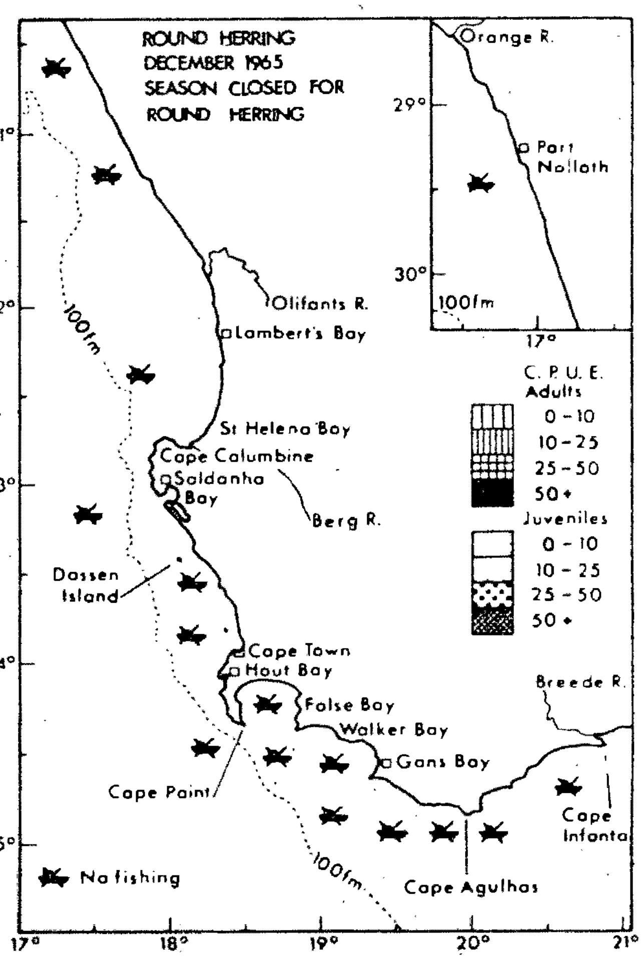
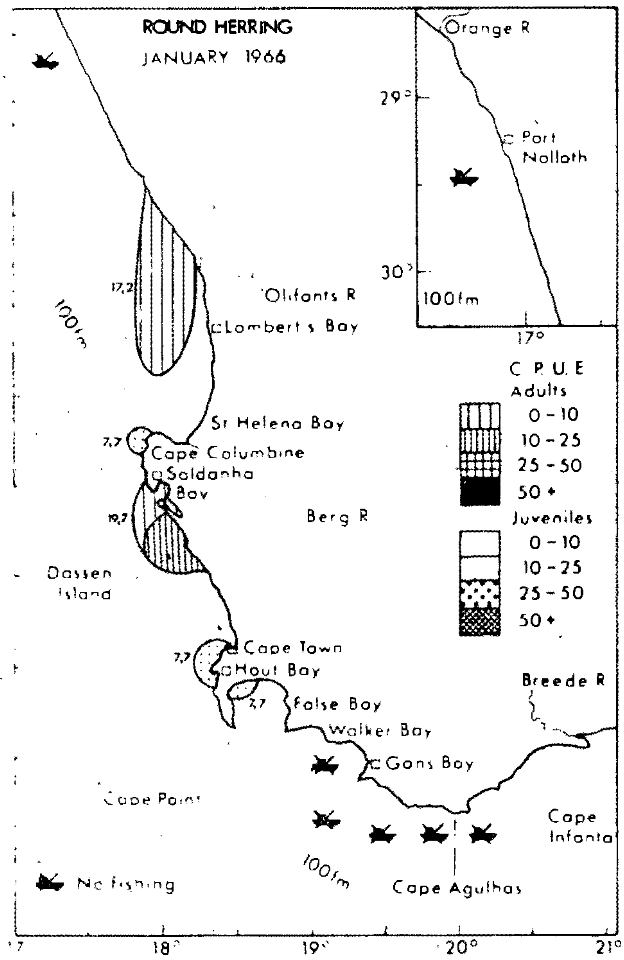
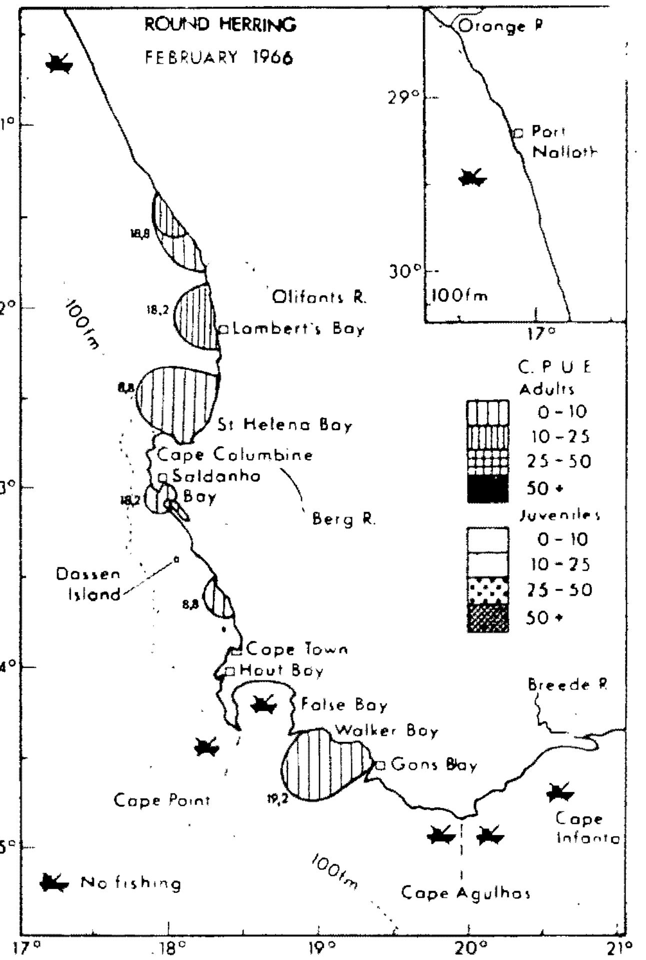
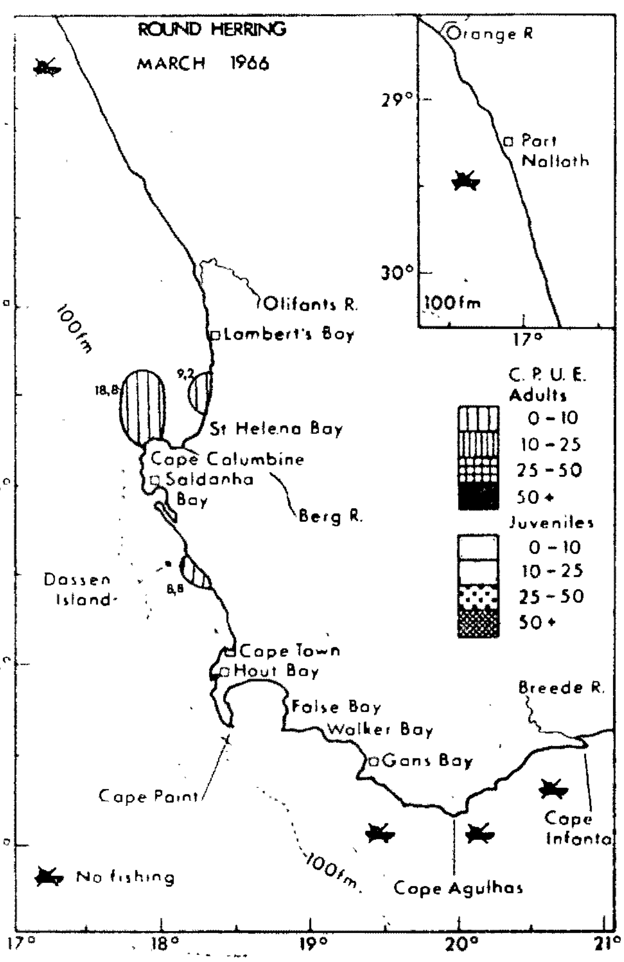
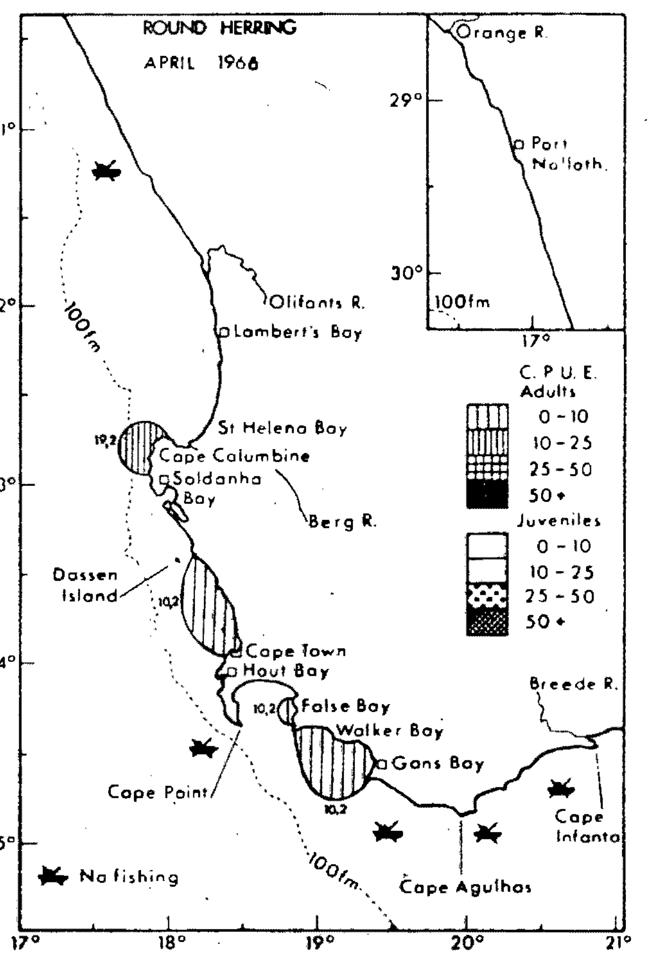
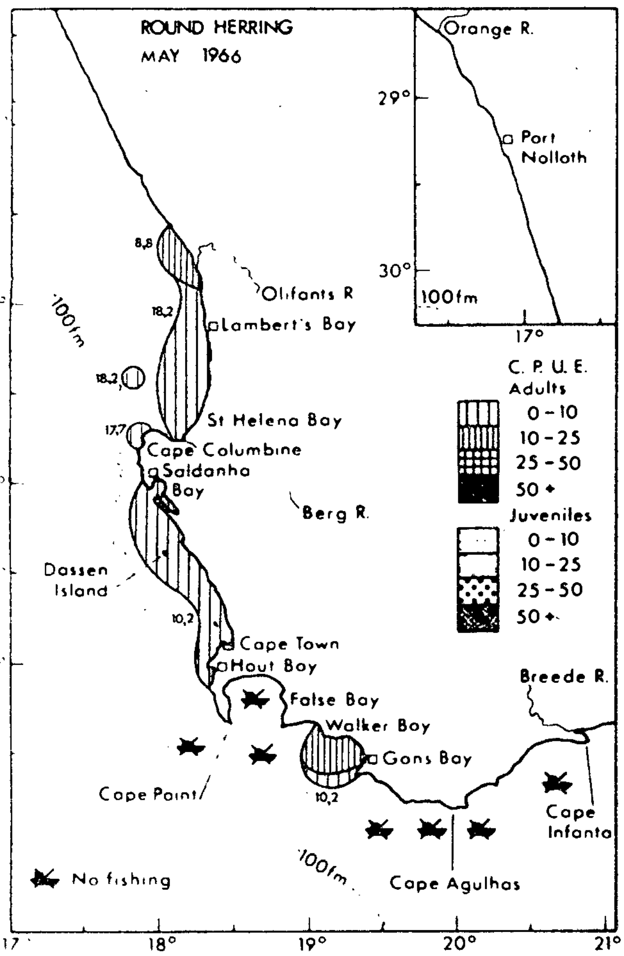

ROUND HERRING
DECEMBER 1965
SEASON CLOSED FOR
ROUND HERRING
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
19°
20°
21°
29°
30°
31°
32°
33°
34°
35°


ROUND HERRING
JANUARY 1966
Orange R
Port Nolloth
100fm
Olifonts R
Lombert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C.P.U.E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17,2
7,7
19,7
7,7
7,7
18°
19°
20°
21°
29°
30°
17°

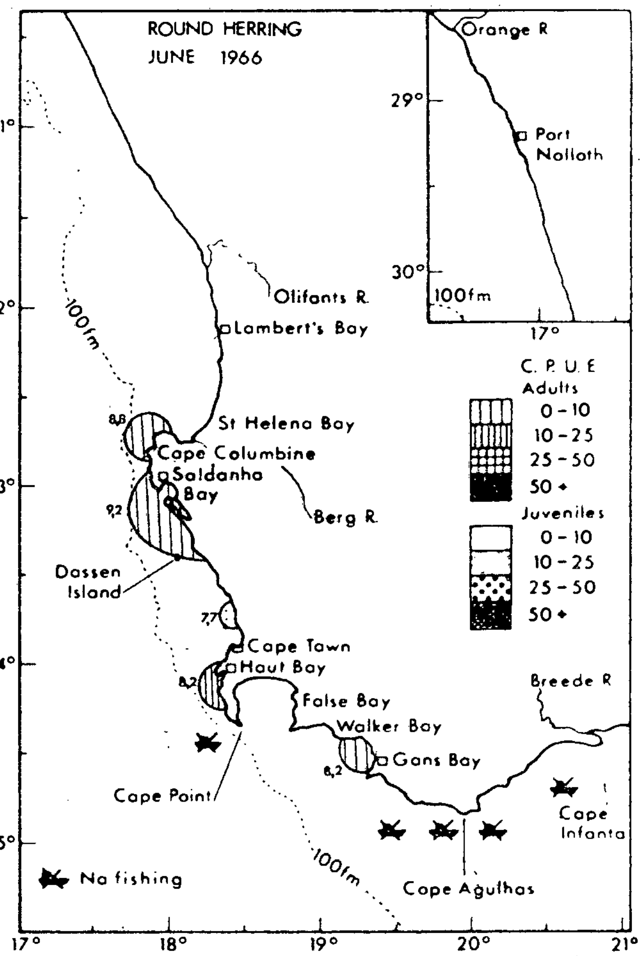

ROUND HERRING
FEBRUARY 1966
Orange R
Port Nolloth
100fm
Olifonts R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C.P.U.E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
18,8
18,2
8,8
18,2
8,8
19,2
31°
32°
33°
34°
35°
17°
18°
19°
20°
21°
29°
30°


ROUND HERRING
MARCH 1966
Orange R
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C.P.U.E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
18,8
9,2
8,8
32°
33°
34°
35°
17°
18°
19°
20°
21°
29°
30°

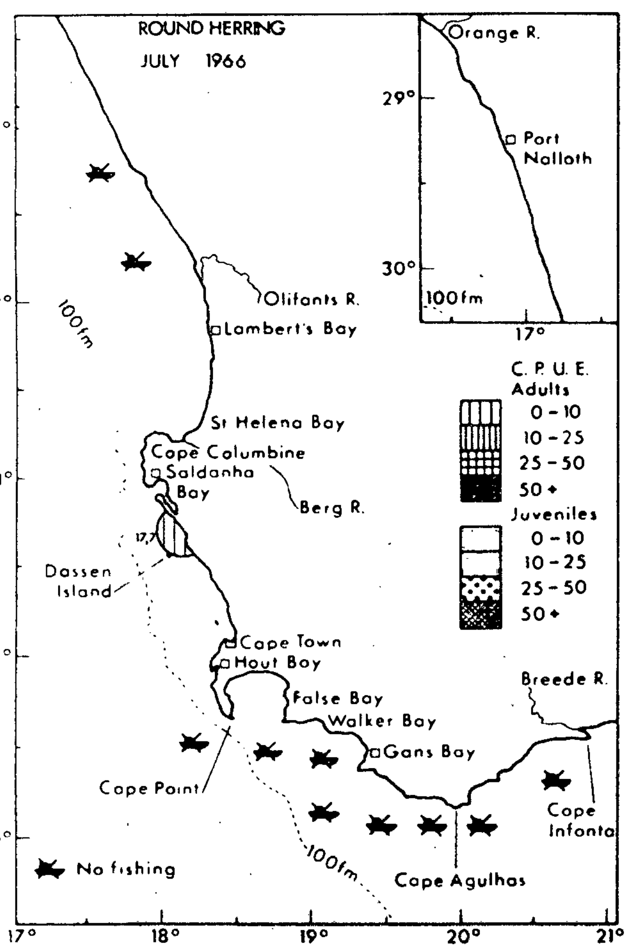

ROUND HERRING
APRIL 1966
Orange R.
Port Nolloth.
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C.P.U.E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
19,2
10,2
10,2
10,2
31°
32°
33°
34°
35°
17°
18°
19°
20°
21°
29°
30°



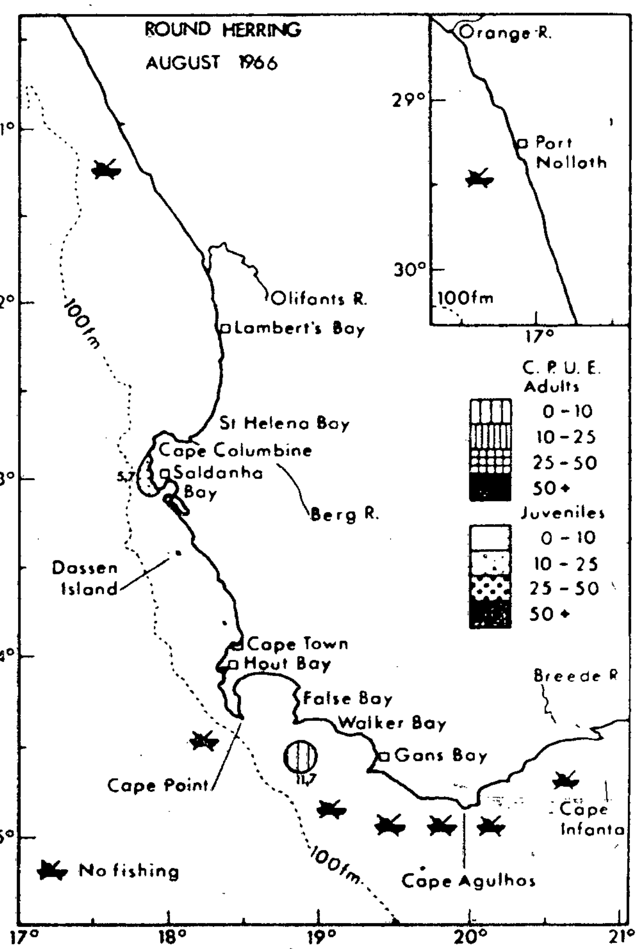
ROUND HERRING
MAY 1966
Orange R.
Port Nolloth
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
8,8
18,2
18,2
17,7
10,2
10,2



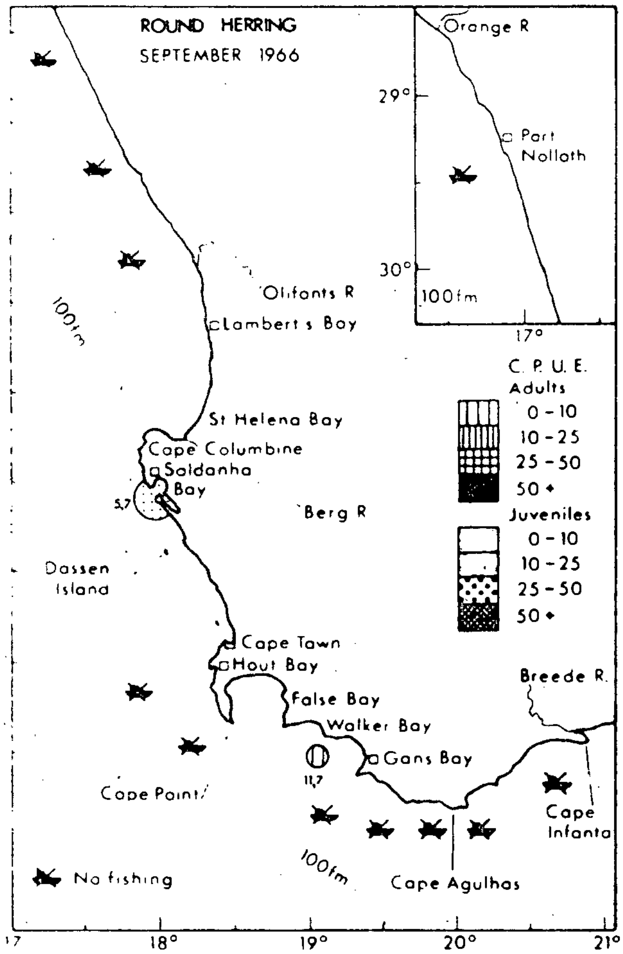
ROUND HERRING
JUNE 1966
Orange R
Port Nolloth
100fm
C. P. U. E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
8,8
9,2
7,7
8,2
8,2

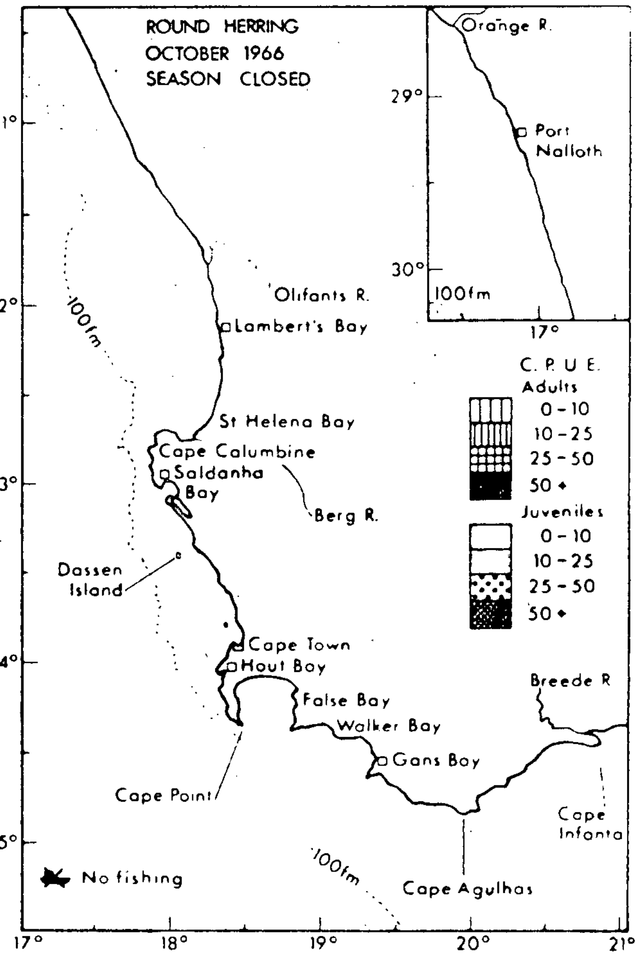


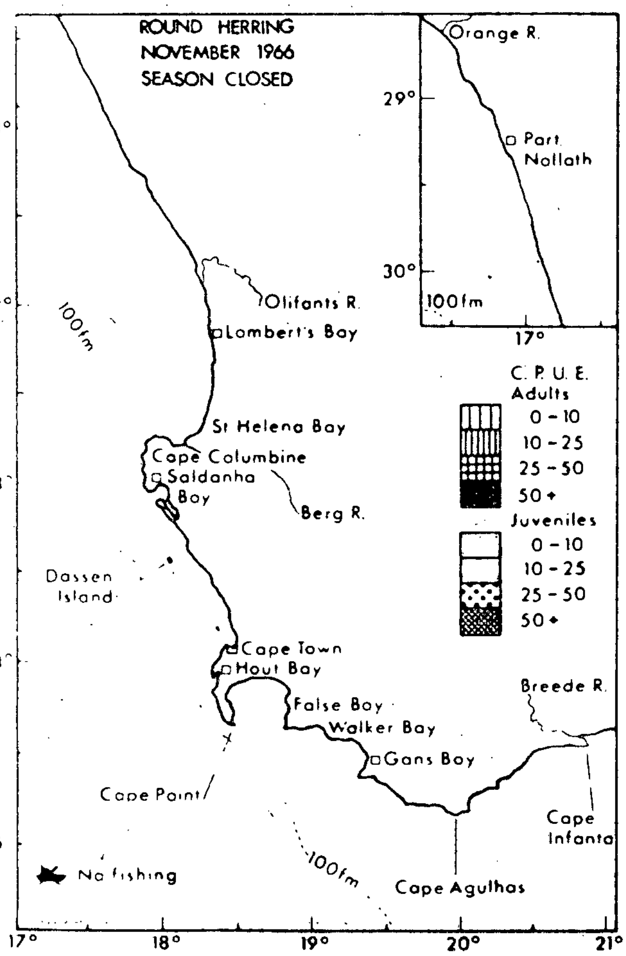
ROUND HERRING
JULY 1966
Orange R.
Port Nolloth
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
17,7

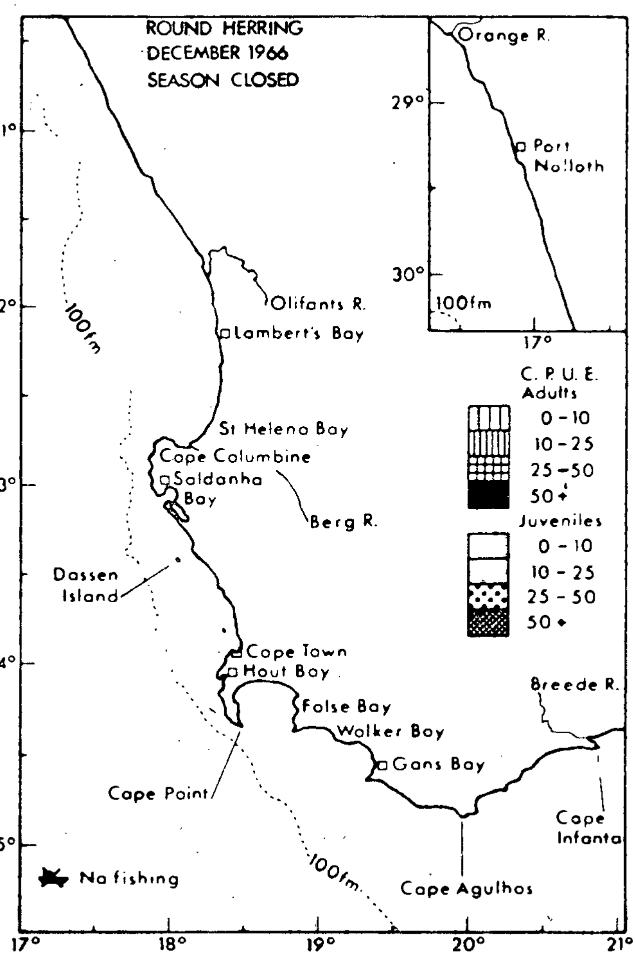


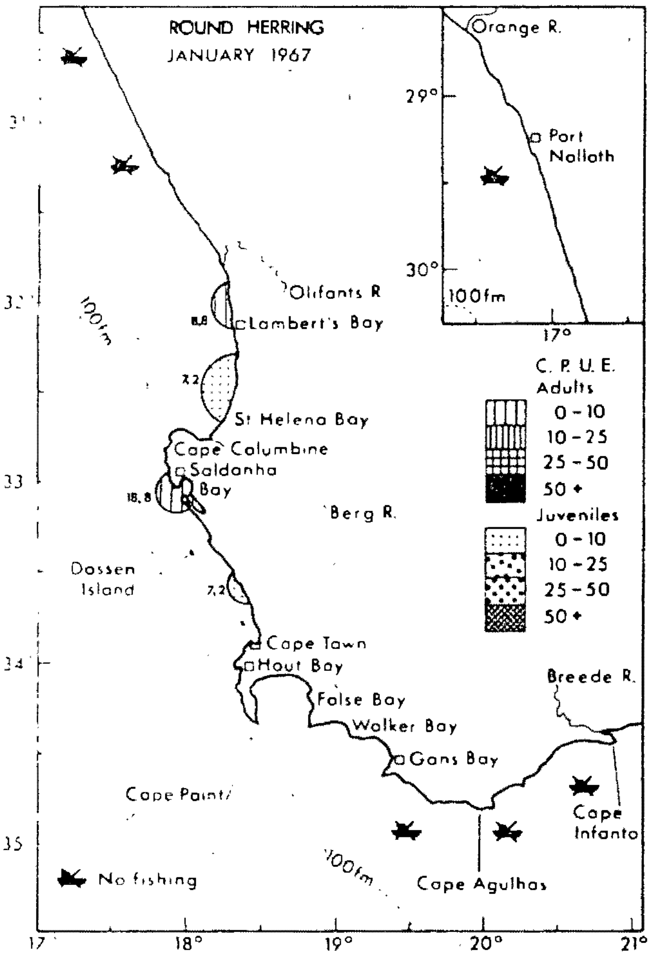
ROUND HERRING
AUGUST 1966
Orange R.
Port Nolloth
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
5,7
11,7

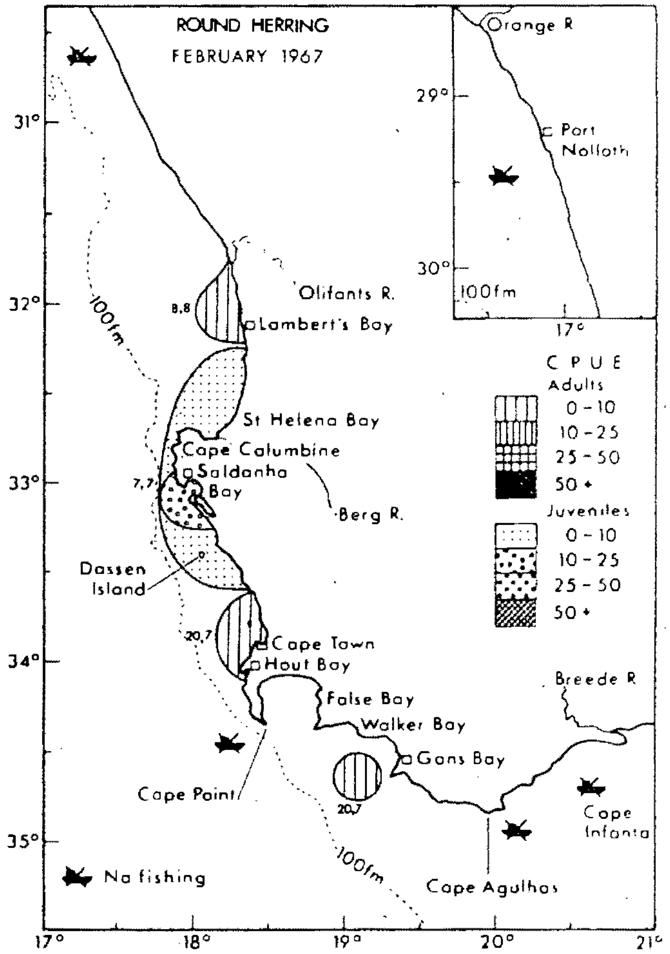

ROUND HERRING
SEPTEMBER 1966
Orange R
29°
Port Nolloth
30°
100fm
17°
Olifants R
Lambert's Bay
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
5,7
Berg R
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
11,7
Cape Point
Cape Infanta
100fm
Cape Agulhas
No fishing
18°
19°
20°
21°

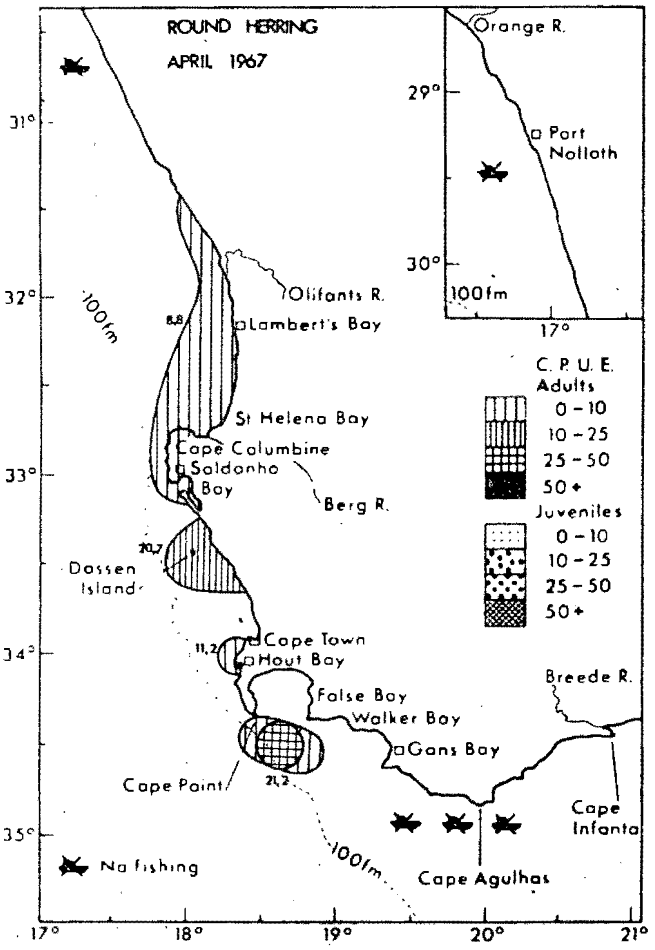

ROUND HERRING
OCTOBER 1966
SEASON CLOSED
Orange R.
29°
Port Nolloth
30°
100fm
17°
31°
32°
100fm
Olifants R.
Lambert's Bay
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
33°
Berg R.
Dassen Island
Cape Town
Hout Bay
34°
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
35°
100fm
No fishing
Cape Agulhas
17°
18°
19°
20°
21°

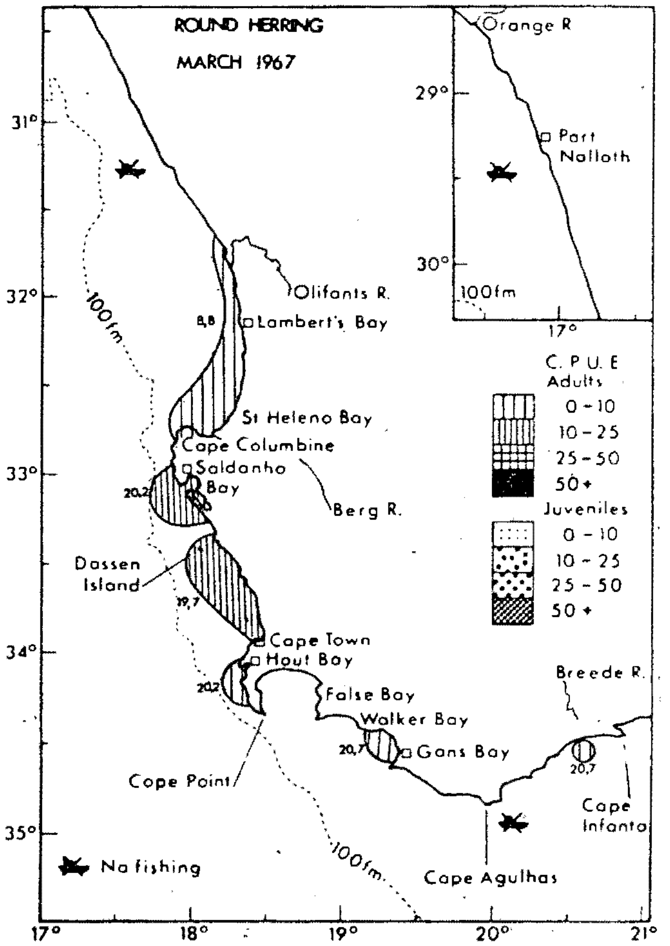

ROUND HERRING
NOVEMBER 1966
SEASON CLOSED
Orange R.
29°
Port Nolloth
30°
100fm
17°
31°
32°
100fm
Olifants R.
Lambert's Bay
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
35
100fm
No fishing
Cape Agulhas
17°
18°
19°
20°
21°


ROUND HERRING
DECEMBER 1966
SEASON CLOSED
Orange R.
29°
Port Nolloth
30°
100fm
17°
31°
32°
100fm
Olifants R.
Lambert's Bay
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
33°
Berg R.
Dassen Island
Cape Town
Hout Bay
34°
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
35°
100fm
No fishing
Cape Agulhas
17°
18°
19°
20°
21°


ROUND HERRING
JANUARY 1967
Orange R.
Port Nolloth
100fm
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dossen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
8,8
7,2
18,8
7,2


ROUND HERRING
FEBRUARY 1967
Orange R
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C P U E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
8,8
7,7
20,7
20,7


ROUND HERRING
APRIL 1967
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dossen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
8,8
20,7
11,2
21,2


ROUND HERRING
MARCH 1967
Orange R
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Heleno Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P U. E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
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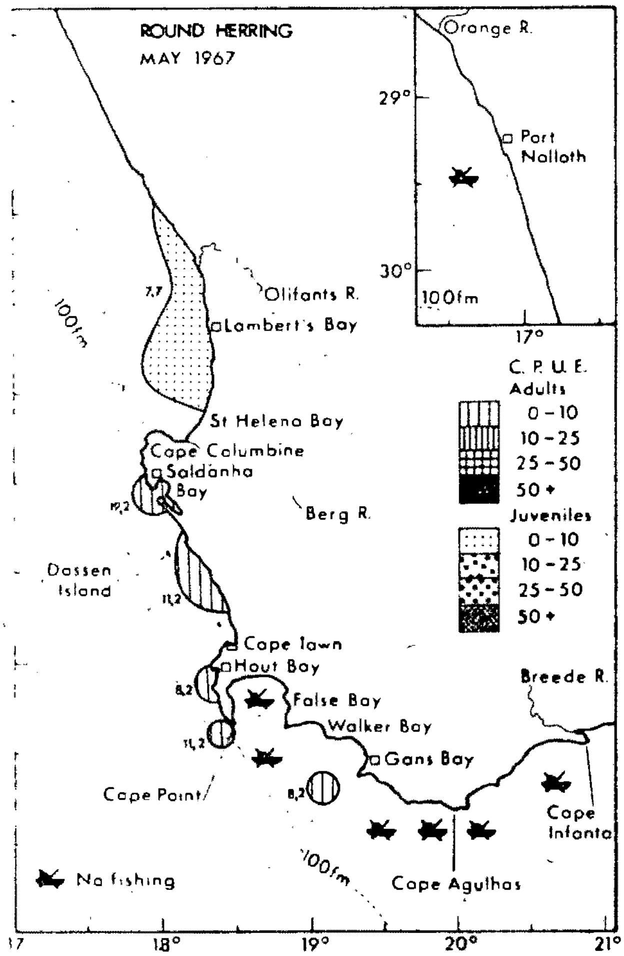
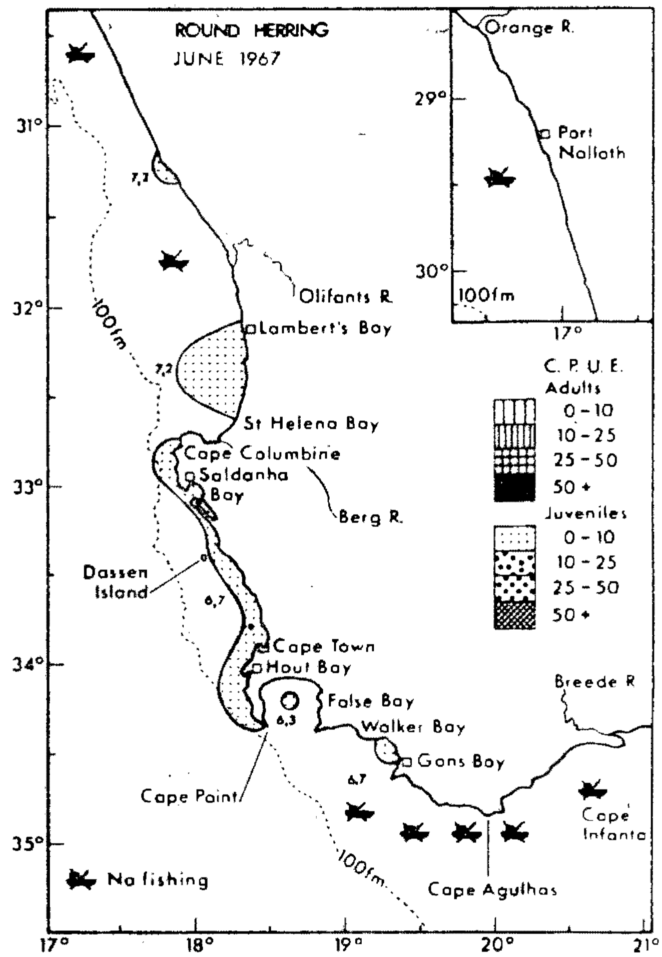
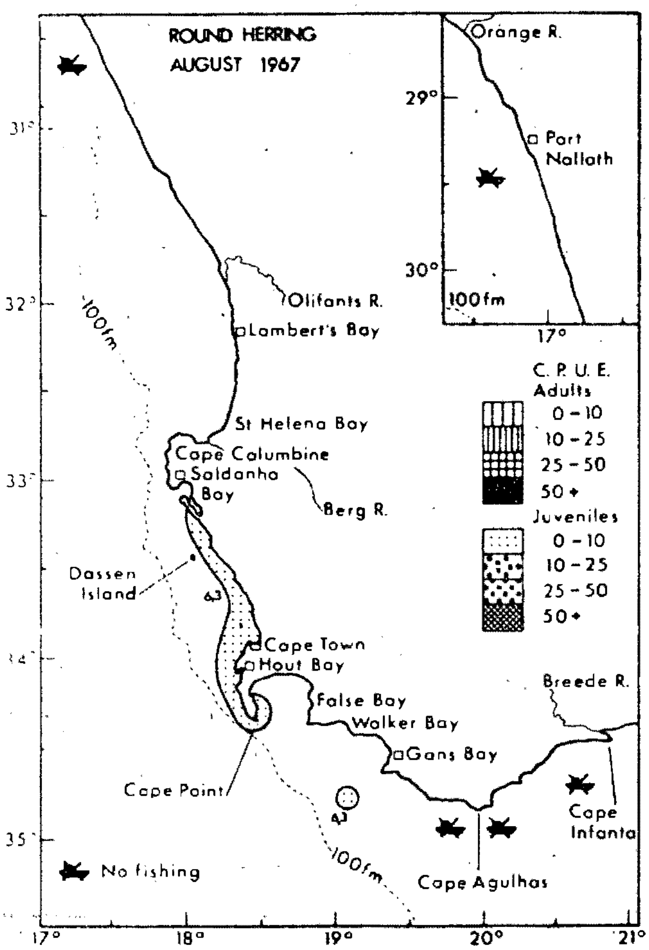
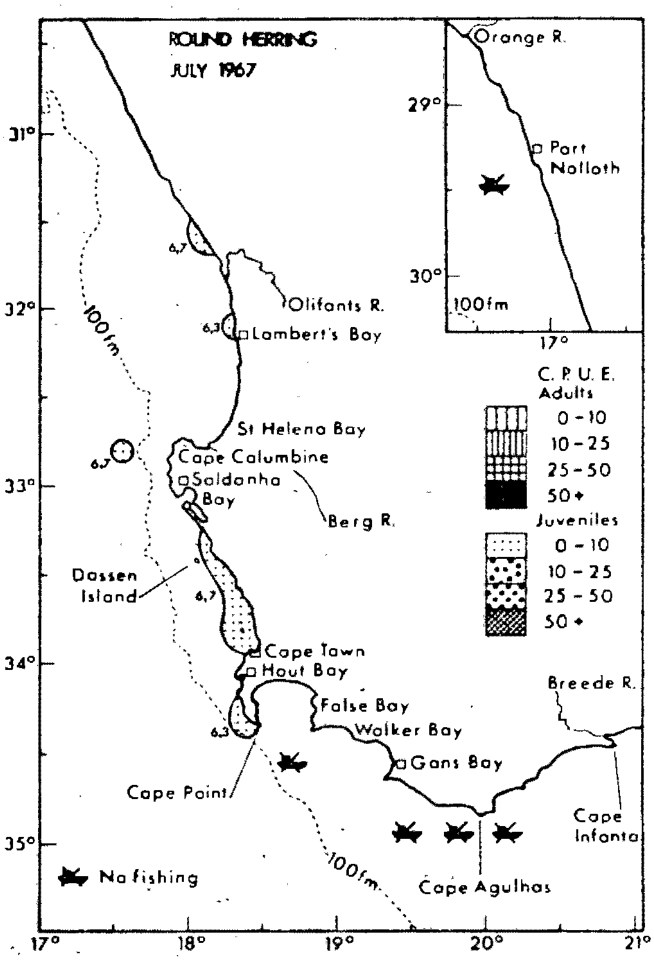
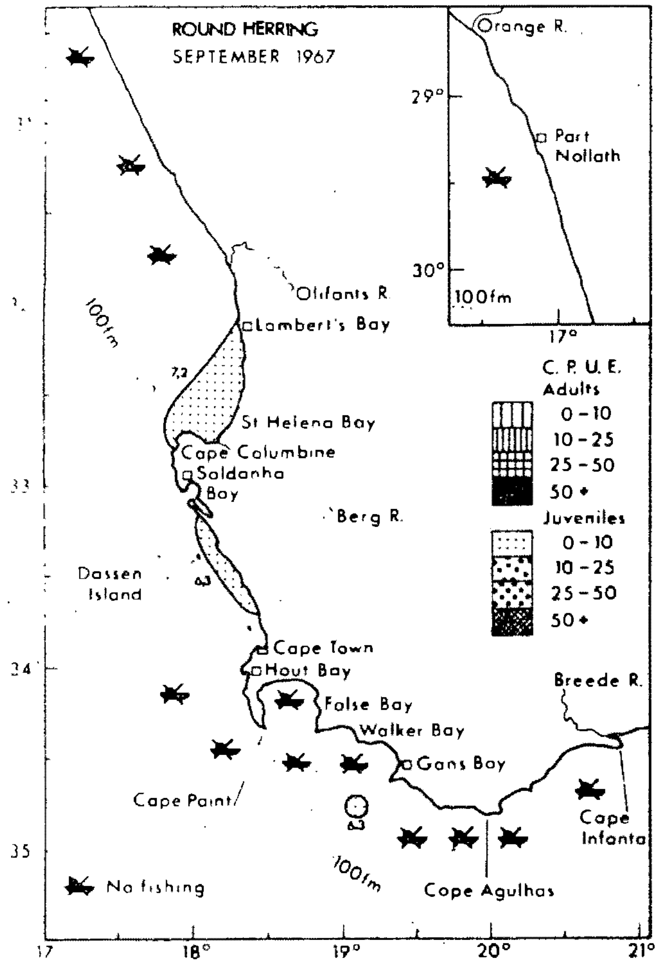
20,2
20,7
20,7

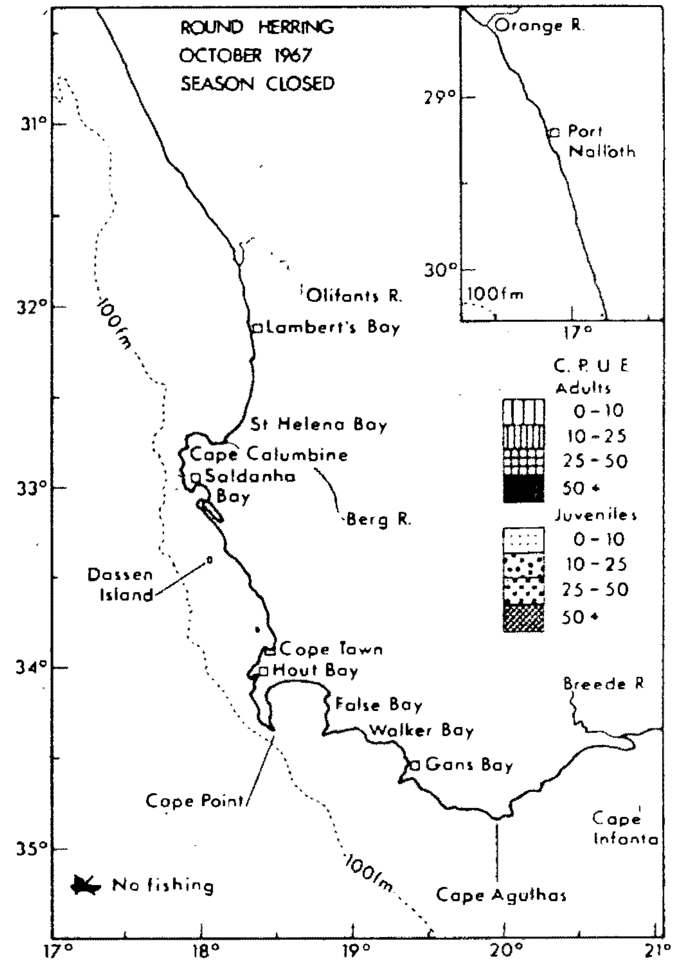

ROUND HERRING
MAY 1967
Orange R.
29°
Port Nolloth
30°
100fm
17°
Olifants R.
Lambert's Bay
100fm
7,7
St Helena Bay
Cape Columbine
Saldanha Bay
10,2
Berg R.
Dassen Island
11,2
Cape Town
Hout Bay
8,2
False Bay
Walker Bay
11,2
Gans Bay
Breede R.
Cape Point
8,2
Cape Infanta
100fm
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17
18°
19°
20°
21°

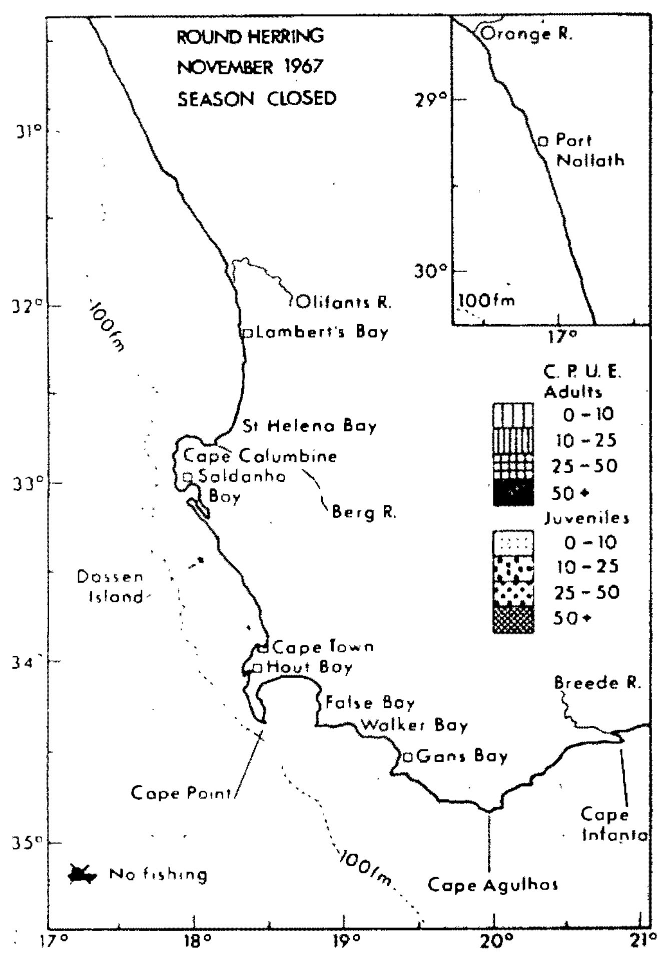

ROUND HERRING
JUNE 1967
Orange R.
29°
Port Nolloth
30°
100fm
17°
31°
7,2
Olifants R.
32°
100fm
Lambert's Bay
7,2
St Helena Bay
Cape Columbine
Saldanha Bay
33°
Berg R.
Dassen Island
6,7
Cape Town
34°
Hout Bay
False Bay
6,3
Walker Bay
Gans Bay
Breede R
6,7
Cape Point
Cape Infanta
35°
100fm
No fishing
Cape Agulhas
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
19°
20°
21°

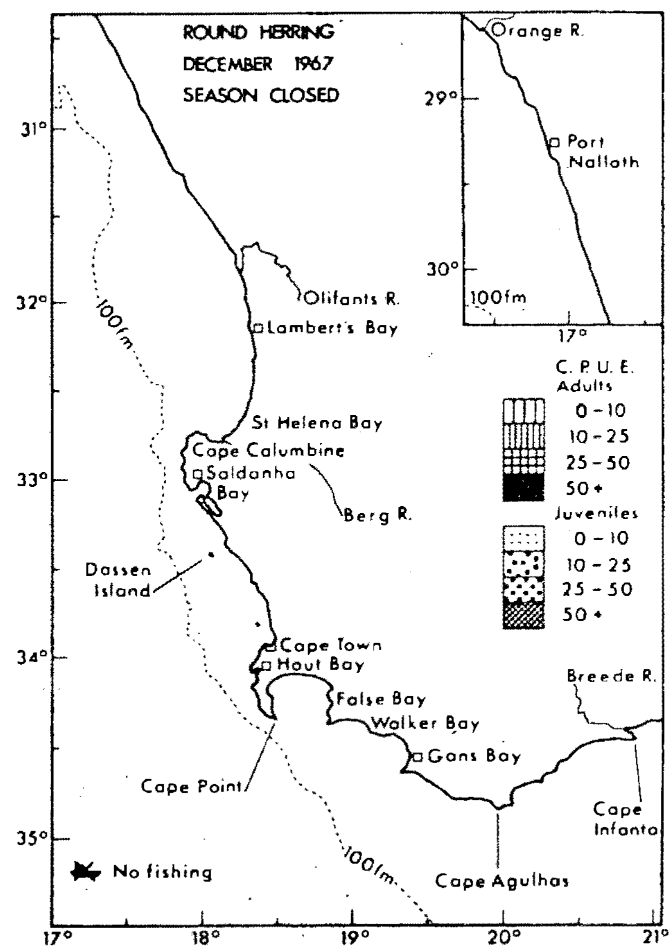

ROUND HERRING
AUGUST 1967
Orange R.
29°
Port Nolloth
30°
100fm
17°
31°
32°
Olifants R.
100fm
Lambert's Bay
St Helena Bay
Cape Columbine
33°
Saldanha Bay
Berg R.
Dassen Island
6,3
Cape Town
34°
Hout Bay
False Bay
Walker Bay
Breede R.
Gans Bay
Cape Point
6,3
Cape Infanta
35°
No fishing
100fm
Cape Agulhas
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
19°
20°
21°

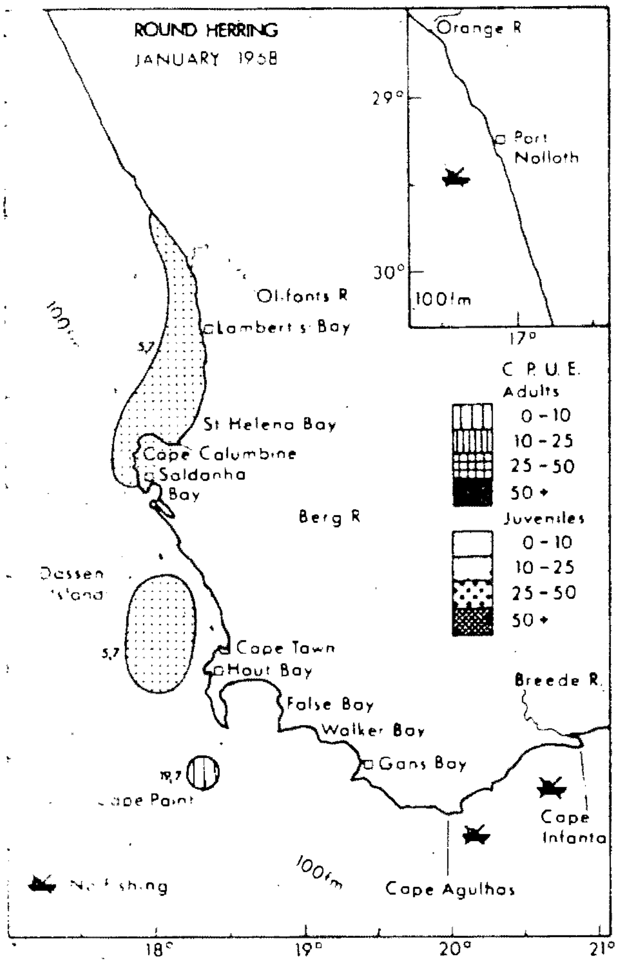

ROUND HERRING
JULY 1967
Orange R.
29°
Port Nolloth
30°
100fm
17°
31°
6,7
Olifants R.
32°
100fm
6,3
Lambert's Bay
St Helena Bay
6,7
Cape Columbine
Saldanha Bay
33°
Berg R.
Dassen Island
6,7
Cape Town
34°
Hout Bay
False Bay
Breede R.
6,3
Walker Bay
Gans Bay
Cape Point
Cape Infanta
35°
100fm
No fishing
Cape Agulhas
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50+
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
19°
20°
21°

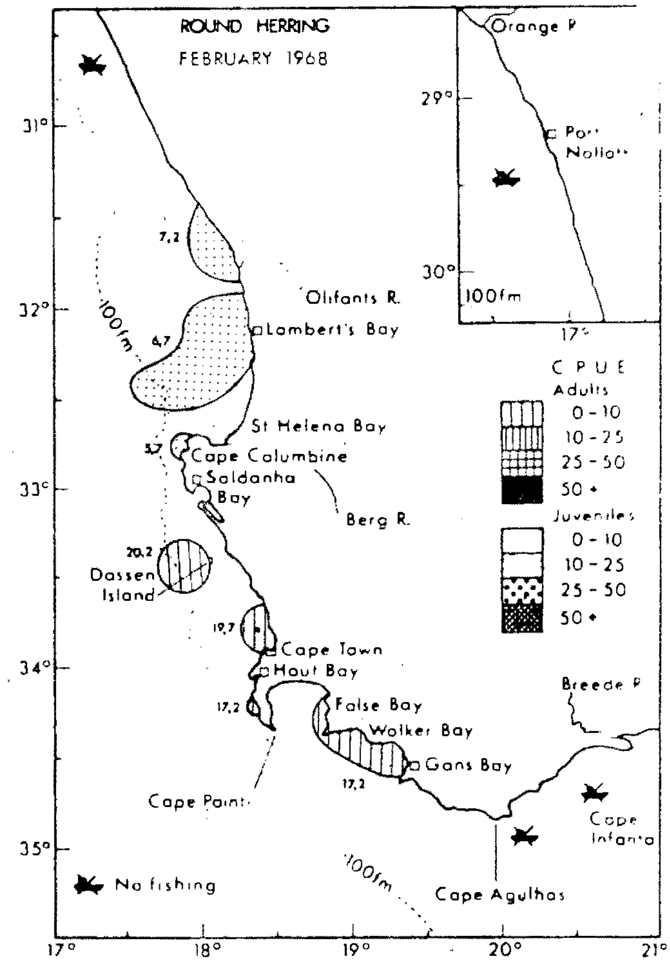

ROUND HERRING
SEPTEMBER 1967
Orange R.
29°
Port Nollath
30°
100fm
17°
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
17
18°
19°
20°
21°

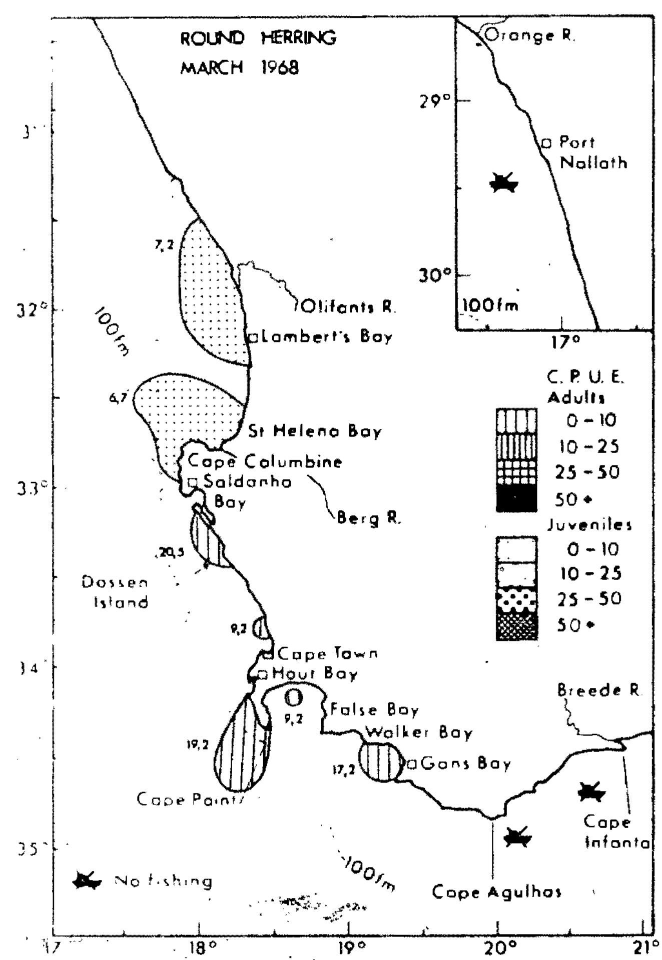

ROUND HERRING
OCTOBER 1967
SEASON CLOSED
Orange R.
29°
Port Nolloth
30°
100fm
17°
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
31°
32°
33°
34°
35°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
17°
18°
19°
20°
21°

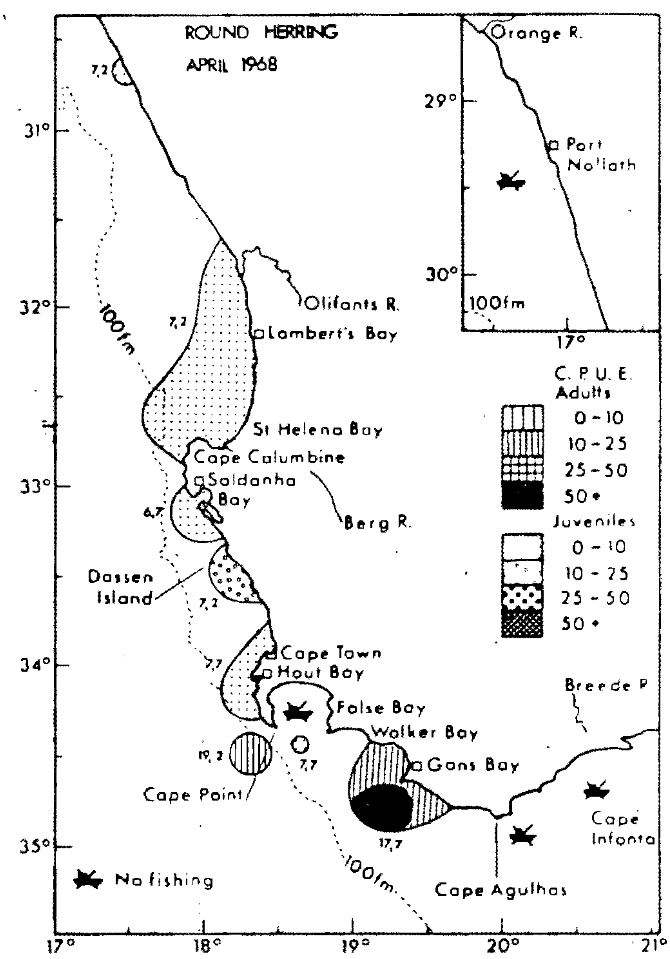

ROUND HERRING
NOVEMBER 1967
SEASON CLOSED
Orange R.
29°
Port Nollath
30°
100fm
17°
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
31°
32°
33°
34°
35°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
17°
18°
19°
20°
21°

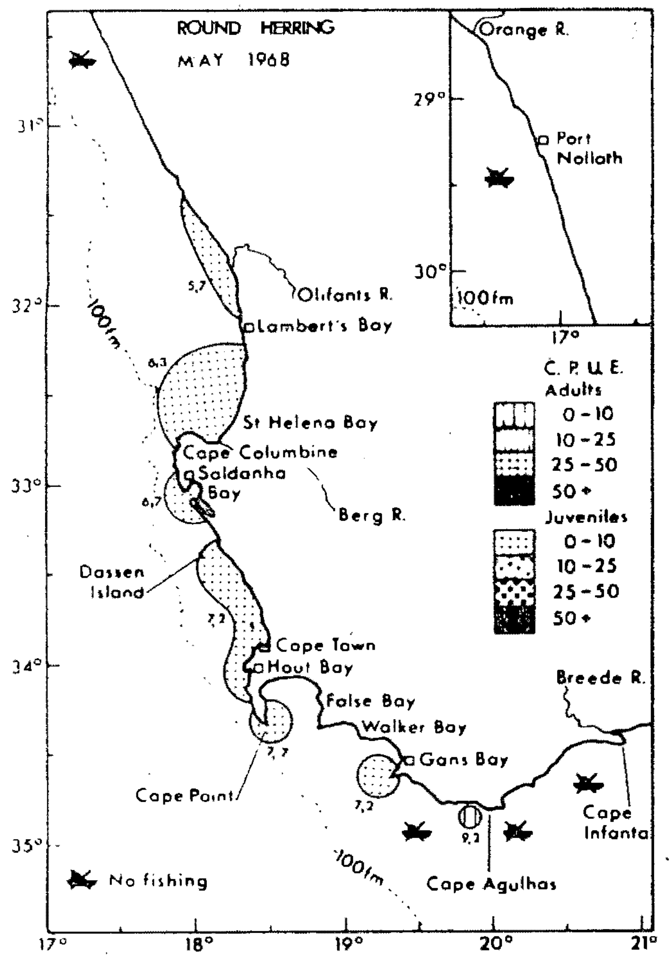

ROUND HERRING
DECEMBER 1967
SEASON CLOSED
Orange R.
29°
Port Nalloth
30°
100fm
17°
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
31°
32°
33°
34°
35°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
17°
18°
19°
20°
21°

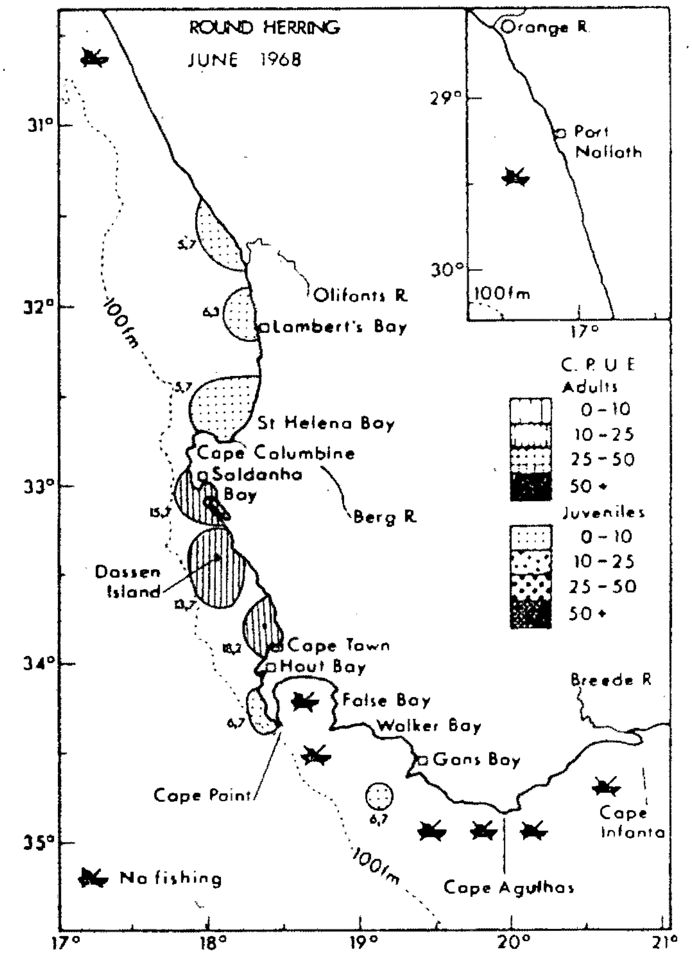

ROUND HERRING
JANUARY 1968
Orange R
29°
Port Nolloth
30°
100fm
17°
Olifants R
Lambert's Bay
5,7
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R
Dassen Island
5,7
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
19,7
Cape Point
Cape Infanta
Cape Agulhas
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
18°
19°
20°
21°

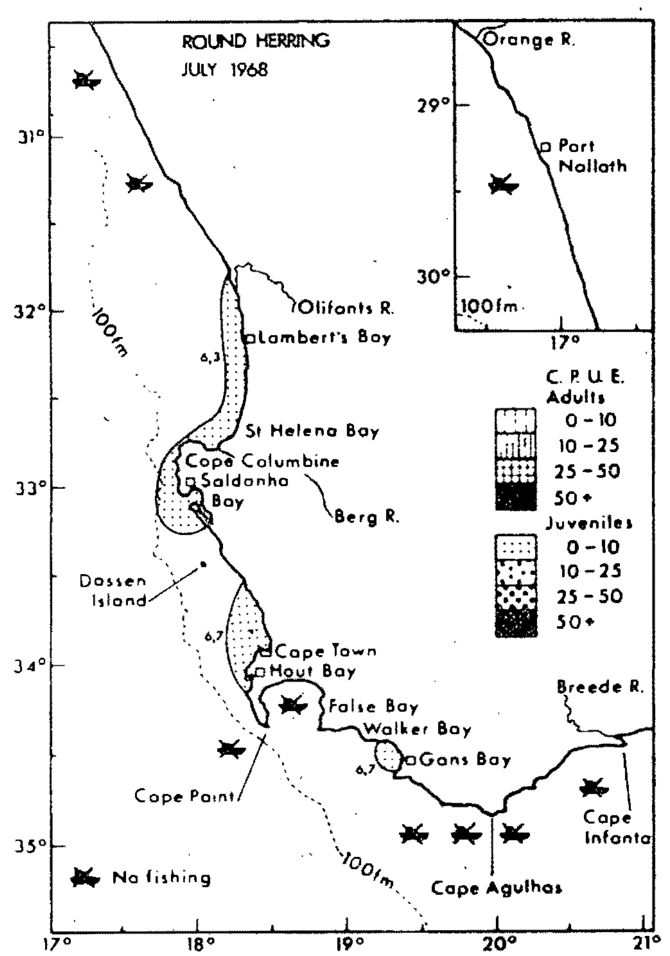

ROUND HERRING
FEBRUARY 1968
Orange R
29°
30°
100fm
17°
31°
32°
33°
34°
35°
7,2
6,7
5,7
20,2
19,7
17,2
17,2
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C P U E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
19°
20°
21°

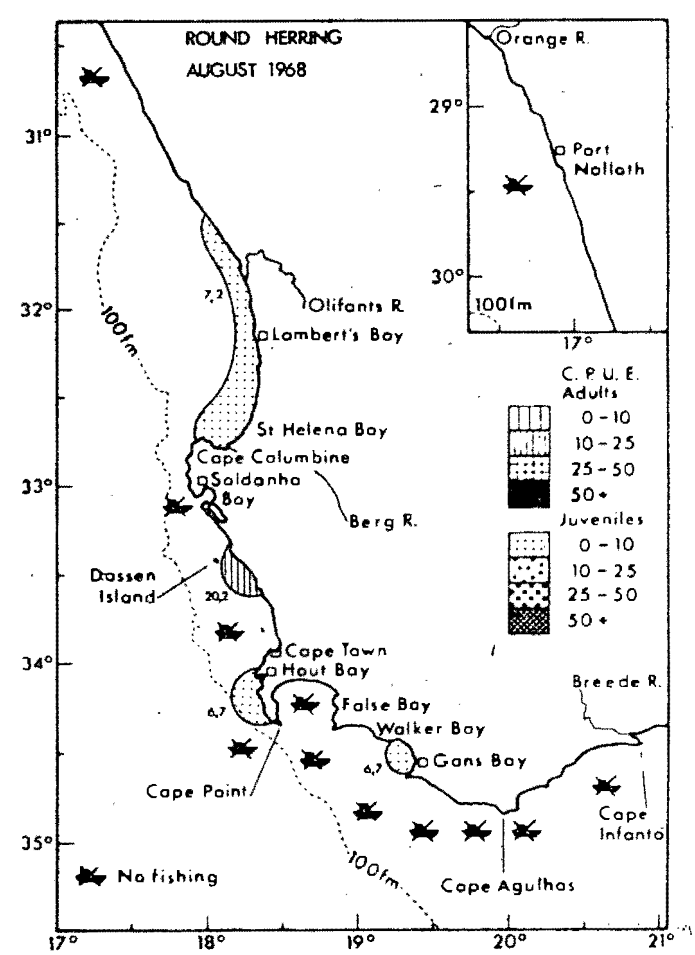

ROUND HERRING
MARCH 1968
Orange R.
29°
Port Nolloth
30°
100fm
17°
32°
33°
34°
35°
100fm
7,2
6,7
20,5
9,2
9,2
19,2
17,2
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17
18°
19°
20°
21°

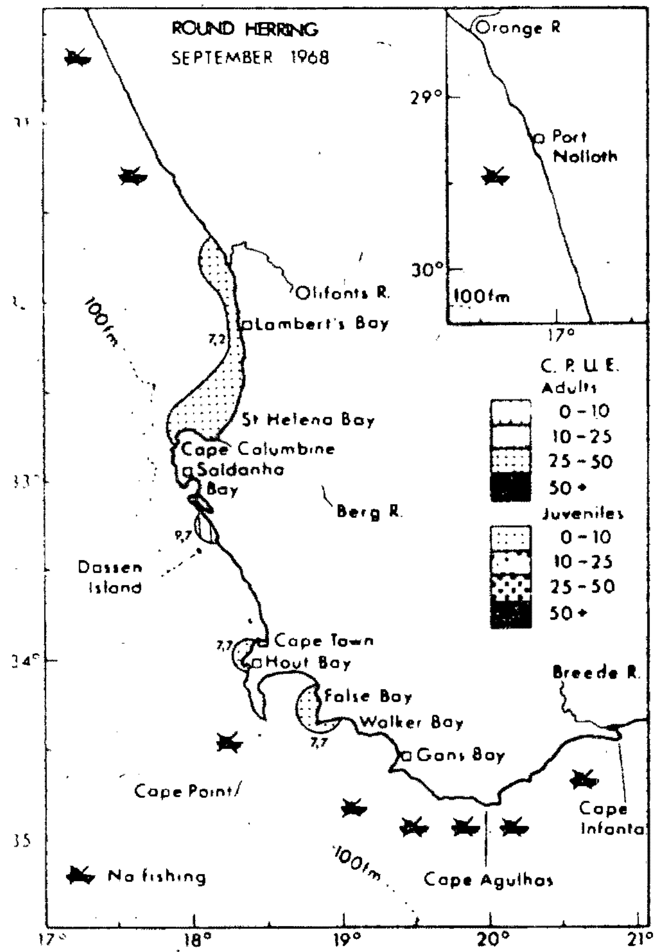

ROUND HERRING
APRIL 1968
Orange R.
29°
Port Nolloth
30°
100fm
17°
31°
32°
33°
34°
35°
7,2
7,2
6,7
7,2
7,7
19,2
7,7
17,7
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
19°
20°
21°

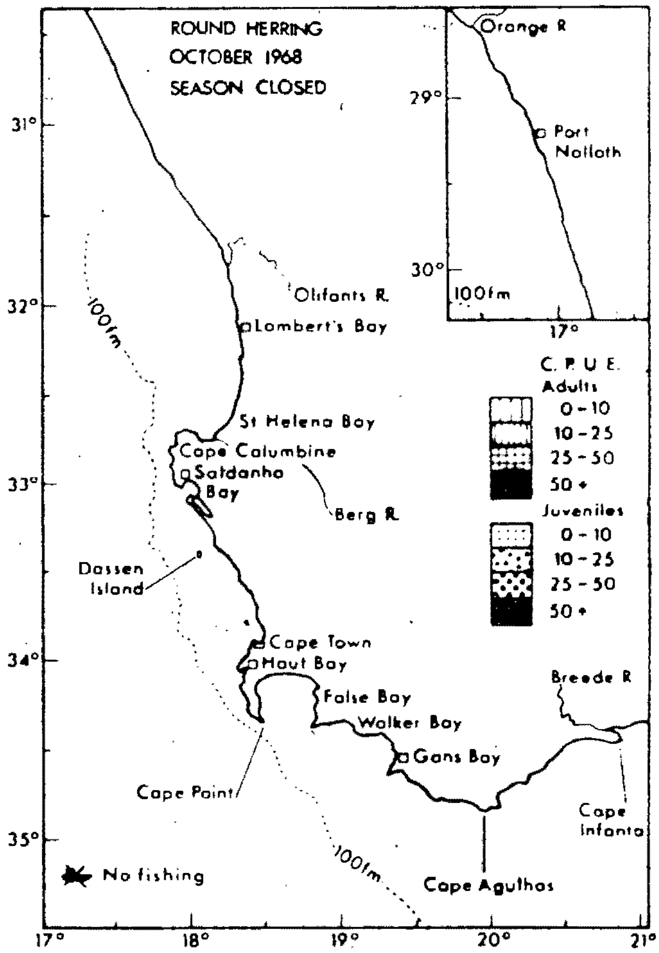

ROUND HERRING
MAY 1968
Orange R.
Port Nollath
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +

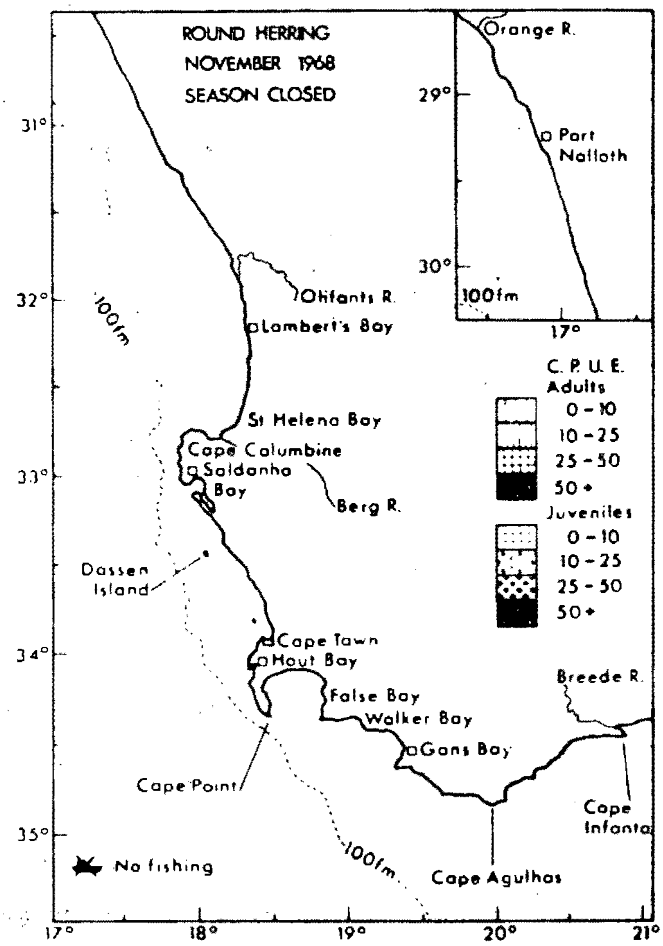

ROUND HERRING
JUNE 1968
Orange R.
Port Nollath
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +

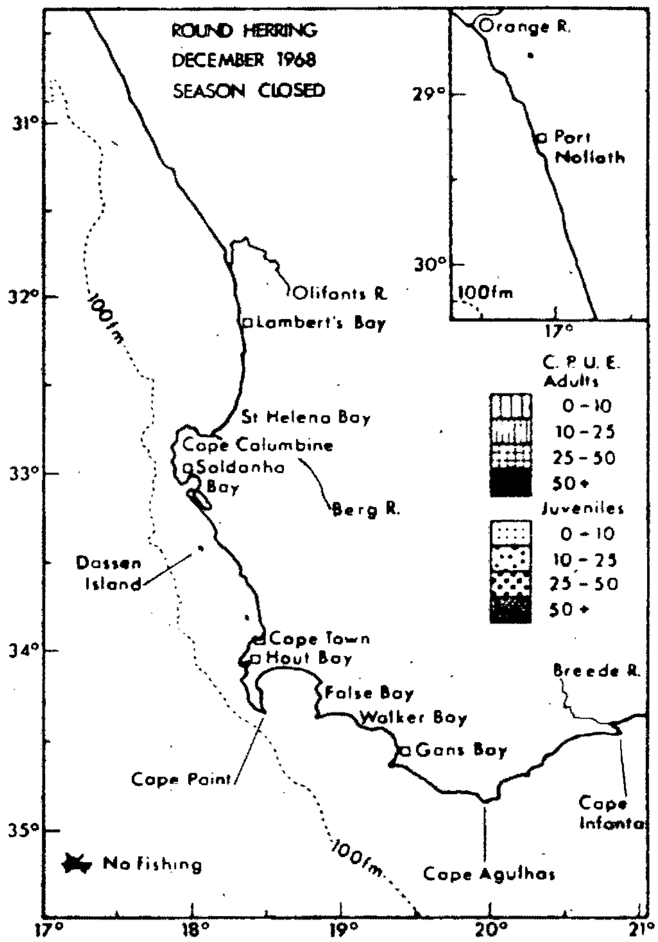

ROUND HERRING
JULY 1968
Orange R.
Port Nollath
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +

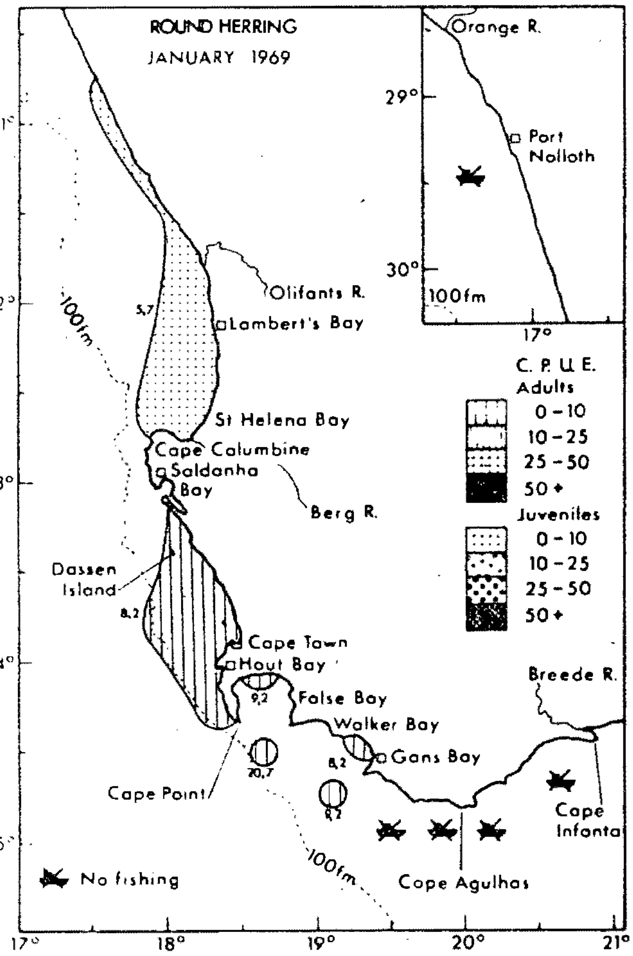

ROUND HERRING
AUGUST 1968
Orange R.
Port Nollath
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +

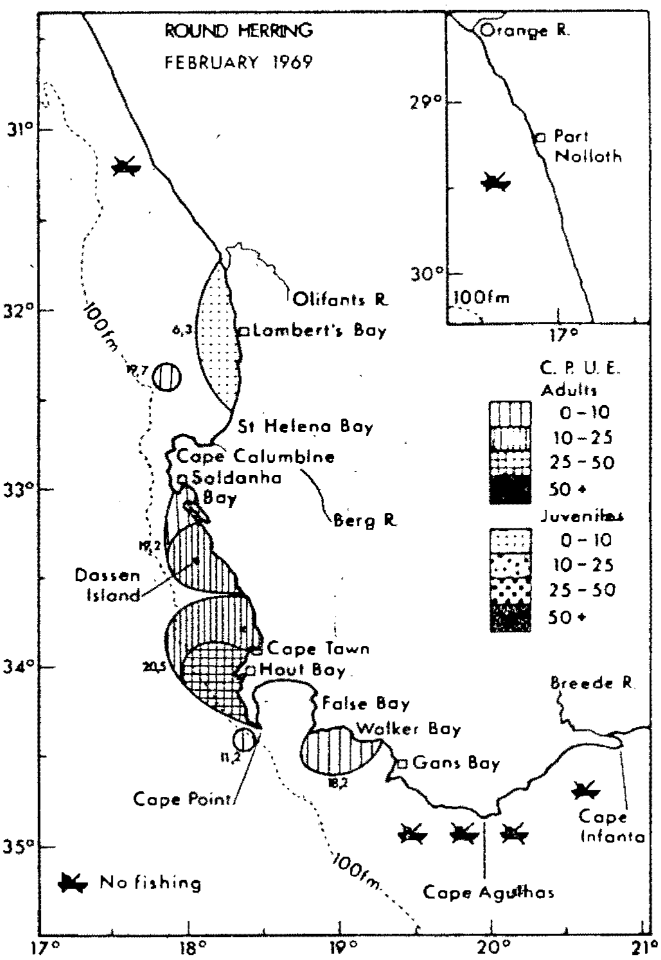

ROUND HERRING
SEPTEMBER 1968
Orange R
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
No fishing
17°
18°
19°
20°
21°

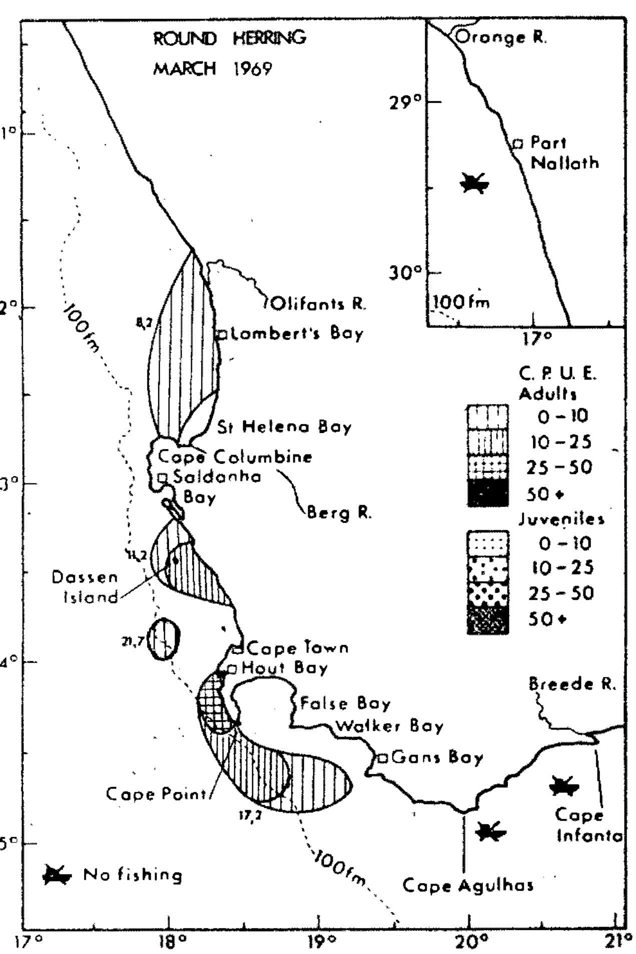

ROUND HERRING
OCTOBER 1968
SEASON CLOSED
Orange R
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
No fishing
31°
32°
33°
34°
35°
17°
18°
19°
20°
21°

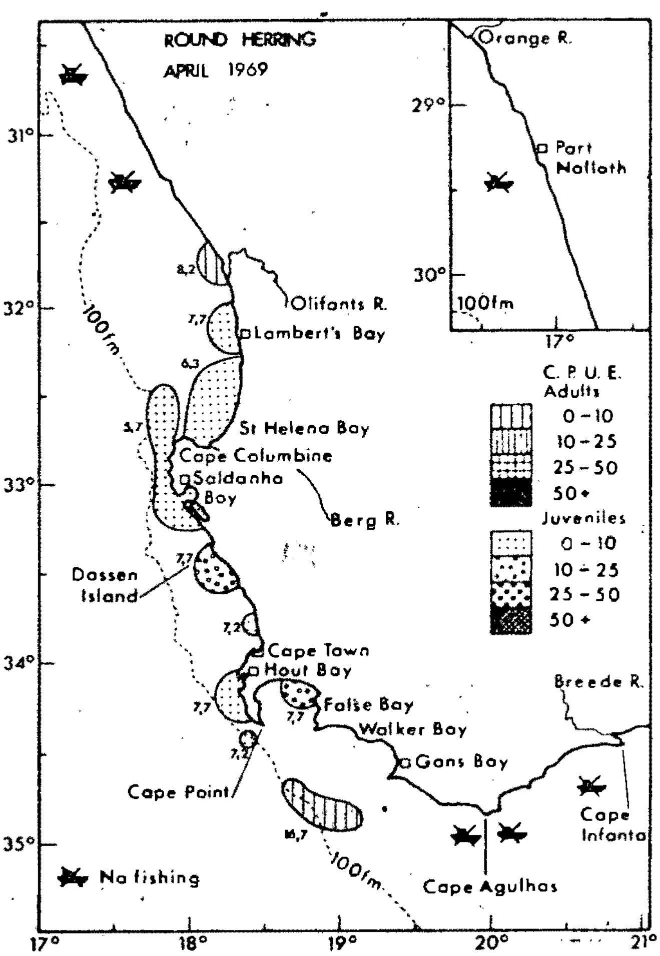

ROUND HERRING
NOVEMBER 1968
SEASON CLOSED
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
No fishing
31°
32°
33°
34°
35°
17°
18°
19°
20°
21°

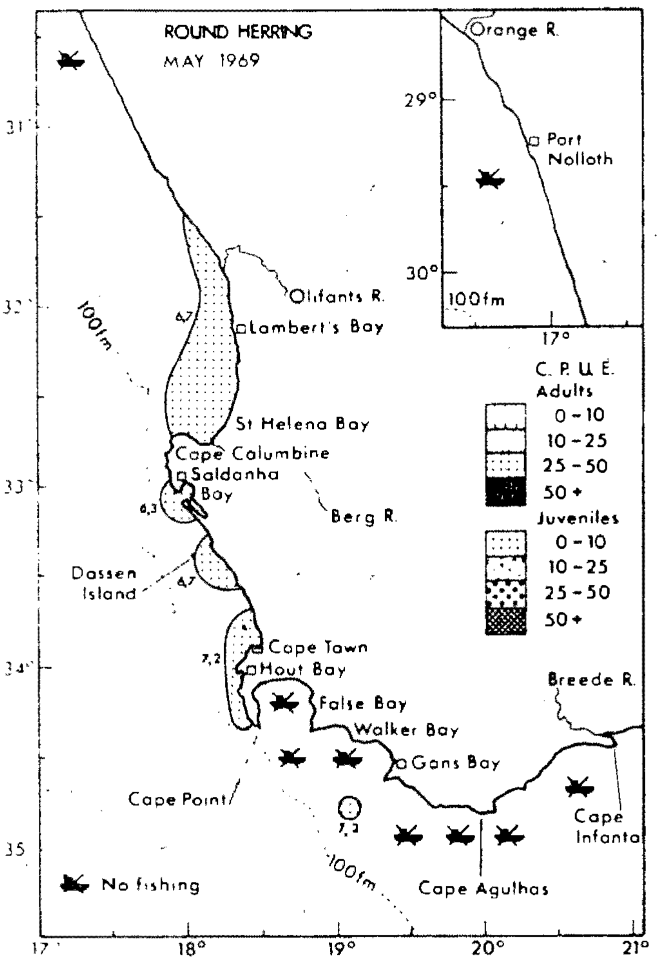

ROUND HERRING
DECEMBER 1968
SEASON CLOSED
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
No Fishing
31°
32°
33°
34°
35°
17°
18°
19°
20°
21°

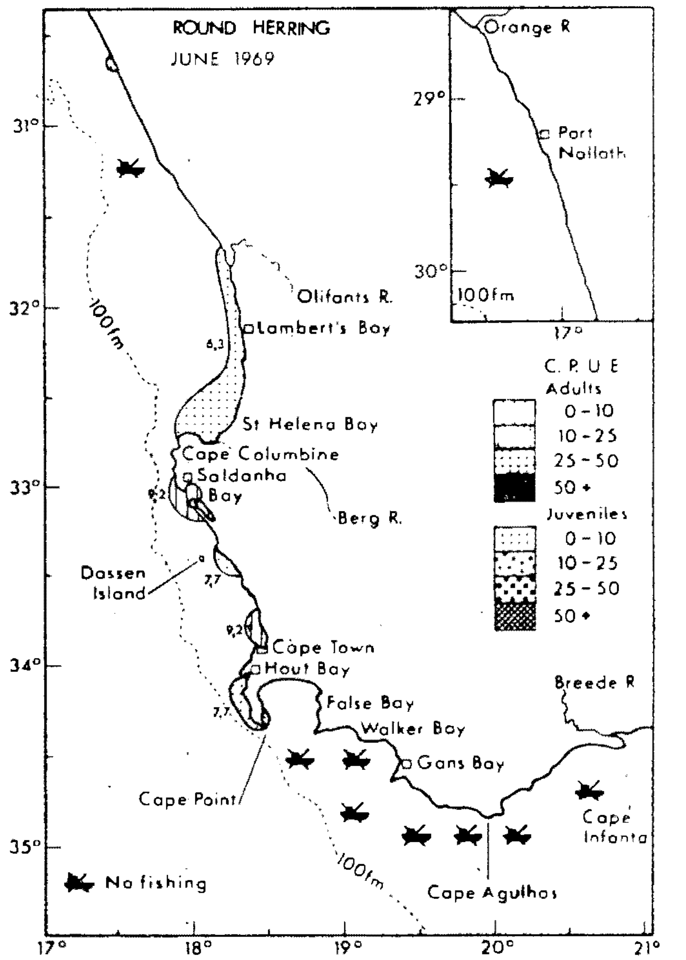

ROUND HERRING
JANUARY 1969
Orange R.
Port Nolloth
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
100fm

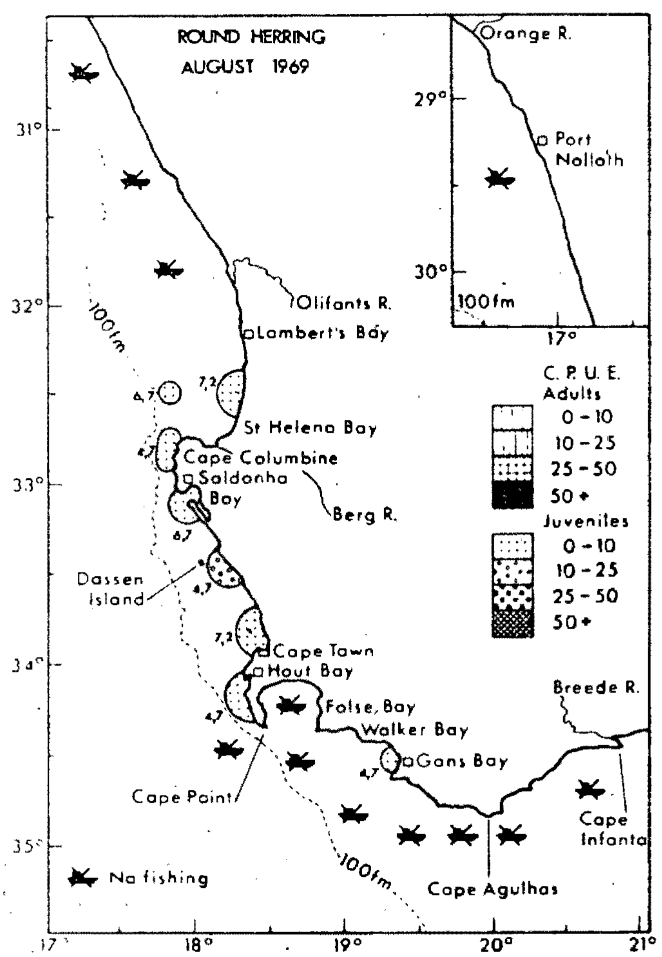

ROUND HERRING
FEBRUARY 1969
Orange R.
Port Nolloth
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
100fm


ROUND HERRING
MARCH 1969
Orange R.
Port Nolloth
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
100fm


ROUND HERRING
APRIL 1969
Orange R.
Port Nolloth
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
100fm


ROUND HERRING
MAY 1969
Orange R.
Port Nolloth
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
No fishing
6,7
6,3
7,2
7,3
29°
30°
17°
31°
32°
33°
34°
35
18°
19°
20°
21°


ROUND HERRING
JUNE 1969
Orange R
Port Nolloth
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
No fishing
6,3
9,2
7,7
29°
30°
17°
31°
32°
33°
34°
35°
18°
19°
20°
21°


ROUND HERRING
AUGUST 1969
Orange R.
Port Nolloth
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
No fishing
7,2
6,7
4,7
29°
30°
17°
31°
32°
33°
34°
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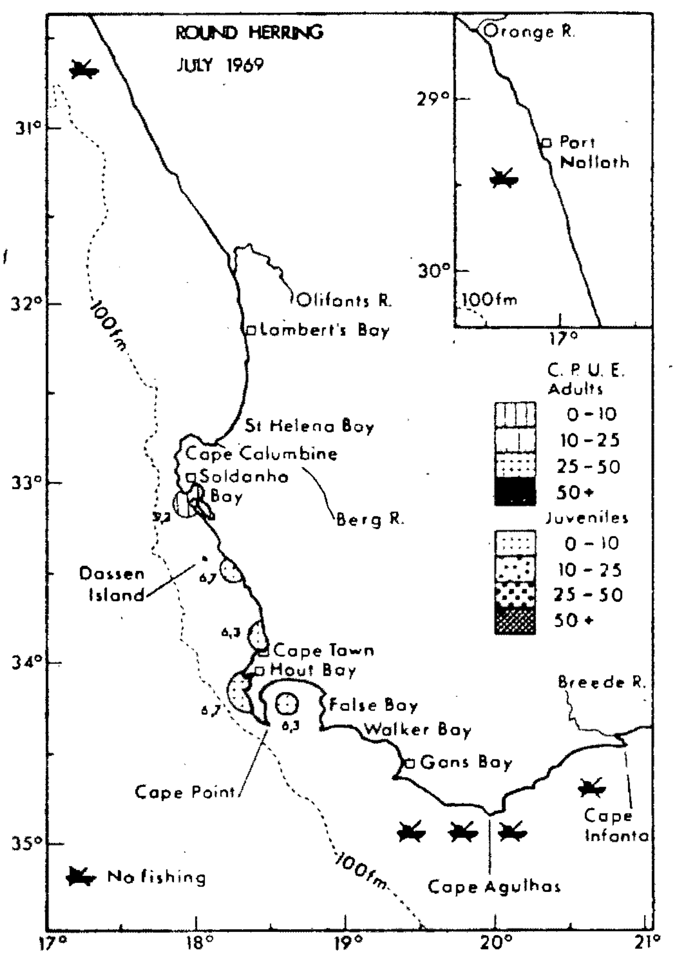
19°
20°
21°


ROUND HERRING
JULY 1969
Orange R.
Port Nolloth
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
No fishing
6,7
6,3
29°
30°
17°
31°
32°
33°
34°
35°
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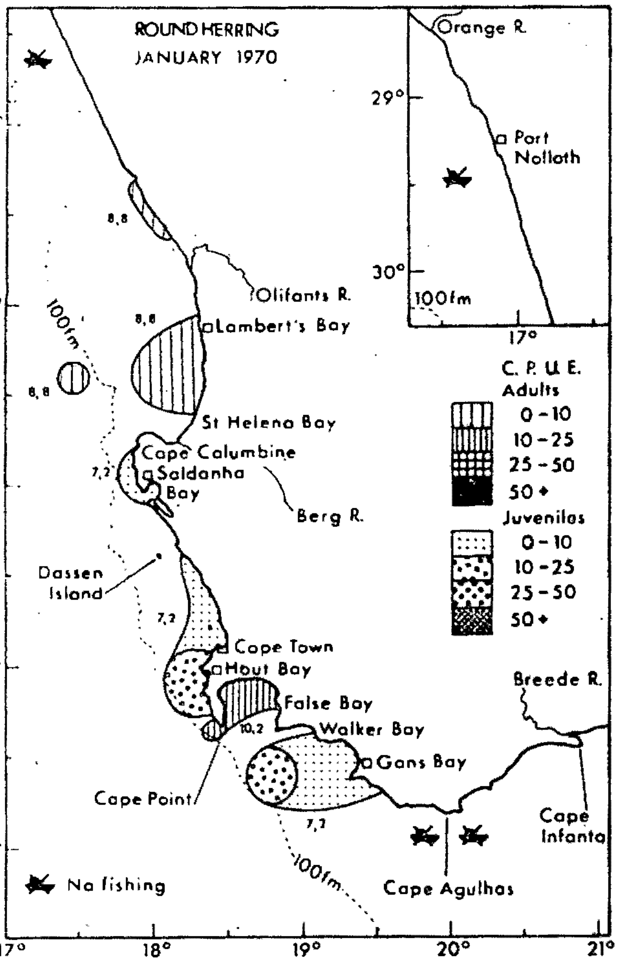
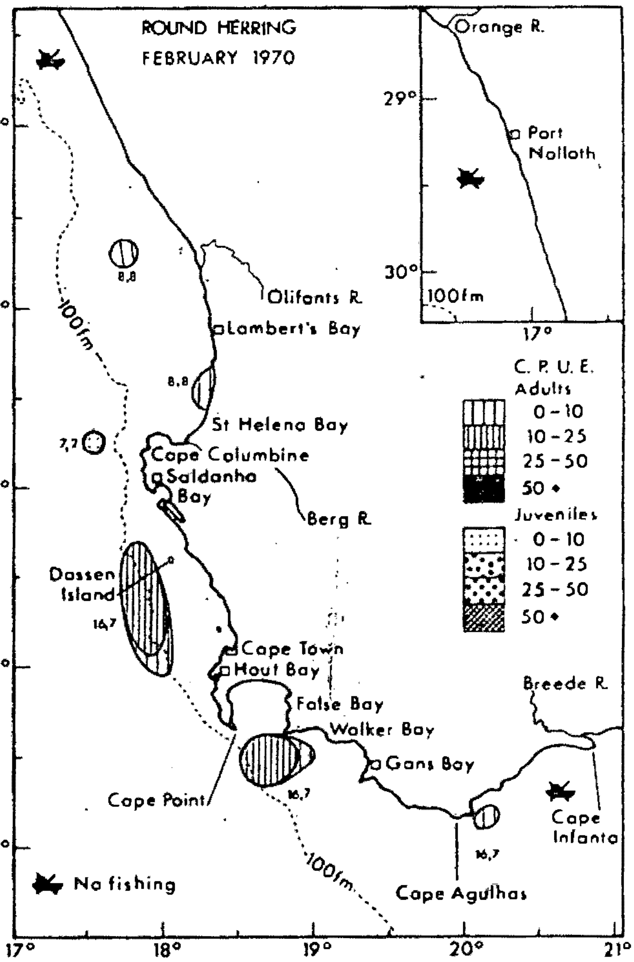
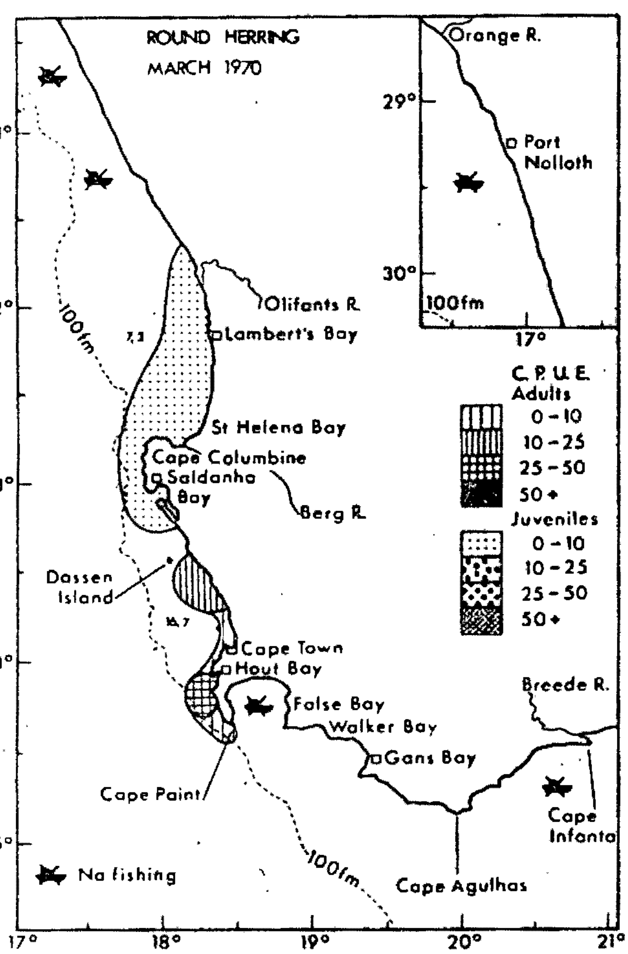
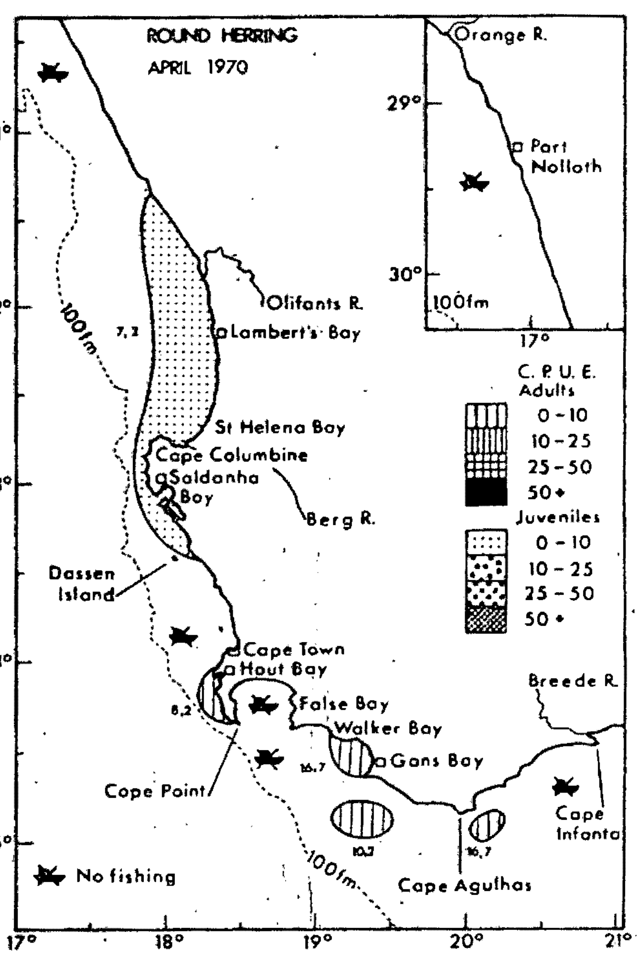
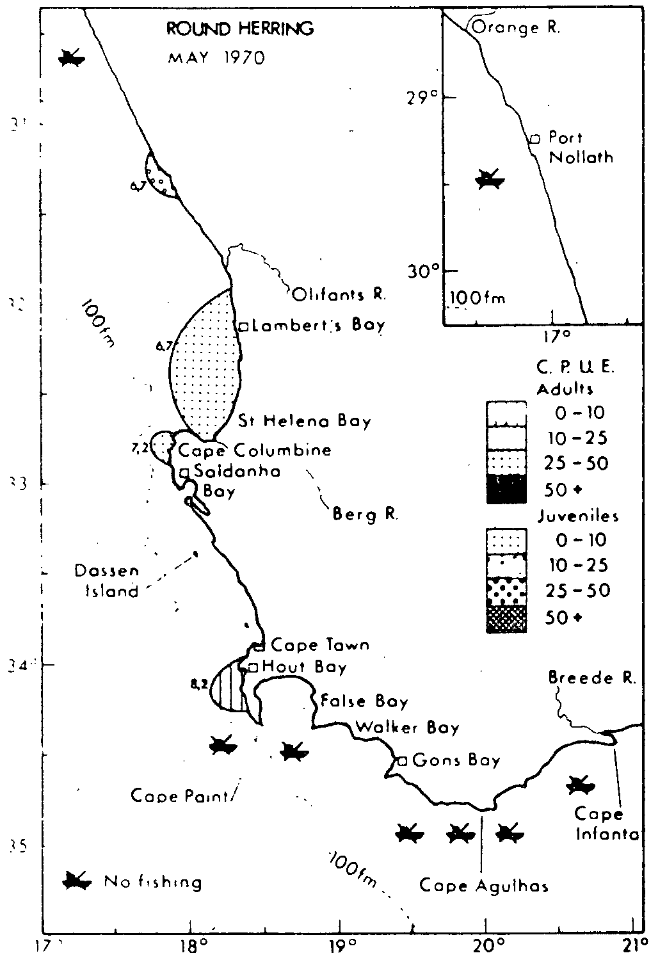
19°
20°
21°

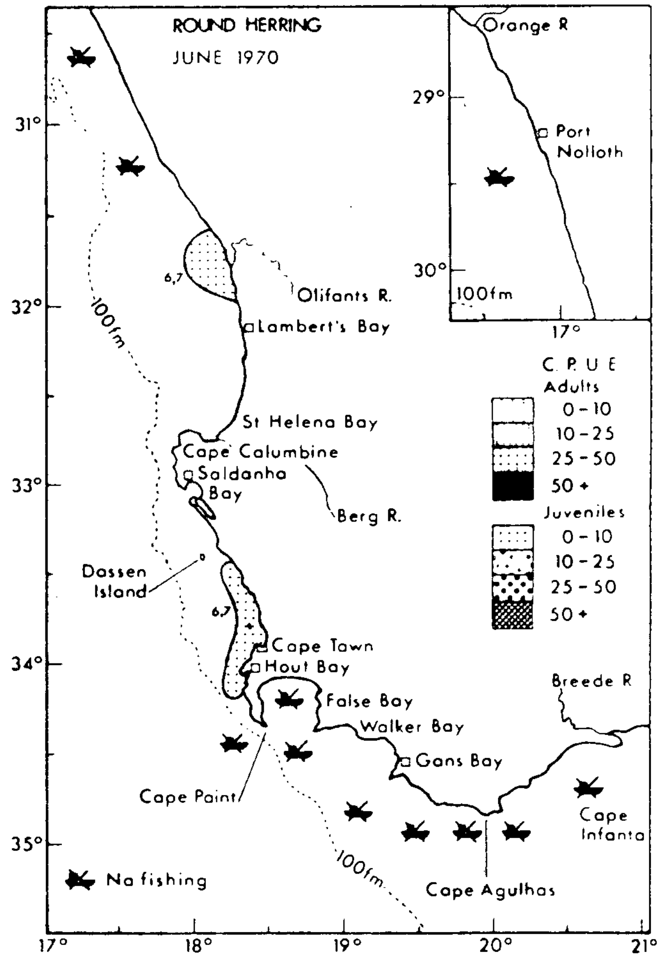

ROUND HERRING
JANUARY 1970
Orange R.
29°
Port Nolloth
30°
100fm
17°
31°
32°
33°
34°
35°
8,8
Olifants R.
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
7,2
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
10,2
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
19°
20°
21°

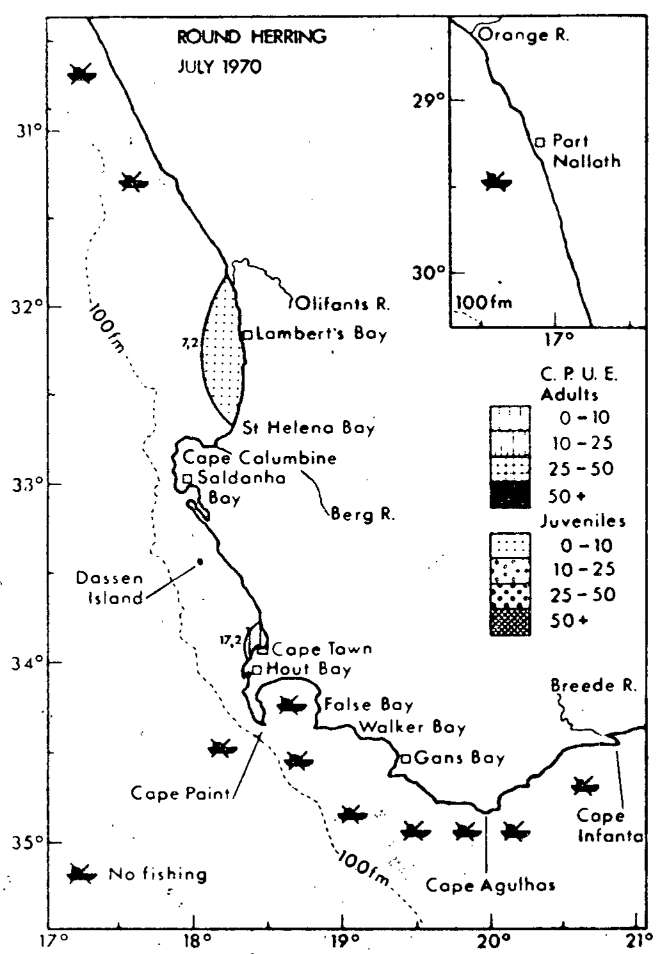

ROUND HERRING
FEBRUARY 1970
Orange R.
29°
Port Nolloth
30°
100fm
17°
31°
32°
33°
34°
35°
8,8
7,2
16,7
Olifants R.
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
19°
20°
21°

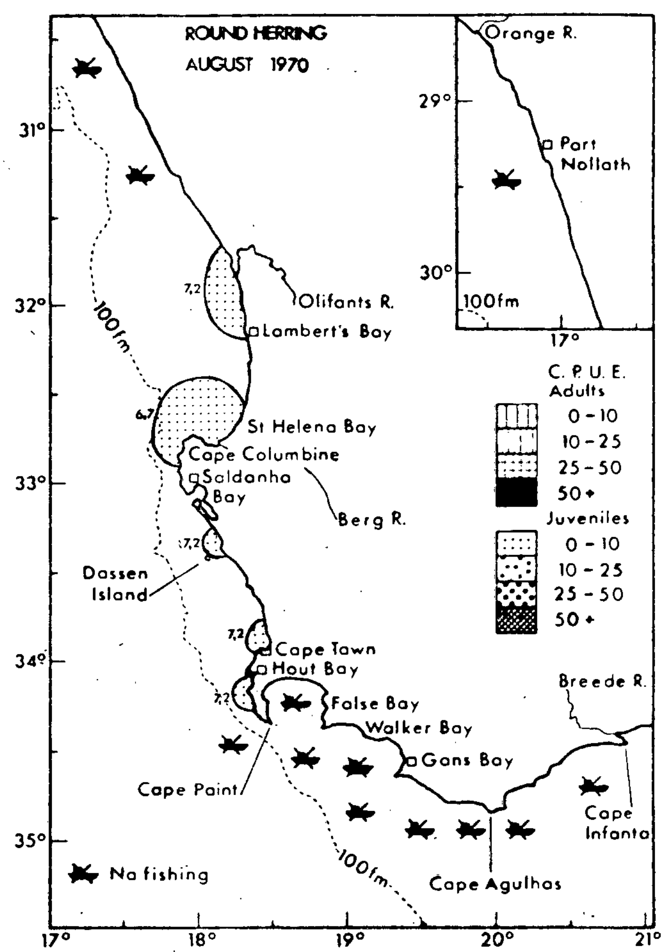

ROUND HERRING
MARCH 1970
Orange R.
29°
Port Nolloth
30°
100fm
17°
31°
32°
33°
34°
35°
7,2
16,7
Olifants R.
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
19°
20°
21°

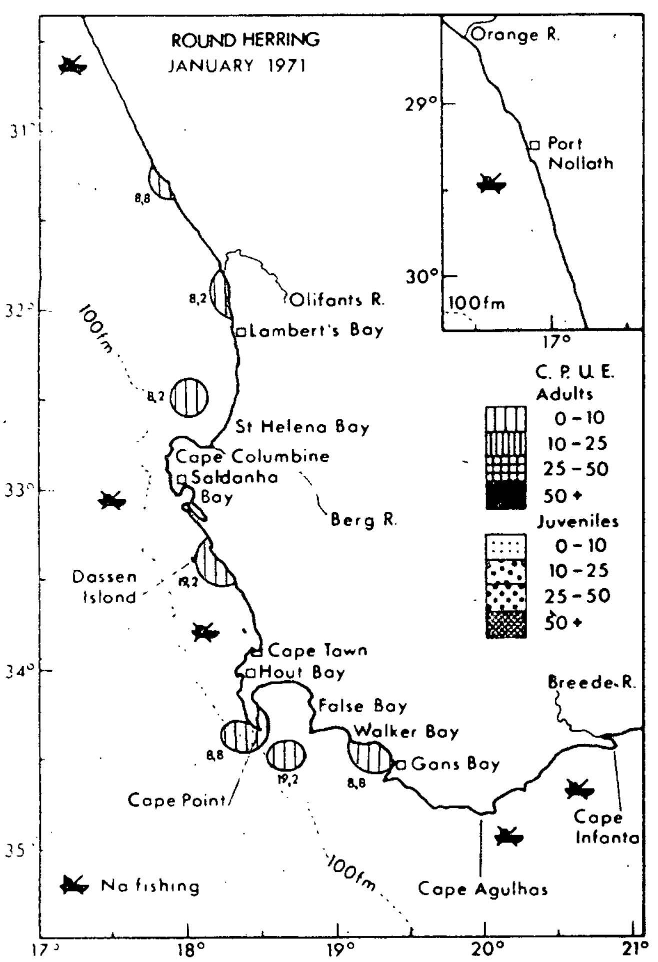

ROUND HERRING
APRIL 1970
Orange R.
29°
Port Nolloth
30°
100fm
17°
31°
32°
33°
34°
35°
7,2
8,2
16,7
10,2
Olifants R.
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
19°
20°
21°

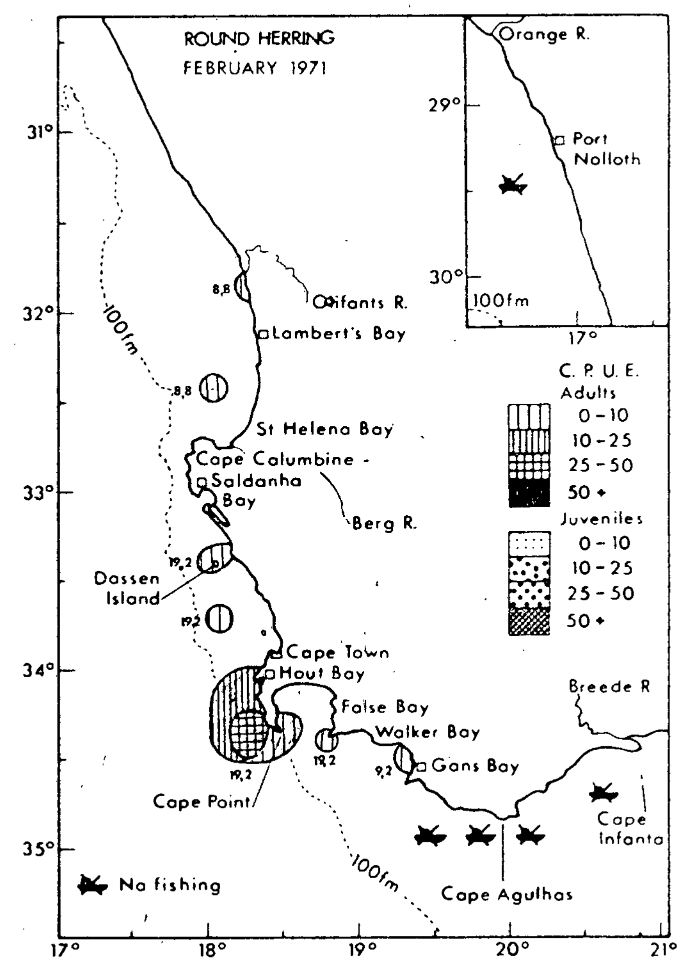

ROUND HERRING
MAY 1970
Orange R.
29°
Port Nolloth
30°
100fm
17°
31°
32°
33°
34°
35°
6,7
6,7
7,2
8,2
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
19°
20°
21°

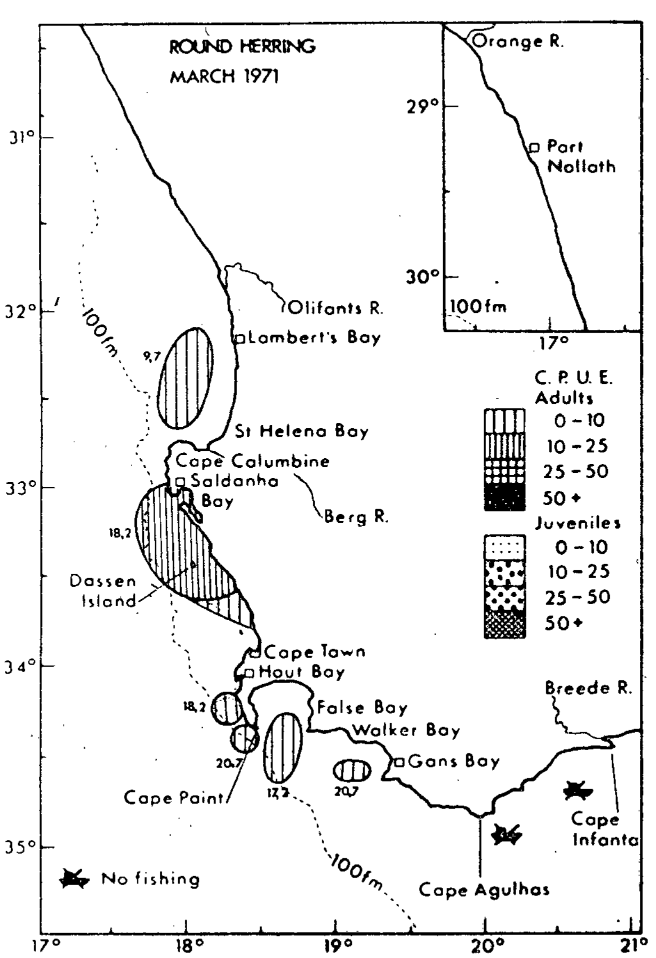

ROUND HERRING
JUNE 1970
Orange R
29°
Port Nolloth
30°
100fm
17°
31°
32°
33°
34°
35°
6,7
6,7
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
19°
20°
21°

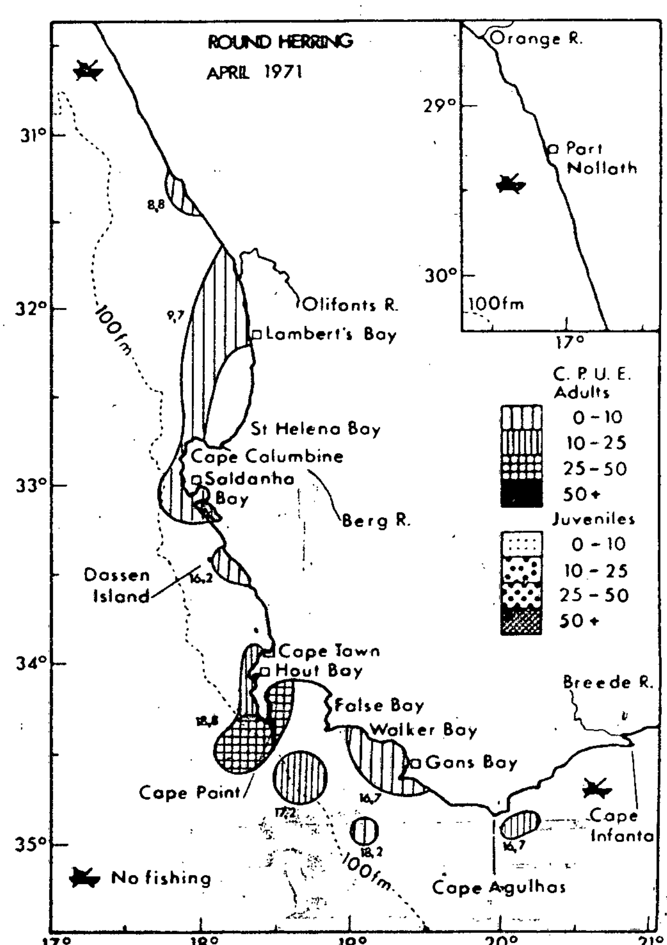

ROUND HERRING
JULY 1970
Orange R.
29°
Port Nolloth
30°
100fm
17°
31°
32°
33°
34°
35°
7,2
17,2
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
19°
20°
21°

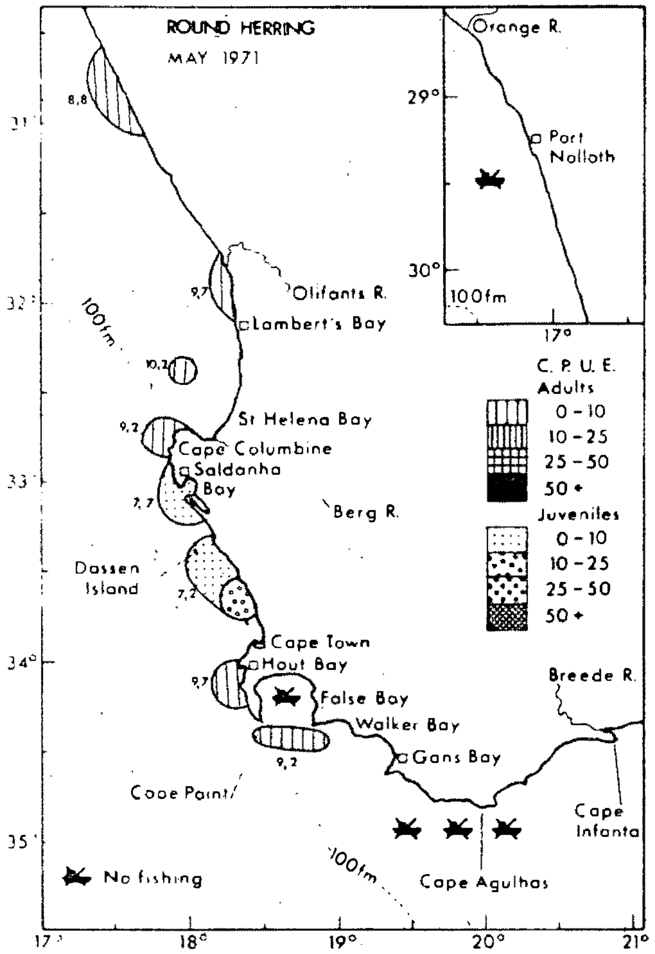

ROUND HERRING
AUGUST 1970
Orange R.
29°
Port Nolloth
30°
100fm
17°
31°
32°
33°
34°
35°
7,2
6,7
17,2
7,2
7,2
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
17°
18°
19°
20°
21°


ROUND HERRING
JANUARY 1971
Orange R.
Port Nolloth
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
100fm


ROUND HERRING
FEBRUARY 1971
Orange R.
Port Nolloth
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
100fm


ROUND HERRING
MARCH 1971
Orange R.
Port Nolloth
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
100fm


ROUND HERRING
APRIL 1971
Orange R.
Port Nolloth
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
100fm


ROUND HERRING
MAY 1971
Orange R.
Port Nolloth
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
8,8
9,7
10,2
9,2
7,7
7,2
9,7
9,2
17°
18°
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21°
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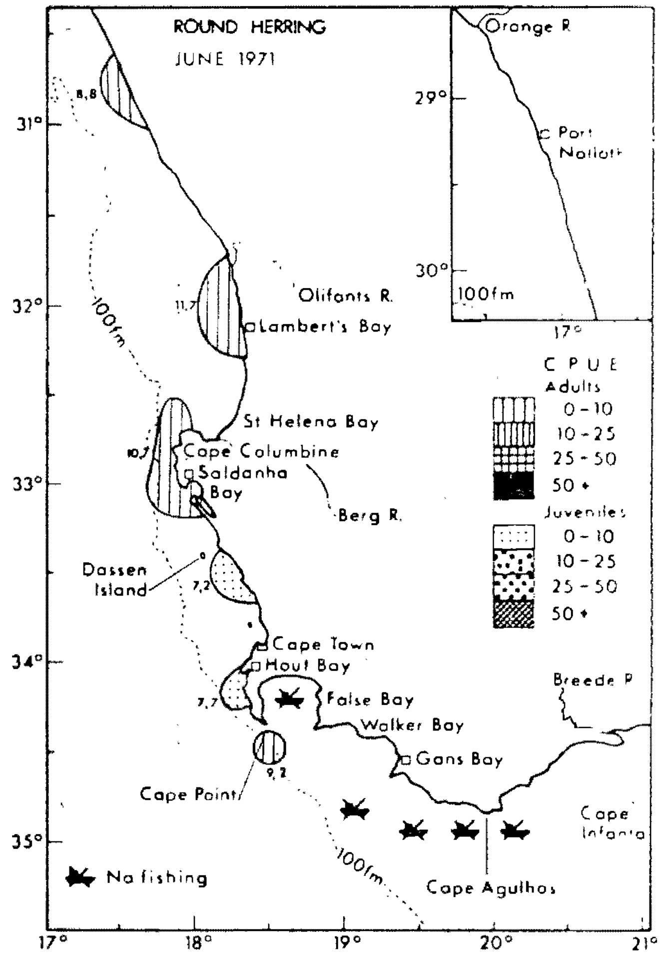
35°


ROUND HERRING
JUNE 1971
Orange R
Port Nolloth
100fm
C P U E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
8,8
11,7
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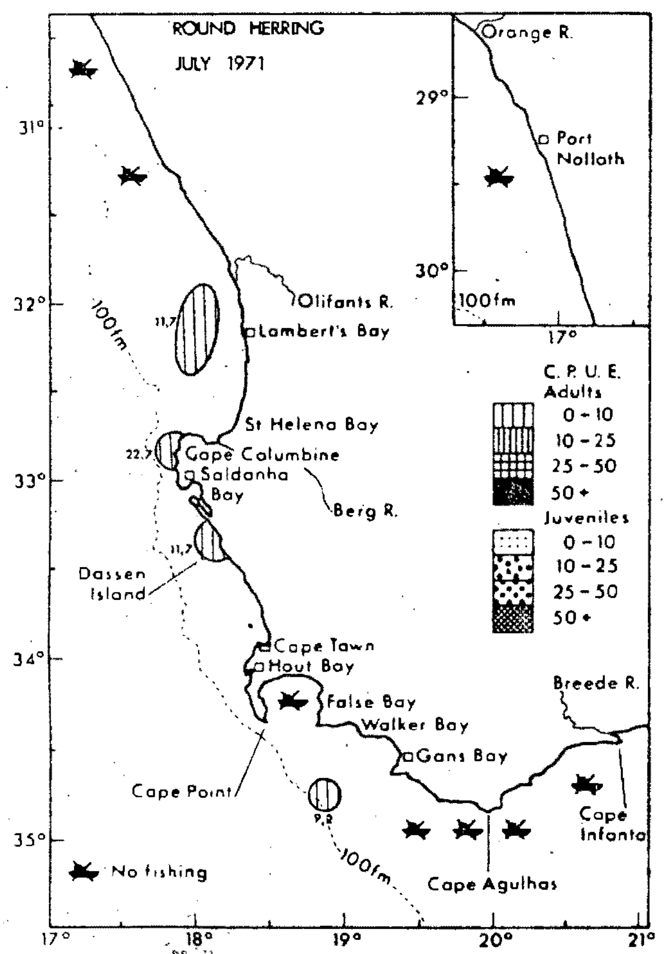
ROUND HERRING
JULY 1971
Orange R.
Port Nolloth
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
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25 - 50
50 +
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
11,7
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11,7
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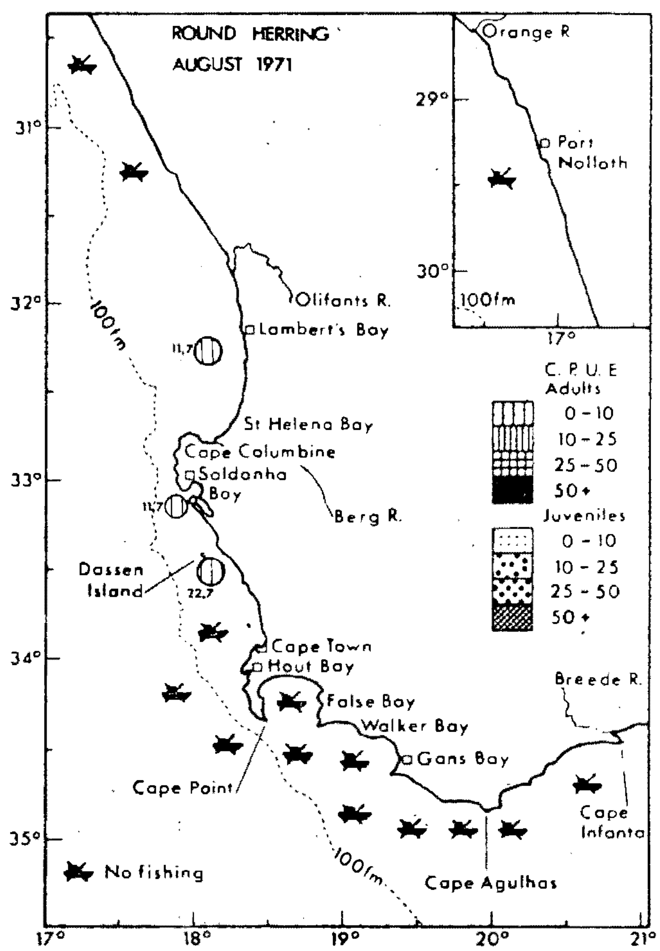
ROUND HERRING
AUGUST 1971
Orange R
Port Nolloth
100fm
C. P. U. E
Adults
0 - 10
10 - 25
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50 +
Juveniles
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Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
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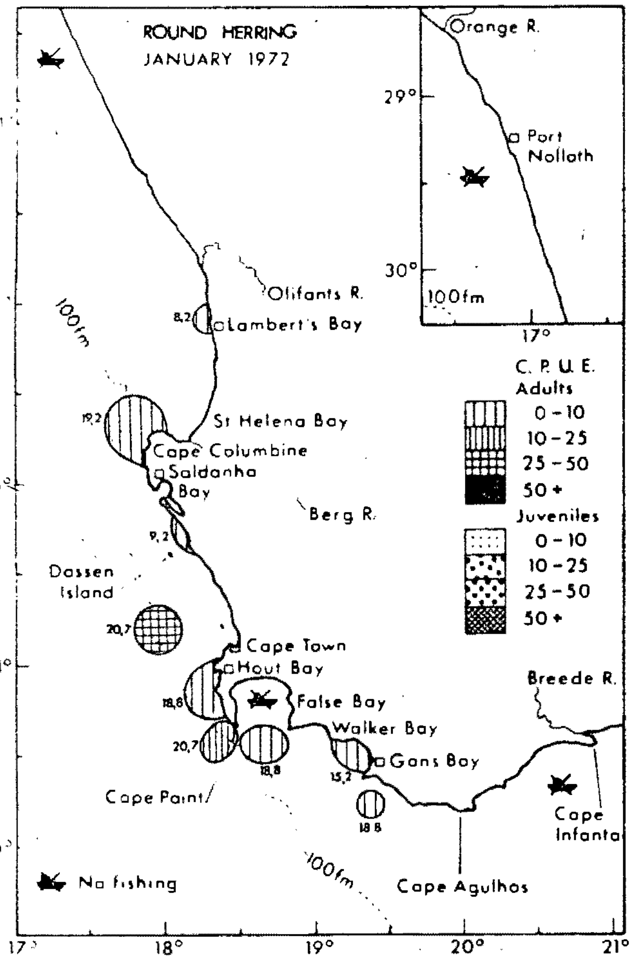
ROUND HERRING
JANUARY 1972
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Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
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No fishing
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Adults
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50 +
Juveniles
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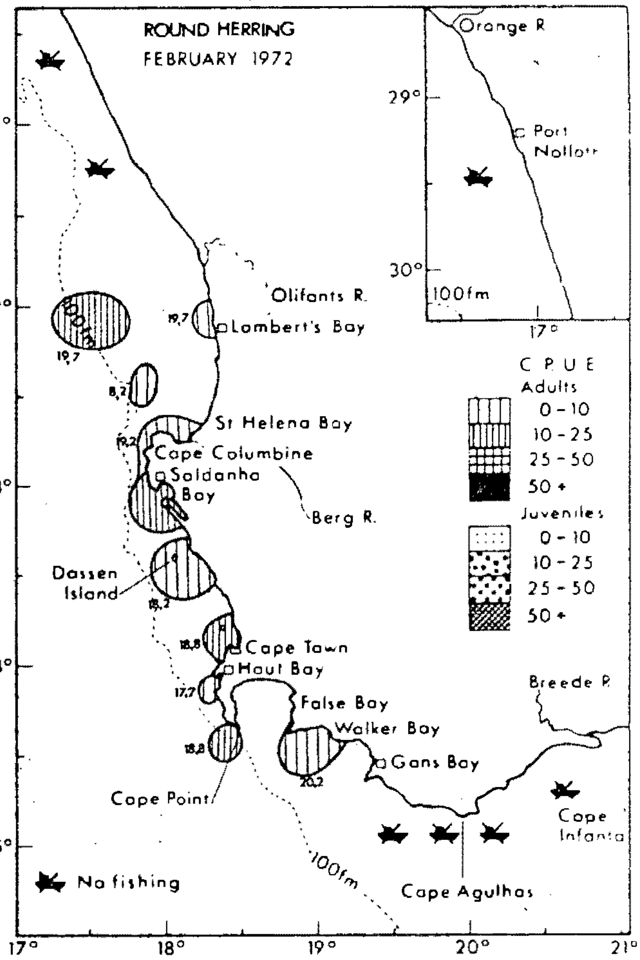
ROUND HERRING
FEBRUARY 1972
Orange R
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
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No fishing
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50 +
Juveniles
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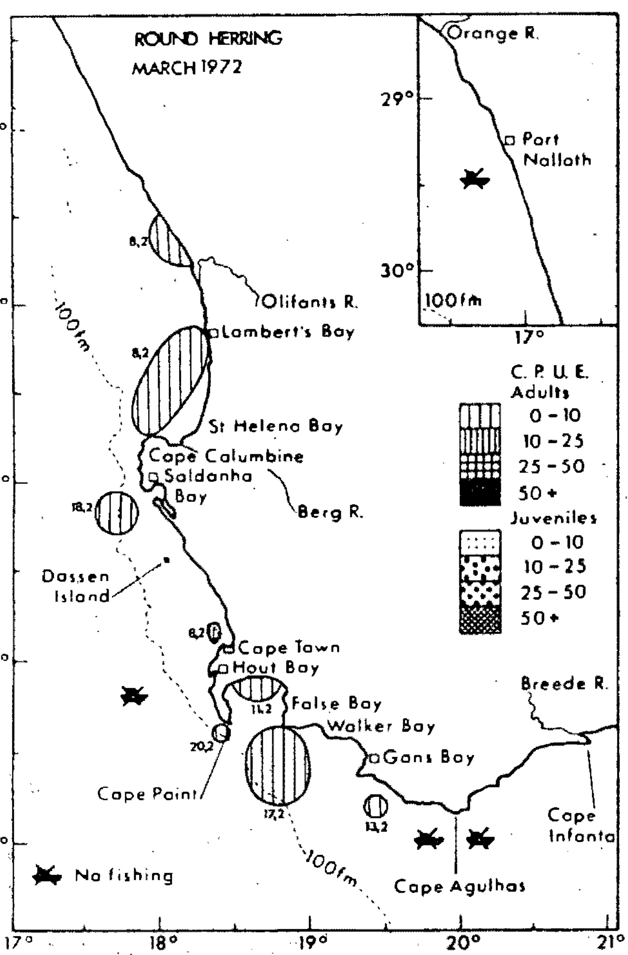
ROUND HERRING
MARCH 1972
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Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
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Gans Bay
Breede R.
Cape Point
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No fishing
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50 +
Juveniles
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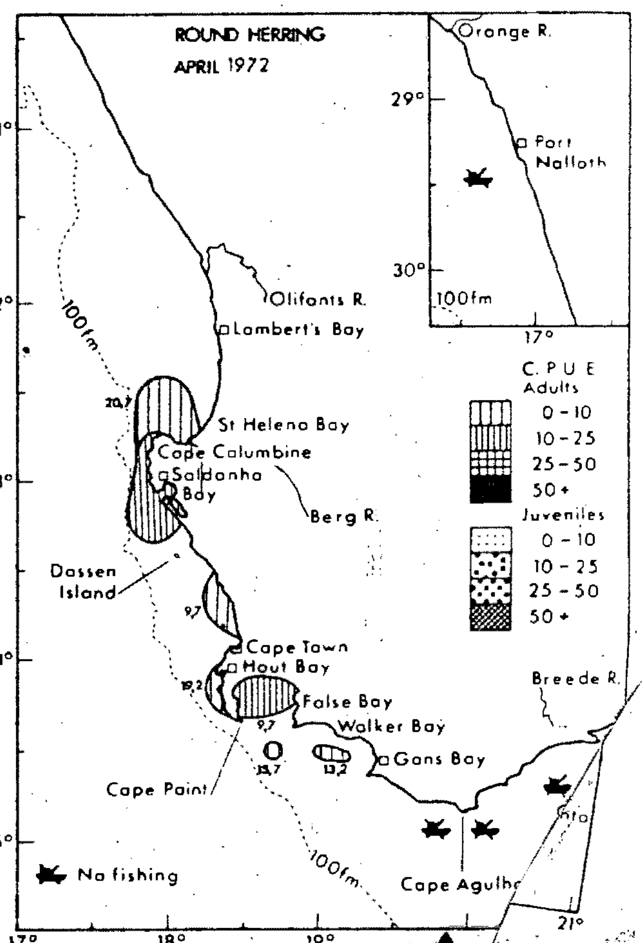
ROUND HERRING
APRIL 1972
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Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
No fishing
C. P. U. E.
Adults
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Juveniles
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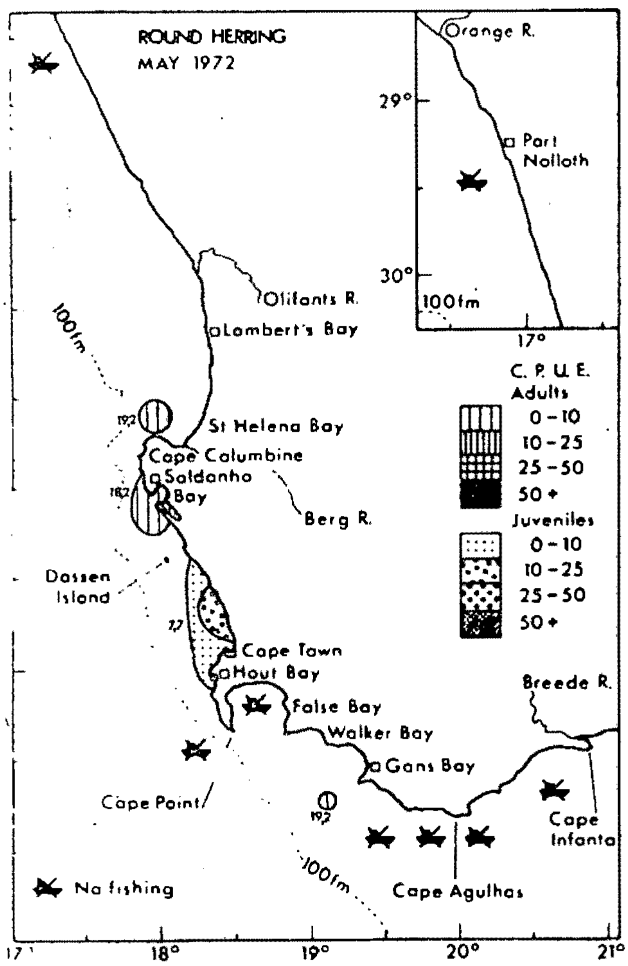
ROUND HERRING
MAY 1972
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29°
Port Nolloth
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100fm
17°
Olifants R.
Lambert's Bay
100fm
C. P. U. E.
Adults
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Juveniles
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50 +
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
100fm
Cape Agulhas
No fishing
18°
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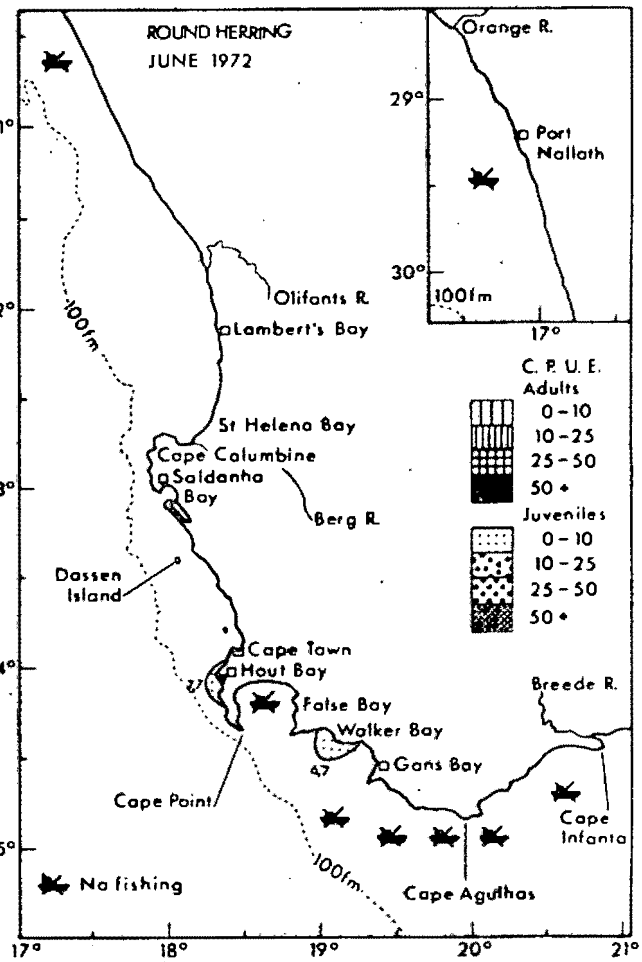
21°


ROUND HERRING
JUNE 1972
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Port Nolloth
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Olifants R.
Lambert's Bay
100fm
C. P. U. E.
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50 +
Juveniles
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St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
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False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
100fm
Cape Agulhas
No fishing
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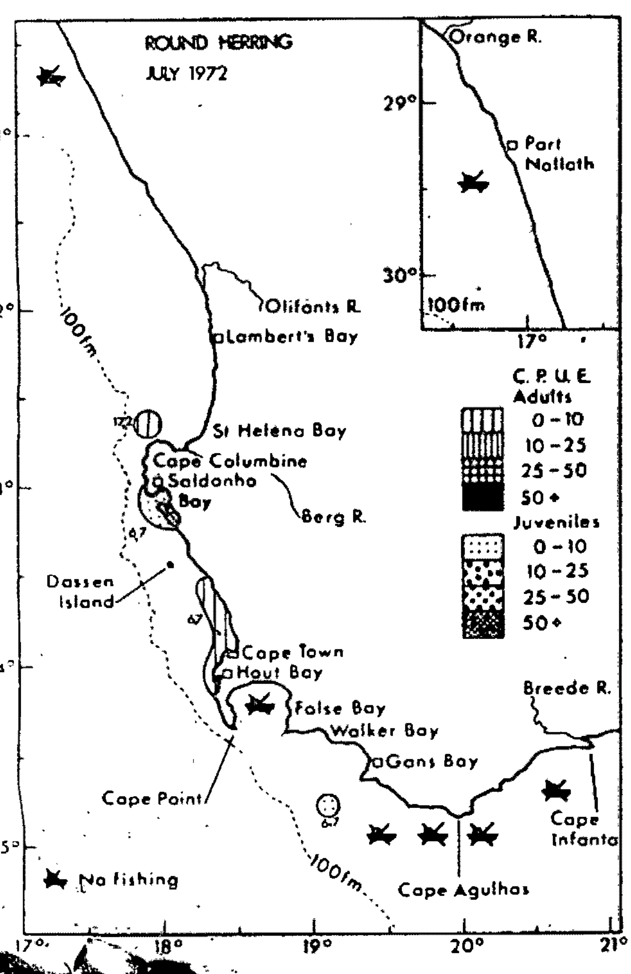
ROUND HERRING
JULY 1972
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Port Nolloth
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100fm
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Olifants R.
Lambert's Bay
100fm
C. P. U. E.
Adults
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50 +
Juveniles
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50 +
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
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False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
100fm
Cape Agulhas
No fishing
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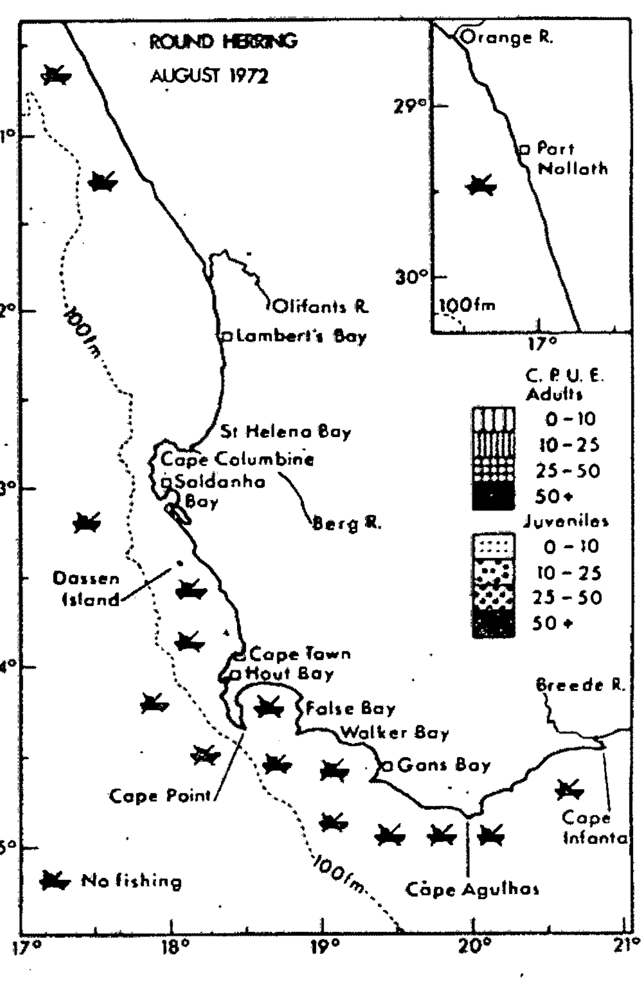
ROUND HERRING
AUGUST 1972
Orange R.
29°
Port Nolloth
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100fm
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35°
Olifants R.
Lambert's Bay
100fm
C. P. U. E.
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50 +
Juveniles
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25 - 50
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St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
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False Bay
Walker Bay
Gans Bay
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Cape Point
Cape Infanta
100fm
Cape Agulhas
No fishing
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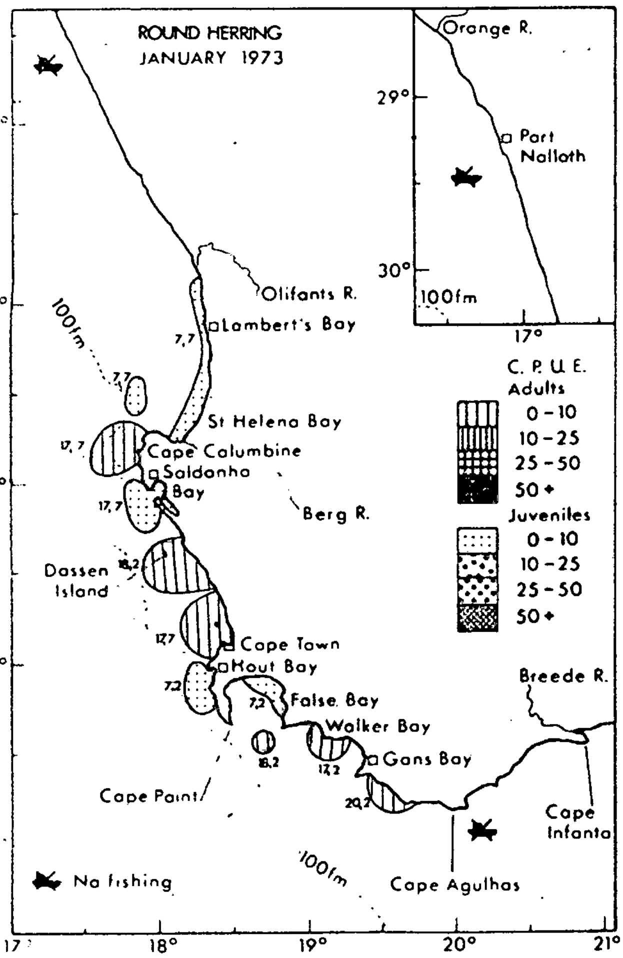
21°


ROUND HERRING
JANUARY 1973
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Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
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Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
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Juveniles
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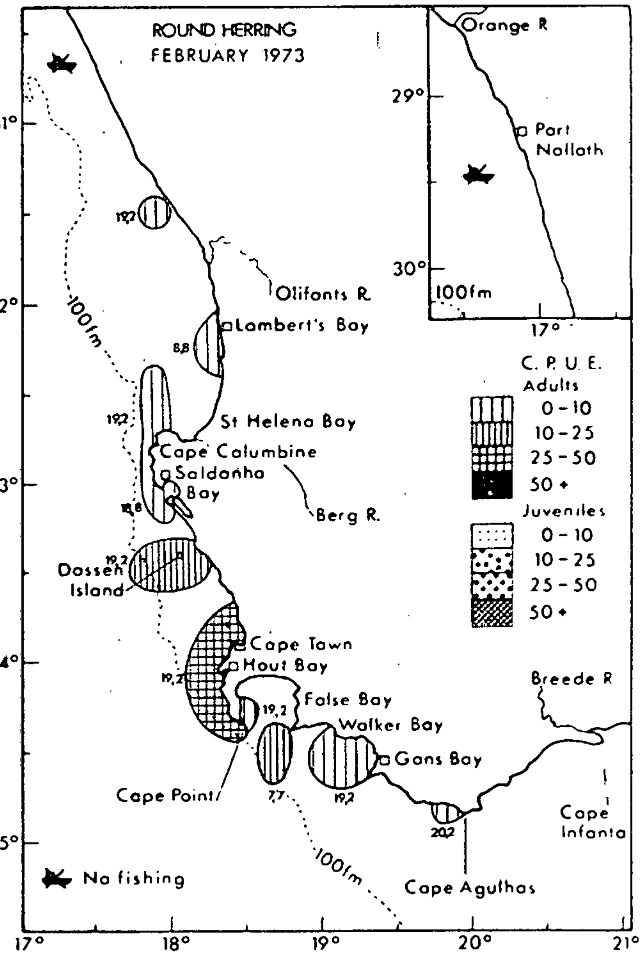
ROUND HERRING
FEBRUARY 1973
Orange R
Port Nolloth
100fm
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Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
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Cape Point
Cape Infanta
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No fishing
C. P. U. E.
Adults
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Juveniles
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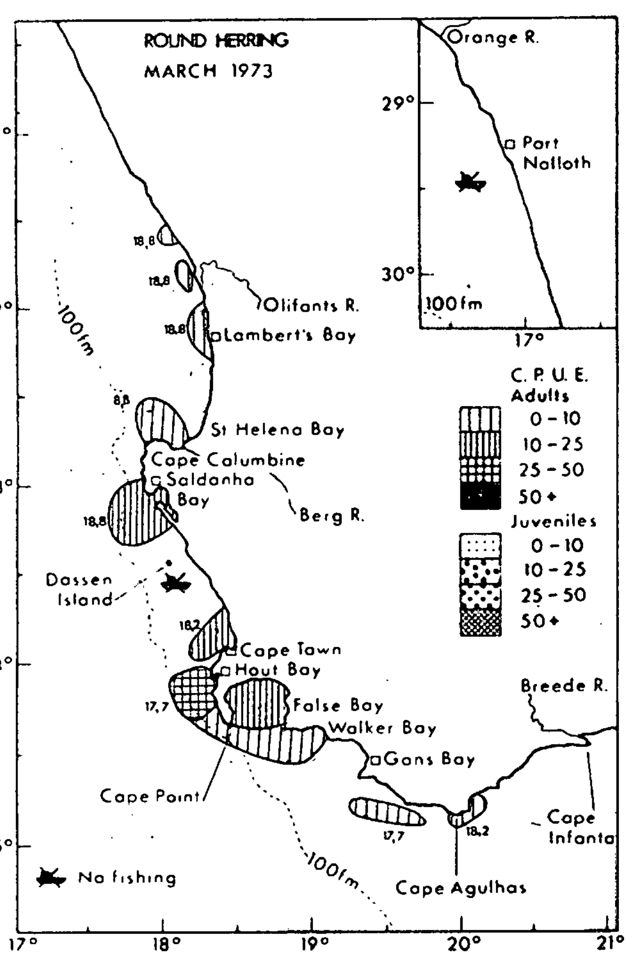
25 - 50
50 +


ROUND HERRING
MARCH 1973
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
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50 +
Juveniles
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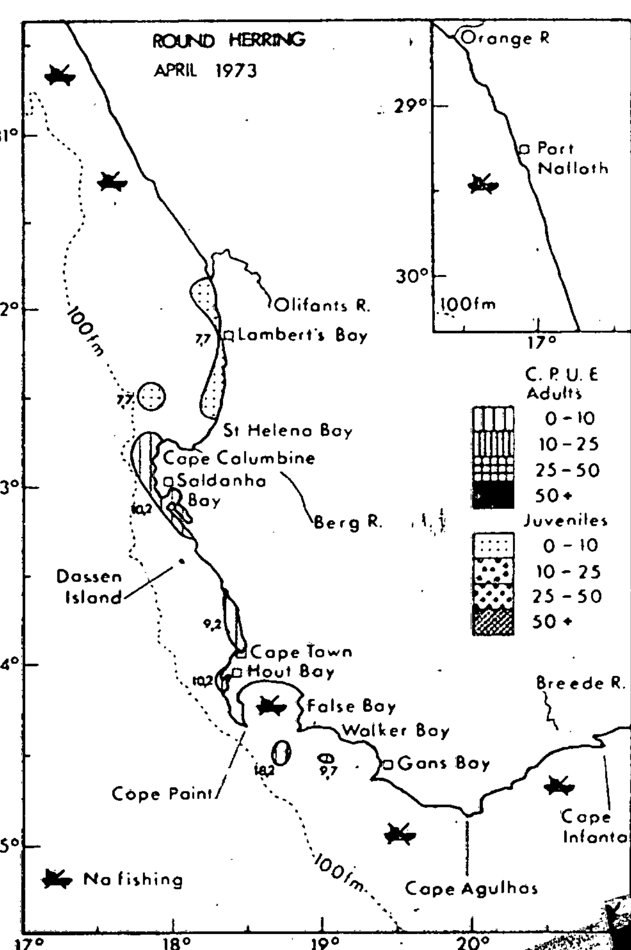
25 - 50
50 +


ROUND HERRING
APRIL 1973
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Port Nolloth
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Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
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Juveniles
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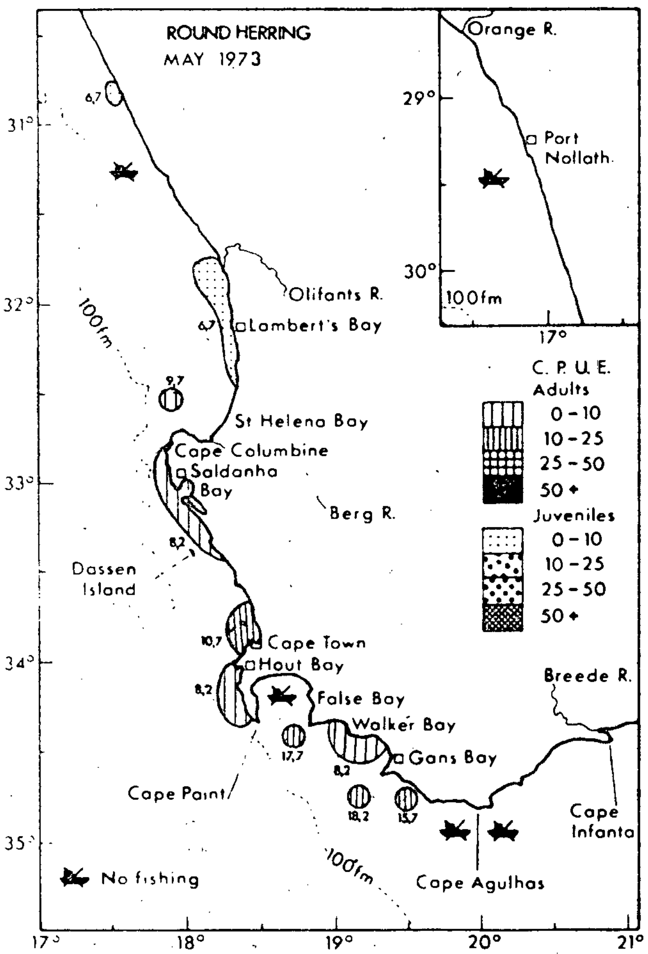
ROUND HERRING
MAY 1973
Orange R.
29°
Port Nollath
30°
100fm
17°
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
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Walker Bay
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Cape Point
Cape Infanta
Cape Agulhas
No fishing
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
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25 - 50
50 +
6,7
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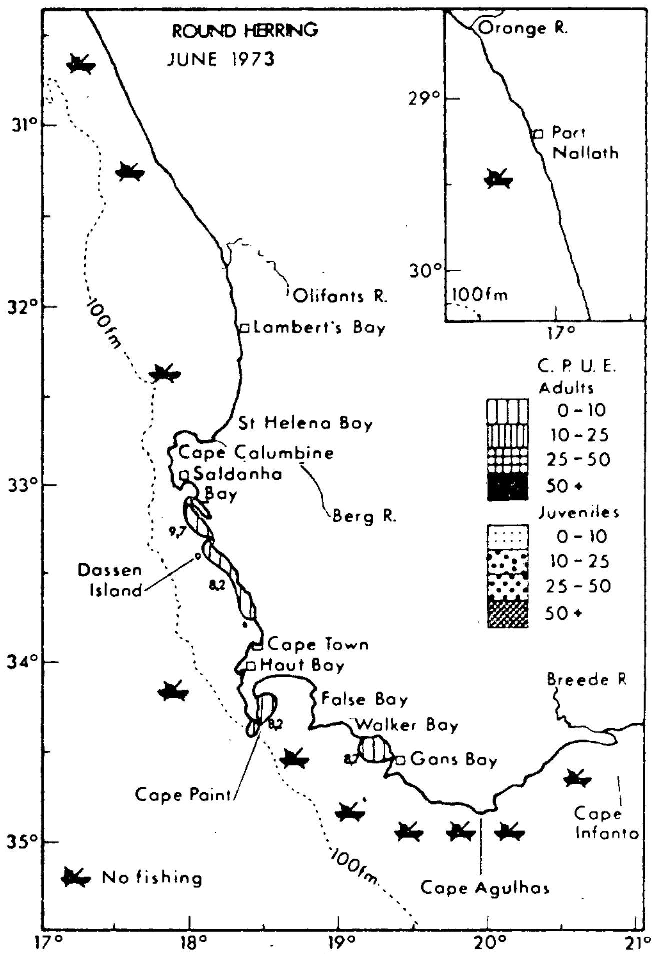
ROUND HERRING
JUNE 1973
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Port Nollath
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17°
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
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Cape Point
Cape Infanta
Cape Agulhas
No fishing
100fm
C. P. U. E.
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25 - 50
50 +
Juveniles
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10 - 25
25 - 50
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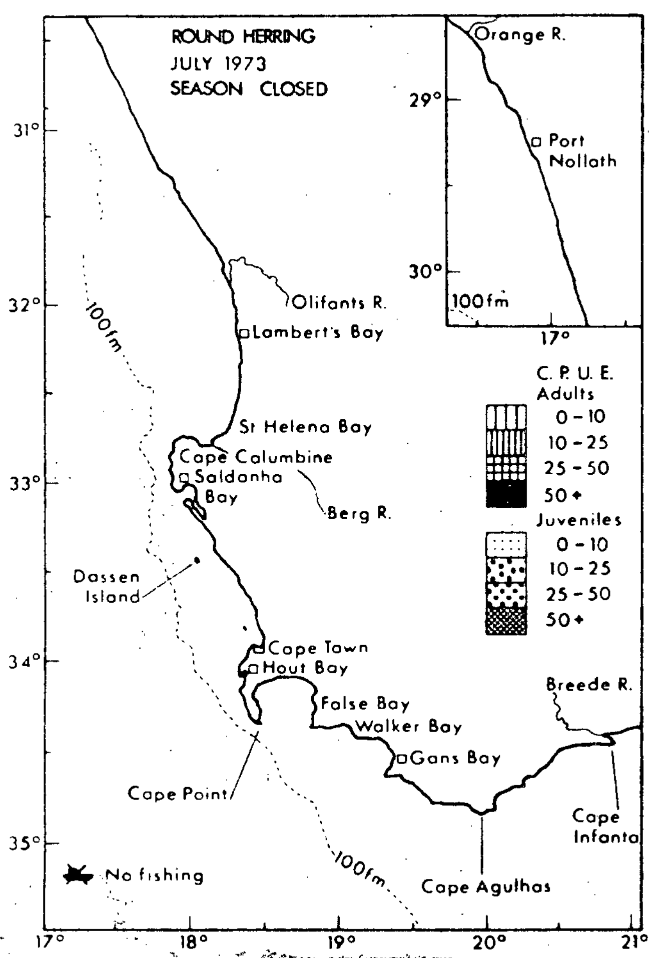
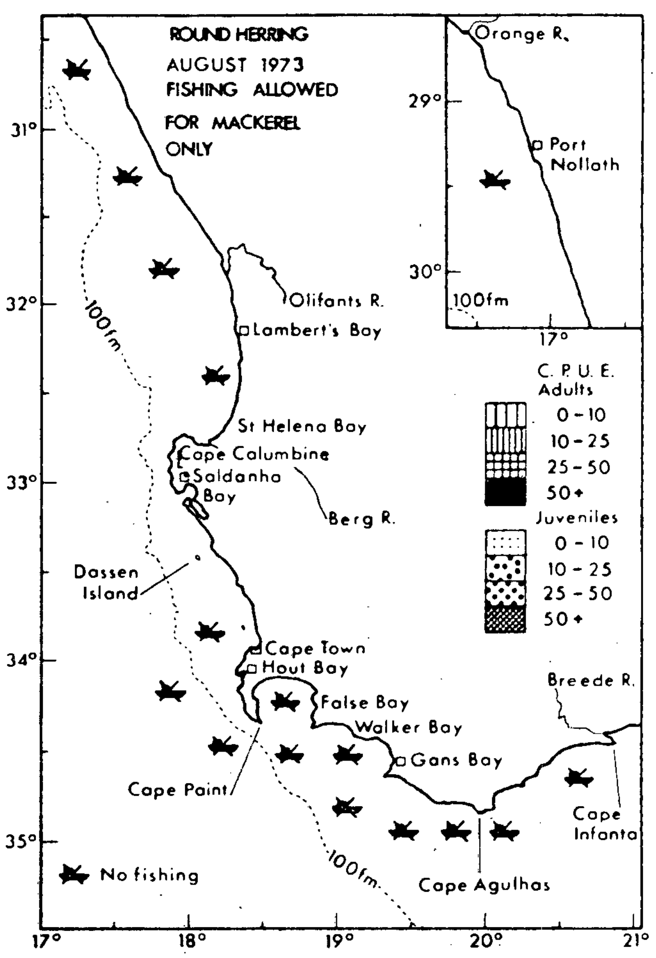
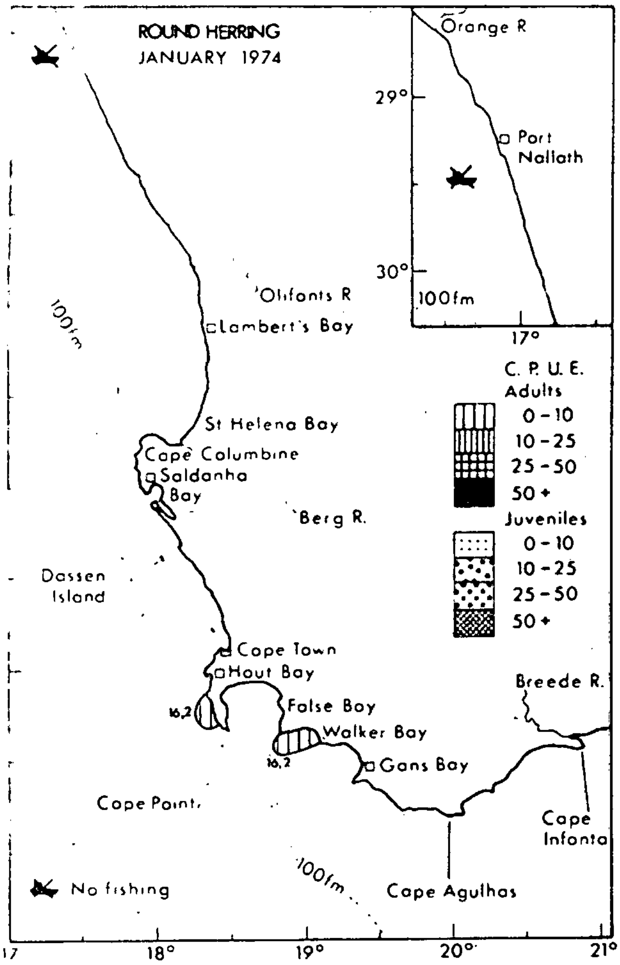
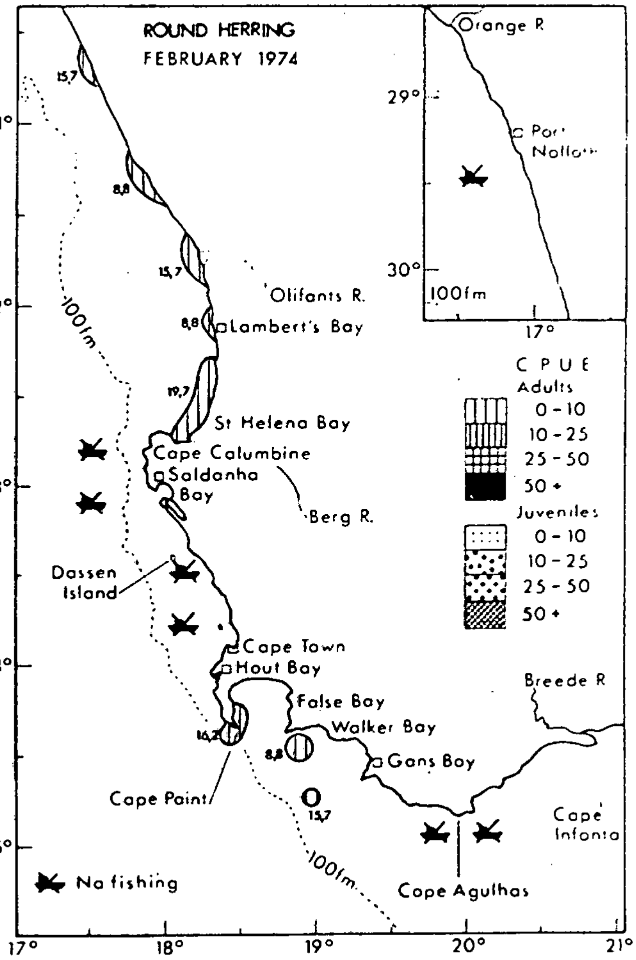
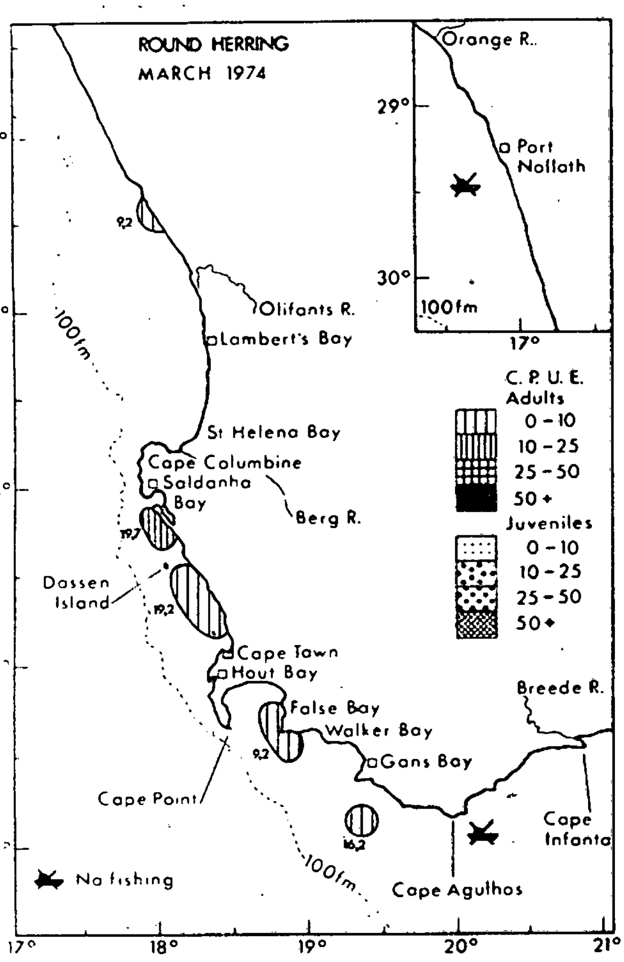
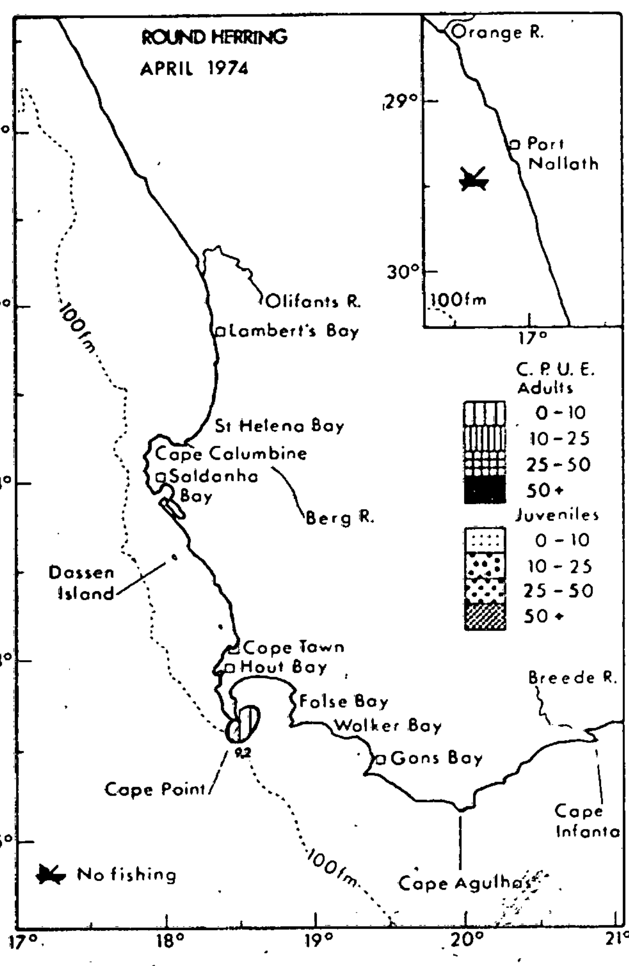

ROUND HERRING
JULY 1973
SEASON CLOSED
Orange R.
29°
Port Nollath
30°
100fm
17°
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
31°
32°
33°
34°
35°
17°
18°
19°
20°
21°

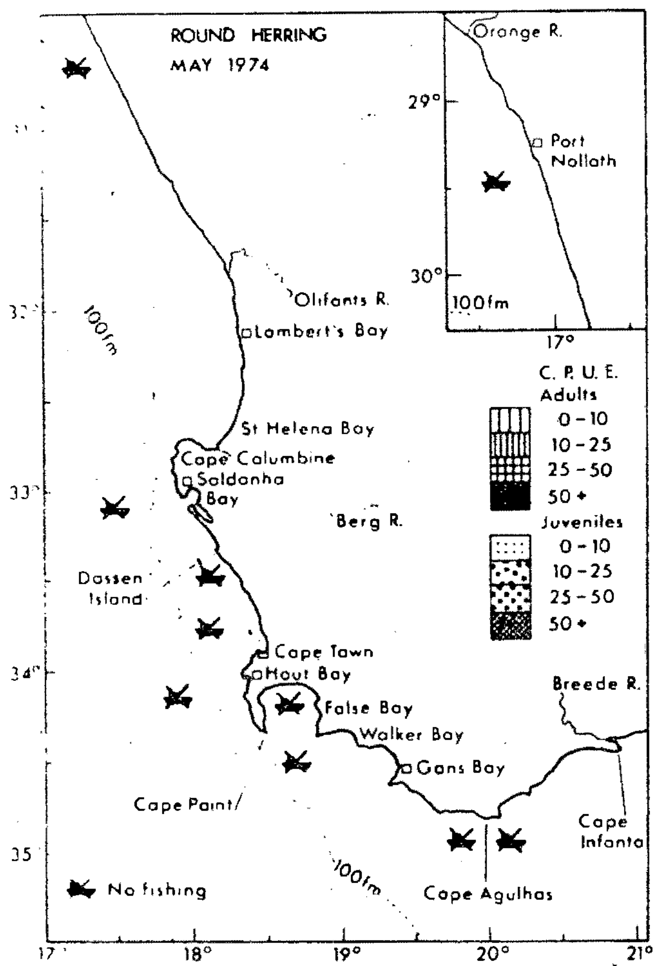

ROUND HERRING
AUGUST 1973
FISHING ALLOWED
FOR MACKEREL
ONLY
Orange R.
29°
Port Nollath
30°
100fm
17°
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
31°
32°
33°
34°
35°
17°
18°
19°
20°
21°

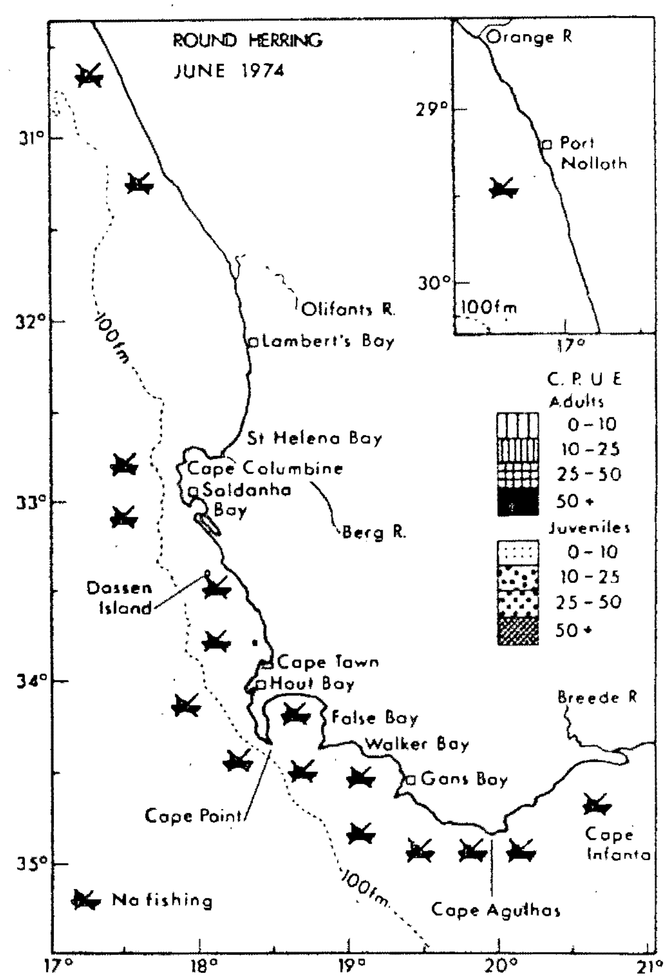

ROUND HERRING
JANUARY 1974
Orange R
Port Nolloth
100fm
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +

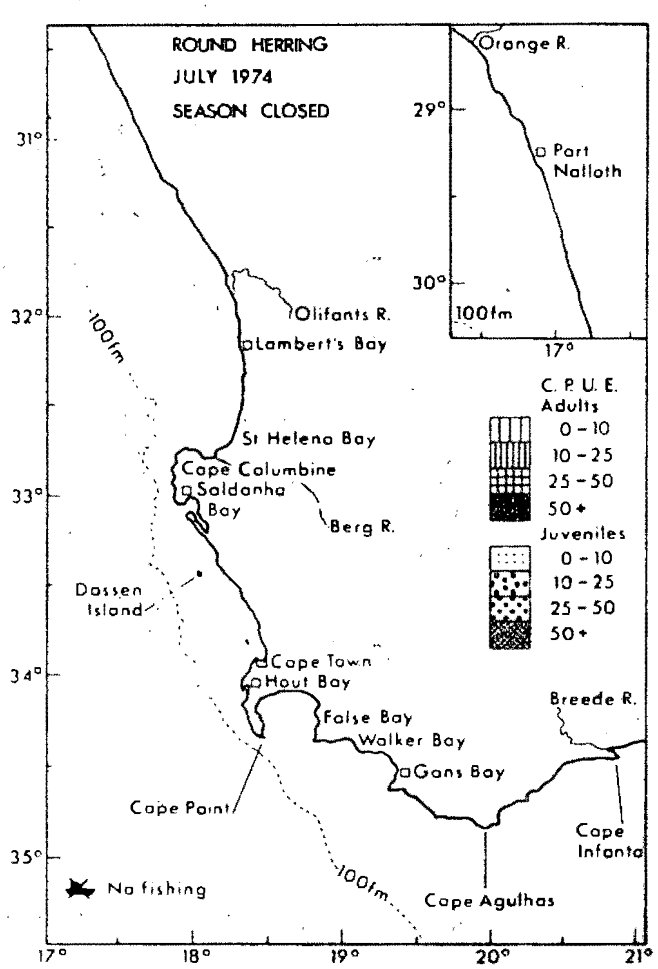

ROUND HERRING
FEBRUARY 1974
Orange R
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C P U E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +

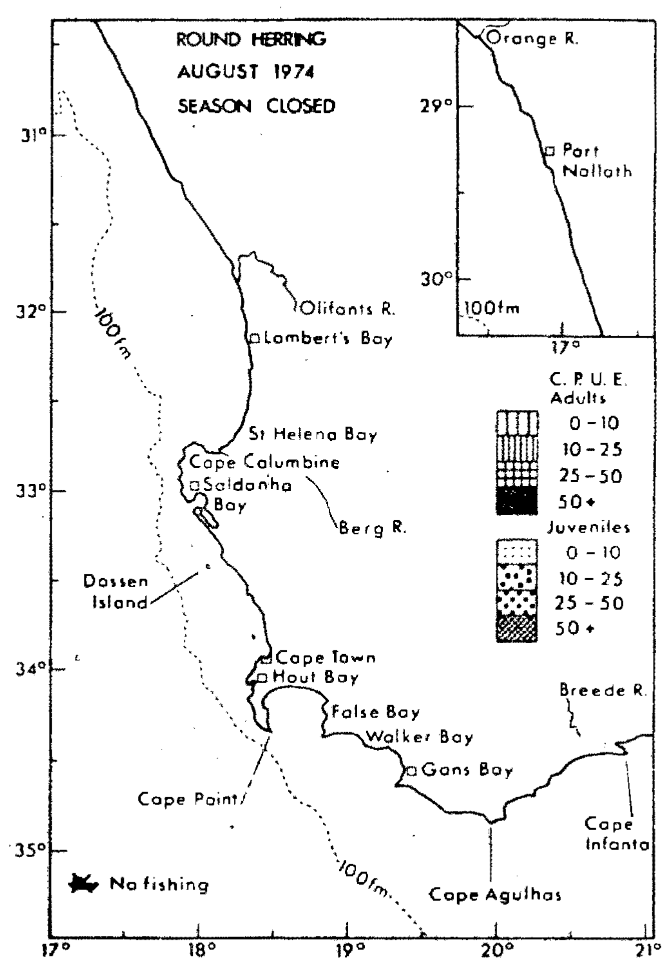

ROUND HERRING
MARCH 1974
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +

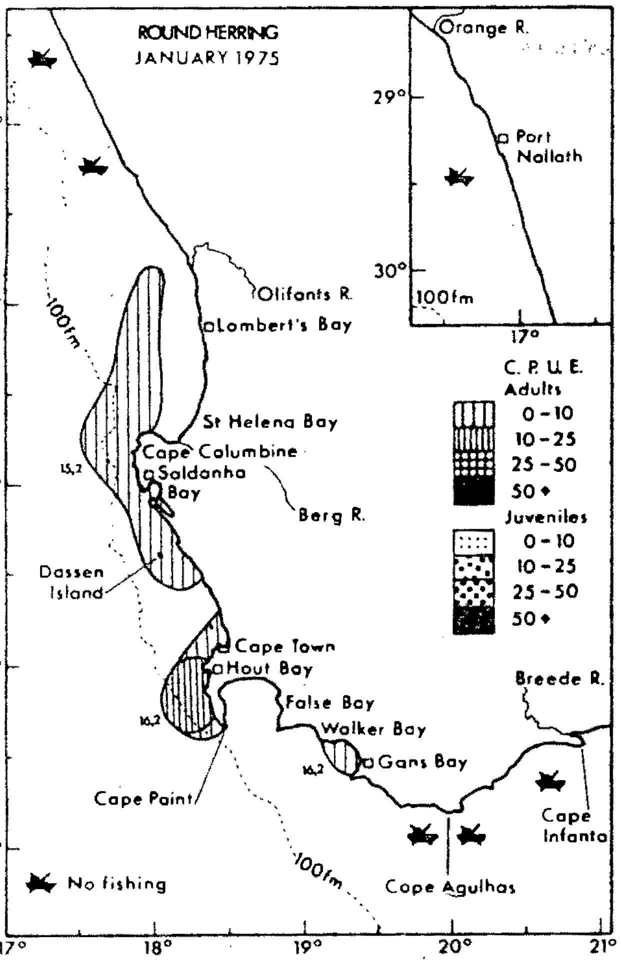

ROUND HERRING
APRIL 1974
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +

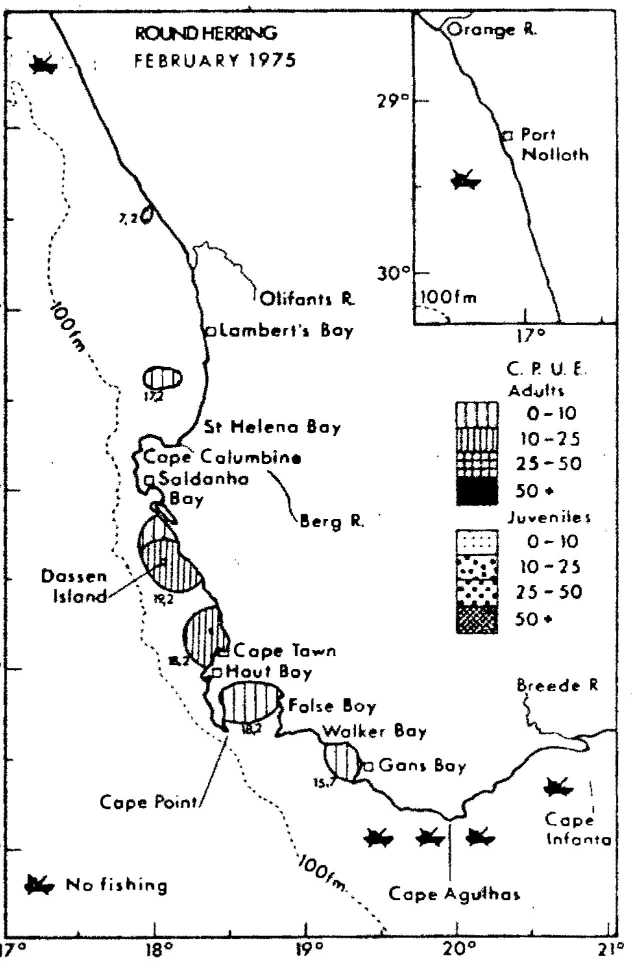

ROUND HERRING
MAY 1974
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +

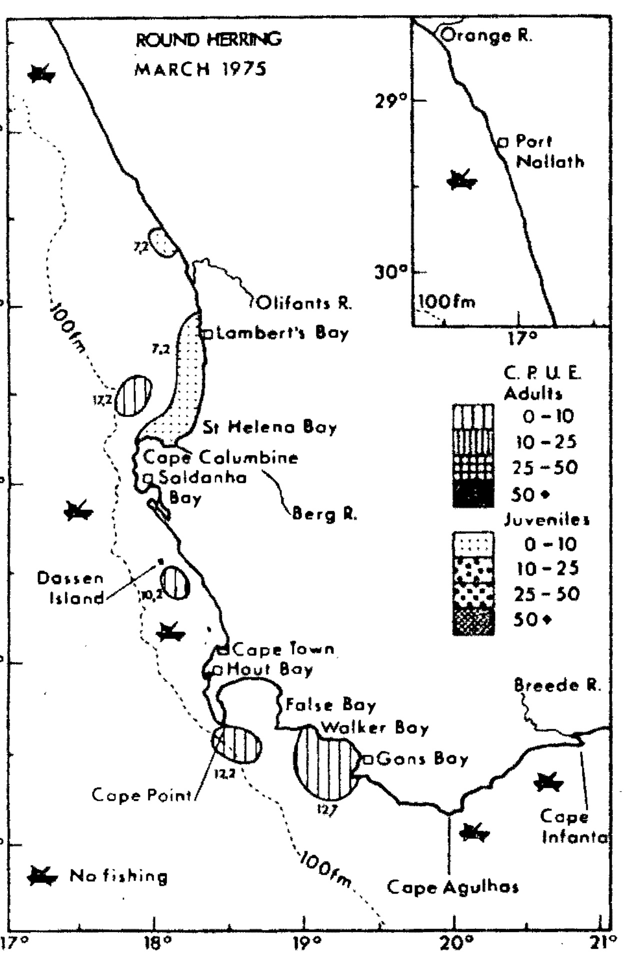

ROUND HERRING
JUNE 1974
Orange R
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +

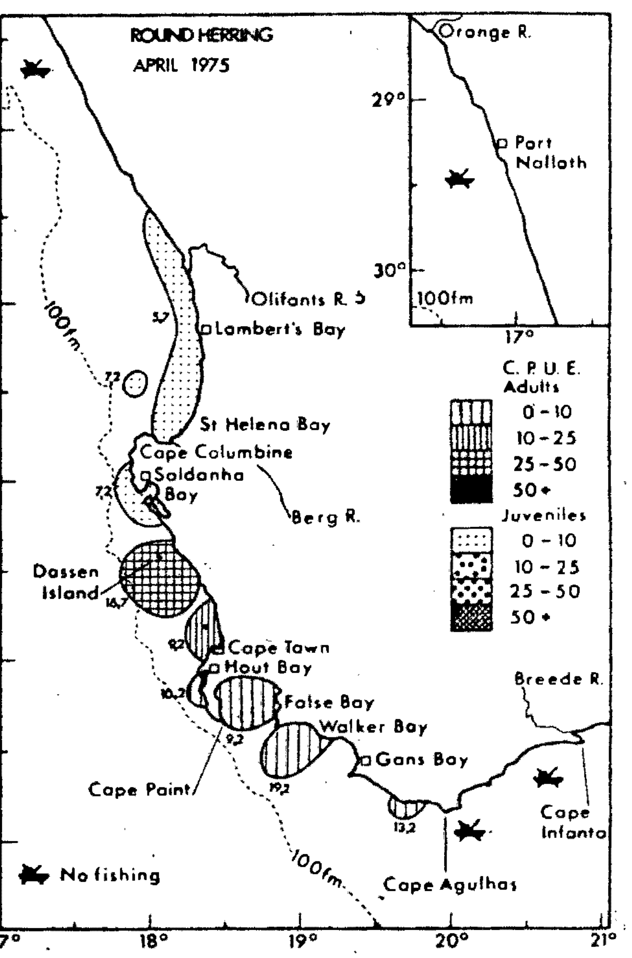

ROUND HERRING
JULY 1974
SEASON CLOSED
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +

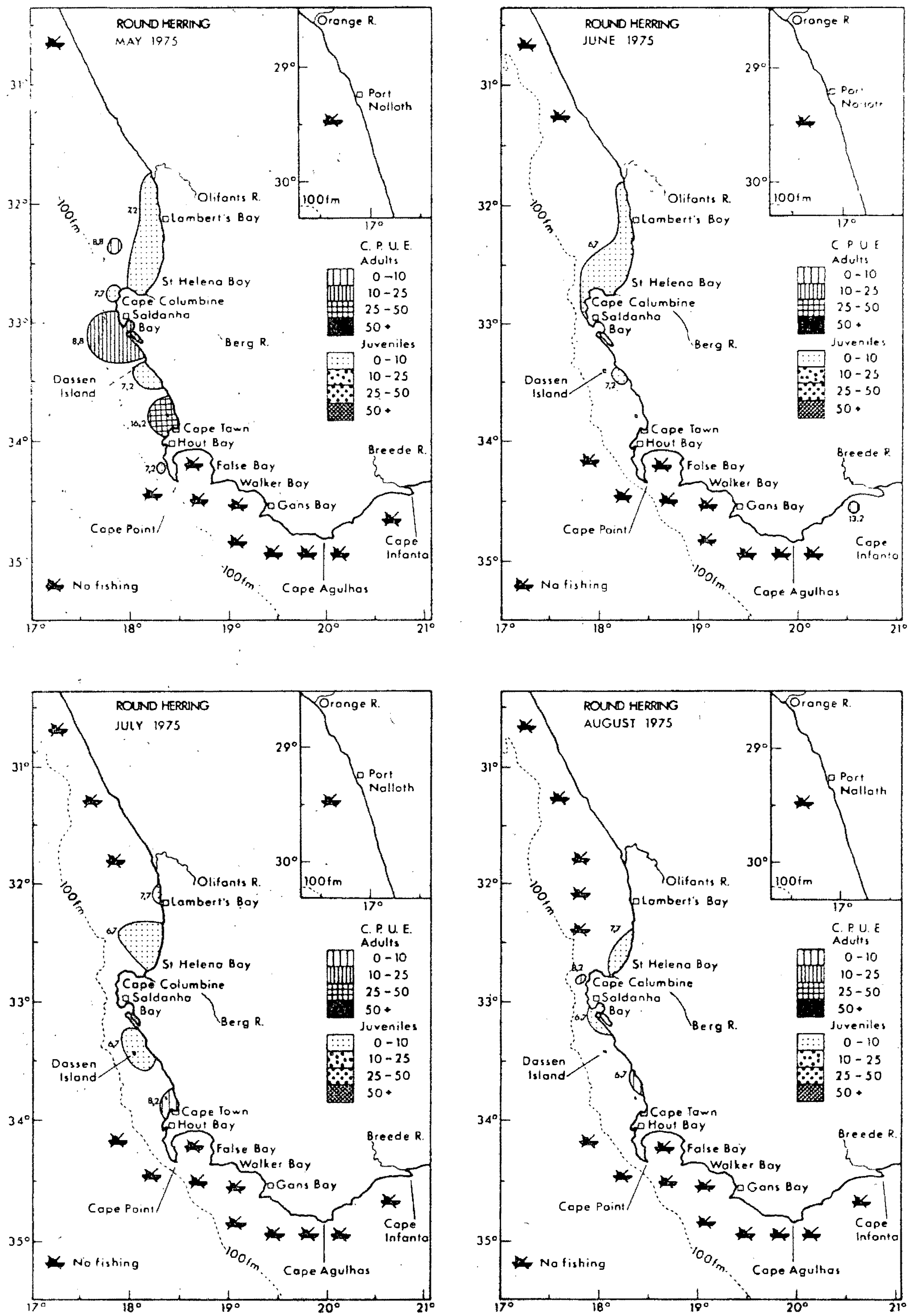

ROUND HERRING
AUGUST 1974
SEASON CLOSED
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +

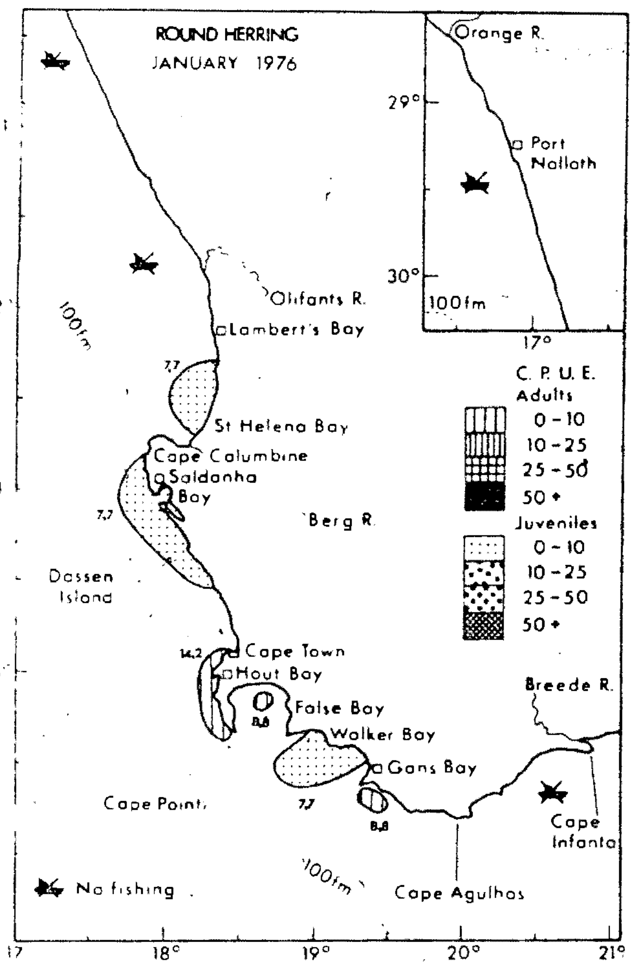

ROUND HERRING
JANUARY 1975
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
15,2
16,2
16,2

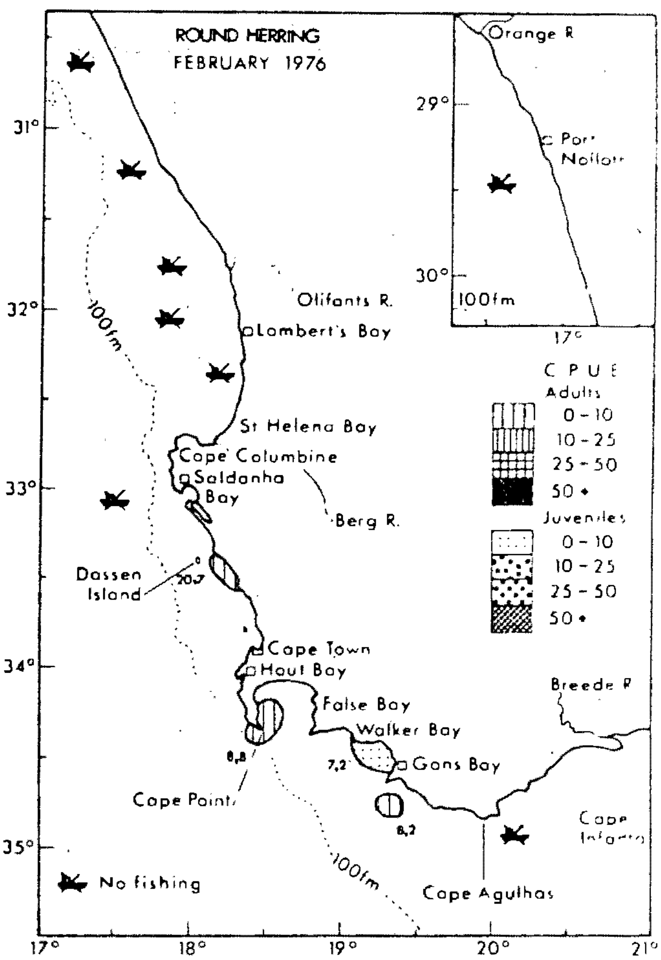

ROUND HERRING
FEBRUARY 1975
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
7,2
17,2
19,2
18,2
18,2
15,7

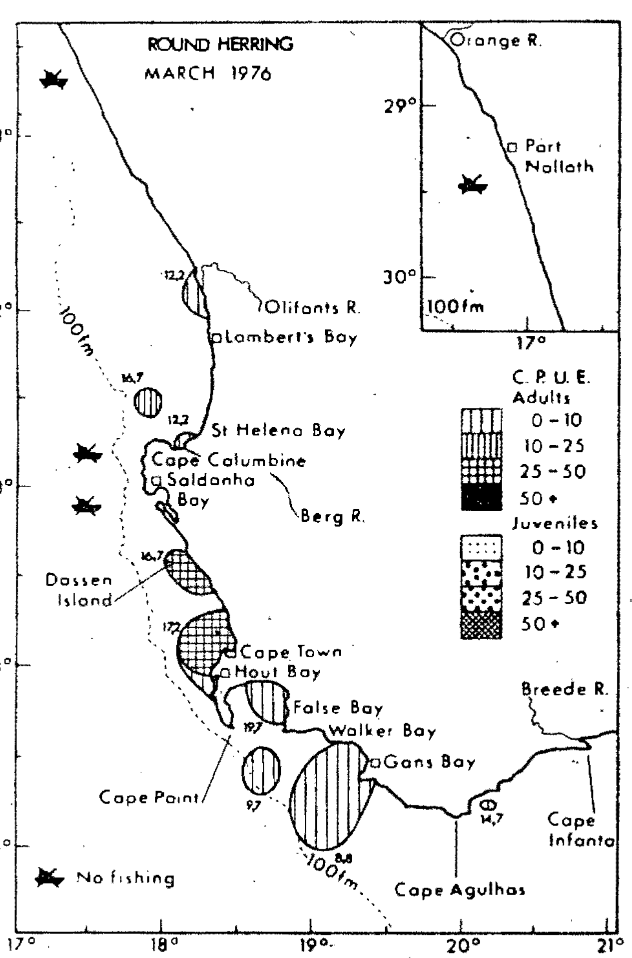

ROUND HERRING
MARCH 1975
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
7,2
7,2
17,2
10,2
12,2
12,7

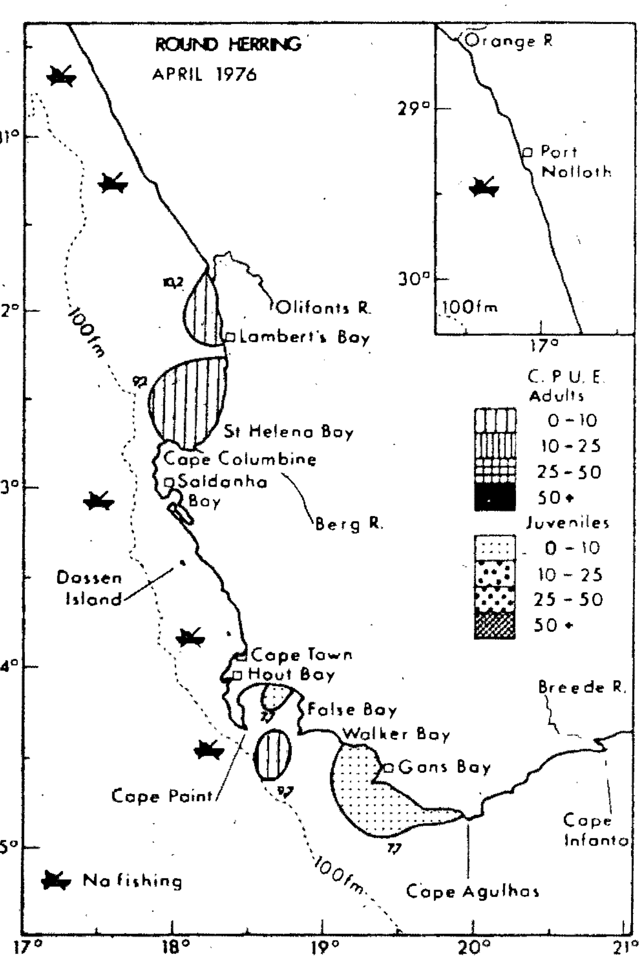

ROUND HERRING
APRIL 1975
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
5,7
7,2
7,2
16,7
9,2
10,2
9,2
19,2
13,2

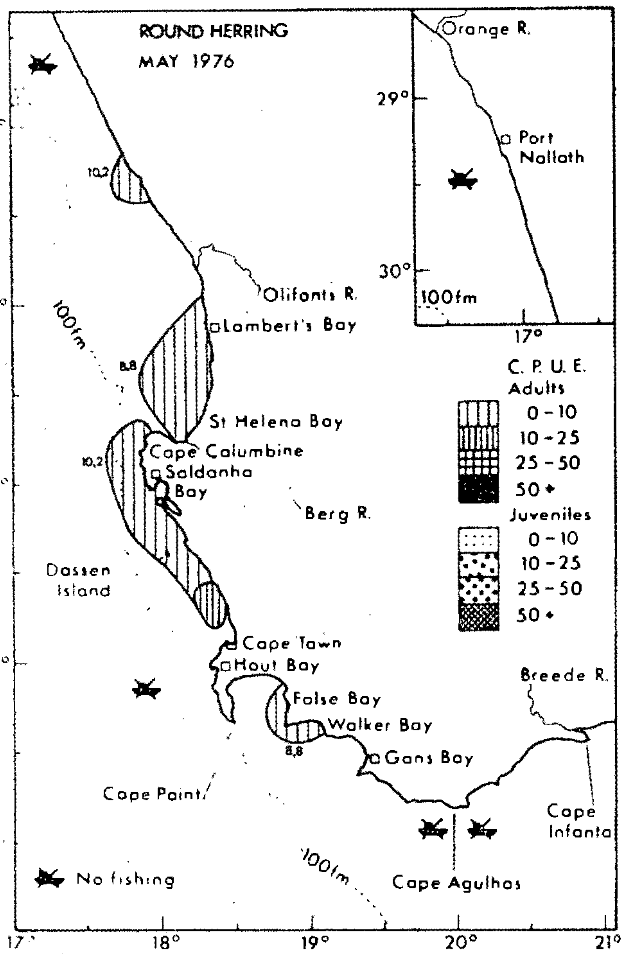

ROUND HERRING
MAY 1975
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
Adults
0 – 10
10 – 25
25 – 50
50 +
Juveniles
0 – 10
10 – 25
25 – 50
50 +
ROUND HERRING
JUNE 1975
ROUND HERRING
JULY 1975
ROUND HERRING
AUGUST 1975
17°
18°
19°
20°
21°
29°
30°
31°
32°
33°
34°
35°

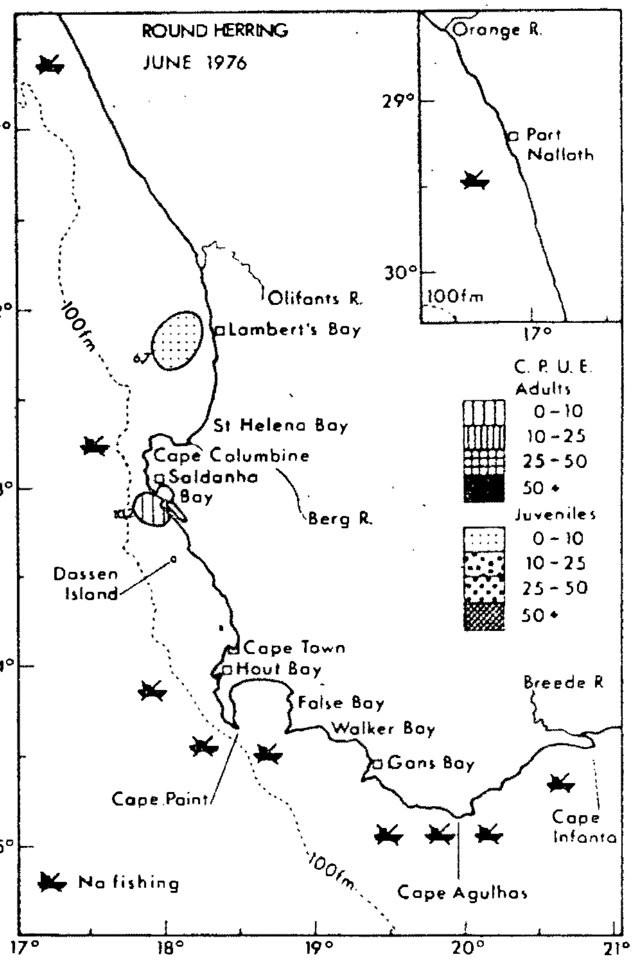

ROUND HERRING
JANUARY 1976
Orange R.
29°
Port Nolloth
30°
100fm
17°
31
32
33
34
35
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
7,7
7,7
14,2
8,8
7,7
8,8
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
No fishing
17
18°
19°
20°
21°

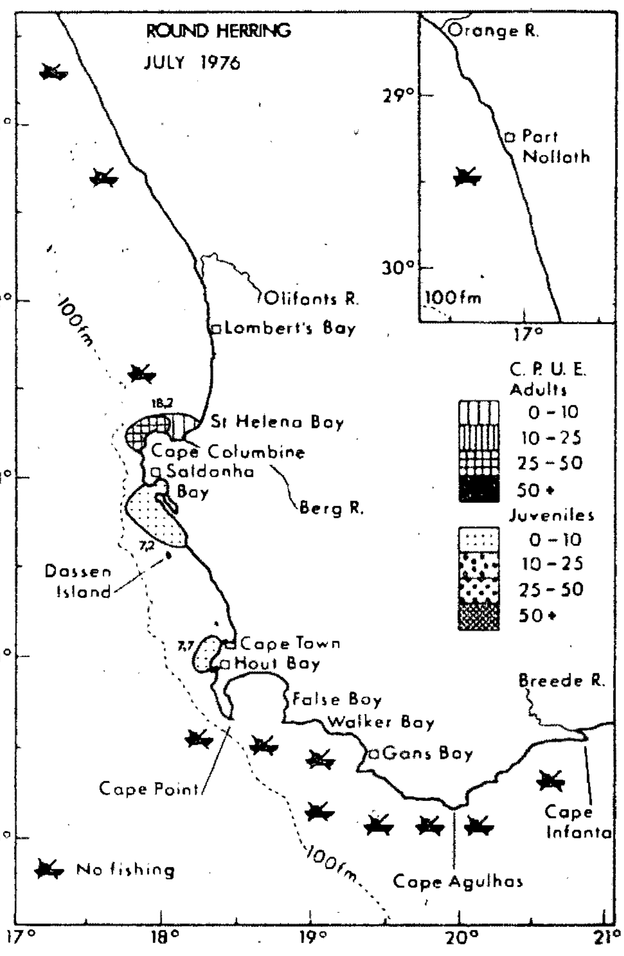

ROUND HERRING
FEBRUARY 1976
Orange R
29°
Port Nolloth
30°
100fm
17°
31°
32°
33°
34°
35°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
20,7
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
8,8
7,2
8,2
Cape Infanta
Cape Agulhas
100fm
C P U E
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
No fishing
17°
18°
19°
20°
21°

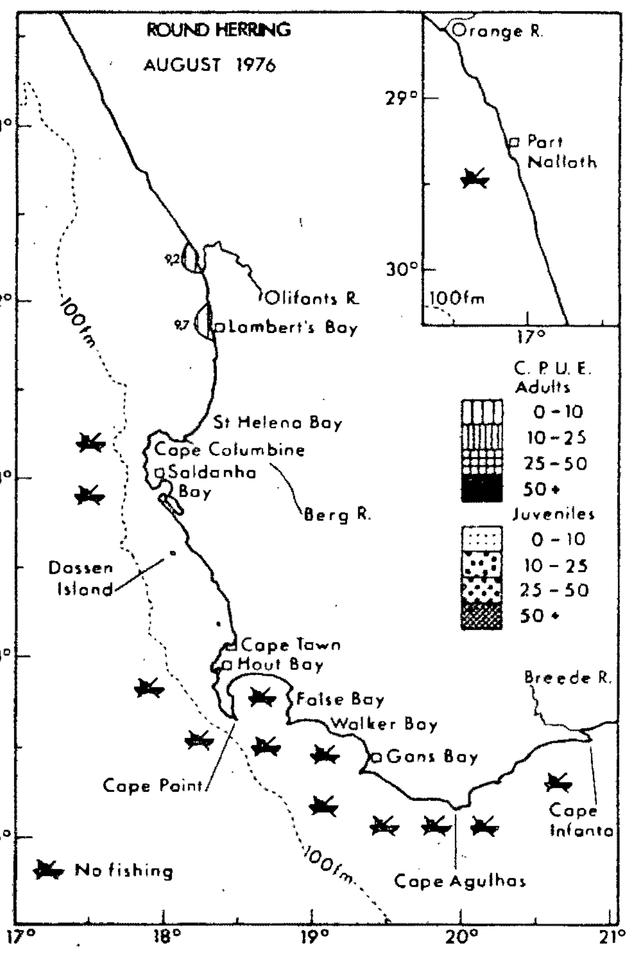

ROUND HERRING
MARCH 1976
Orange R.
29°
Port Nolloth
30°
100fm
17°
31°
32°
33°
34°
35°
100fm
12,2
Olifants R.
Lambert's Bay
16,7
12,2
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
16,7
Dassen Island
17,2
Cape Town
Hout Bay
False Bay
19,7
Walker Bay
Gans Bay
Breede R.
Cape Point
9,7
8,8
14,7
Cape Infanta
100fm
Cape Agulhas
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
No fishing
17°
18°
19°
20°
21°

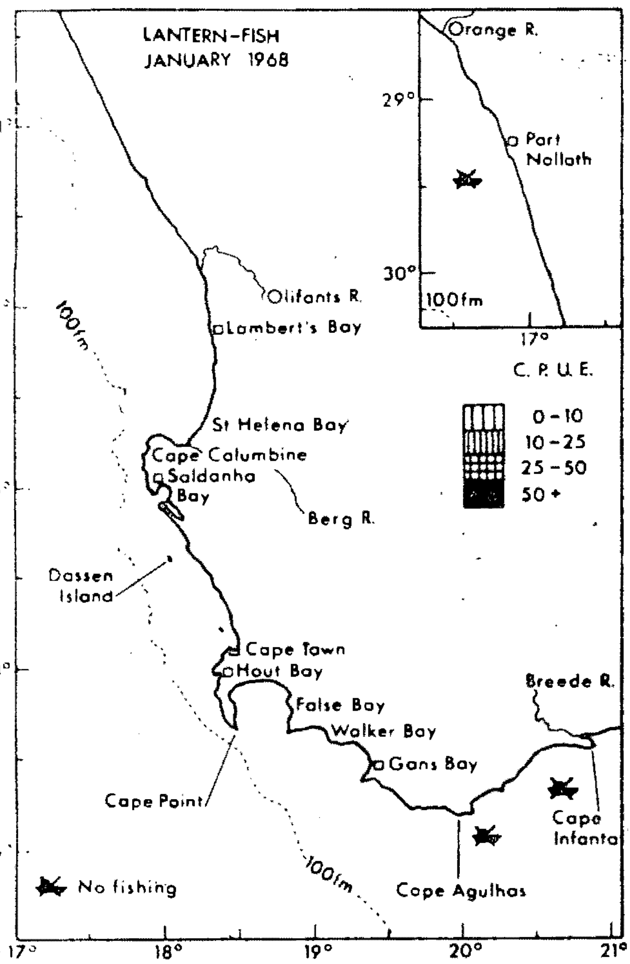

ROUND HERRING
APRIL 1976
Orange R
29°
Port Nolloth
30°
100fm
17°
31°
32°
33°
34°
35°
100fm
10,2
Olifants R.
Lambert's Bay
9,2
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dossen Island
Cape Town
Hout Bay
7,7
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
9,7
7,7
Cape Infanta
Cape Agulhas
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
No fishing
17°
18°
19°
20°
21°

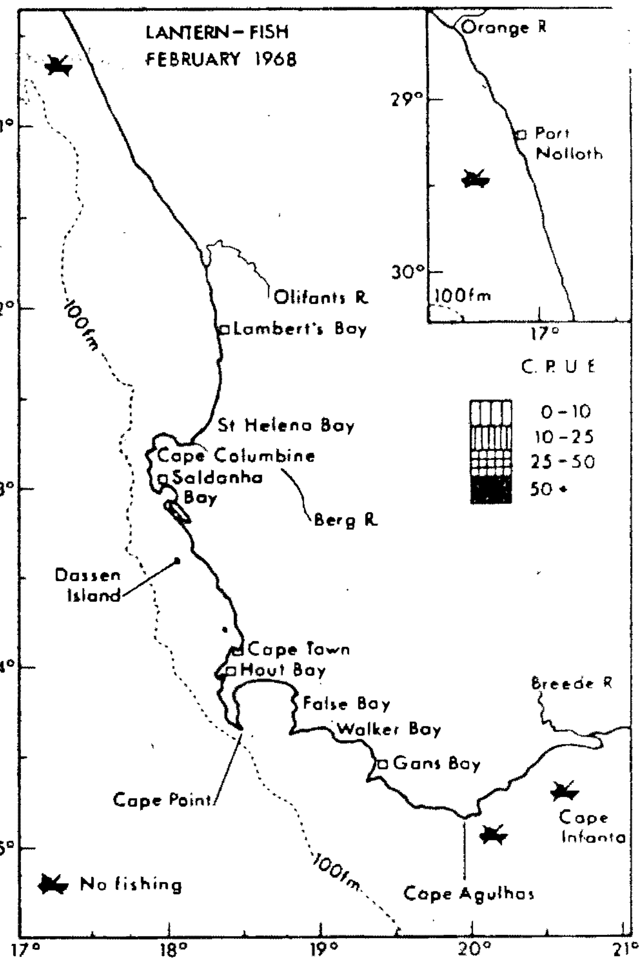

ROUND HERRING
MAY 1976
Orange R.
29°
Port Nolloth
30°
100fm
17°
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
31°
32°
33°
34°
35°
10,2
8,8
10,2
8,8
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
100fm
17°
18°
19°
20°
21°

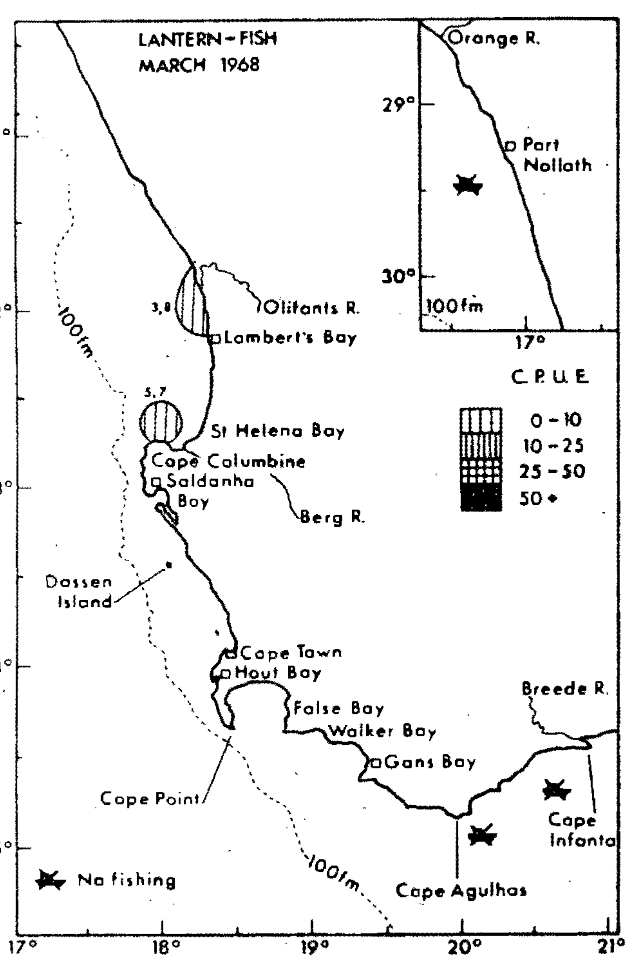

ROUND HERRING
JUNE 1976
Orange R.
29°
Port Nolloth
30°
100fm
17°
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
31°
32°
33°
34°
35°
100fm
6,7
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
100fm
17°
18°
19°
20°
21°


ROUND HERRING
JULY 1976
Orange R.
29°
Port Nolloth
30°
100fm
17°
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
31°
32°
33°
34°
35°
100fm
18,2
7,2
7,7
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
100fm
17°
18°
19°
20°
21°


ROUND HERRING
AUGUST 1976
Orange R.
29°
Port Nolloth
30°
100fm
17°
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Juveniles
0 - 10
10 - 25
25 - 50
50 +
31°
32°
33°
34°
35°
100fm
9,2
9,7
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
100fm
17°
18°
19°
20°
21°


LANTERN-FISH
JANUARY 1968
Orange R.
29°
Port Nolloth
30°
100fm
17°
C. P. U. E.
0-10
10-25
25-50
50+
Olifants R.
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
31°
32°
33°
34°
35°
17°
18°
19°
20°
21°


LANTERN-FISH
FEBRUARY 1968
Orange R
29°
Port Nolloth
30°
100fm
17°
C. P. U. E.
0-10
10-25
25-50
50+
Olifants R.
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
31°
32°
33°
34°
35°
17°
18°
19°
20°
21°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MARCH 1968
Orange R.
29°
Port Nolloth
30°
100fm
17°
C. P. U. E.
0-10
10-25
25-50
50+
3,8
Olifants R.
Lambert's Bay
100fm
5,7
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
31°
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17°
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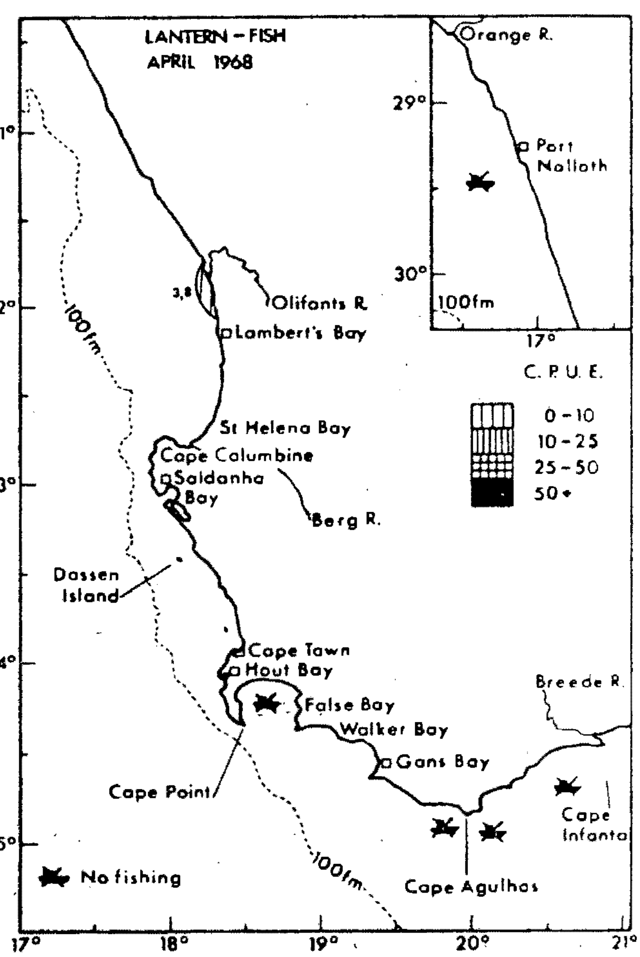
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APRIL 1968
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25-50
50+
3,8
Olifants R.
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
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32°
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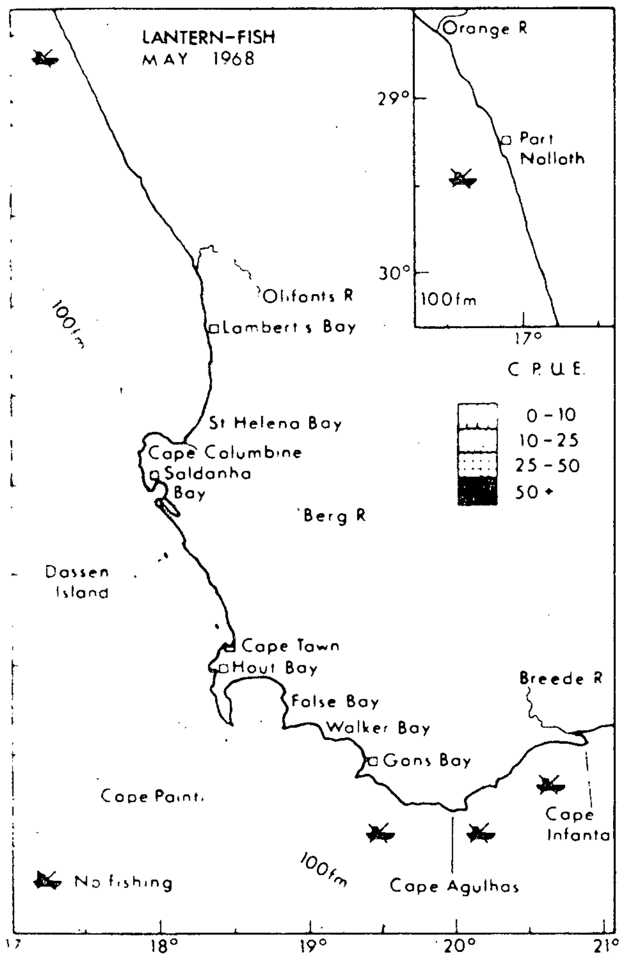
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MAY 1968
Orange R
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Port Nolloth
30°
100fm
17°
C.P.U.E.
0 - 10
10 - 25
25 - 50
50 +
100fm
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
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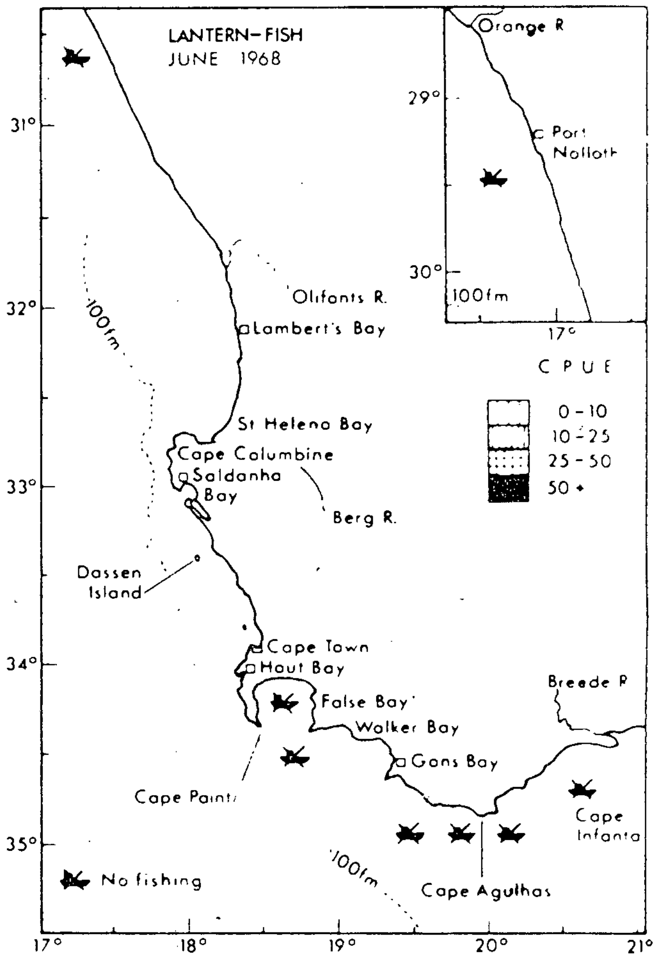
21°


LANTERN-FISH
JUNE 1968
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17°
C.P.U.E.
0 - 10
10 - 25
25 - 50
50 +
31°
32°
33°
34°
35°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
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Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
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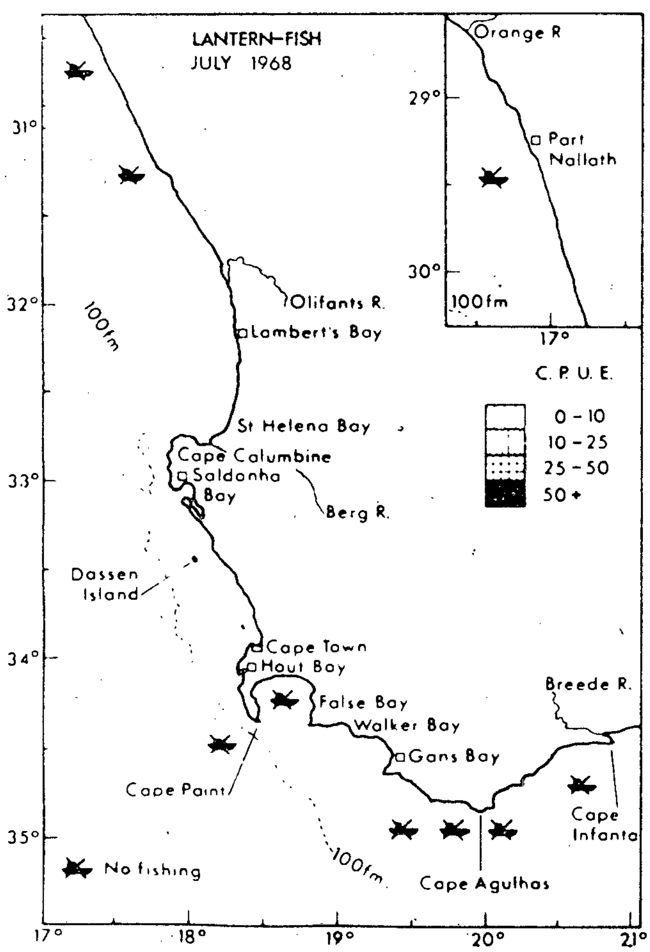
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JULY 1968
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Port Nolloth
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17°
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25 - 50
50 +
31°
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100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
17°
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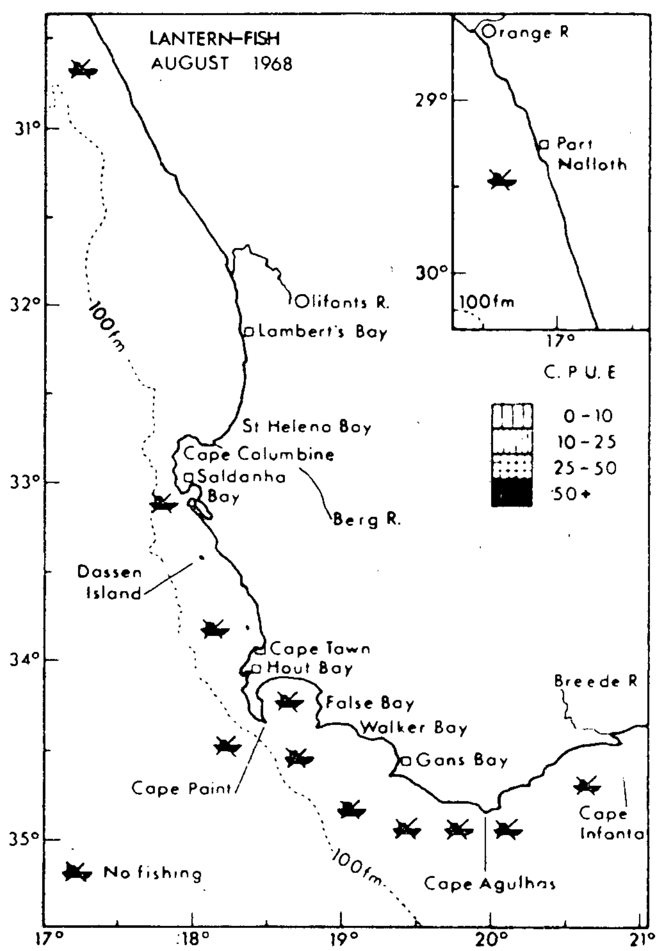
LANTERN-FISH
AUGUST 1968
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Port Nolloth
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100fm
17°
C.P.U.E.
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10 - 25
25 - 50
50 +
31°
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100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
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Gans Bay
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Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
17°
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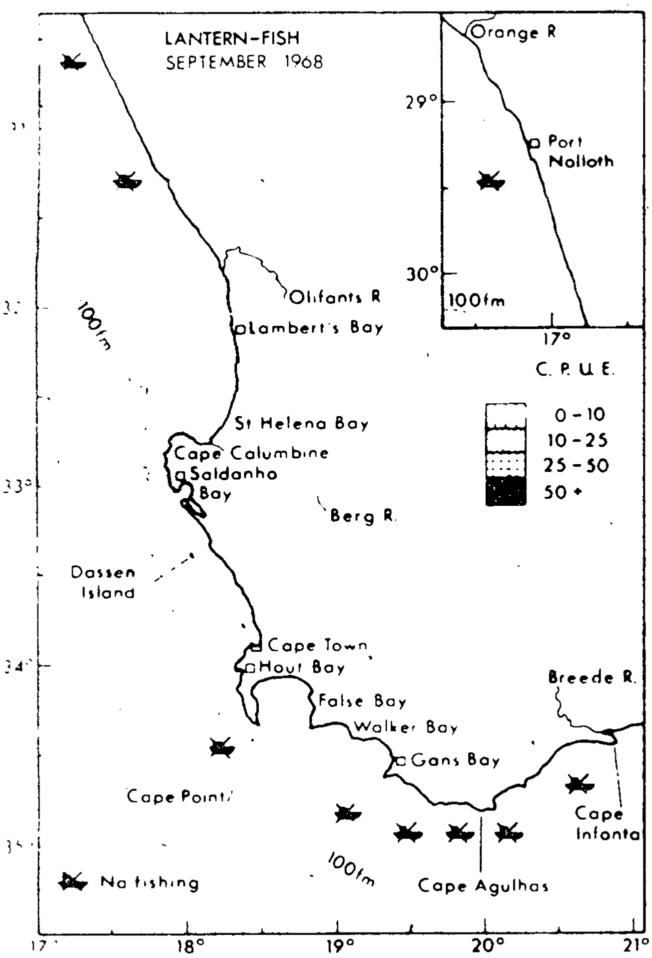
LANTERN-FISH
SEPTEMBER 1968
Orange R
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Port Nolloth
30°
100fm
17°
Olifants R
Lambert's Bay
100fm
C. P. U. E.
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
Breede R.
False Bay
Walker Bay
Gans Bay
Cape Point
Cape Infanta
100fm
Cape Agulhas
No fishing
17°
18°
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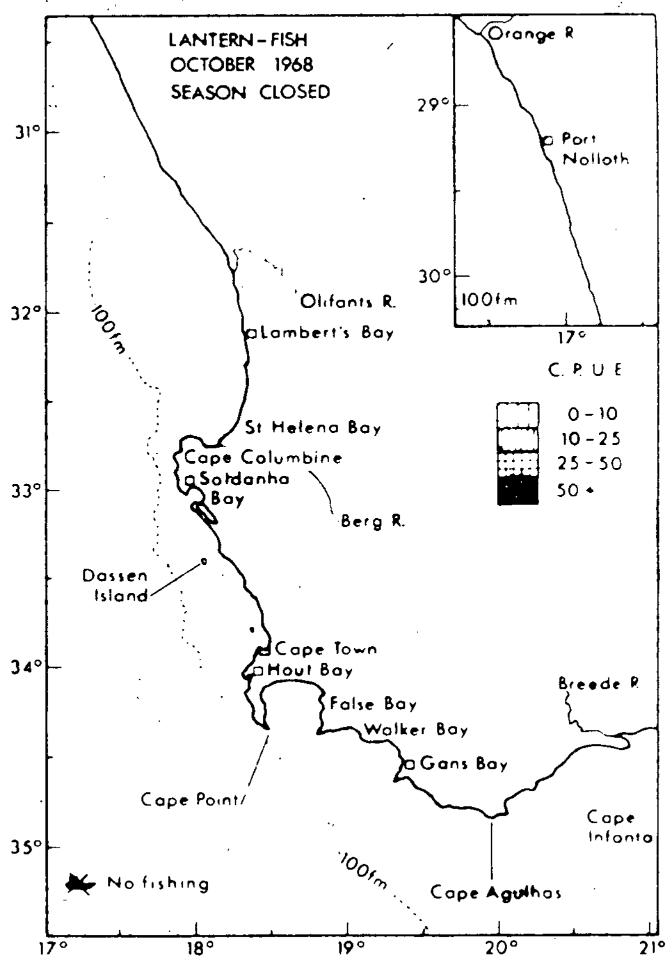
20°
21°


LANTERN-FISH
OCTOBER 1968
SEASON CLOSED
Orange R
29°
Port Nolloth
30°
100fm
17°
31°
Olifants R.
32°
Lambert's Bay
100fm
C. P. U. E.
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
33°
Berg R.
Dassen Island
Cape Town
34°
Hout Bay
Breede R.
False Bay
Walker Bay
Gans Bay
Cape Point
Cape Infanta
35°
100fm
No fishing
Cape Agulhas
17°
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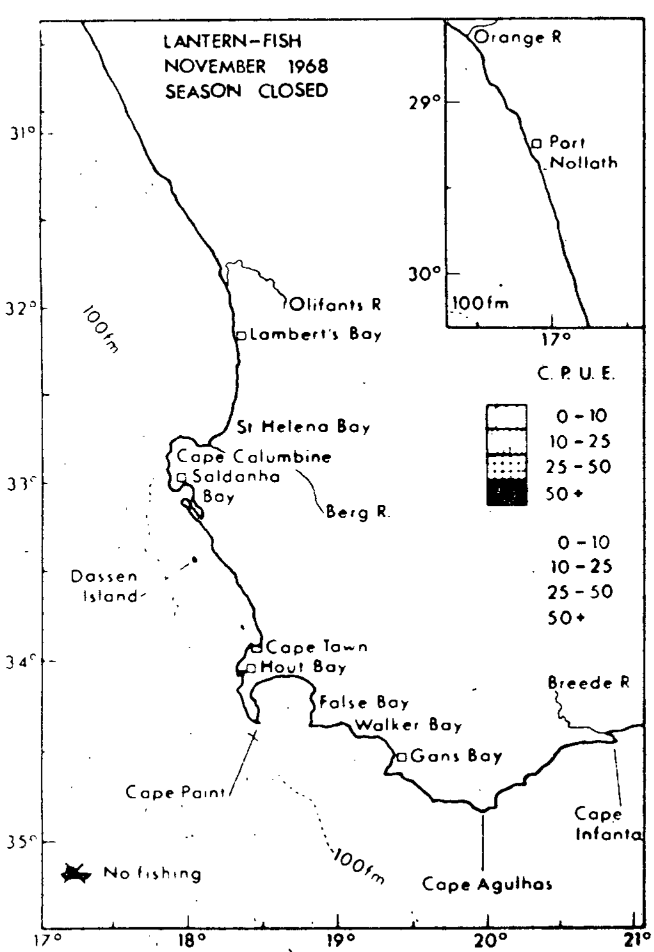
LANTERN-FISH
NOVEMBER 1968
SEASON CLOSED
Orange R
29°
Port Nolloth
31°
30°
100fm
17°
32°
Olifants R
Lambert's Bay
100fm
C. P. U. E.
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
33°
Berg R.
0 - 10
10 - 25
25 - 50
50 +
Dassen Island
Cape Town
34°
Hout Bay
Breede R
False Bay
Walker Bay
Gans Bay
Cape Point
Cape Infanta
35°
100fm
No fishing
Cape Agulhas
17°
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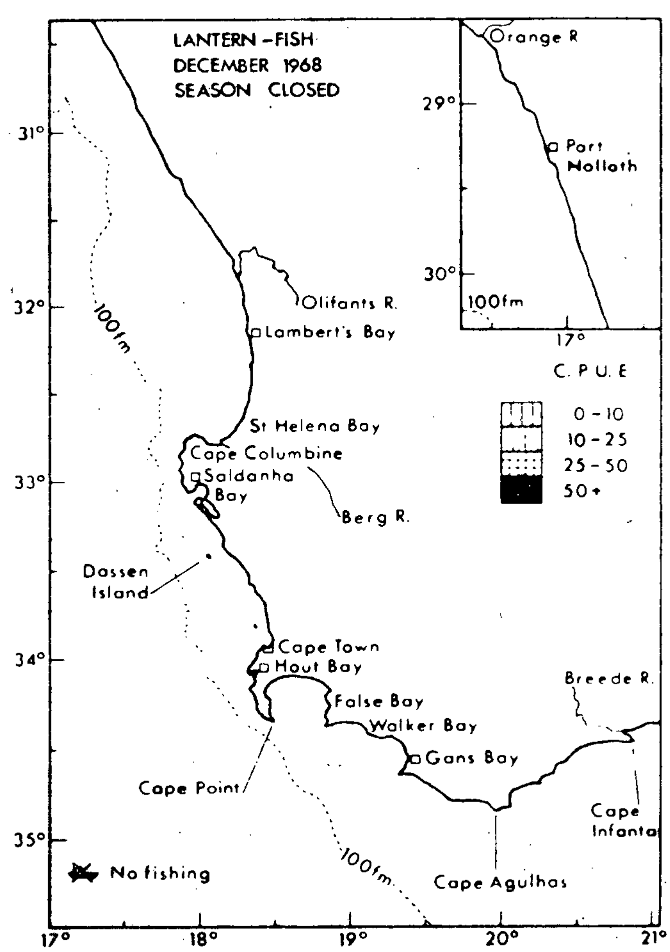
LANTERN-FISH
DECEMBER 1968
SEASON CLOSED
Orange R
29°
31°
Port Nolloth
30°
100fm
17°
32°
Olifants R.
Lambert's Bay
100fm
C. P. U. E.
0 - 10
10 - 25
25 - 50
50 +
St Helena Bay
Cape Columbine
Saldanha Bay
33°
Berg R.
Dassen Island
Cape Town
34°
Hout Bay
Breede R.
False Bay
Walker Bay
Gans Bay
Cape Point
Cape Infanta
35°
100fm
No fishing
Cape Agulhas
17°
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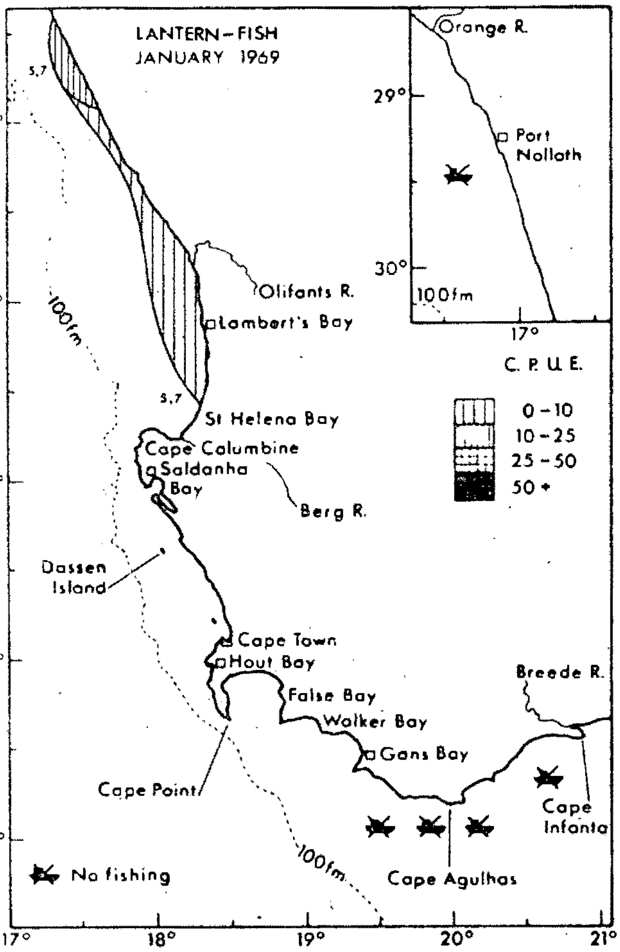
LANTERN-FISH
JANUARY 1969
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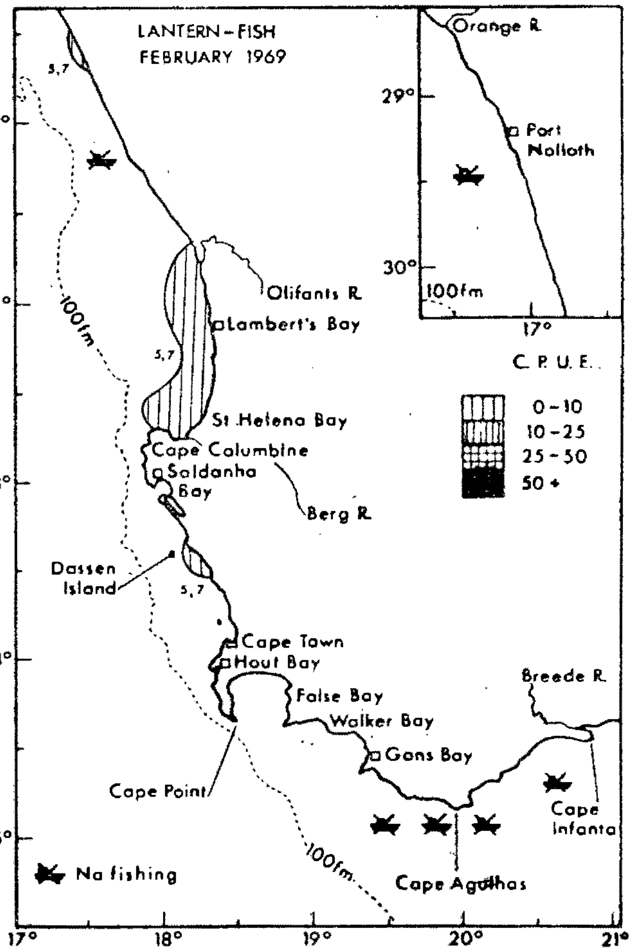
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
0-10
10-25
25-50
50+


LANTERN-FISH
FEBRUARY 1969
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
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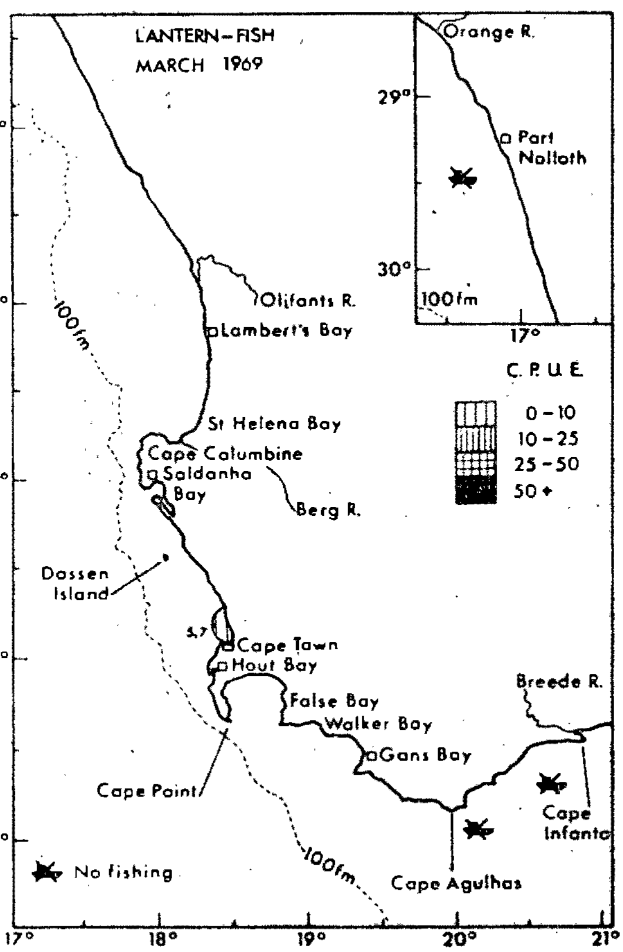
LANTERN-FISH
MARCH 1969
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Port Nolloth
100fm
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Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
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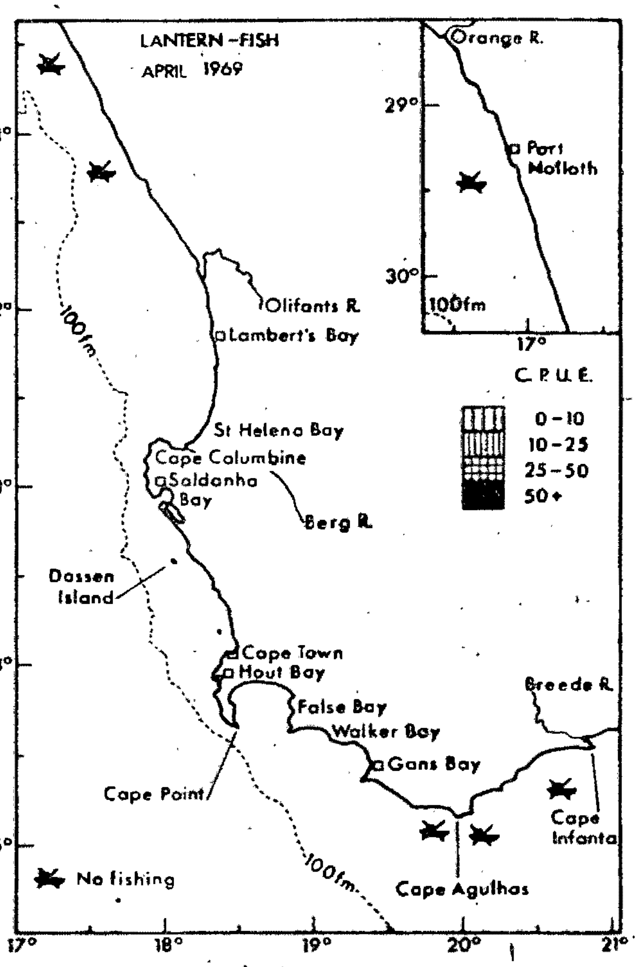
LANTERN-FISH
APRIL 1969
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Port Nolloth
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Lambert's Bay
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Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
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Cape Point
Cape Infanta
Cape Agulhas
No fishing
C. P. U. E.
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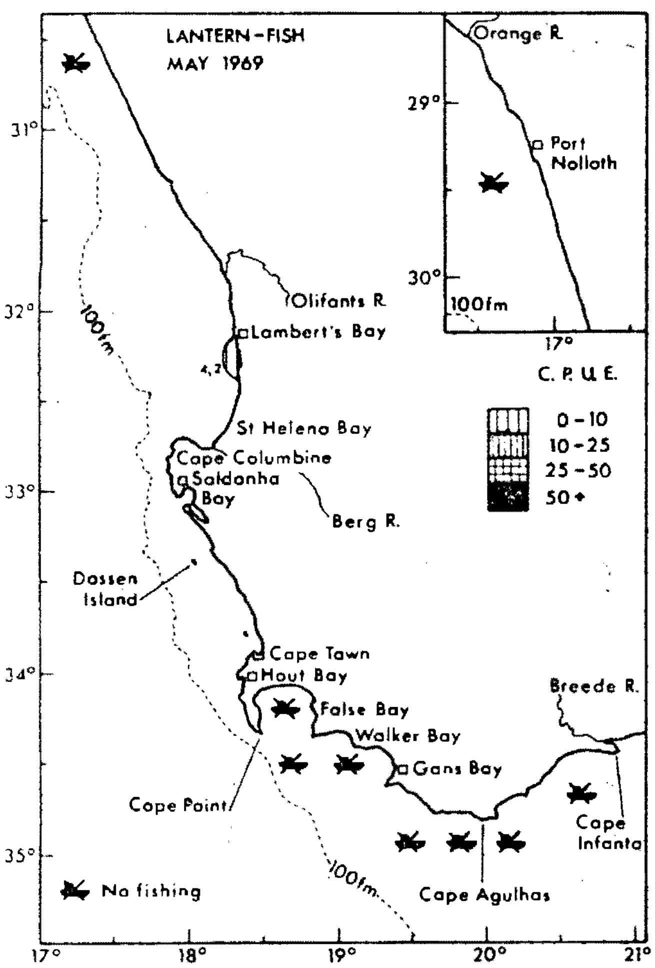
LANTERN-FISH
MAY 1969
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100fm
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50+
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100fm
Olifants R.
Lambert's Bay
4,2
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
17°
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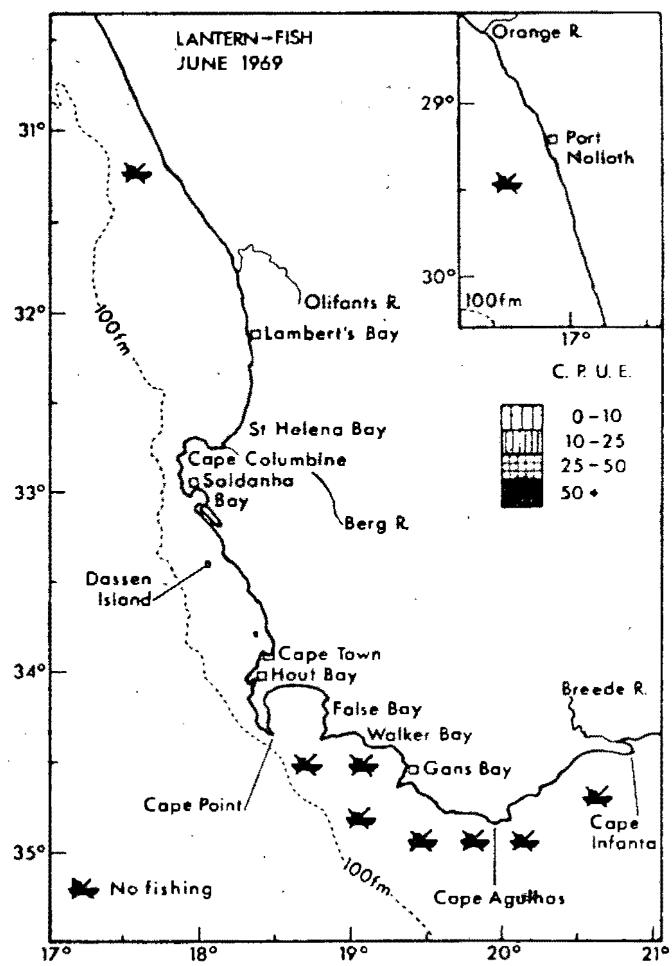
LANTERN-FISH
JUNE 1969
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Port Nolloth
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100fm
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Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
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Cape Point
Cape Infanta
Cape Agulhas
No fishing
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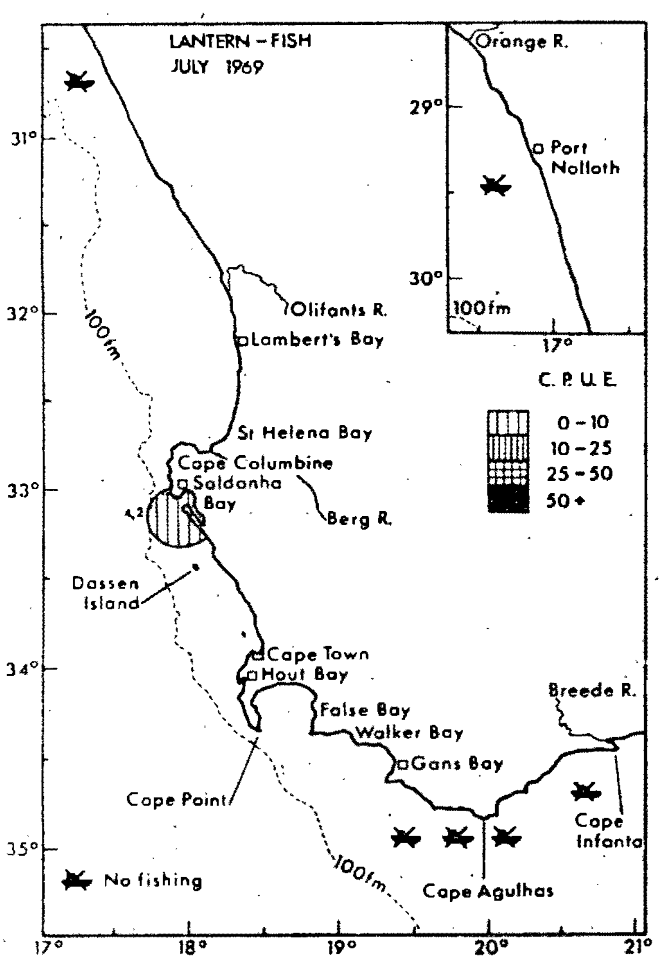
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JULY 1969
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Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
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Berg R.
Dassen Island
Cape Town
Hout Bay
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Gans Bay
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Cape Agulhas
No fishing
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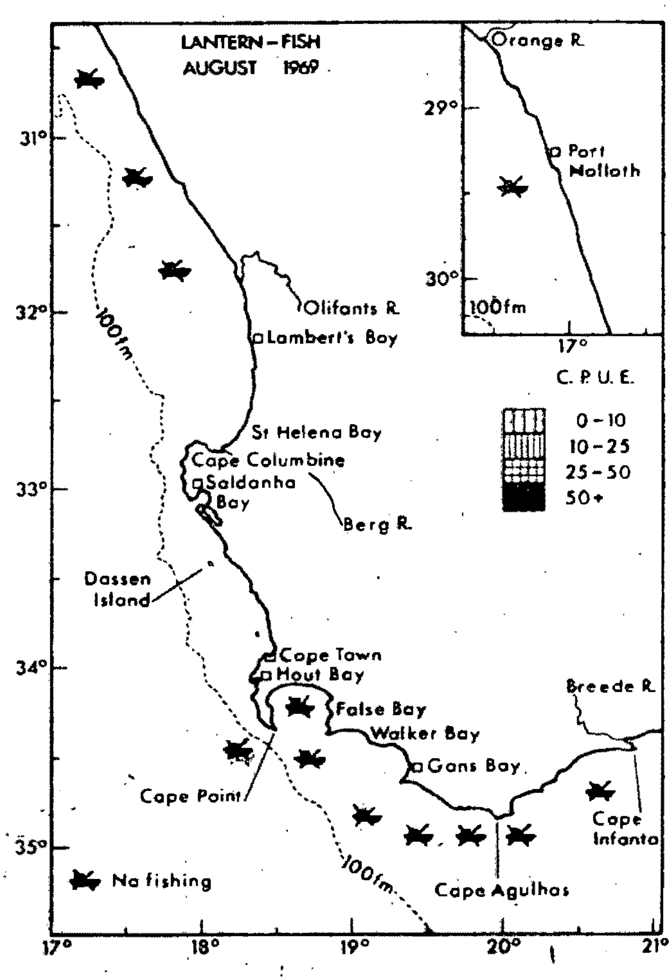
LANTERN-FISH
AUGUST 1969
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100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
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Cape Agulhas
No fishing
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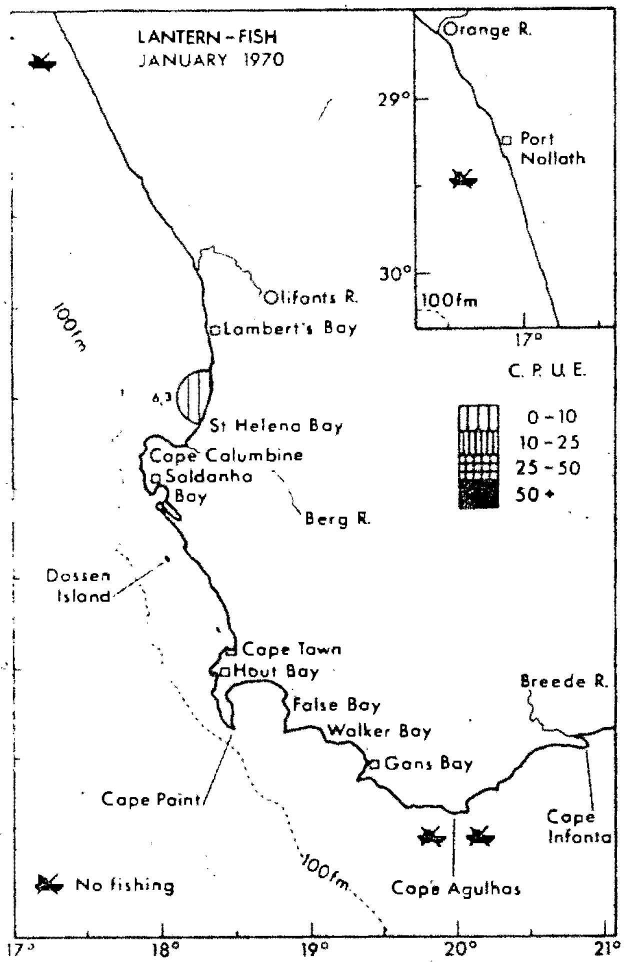
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Olifants R.
Lambert's Bay
100fm
6,3
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dossen Island
Cape Town
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False Bay
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Cape Agulhas
100fm
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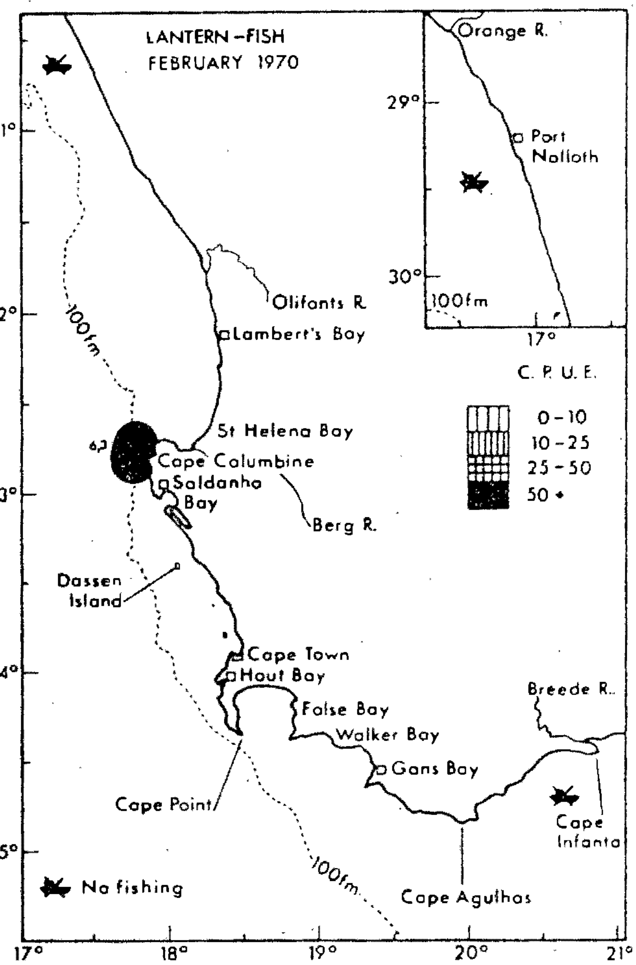
LANTERN-FISH
FEBRUARY 1970
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Olifants R.
Lambert's Bay
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St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
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Hout Bay
False Bay
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Cape Agulhas
100fm
No fishing
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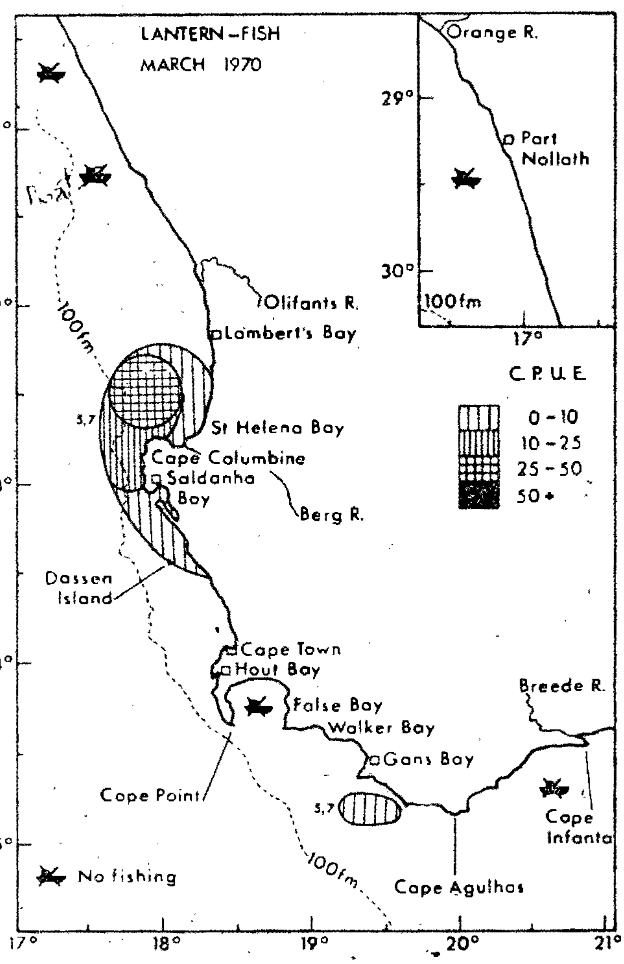
LANTERN-FISH
MARCH 1970
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Port Nolloth
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Olifants R.
Lambert's Bay
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St Helena Bay
Cape Columbine
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Dassen Island
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Hout Bay
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Walker Bay
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Cape Infanta
Cape Agulhas
100fm
No fishing
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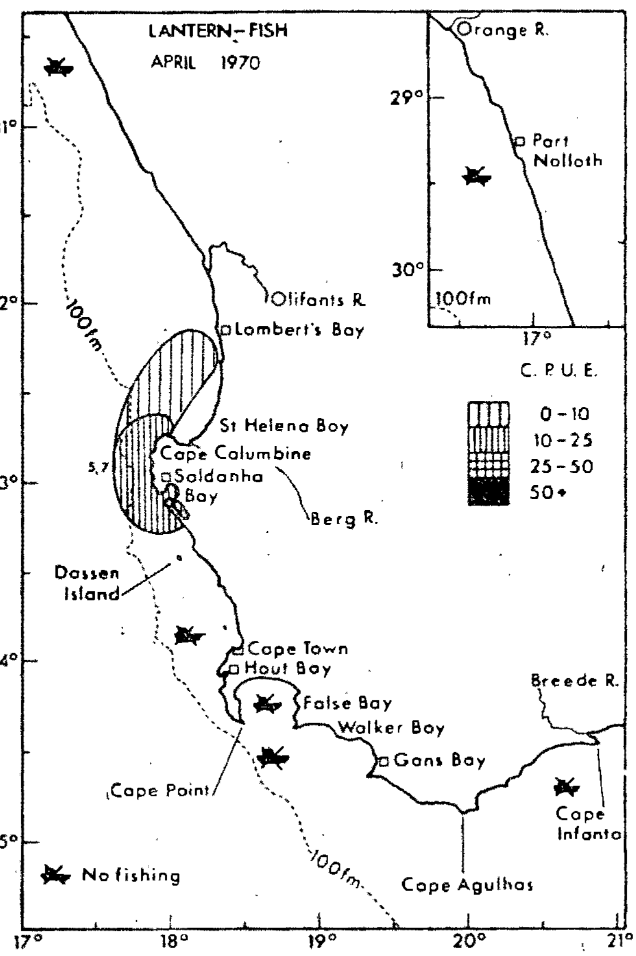
LANTERN-FISH
APRIL 1970
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Port Nolloth
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Olifants R.
Lambert's Bay
100fm
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St Helena Bay
Cape Columbine
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False Bay
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Cape Agulhas
100fm
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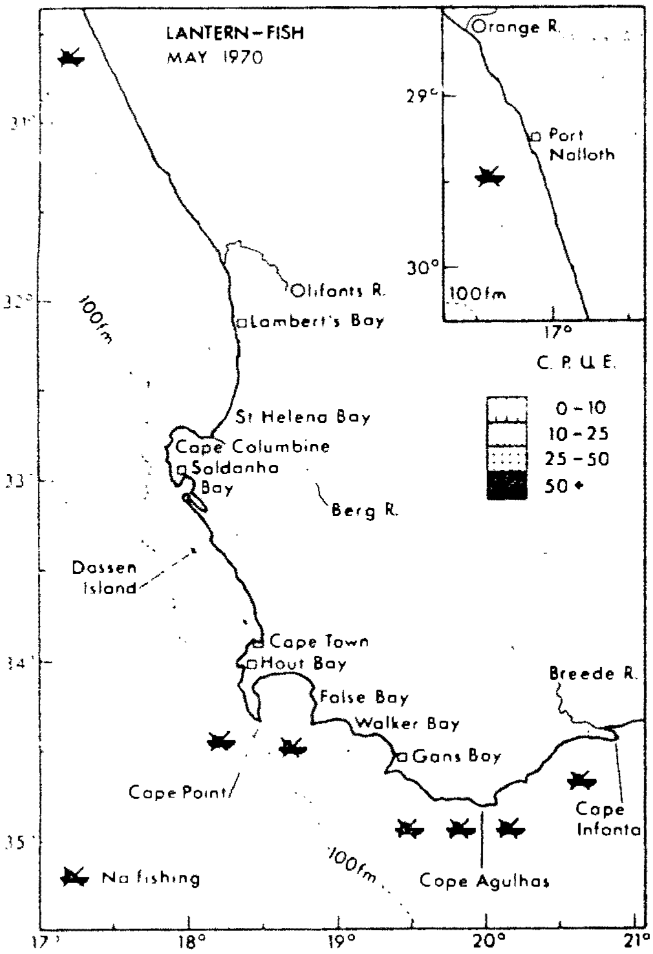
LANTERN-FISH
MAY 1970
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Port Nolloth
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Olifants R.
Lambert's Bay
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Dassen Island
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Hout Bay
False Bay
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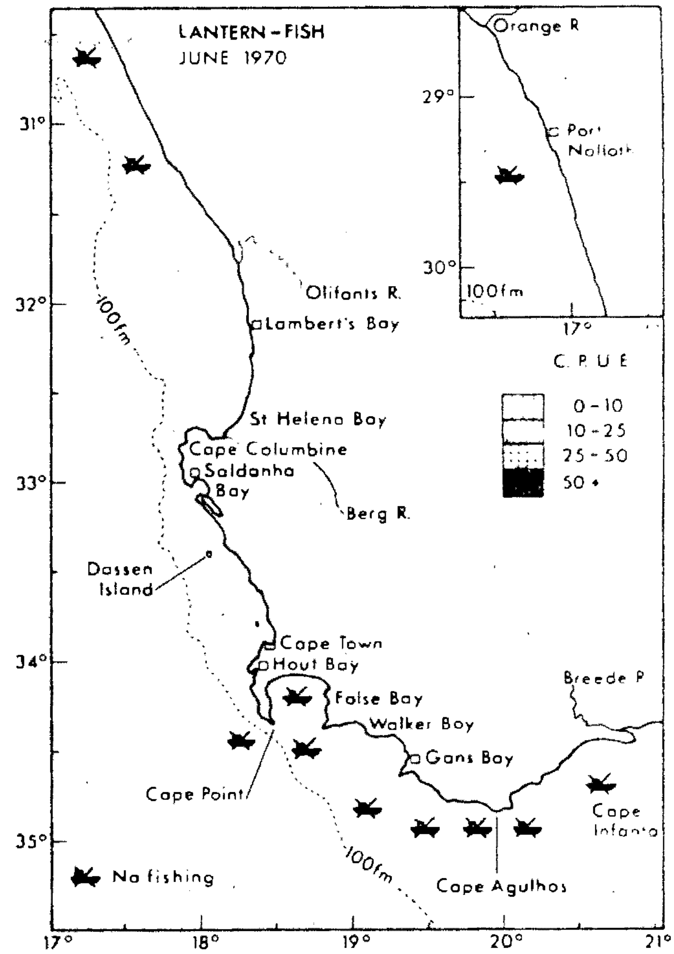
LANTERN-FISH
JUNE 1970
Orange R
Port Nolloth
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Olifants R.
Lambert's Bay
St Helena Bay
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Saldanha Bay
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Dassen Island
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Cape Agulhas
No fishing
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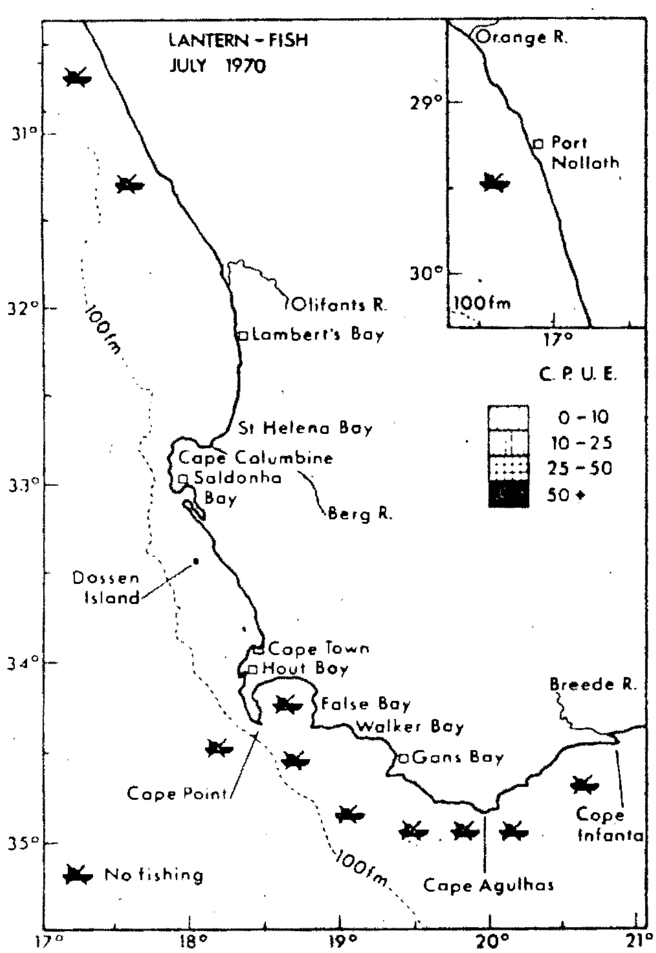
LANTERN-FISH
JULY 1970
Orange R.
Port Nolloth
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Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
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Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
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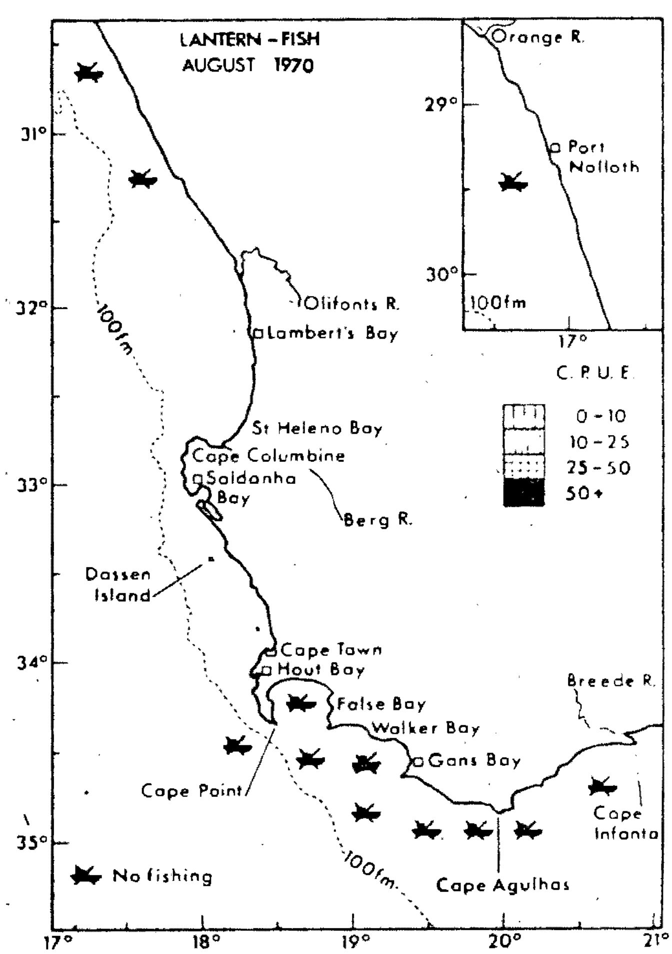
LANTERN-FISH
AUGUST 1970
Orange R.
Port Nolloth
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Olifants R.
Lambert's Bay
St Heleno Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
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Cape Infanta
Cape Agulhas
No fishing
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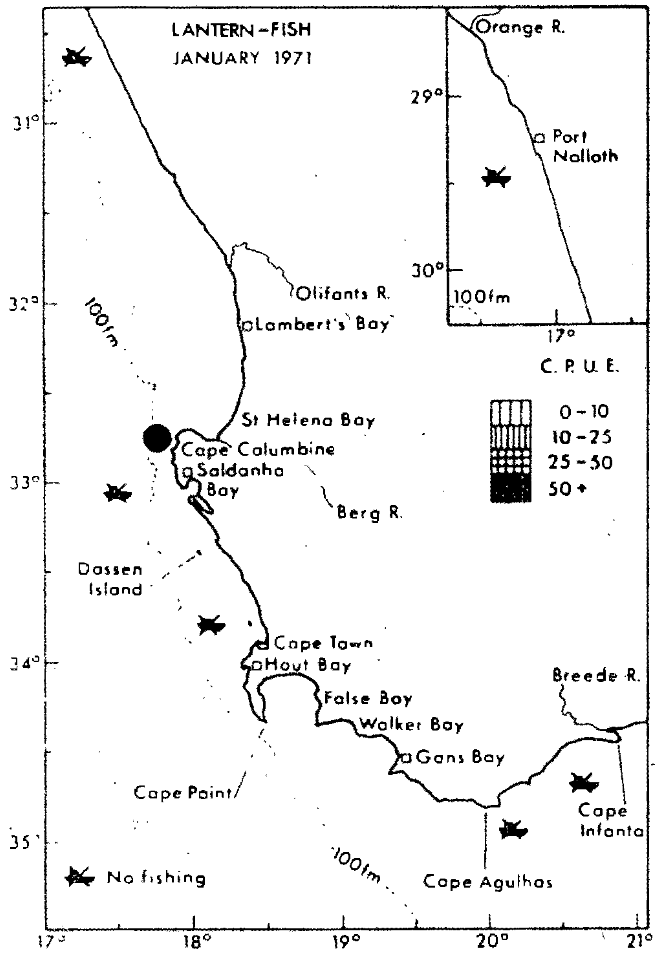
LANTERN-FISH
JANUARY 1971
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Port Nolloth
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100fm
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C. P. U. E.
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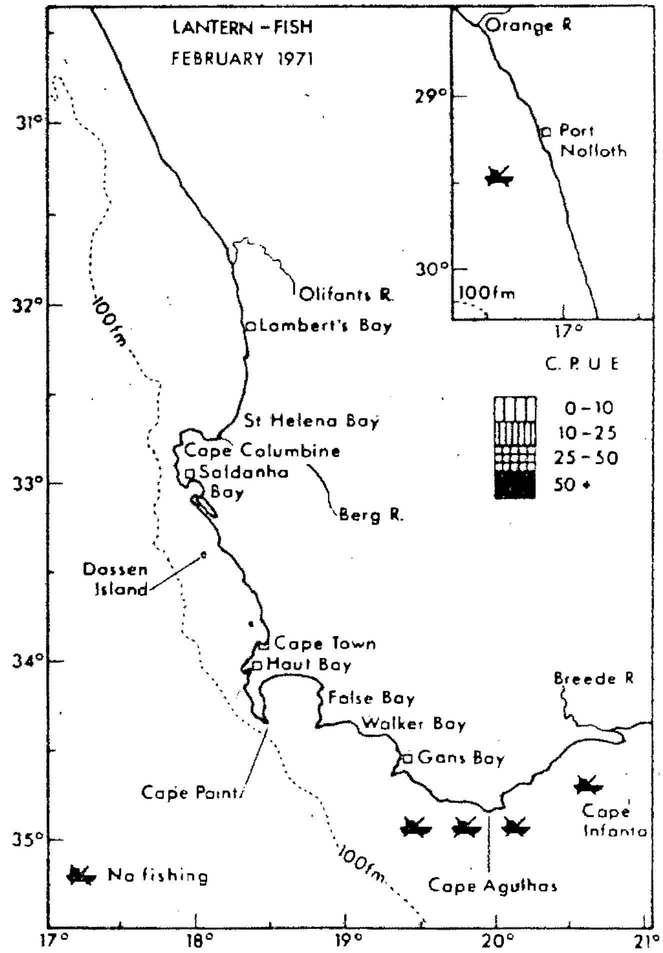
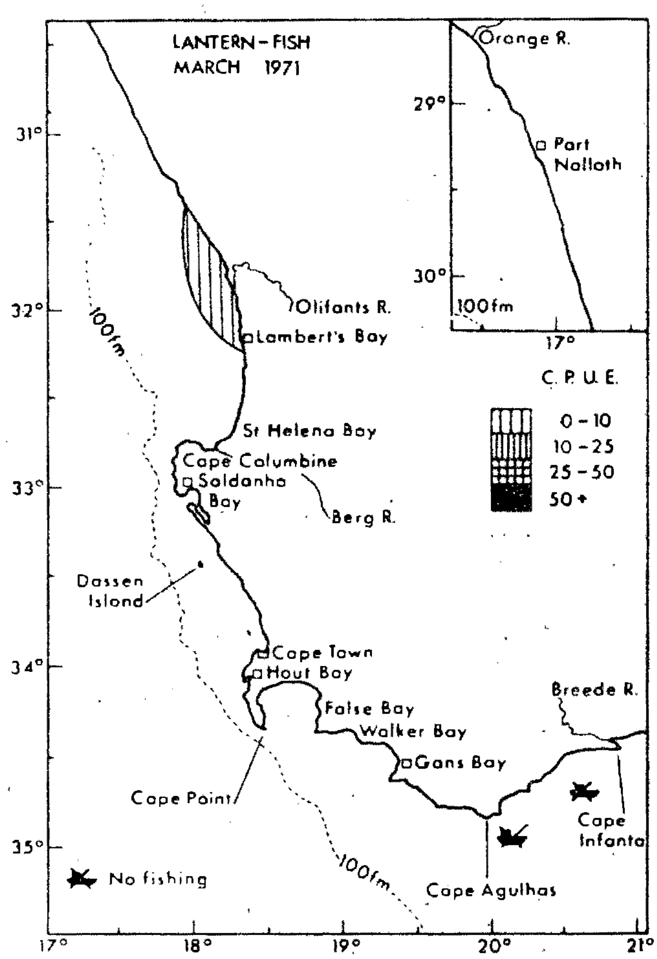
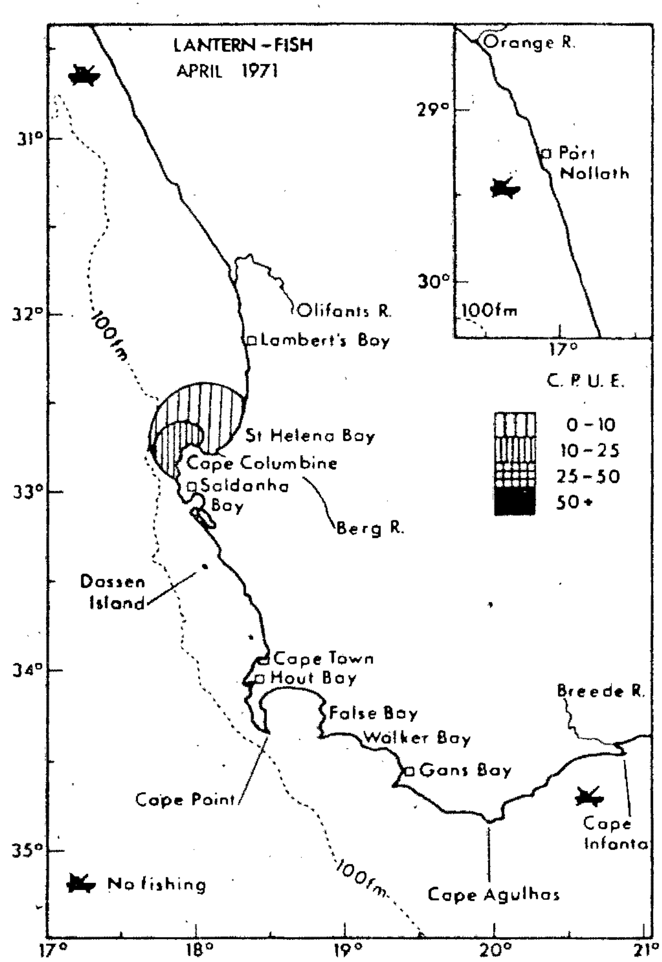
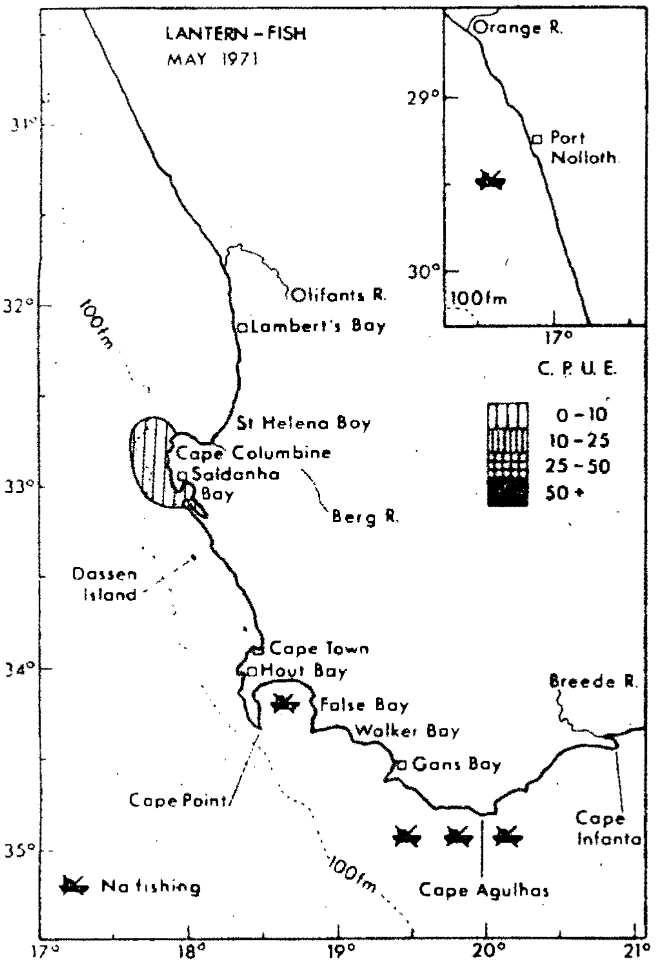
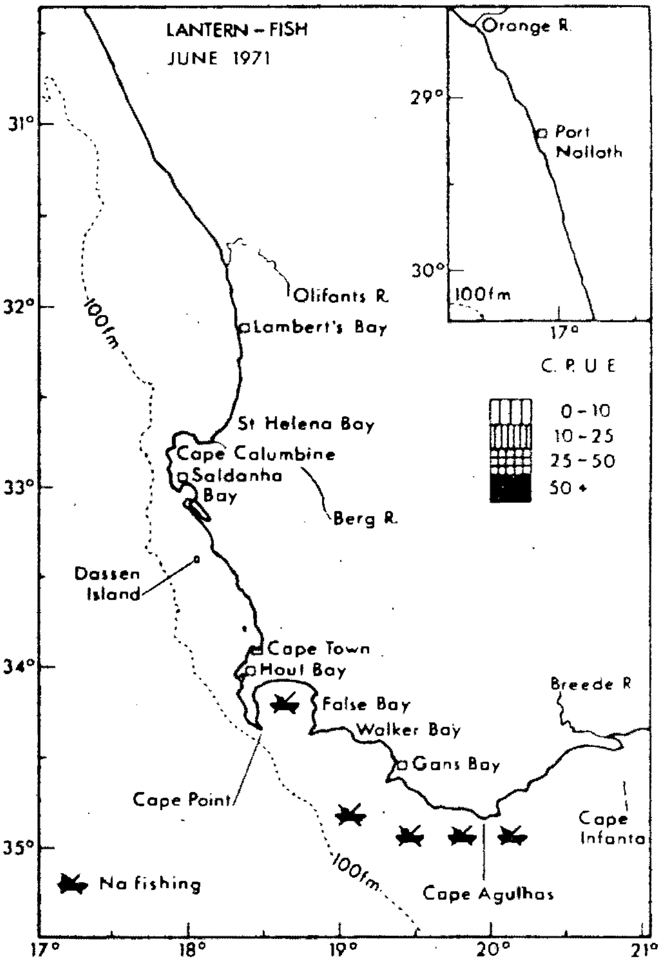
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
17°
18°
19°
20°
21°

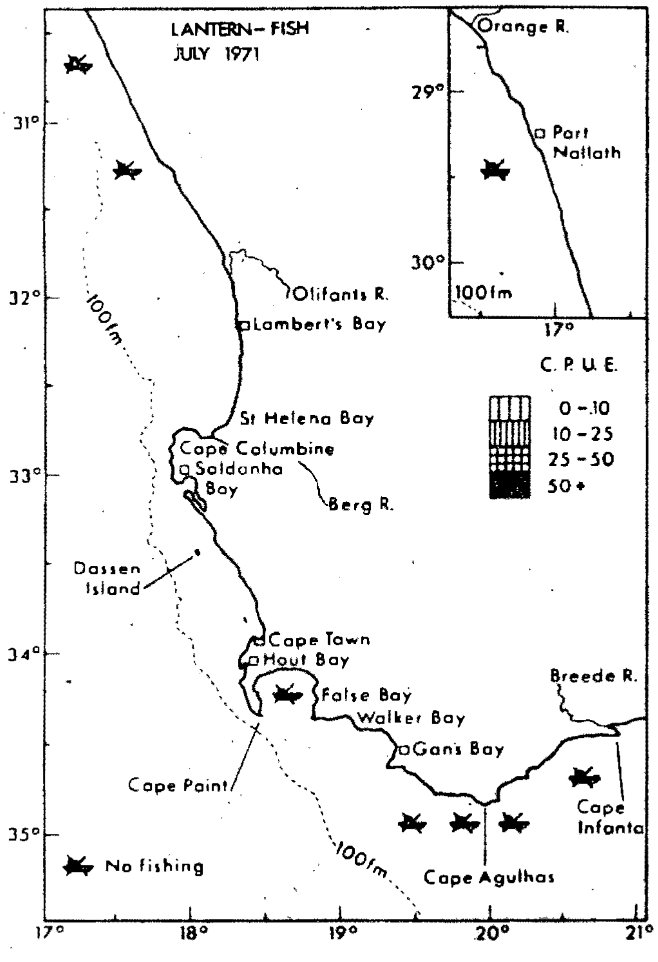

LANTERN-FISH
FEBRUARY 1971
Orange R
29°
Port Nolloth
30°
100fm
17°
C. P. U. E
0-10
10-25
25-50
50+
31°
32°
33°
34°
35°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
17°
18°
19°
20°
21°

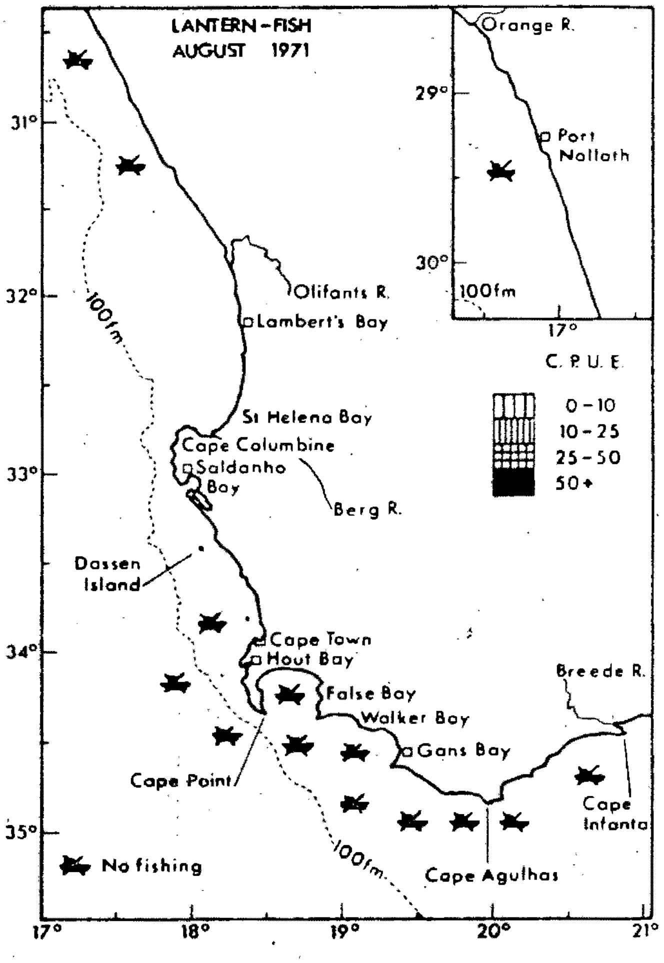

LANTERN-FISH
MARCH 1971
Orange R.
29°
Port Nolloth
30°
100fm
17°
C. P. U. E.
0-10
10-25
25-50
50+
31°
32°
33°
34°
35°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
17°
18°
19°
20°
21°

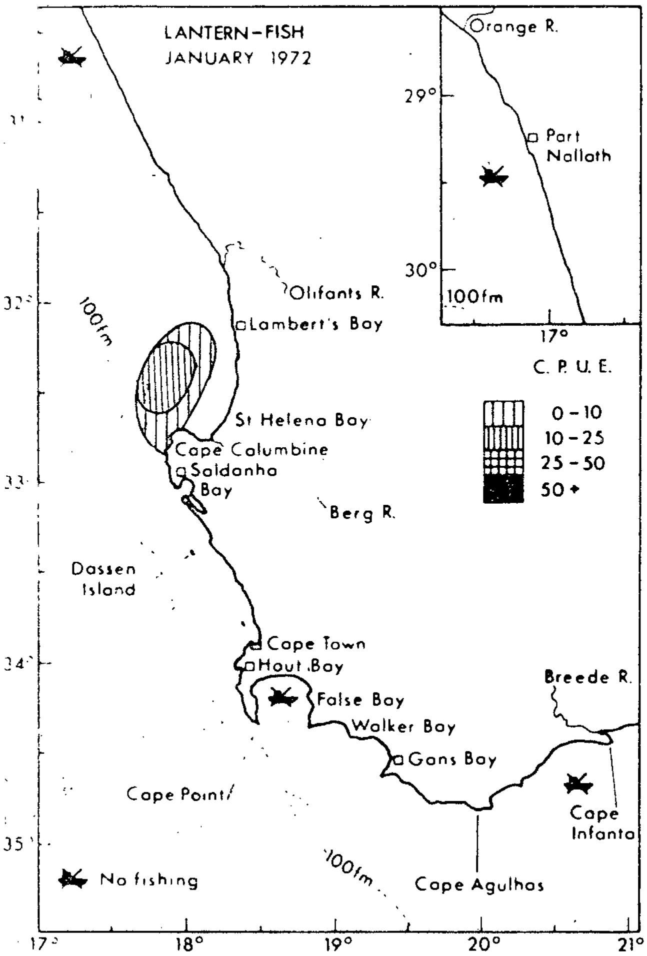

LANTERN-FISH
APRIL 1971
Orange R.
29°
Port Nolloth
30°
100fm
17°
C. P. U. E.
0-10
10-25
25-50
50+
31°
32°
33°
34°
35°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
17°
18°
19°
20°
21°

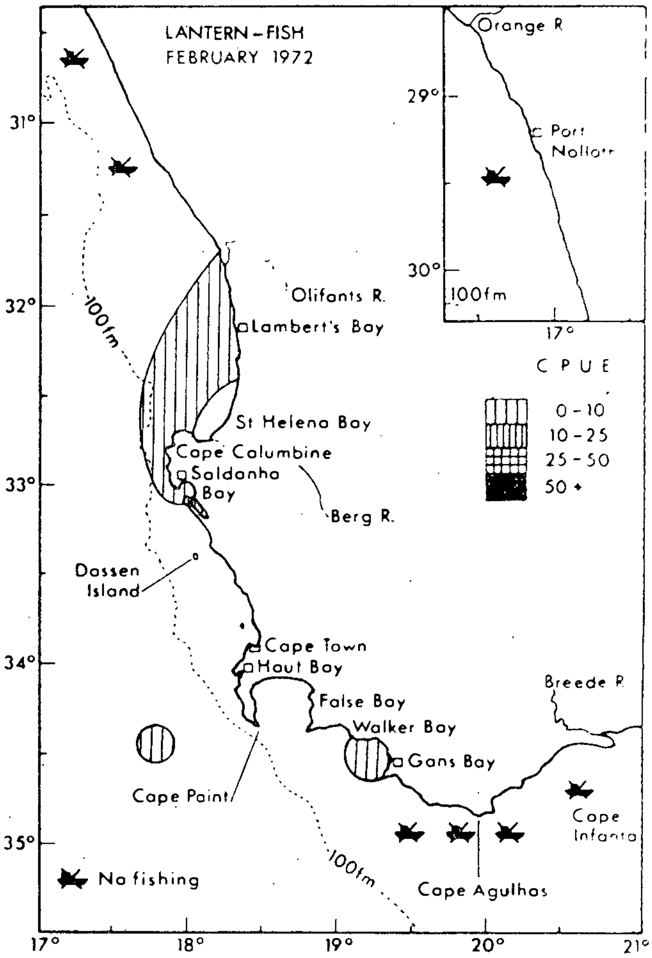

LANTERN - FISH
MAY 1971
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
C. P. U. E.
0 - 10
10 - 25
25 - 50
50 +
No fishing

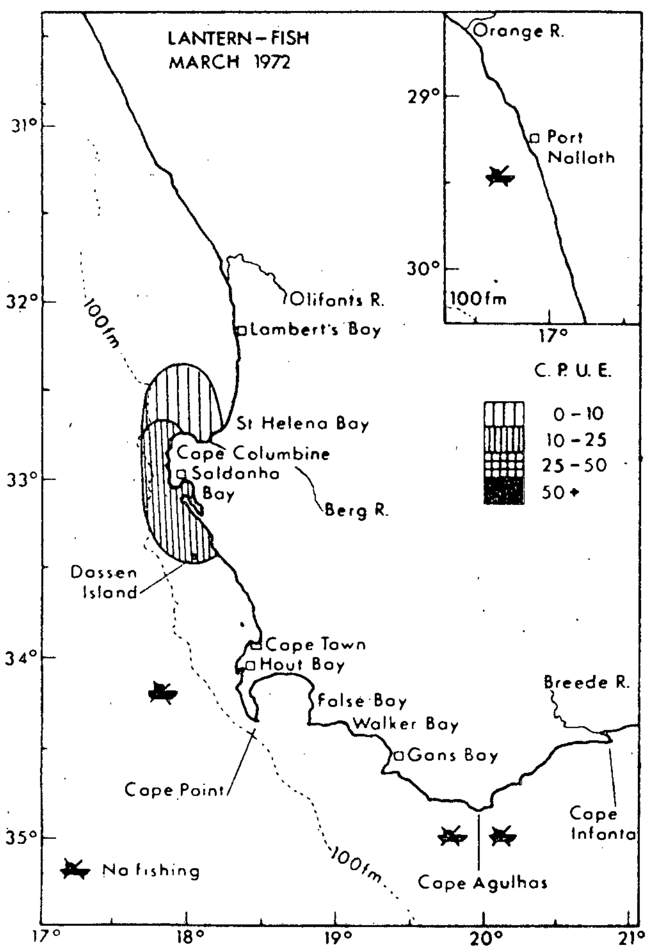

LANTERN - FISH
JUNE 1971
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
C. P. U. E.
0 - 10
10 - 25
25 - 50
50 +
No fishing

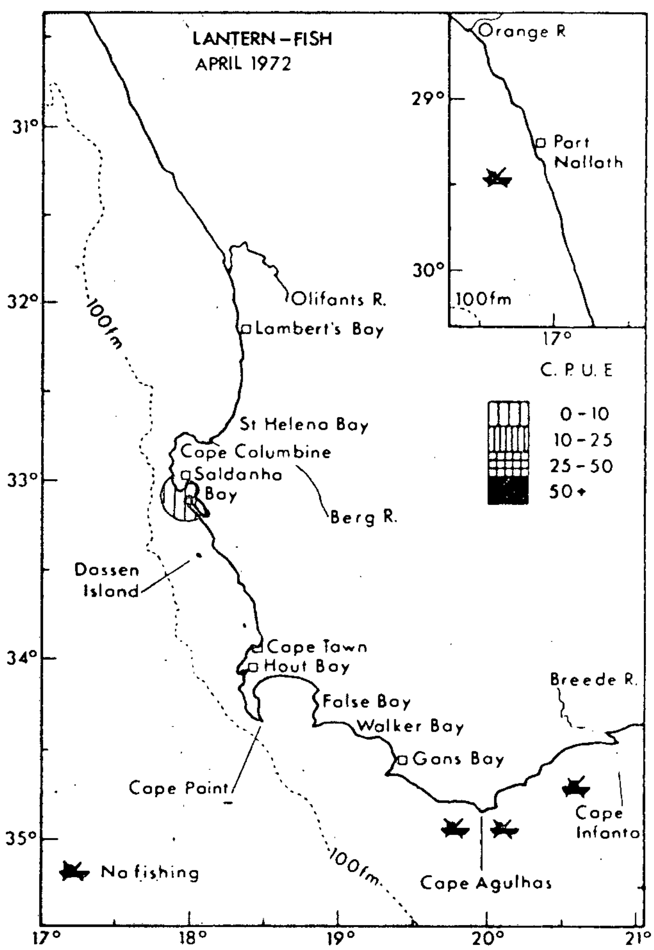

LANTERN- FISH
JULY 1971
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
C. P. U. E.
0 - 10
10 - 25
25 - 50
50 +
No fishing

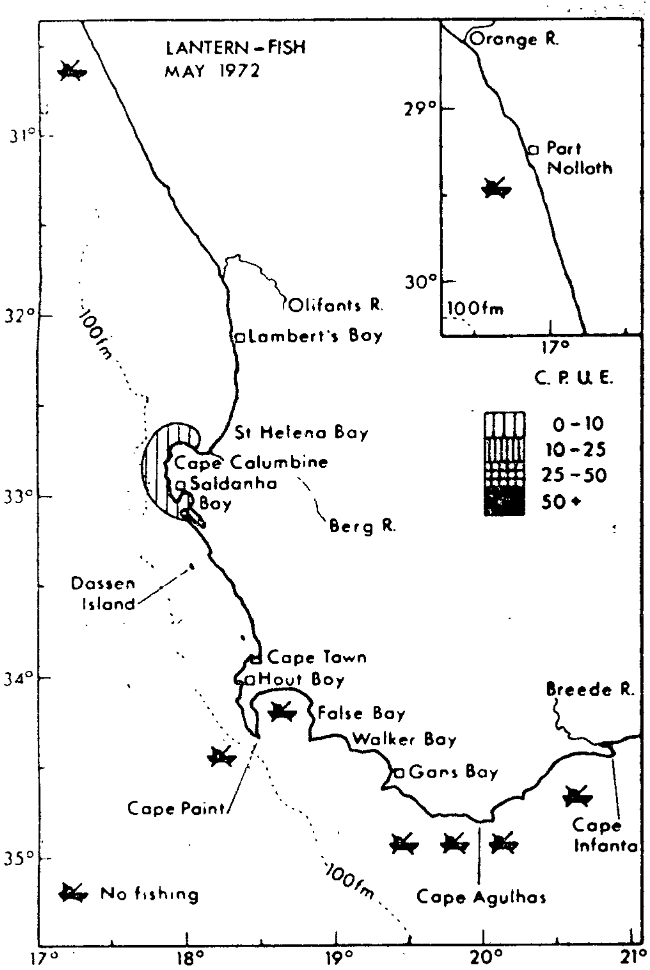

LANTERN - FISH
AUGUST 1971
Orange R.
Port Nolloth
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
C. P. U. E.
0 - 10
10 - 25
25 - 50
50 +
No fishing

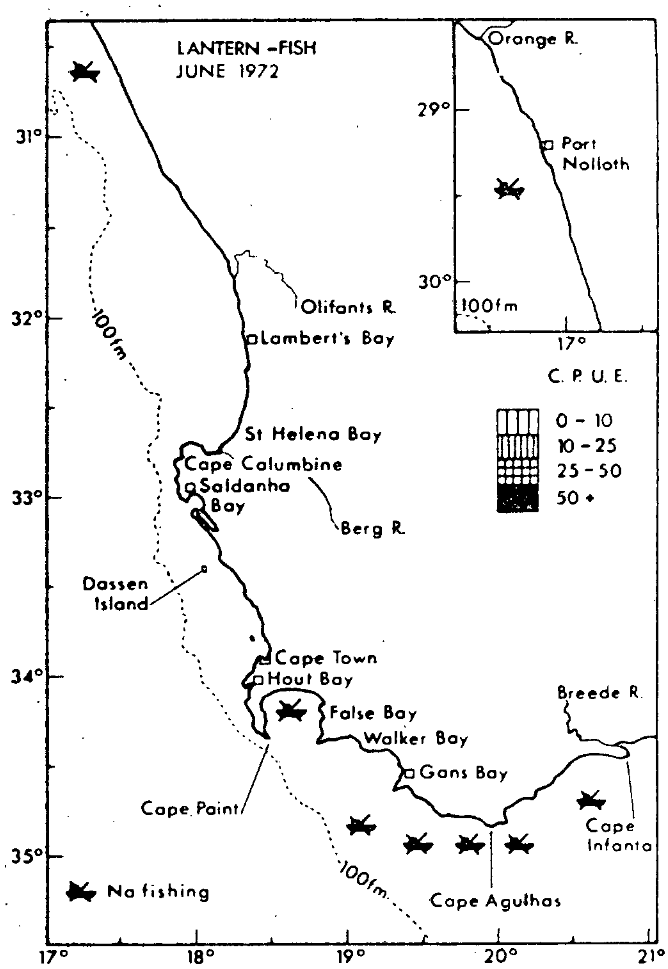

LANTERN-FISH
JANUARY 1972
Orange R.
29°
Port Nollath
30°
100fm
17°
C. P. U. E.
0 - 10
10 - 25
25 - 50
50 +
Olifants R.
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
100fm
32°
35°
17°
18°
19°
20°
21°

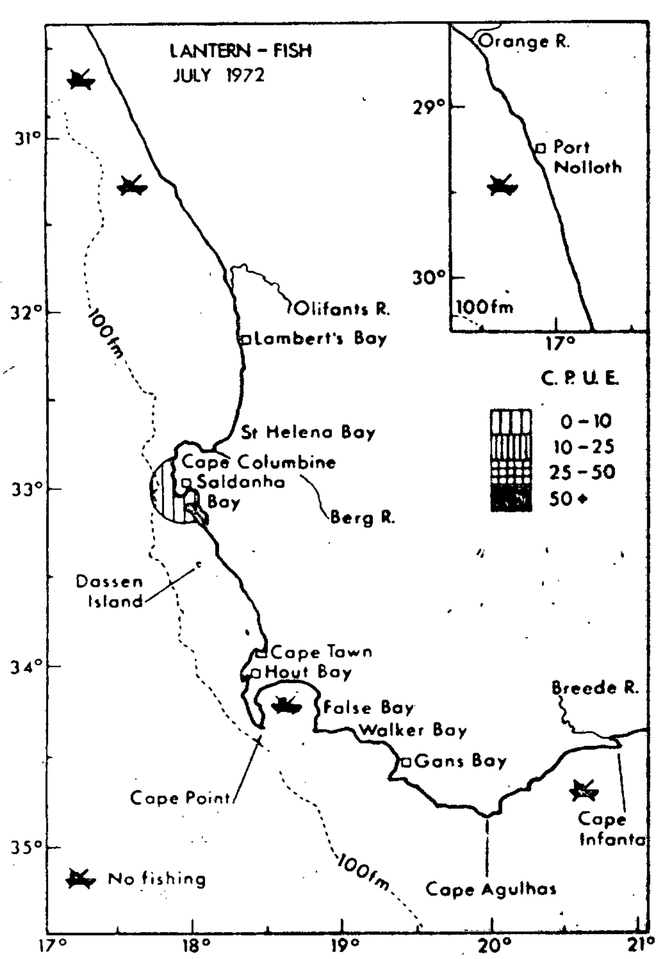

LANTERN-FISH
FEBRUARY 1972
Orange R
29°
Port Nolloth
30°
100fm
17°
C P U E
0 - 10
10 - 25
25 - 50
50 +
31°
32°
33°
34°
35°
Olifants R.
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape Infanta
Cape Agulhas
No fishing
100fm
17°
18°
19°
20°
21°

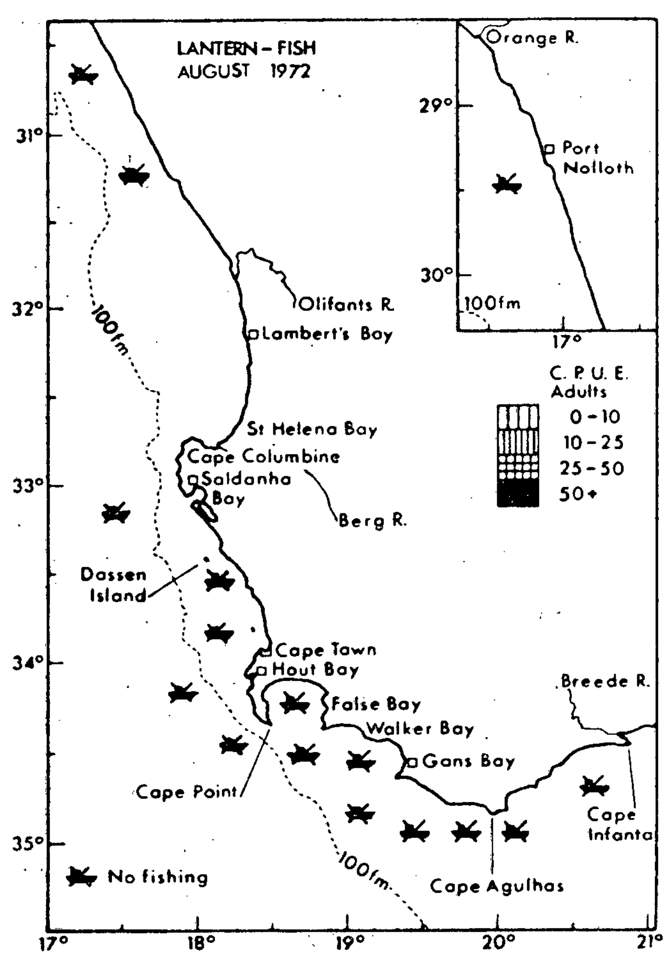

LANTERN-FISH
MARCH 1972
Orange R.
29°
Port Nollath
30°
100fm
17°
C. P. U. E.
0 - 10
10 - 25
25 - 50
50 +
31°
32°
33°
34°
35°
Olifants R.
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
100fm
17°
18°
19°
20°
21°

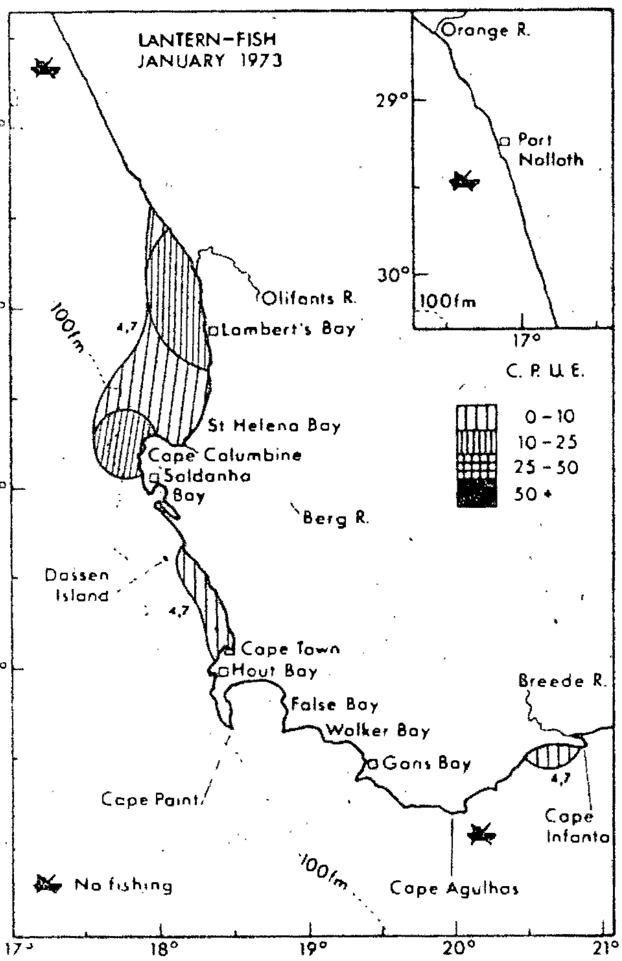

LANTERN-FISH
APRIL 1972
Orange R
29°
Port Nollath
30°
100fm
17°
C. P. U. E
0 - 10
10 - 25
25 - 50
50 +
31°
32°
33°
34°
35°
Olifants R.
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
100fm
17°
18°
19°
20°
21°

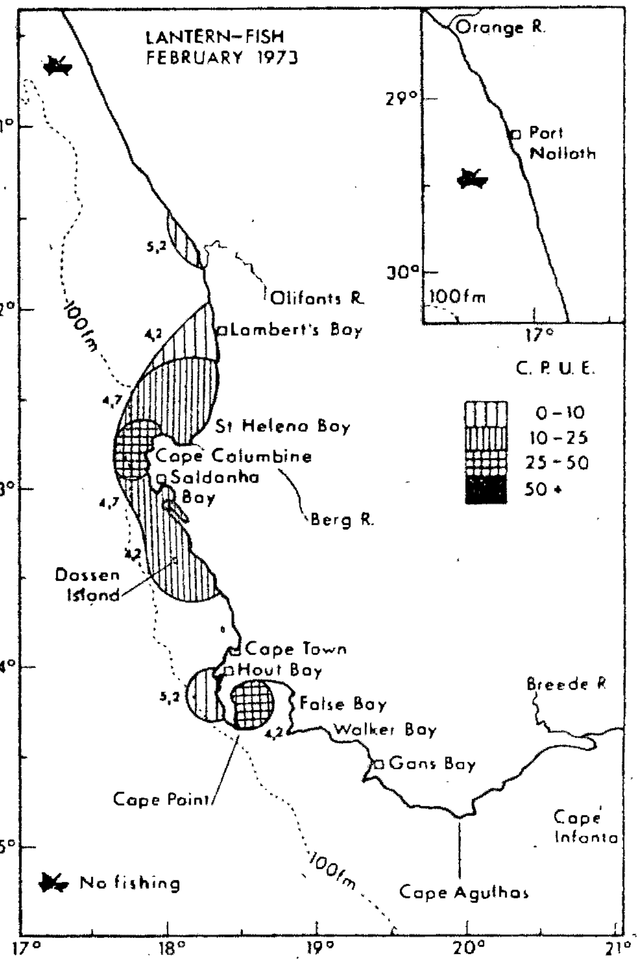

LANTERN - FISH
MAY 1972
Orange R.
Port Nolloth
100fm
C. P. U. E.
0 - 10
10 - 25
25 - 50
50 +
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
100fm

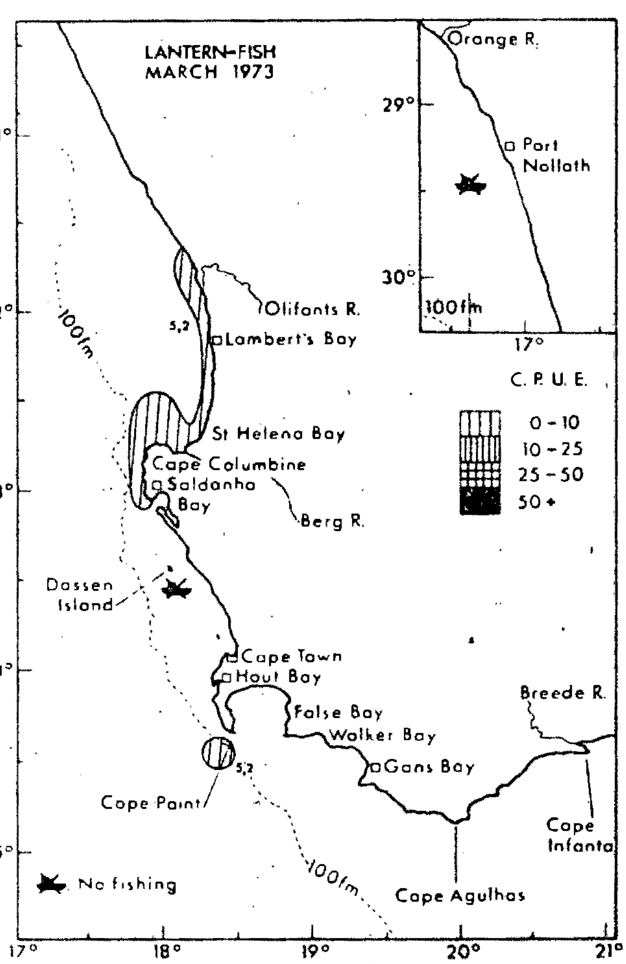

LANTERN - FISH
JUNE 1972
Orange R.
Port Nolloth
100fm
C. P. U. E.
0 - 10
10 - 25
25 - 50
50 +
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
100fm


LANTERN - FISH
JULY 1972
Orange R.
Port Nolloth
100fm
C. P. U. E.
0 - 10
10 - 25
25 - 50
50 +
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
100fm


LANTERN - FISH
AUGUST 1972
Orange R.
Port Nolloth
100fm
C. P. U. E.
Adults
0 - 10
10 - 25
25 - 50
50 +
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
100fm


LANTERN-FISH
JANUARY 1973
Orange R.
29°
Port
Nolloth
30°
100fm
17°
C. P. U. E.
0 - 10
10 - 25
25 - 50
50 +
31°
32°
33°
34°
35°
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha
Bay
Berg R.
Dassen
Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape
Infanta
Cape Point
Cape Agulhas
100fm
4,7
No fishing
18°
19°
20°
21°


LANTERN-FISH
FEBRUARY 1973
Orange R.
29°
Port
Nolloth
30°
100fm
17°
C. P. U. E.
0 - 10
10 - 25
25 - 50
50 +
31°
32°
33°
34°
35°
5,2
4,2
4,7
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha
Bay
Berg R.
Dassen
Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape
Infanta
Cape Point
Cape Agulhas
100fm
No fishing
17°
18°
19°
20°
21°


LANTERN-FISH
MARCH 1973
Orange R.
29°
Port
Nolloth
30°
100fm
17°
C. P. U. E.
0 - 10
10 - 25
25 - 50
50 +
31°
32°
33°
34°
35°
5,2
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha
Bay
Berg R.
Dassen
Island
Cape Town
Hout Bay
False Bay
Walker Bay
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Infanta
Cape Point
Cape Agulhas
100fm
No fishing
17°
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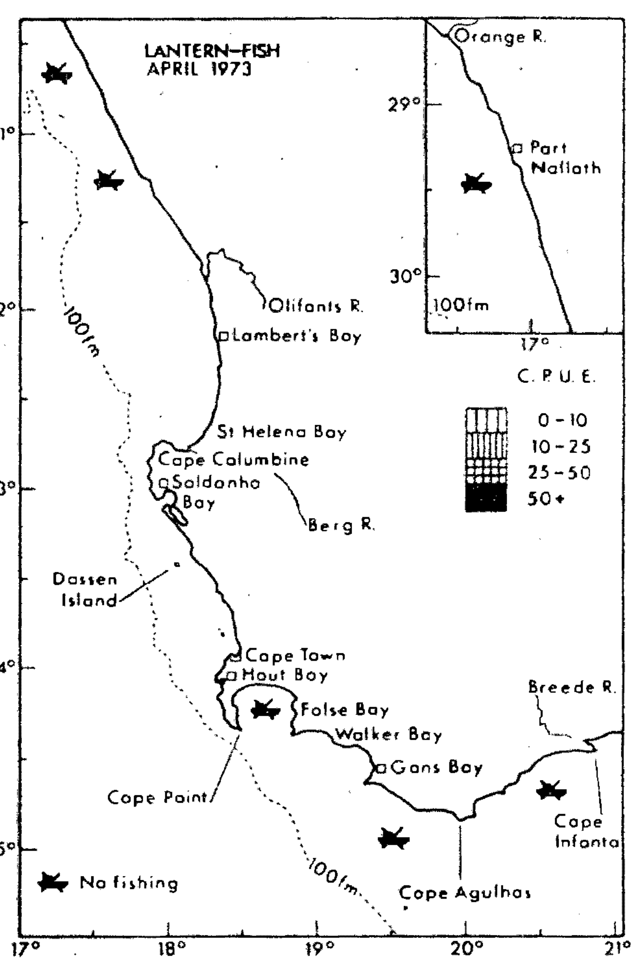
LANTERN-FISH
APRIL 1973
Orange R.
29°
Port
Nolloth
30°
100fm
17°
C. P. U. E.
0 - 10
10 - 25
25 - 50
50 +
31°
32°
33°
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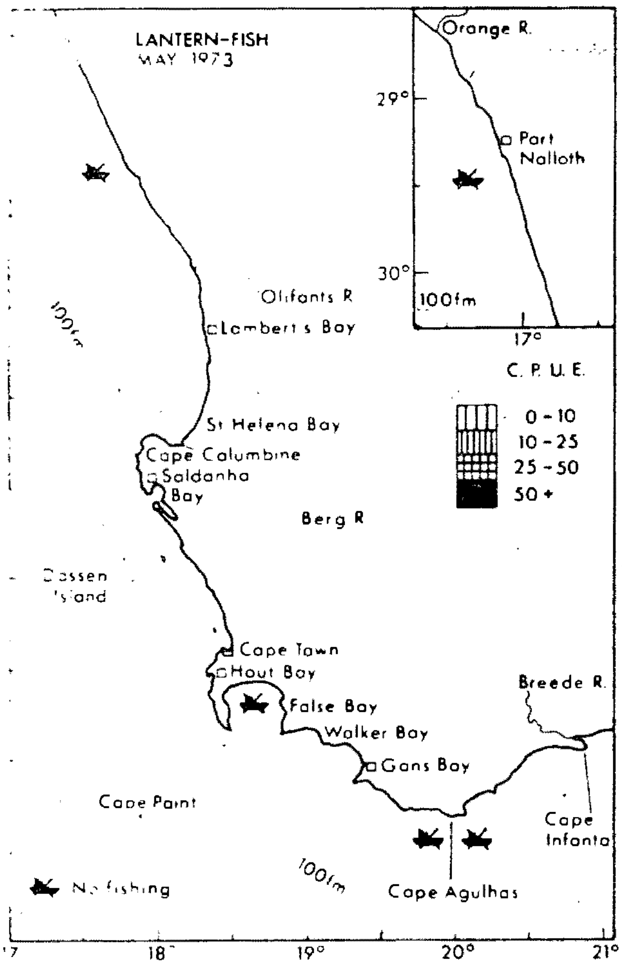
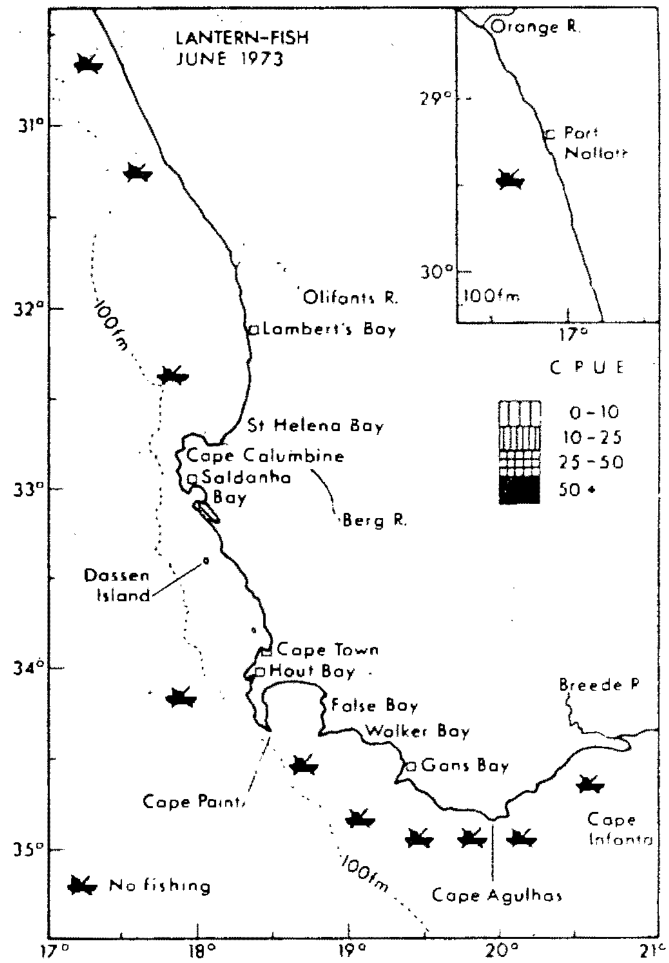
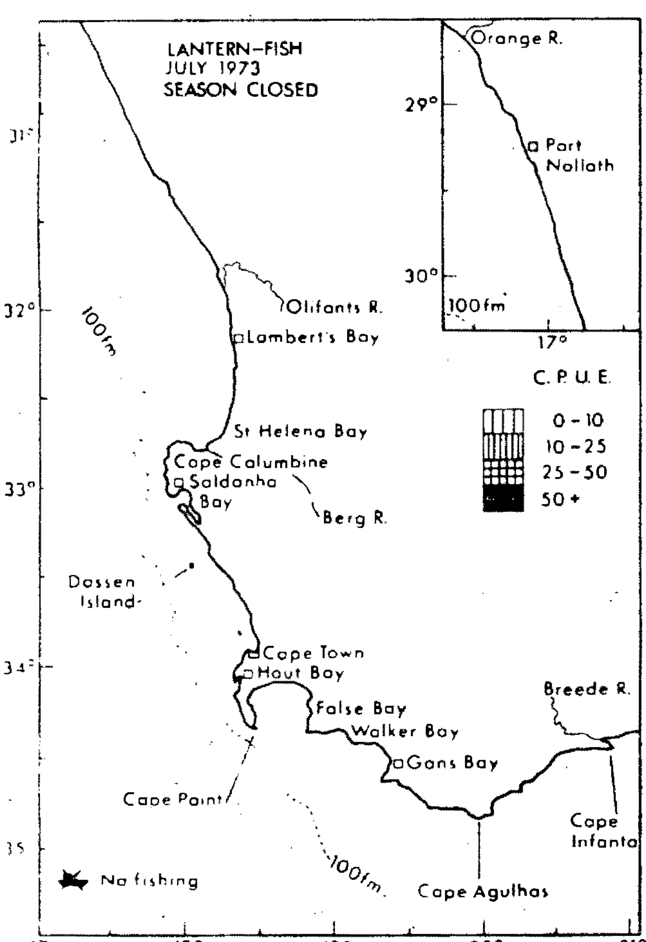
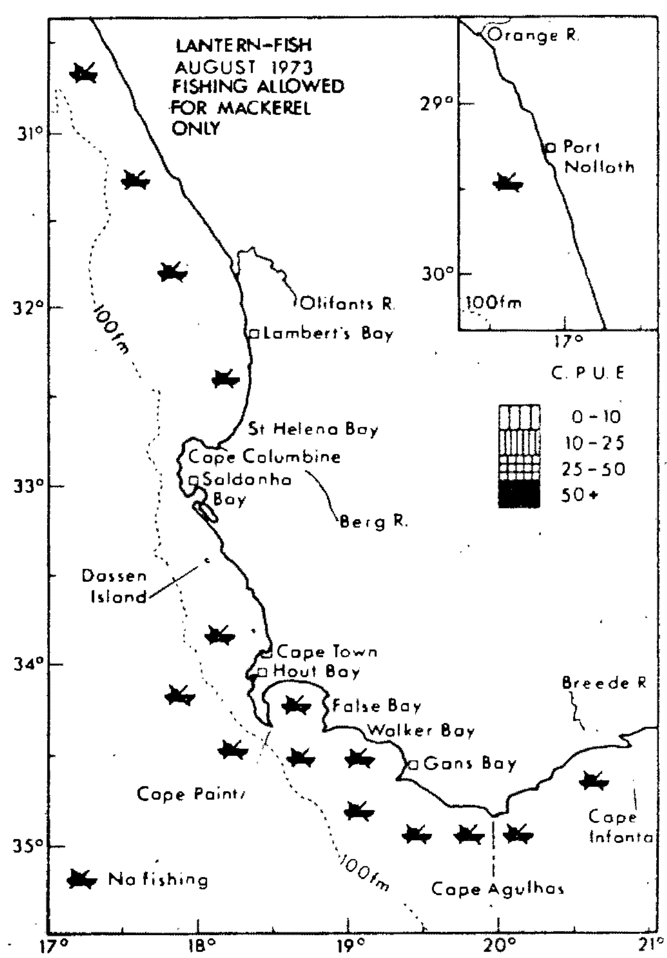
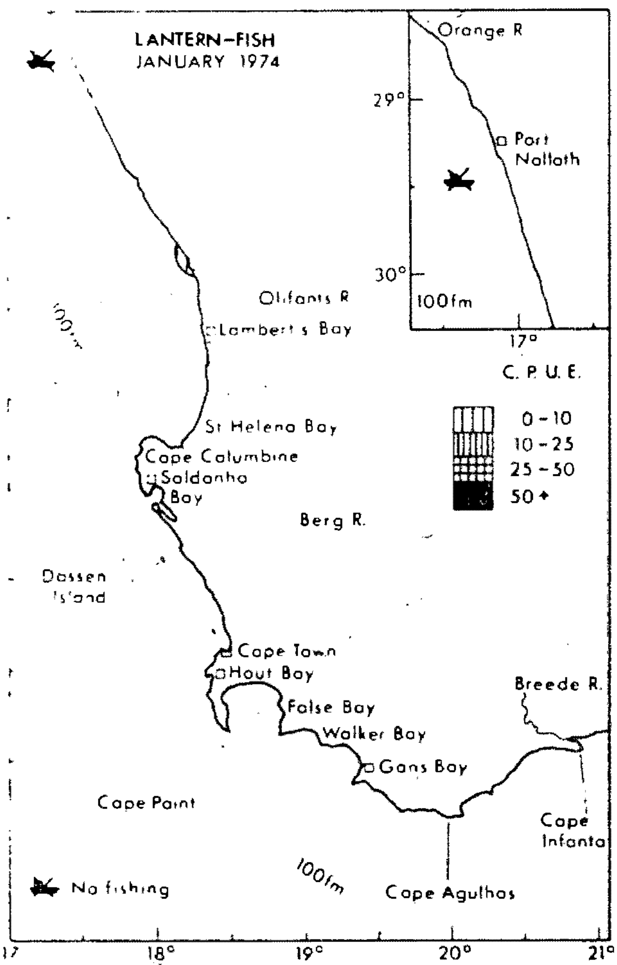
35°
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha
Bay
Berg R.
Dassen
Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape
Infanta
Cape Point
Cape Agulhas
100fm
No fishing
17°
18°
19°
20°
21°

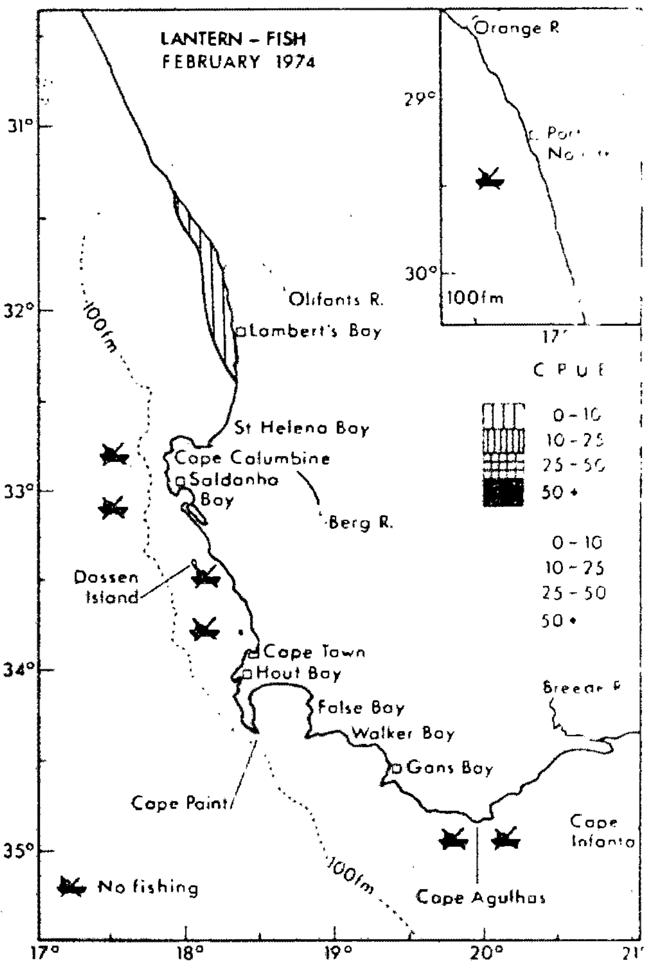

LANTERN-FISH
MAY 1973
Orange R.
29°
Port
Nolloth
30°
100fm
17°
C. P. U. E.
0 - 10
10 - 25
25 - 50
50 +
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha
Bay
Berg R
Dassen
Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape
Infanta
100fm
No fishing
Cape Agulhas
18°
19°
20°
21°

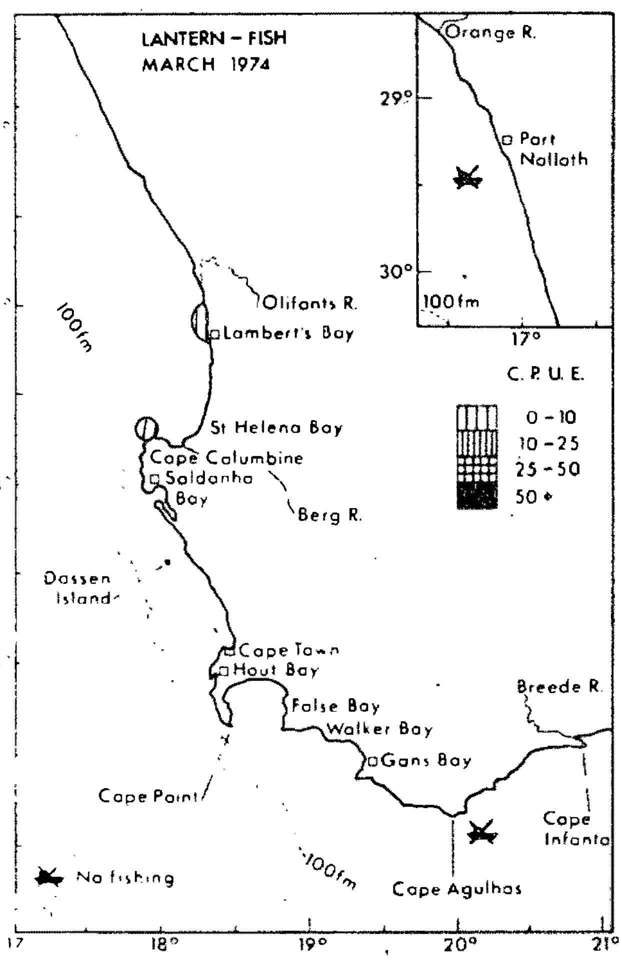

LANTERN-FISH
JUNE 1973
Orange R.
29°
Port
Nolloth
30°
100fm
17°
C P U E
0 - 10
10 - 25
25 - 50
50 +
31°
32°
33°
34°
35°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha
Bay
Berg R.
Dassen
Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape
Infanta
100fm
No fishing
Cape Agulhas
17°
18°
19°
20°
21°

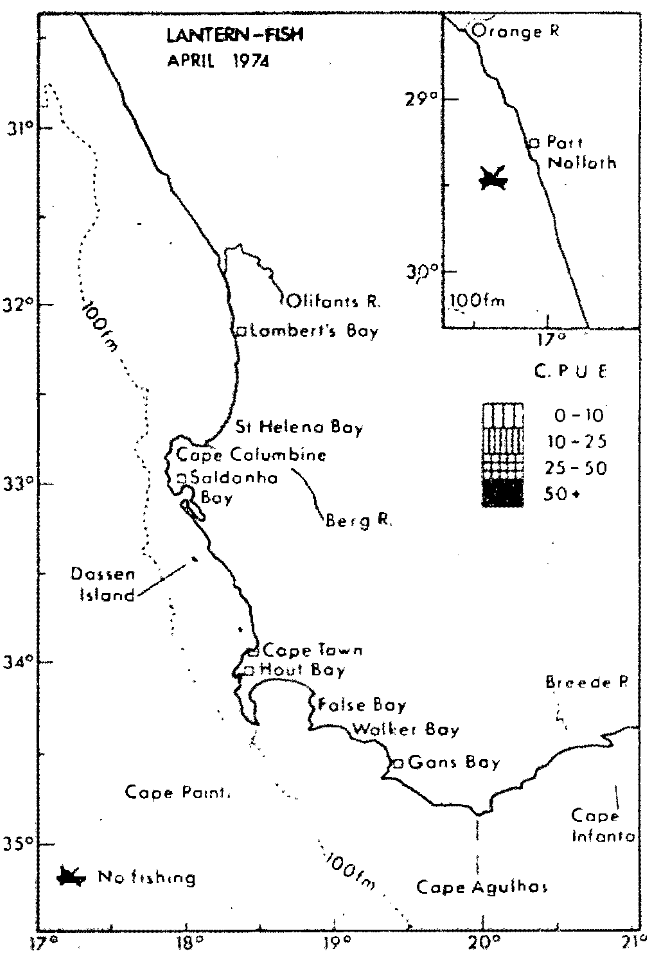

LANTERN-FISH
JULY 1973
SEASON CLOSED
Orange R.
29°
Port
Nolloth
30°
100fm
17°
C. P. U. E.
0 - 10
10 - 25
25 - 50
50 +
32°
33°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha
Bay
Berg R.
Dassen
Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape
Infanta
100fm
No fishing
Cape Agulhas
17
18°
19°
20°
21°

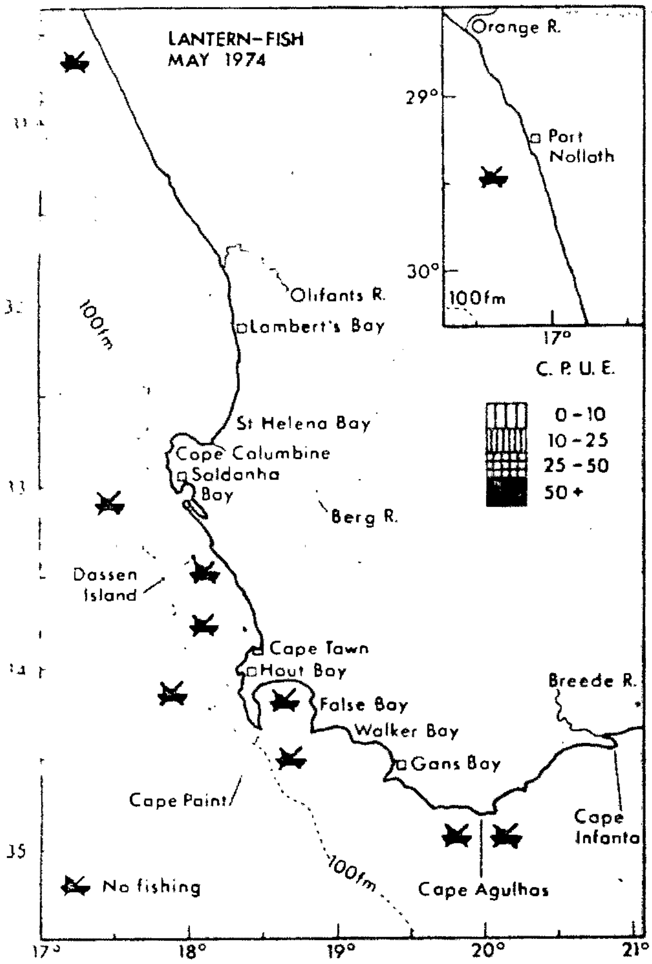

LANTERN-FISH
AUGUST 1973
FISHING ALLOWED
FOR MACKEREL
ONLY
Orange R.
29°
Port
Nolloth
30°
100fm
17°
C. P. U. E
0 - 10
10 - 25
25 - 50
50 +
31°
32°
33°
34°
35°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha
Bay
Berg R.
Dassen
Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R
Cape Point
Cape
Infanta
100fm
No fishing
Cape Agulhas
17°
18°
19°
20°
21°

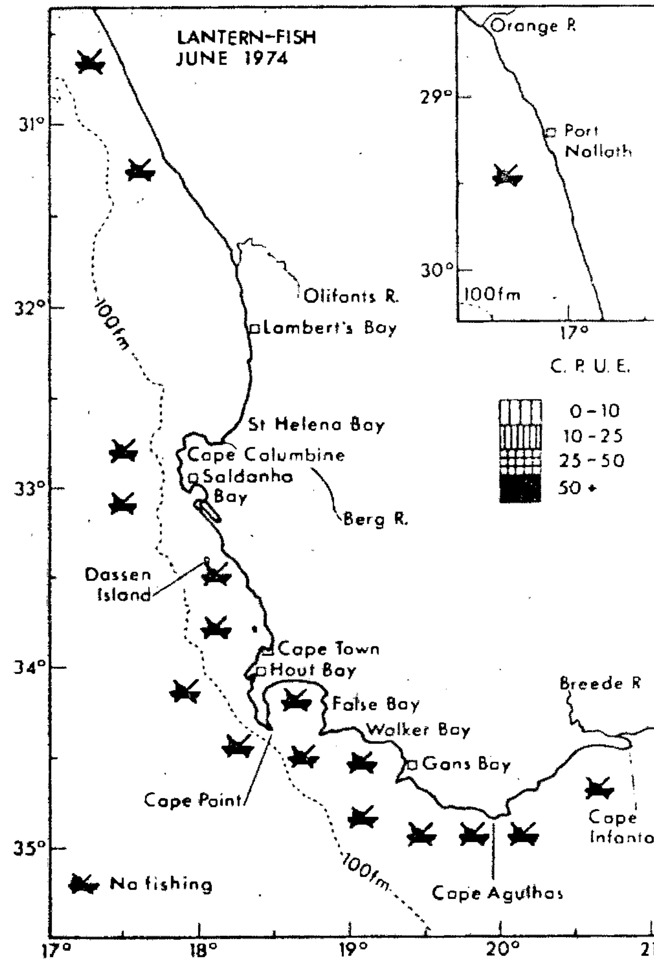

LANTERN-FISH
JANUARY 1974
Orange R
29°
Port
Nolloth
30°
100fm
17°
C. P. U. E.
0 - 10
10 - 25
25 - 50
50 +
Olifants R
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha
Bay
Berg R.
Dassen
Island
Cape Town
Hout Bay
False Bay
Walker Bay
Breede R.
Gans Bay
Cape Point
Cape
Infanta
100fm
Cape Agulhas
No fishing
18°
19°
20°
21°

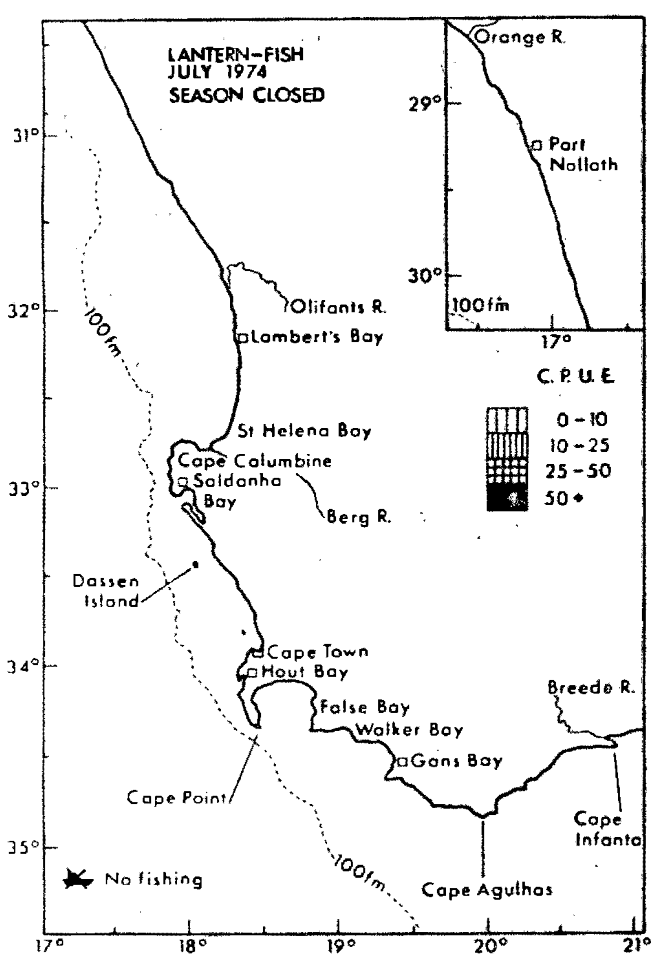

LANTERN - FISH
FEBRUARY 1974
Orange R
29°
30°
100fm
31°
32°
33°
34°
35°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha
Bay
Berg R.
C P U E
0 - 10
10 - 25
25 - 50
50 +
Dassen
Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Cape Point
Cape
Infanta
100fm
Cape Agulhas
No fishing
17°
18°
19°
20°

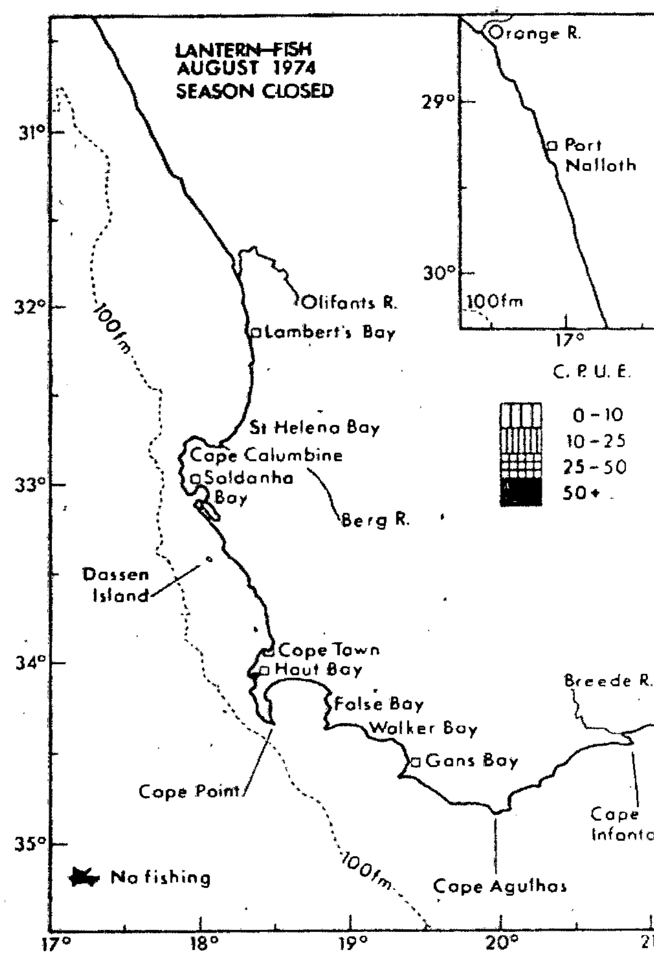

LANTERN - FISH
MARCH 1974
Orange R.
29°
Port
Nolloth
30°
100fm
17°
C. P. U. E.
0 - 10
10 - 25
25 - 50
50 +
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha
Bay
Berg R.
Dassen
Island
Cape Town
Hout Bay
False Bay
Walker Bay
Breede R.
Gans Bay
Cape Point
Cape
Infanta
100fm
Cape Agulhas
No fishing
18°
19°
20°
21°

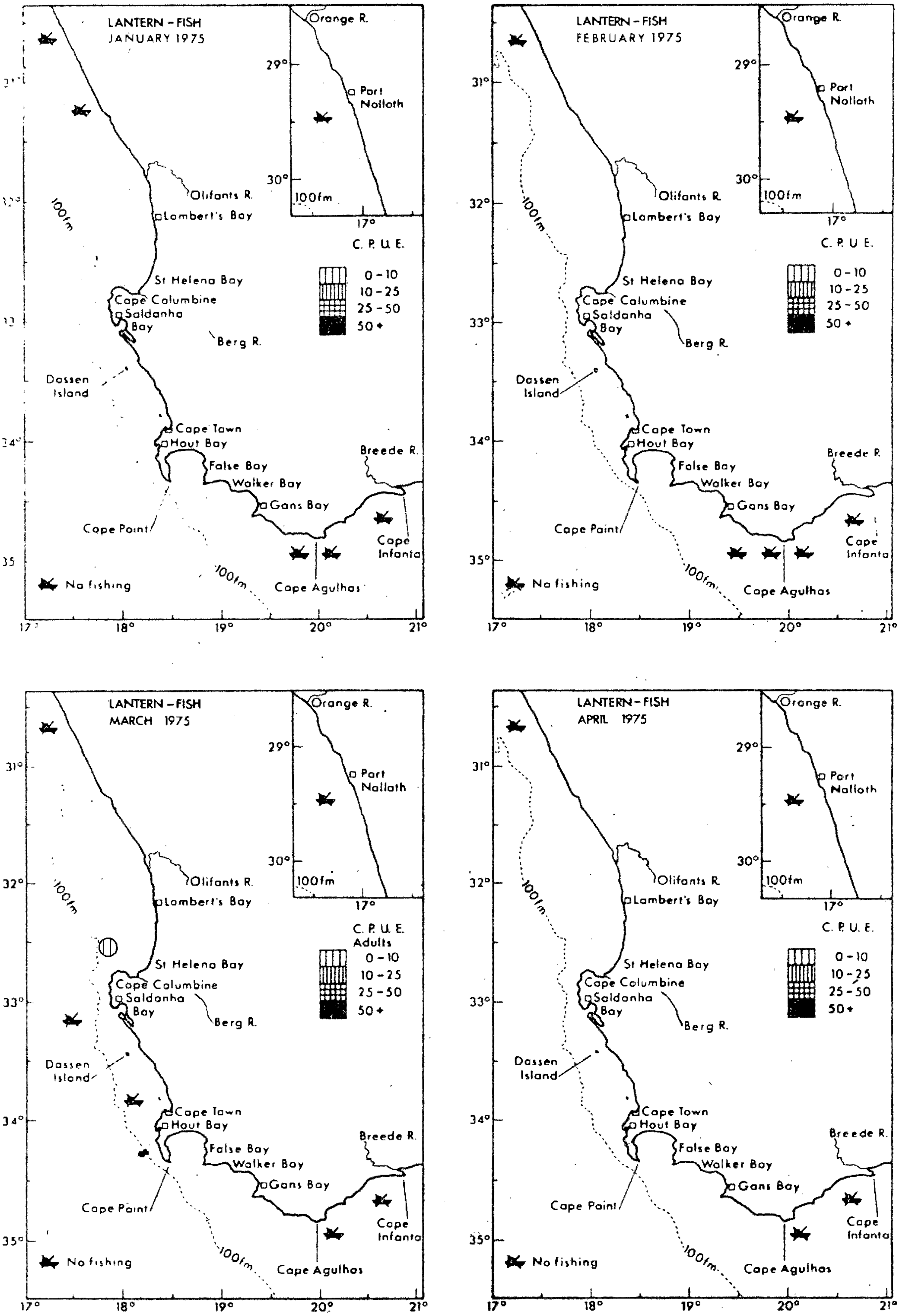

LANTERN-FISH
APRIL 1974
Orange R
29°
Port
Nolloth
30°
100fm
17°
C. P U E
0 - 10
10 - 25
25 - 50
50 +
31°
32°
33°
34°
35°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha
Bay
Berg R.
Dassen
Island
Cape Town
Hout Bay
False Bay
Walker Bay
Breede R
Gans Bay
Cape Point.
Cape
Infanta
100fm
Cape Agulhas
No fishing
17°
18°
19°
20°
21°


LANTERN-FISH
MAY 1974
Orange R.
29°
Port Nolloth
30°
100fm
17°
C. P. U. E.
0 - 10
10 - 25
25 - 50
50 +
Olifants R.
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Breede R.
Gans Bay
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
35
17°
18°
19°
20°
21°


LANTERN-FISH
JUNE 1974
Orange R.
29°
Port Nolloth
30°
100fm
17°
C. P. U. E.
0 - 10
10 - 25
25 - 50
50 +
31°
32°
33°
34°
35°
Olifants R.
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Breede R
Gans Bay
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
17°
18°
19°
20°
21°


LANTERN-FISH
JULY 1974
SEASON CLOSED
Orange R.
29°
Port Nolloth
30°
100fm
17°
C. P. U. E.
0 - 10
10 - 25
25 - 50
50 +
31°
32°
33°
34°
35°
Olifants R.
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Breede R.
Gans Bay
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
17°
18°
19°
20°
21°


LANTERN-FISH
AUGUST 1974
SEASON CLOSED
Orange R.
29°
Port Nolloth
30°
100fm
17°
C. P. U. E.
0 - 10
10 - 25
25 - 50
50 +
31°
32°
33°
34°
35°
Olifants R.
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Breede R.
Gans Bay
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
17°
18°
19°
20°
21°


LANTERN - FISH
JANUARY 1975
LANTERN - FISH
FEBRUARY 1975
LANTERN - FISH
MARCH 1975
LANTERN - FISH
APRIL 1975
Orange R.
Port Nolloth
100fm
C. P. U. E.
C. P. U. E. Adults
0 - 10
10 - 25
25 - 50
50 +
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
Cape Agulhas
No fishing
100fm
17°
18°
19°
20°
21°
29°
30°
31°
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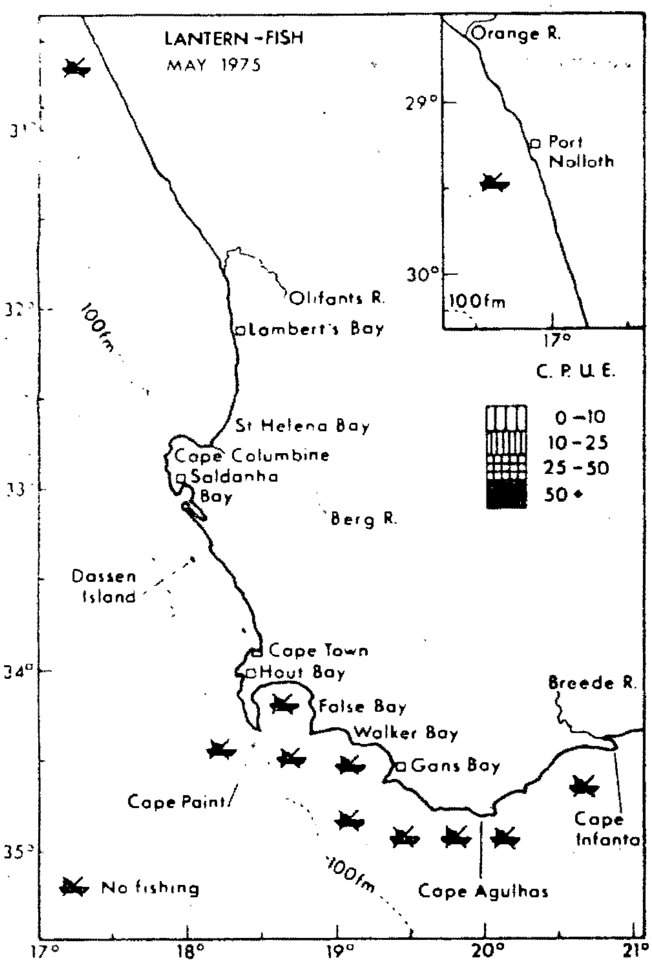
34°
35°


LANTERN-FISH
MAY 1975
Orange R.
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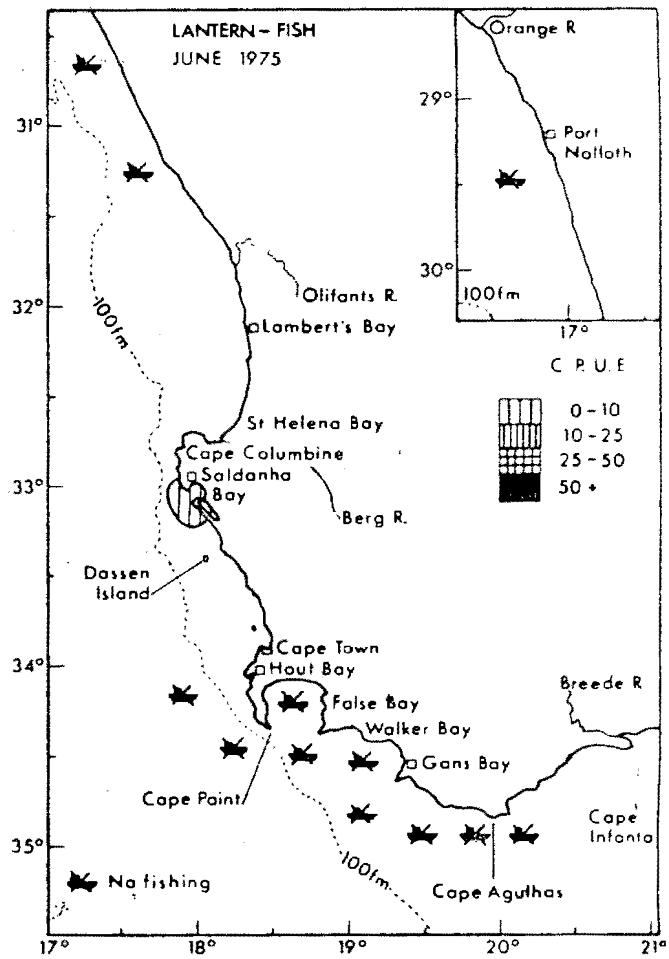
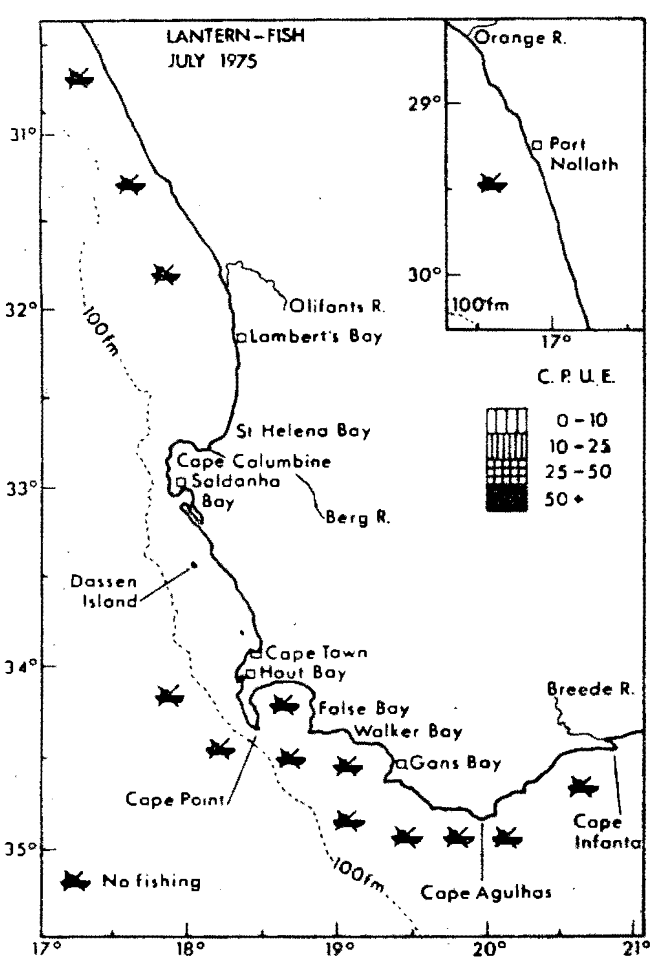
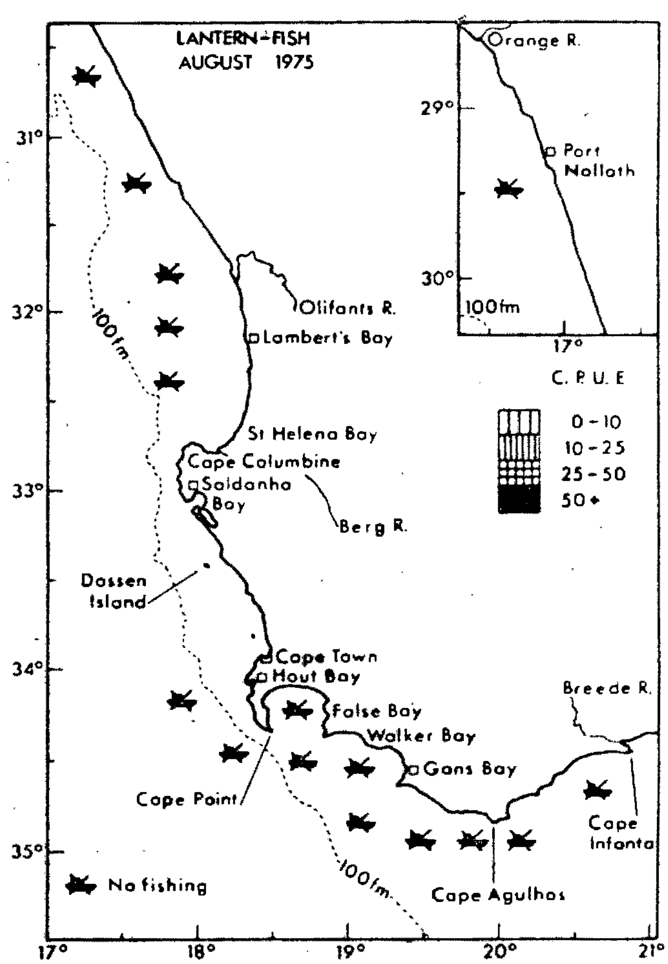
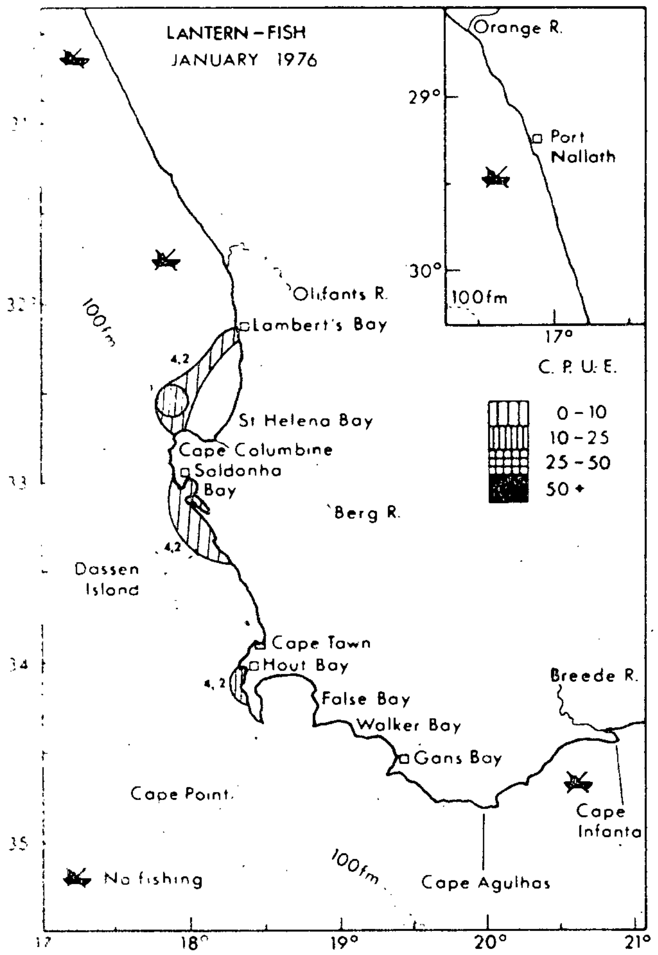
Port Nolloth
30°
100fm
17°
C. P. U. E.
0-10
10-25
25-50
50+
Olifants R.
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
Gans Bay
Breede R.
Cape Point
Cape Infanta
No fishing
100fm
Cape Agulhas
34°
17°
18°
19°
20°
21°


LANTERN-FISH
JUNE 1975
Orange R
29°
Port Nolloth
30°
100fm
17°
C. P. U. E
0-10
10-25
25-50
50+
31°
Olifants R
32°
Lambert's Bay
100fm
St Helena Bay
Cape Columbine
Saldanha Bay
33°
Berg R.
Dassen Island
Cape Town
Hout Bay
34°
False Bay
Breede R
Walker Bay
Gans Bay
Cape Point
Cape Infanta
35°
No fishing
100fm
Cape Agulhas
17°
18°
19°
20°
21°


LANTERN-FISH
JULY 1975
Orange R.
29°
Port Nolloth
31°
30°
100fm
Olifants R.
32°
Lambert's Bay
17°
100fm
C. P. U. E.
0-10
10-25
25-50
50+
St Helena Bay
Cape Columbine
Saldanha Bay
33°
Berg R.
Dassen Island
Cape Town
Hout Bay
34°
False Bay
Breede R.
Walker Bay
Gans Bay
Cape Point
Cape Infanta
35°
No fishing
100fm
Cape Agulhas
17°
18°
19°
20°
21°


LANTERN-FISH
AUGUST 1975
Orange R.
29°
Port Nolloth
31°
30°
100fm
Olifants R.
32°
Lambert's Bay
100fm
17°
C. P. U. E
0-10
10-25
25-50
50+
St Helena Bay
Cape Columbine
Saldanha Bay
33°
Berg R.
Dassen Island
Cape Town
Hout Bay
34°
Breede R.
False Bay
Walker Bay
Gans Bay
Cape Point
Cape Infanta
35°
No fishing
100fm
Cape Agulhas
17°
18°
19°
20°
21°


LANTERN – FISH
JANUARY 1976
Orange R.
29°
Port Nollath
30°
100fm
17°
C. P. U. E.
0 – 10
10 – 25
25 – 50
50 +
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
False Bay
Walker Bay
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Cape Point
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Cape Agulhas
100fm
No fishing
18°
19°
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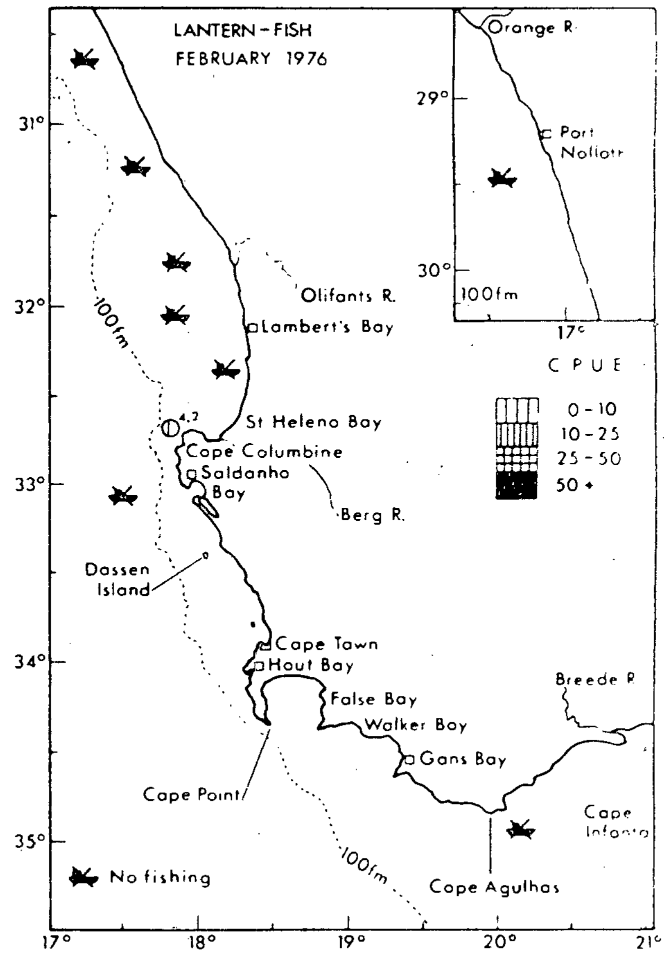
21°


LANTERN – FISH
FEBRUARY 1976
Orange R.
29°
Port Nolloth
30°
100fm
17°
C P U E
0 – 10
10 – 25
25 – 50
50 +
31°
32°
33°
34°
35°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
Dassen Island
Cape Town
Hout Bay
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Walker Bay
Gans Bay
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Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
17°
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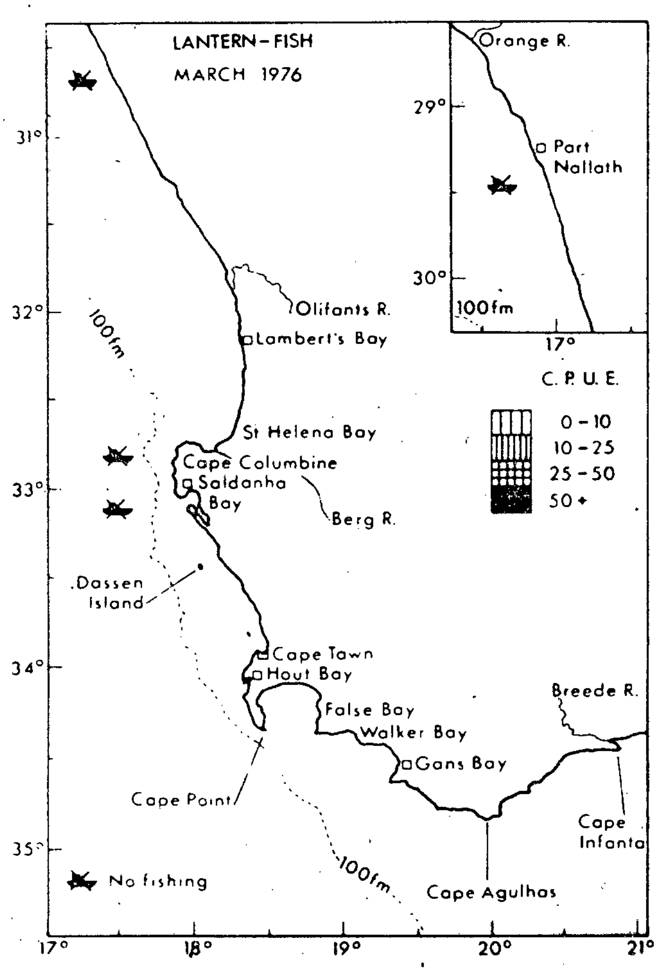
LANTERN – FISH
MARCH 1976
Orange R.
29°
Port Nollath
30°
100fm
17°
C. P. U. E.
0 – 10
10 – 25
25 – 50
50 +
31°
32°
33°
34°
35°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
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Cape Town
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Breede R.
Cape Point
Cape Infanta
Cape Agulhas
100fm
No fishing
17°
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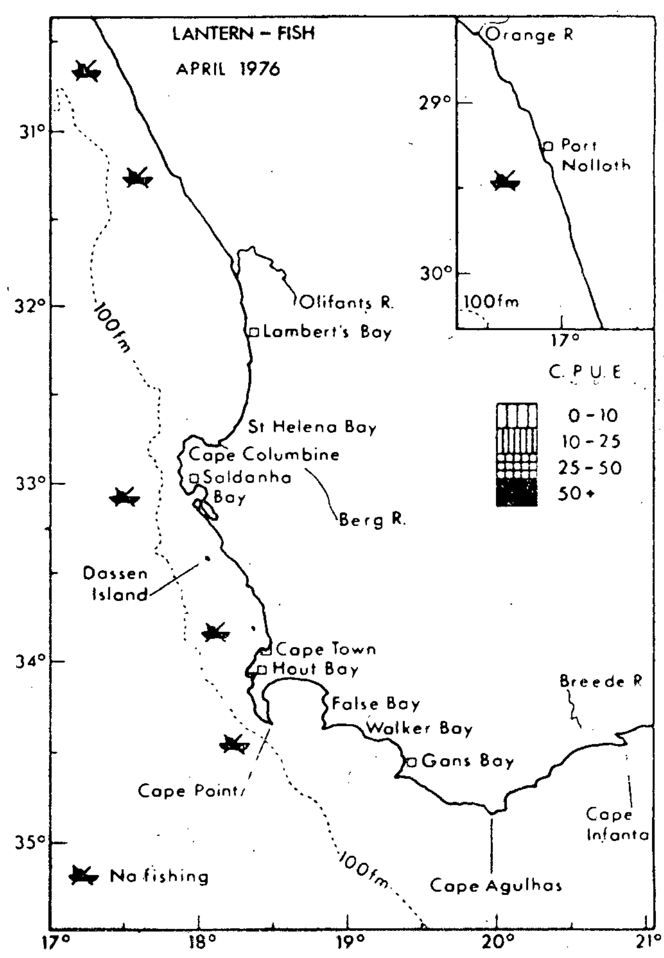
LANTERN – FISH
APRIL 1976
Orange R
29°
Port Nolloth
30°
100fm
17°
C. P. U. E
0 – 10
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25 – 50
50 +
31°
32°
33°
34°
35°
100fm
Olifants R.
Lambert's Bay
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
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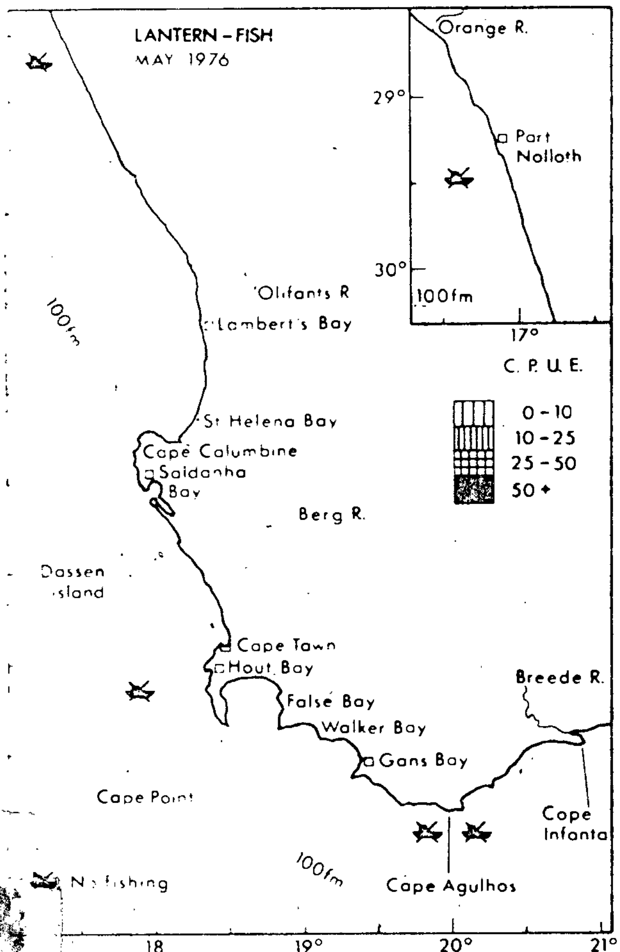
LANTERN-FISH
MAY 1976
Orange R.
Port Nolloth
29°
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100fm
17°
Olifants R
Lambert's Bay
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Cape Infanta
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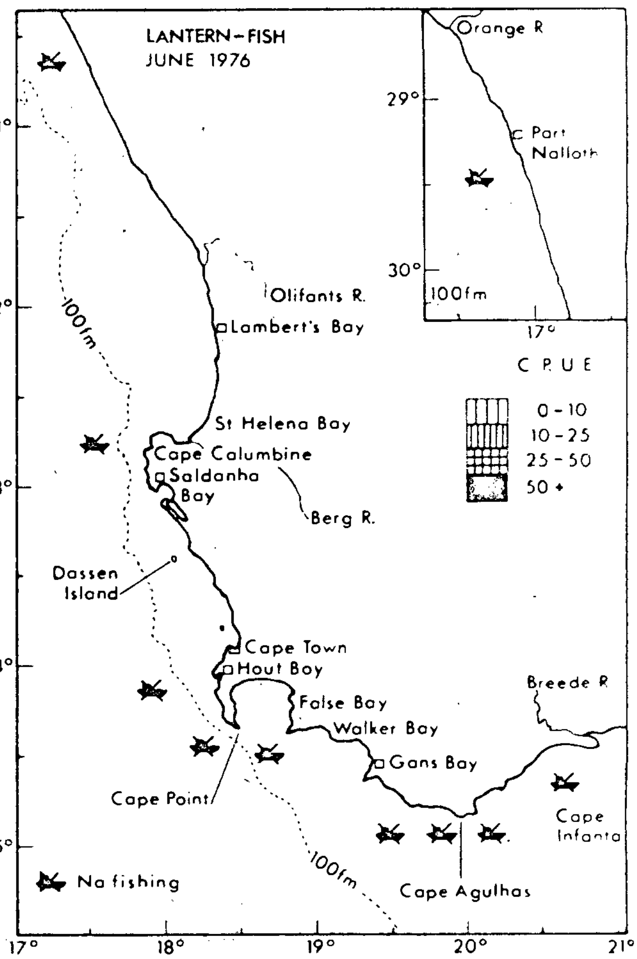
LANTERN-FISH
JUNE 1976
Orange R
Port Nolloth
29°
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100fm
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Olifants R.
Lambert's Bay
C. P. U. E
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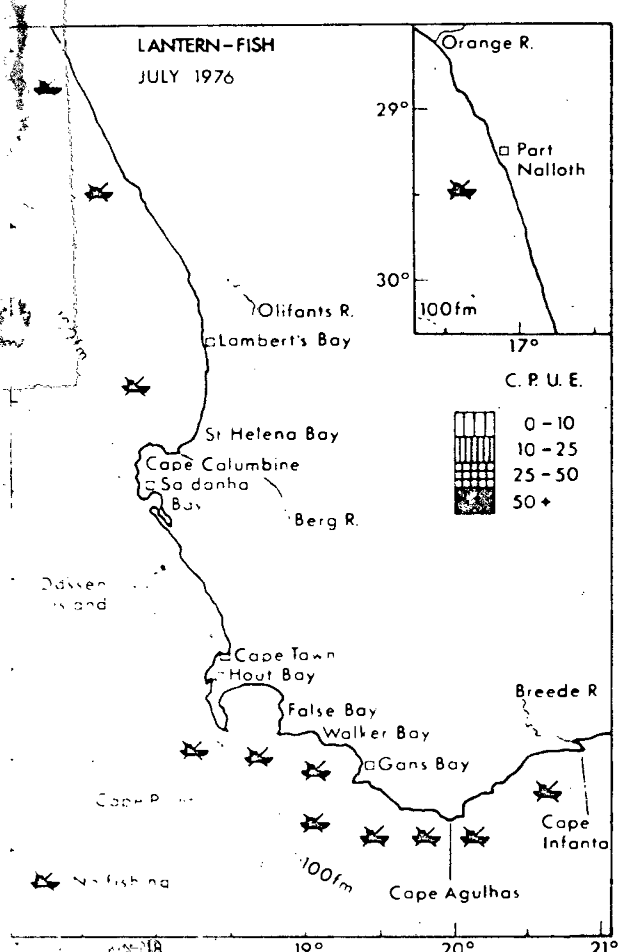
LANTERN-FISH
JULY 1976
Orange R.
Port Nolloth
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Olifants R.
Lambert's Bay
C. P. U. E.
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Walker Bay
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Cape Infanta
Cape Agulhas
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19°
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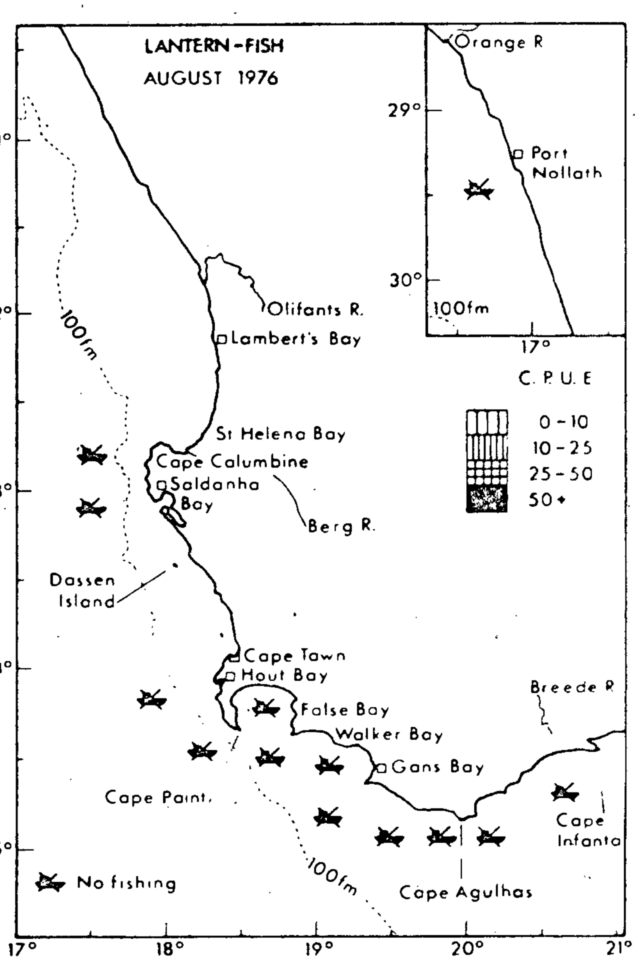
LANTERN-FISH
AUGUST 1976
Orange R
Port Nollath
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30°
100fm
17°
31°
32°
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34°
35°
Olifants R.
Lambert's Bay
C. P. U. E
0-10
10-25
25-50
50+
St Helena Bay
Cape Columbine
Saldanha Bay
Berg R.
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Hout Bay
False Bay
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Cape Point
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No fishing
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