THE EFFECTS OF RECREATIONAL ACTIVITIES ON AQUATIC AVIFAUNA

by

B.W. ROWLANDS

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ABSTRACT

The Rietvlei wetland system, 10 km north of Cape Town, South Africa, supports 158 species of birds (Winterbottom,1960), and is the principal wetland for breeding waterbird numbers in the south-western Cape Province.

It is an important collection, pairing and distribution centre prior to the breeding season. Emerging mudflats during evaporation in late summer are a major gathering point for waders before migratory departure.

Increasing human pressure on open spaces is threatening this natural habitat of aquatic birds. For future waterbird conservation it is necessary to ascertain the impact of recreation and human disturbance in this area.

Recreational activities on the northern of two dredged lakes in the north-western corner of Rietvlei are therefore examined to investigate possible causal relationships between recreational activity and the numbers and behaviour of aquatic avifauna.

Counts of waterbirds were carried out in the presence of people involved with various forms of recreational activity. These observations were made between February and May 1983. As a null hypothesis it is proposed that recreational activities on this lake and wetland system do not have a significant effect upon water birds in the area. The method used

to test this hypothesis is based on statistical analysis by computer, with disturbance measured by means of correlation coefficients between recreational activities and bird numbers.

The major findings (Chapter 5) and subsequent recommendations (Chapter 6) for waterbird conservation on the Rietvlei dredged lakes are presented, and proposals for further research in this field are suggested.

PREFACE

Although research into the effects of recreation upon avifauna has been carried out (e.g. de Roos & Schaafsma, 1981), this has tended to focus upon increasing human use of the coastal zone as a current major source of disturbance, while the effects of recreation on birds in the wetland environment is a virtually unexplored field.

The research work described in this thesis was carried out under the auspices of the School of Environmental Studies, University of Cape Town, from February to May 1983, under the supervision of Dr D. Hey and Professor J.R. Grindley.

This study represents original work by the author and has not been submitted in any form to another University. Where assistance was afforded by others it has been duly acknowledged in the text.

CONTENTS

CHAPTER 1

INTRODUCTION

1.1 RATIONALE AND OBJECTIVES

Many bird populations and their characteristic habitats are threatened (de Roos, 1981), by increasing human demands (e.g. recreation) upon the natural environment. Man, in his recreational pursuits, is beginning to threaten many ecosystems. Here, we are concerned with a particular pattern of recreation in a specific wetland ecosystem where aquatic birds are an important component.

Some appropriate measure to moderate the impact of recreation on water birds is desirable. Unless firm controls are introduced adverse changes to bird populations are liable to occur, and many species may leave the area.

An attitudinal change by society is required in which values regarding the need to coexist with the natural environment are needed. It is also important that mankind's collective needs, and resources, be given more weight than the selfish needs of individuals.

The northern of two dredged lakes in the north-western corner of the

Rietvlei wetland system (Section 2.1) north of Cape Town, South Africa, was selected as the area of study. This area serves as a feeding and resting site for large numbers of waterbirds, including marine species, many of which are migrants. In addition, this North Lake, being a permanent water body, attracts at times up to 300 aquatic sports enthusiasts and visitors. Recreational activities such as powerboating, yachting and boardsailing increase over weekends and holidays. The Milnerton Aquatic Club, established at the lake in 1976, has 108 active members, mainly from the northern suburbs.

Above all, the importance of the Rietvlei system as a whole was recognized by the state when an interim committee was appointed by the Minister of Environment Affairs to submit recommendations on the future use and management of the area, a large portion of which is in private ownership.

The study attempts as its ultimate goal to make a contribution to a body of knowledge which deals with the effect various forms of human activities such as recreation can have on aquatic avifauna.

In summary, the above goal can be translated into major objectives; these are as follows:

a) To analyse the effect of recreational activity on aquatic avifauna numbers.
b) To formulate and test an hypothesis through the use of statistical methods.
c) To analyse the effects of recreational activity on the distance at which aquatic birds are disturbed.

d) To describe these effects in quantitative terms.

e) To present the material and data collected in the form of a structured document which could be used by various institutions, both public and private.

f) To make specific recommendations based on the results of the study.

g) To outline what further research is necessary.

As a point of departure, the study attempts to test the following hypotheses:

1.1.1 The Null Hypothesis (H_0)

Recreational activities on this lake and wetland system do not have a significant effect upon waterbirds in the area.

1.1.2 The Alternative Hypothesis (H_1)

Recreational activities on this lake and wetland system indeed have a significant effect upon waterbirds in the area.

1.2 A BRIEF ACCOUNT OF RECREATION IN THE AREA

1.2.1 Rietvlei as a System

1.2.1.1 A general description of the Rietvlei wetland system as a whole, including certain recreational activities, appears in Appendix A.

1.2.1.2 An account of the importance of the Rietvlei wetland system as a habitat for birds, and types of species found, is given in Appendix B.

1.2.1.3 A general description of the dredged lakes follows in Appendix C.

1.2.2 Recreation Around the Dredged Lakes

The dredged North and South Lakes are presently under the control of the Management Committee of the Milnerton Aquatic Club, whose aims are the fostering of aquatic activities with a strong conservation emphasis. Permission has been obtained by the Club's conservation committee to exercise control of both lakes. While regular users are invited to join the club the public are admitted to the club area for a prescribed daily fee.

Rules and by-laws for the lakes have been drawn up by the club; conservation and fishing regulations appear in Appendix D. Jurisdiction of the club also covers a thin strip of shoreline around both lakes. To the north lies a fairly elevated open flat area, utilised by scrambler (motocross) motorcyclists. On one Sunday morning ten machines were active on well-worn tracks. This area was subsequently flooded during the rains.

The following is a more specific discussion of recreational activity and other disturbance observed at the North Lake.

1.2.3 Observed Recreational Activities

1.2.3.1 Sailboards

This sport is increasing in popularity (Phillip, 1982). Comapred with yachts, sailboards are cheaper to purchase and maintain; while simple to transport and assemble, their use is virtually cost-free as no fuel is required. Sailboards were more readily found at a given time in the week and were hence observed for longer periods. Although a single powerboat can comparatively create far more disturbance, sailboards collectively outnumber powerboats and so their effects are considerable. In addition, compared with yachts, sailboards follow a more erratic course and flop over more readily. The user, on his feet and large in proportion to his craft, is very conspicuous to birds.

1.2.3.2 Yachts

Although on the water for longer periods than powerboats, yachts were observed to create minimal disturbance. Unlike sailboards, they tend to follow a set course, do not capsize as readily and are larger in relation to their crew. More bulky to handle on shore, yachts occurred less often through the week. Crewmen tend to sit low and are hence not so conspicuous to birds, which were seen to merely move aside, or dive briefly, when a yacht passed.

1.2.3.3 Powerboats

For observation purposes, this noisy form of recreation was sub-divided

into three groups: stationary powerboats with people, powerboats in motion and powerboats towing waterskiers. It was observed that powerboats, unless towing waterskiers, were less active than yachts or sailboards, perhaps because of fuel costs. On a day of heavy recreational activity, powerboats were seen to convey picnickers to barbecue sites along the southern and western shores. On arrival they were beached at the picnic site for the day, save for occasional "spins" or when towing skiers. They seldom entered the South Lake where a speed restriction of 5 kmh has been imposed to minimise wash. Powerboats are restricted to 20 kmh within 20 metres of the shore, but waterskiers are able to swing closer to the banks and thereby flush roosting birds. However, powerboats were few compared with sailboards, and unlike sailboards, may not be operated by any person under 16 years.

1.2.3.4 Jet-skis

This noisy aquatic sport was observed only on 7 and 8 April, during the autumn school/university holiday period. However, jet-skis were included in observations for powerboats in motion (Section 1.2.3.3) as their disturbance effect was similar.

1.2.3.5 Radio Speedboats

Also a very noisy form of recreation, in spite of their tiny size. Radio speedboats occurred only on 8 April. Only four craft were operated, just off the club grounds, but this area had already been vacated by birds following a large influx of visitors during the school holidays.

1.2.3.6 Canoes and Paddle-skis

These very rarely occurred, as they are not permitted on the North and South Lakes. Although not counted, their occupants were included in Section 1.2.3.10.

1.2.3.7 Divers

The clarity of the North Lake is conducive to diving. Instruction was given to a party of senior schoolchildren on 7 April and a group from the University of Cape Town Oceanography Department visited the club grounds on 10 May. Divers are included in Section 1.2.3.10.

1.2.3.8 Bathers

Swimming in the dredged lakes is not permitted. The North Lake is as much as 16 metres deep and the banks drop steeply. The few bathers observed (club grounds only) are included in Section 1.2.3.10.

1.2.3.9 Anglers

Angling is permitted (see Appendix D for the relevant rules) but fishing was very seldom observed. Anglers, who utilised the club's jetty (also the eastern point bar on 23 February), are included in Section 1.2.3.10. No fishing from boats took place.

1.2.3.10 Human Activity (Numbers of People)

This covers all other forms of recreation - picnickers, cyclists, bird-watchers (members of the Cape Bird Club's 1980-1985 Rietvlei counts teams), joggers, ramblers circling the lakes, a nudist sunbather, an occasional motorcyclist or horse-rider, and children. Visitors on heavy recreation days congregated at the club grounds, and at the barbecue sites along the west and south shores subject to the prevailing wind. Schoolchildren on bicycles passed through the club grounds or along the north shore on many weekday afternoons. Joggers, occasionally with dogs, occurred singly or in twos along the north side and in the motocross area. Horse-riders and motorcyclists moved along the west shore a few times, entering the area from the motocross site. The abovementioned sun-bather was a motorcyclist who arrived on the south shore via the dry marshlands to the south-east to take advantage of hot conditions (east winds) on 19 and 20 April, keeping the south-east roost (Section 2.1.1) deserted for some hours. People aboard craft are also included, as are Sections 1.2.3.6, 1.2.3.7, 1.2.3.8 and 1.2.3.9.

People, even when not occupied in recreational pursuits were counted. On the quietest count hours the only other person present was the club's caretaker, whose family occupied huts near the entrance gates. Occasional labourers, mainly from building sites at the neighbouring expanding township of Flamingo Vlei (part of Table View) and from the construction-site of the new SANCCOB (South African National Council for the Conservation of Coastal Birds) station north of the club passed through; one was observed washing trousers on the west side.

Deliverymen in commercial vehicles called at the club during the week, as did repairmen. A forestry officer from Malmesbury collected water samples. Club committee members also called occasionally on weekdays.

1.2.3.11 Dogs

Dogs are not permitted anywhere at the dredged lakes, but were brought into the club grounds. Unaccompanied animals, invariably from adjacent properties, ranged the shores of both lakes and took to the water, generating immediate disturbance. On 18 March a sailboard was followed by an Alsatian, which swam across to the west side, thereafter putting up roosts along the north shore. Fencing is inadequate; more notices prohibiting dogs are required. Animals exercised by joggers or picnickers were counted together with unaccompanied dogs.

1.2.3.12 Helicopters

Although not a recreational activity, these passed over from time to time and on the hour were counted as a disturbance factor. Flamingos were particularly sensitive (though not reacting on all occasions), circling the lake up to four times before resettling. Helicopters are the most disturbing of all transport (D. Hey, pers. comm.) (see Section 1.3.3).

1.2.3.13 Other Aircraft

These were counted in the same way as helicopters. Certain aircraft (usually military) emitted sound vibrations which flamingos could not tolerate at any time.

1.3 A REVIEW OF LITERATURE

1.3.1

Although water-, marsh- and sea-birds are sensitive to frequent disturbances, publications with exact information in this regard are scanty (de Roos, 1981). My major literary guideline here is G. de Roos (1981) who summarises research into the impact of tourism on breeding waders on the island of Vlieland in the Dutch Wadden islands, in which he notes the following:

1.3.1.1

Open water species such as the Great Crested Grebe (Podiceps cristatus) in the Netherlands have proved to be particularly sensitive to power-boats towing waterskiiers (Leys, 1966; de Zeeuw, 1968; Leys et al., 1971; van den Berg, 1974; de Zeeuw, 1976). The Grebe's main nesting season in the Netherlands is in May and June. Breeding success is rather low, although breeding pairs with five fully developed juveniles do occur, especially on isolated ponds and lakes (Leys et al., 1971). Such suitable sites would be disturbed by increased recreation and it is necessary to close a number of places in open water recreation areas to speedboats (Leys et al., 1971) otherwise the species will disappear completely from such areas. This species has, prior to the Second World War, suffered harassment from fishermen, who have destroyed nests and eggs.

1.3.1.2

The same phenomenon is mentioned by Reicholf (1974) along the "Inn"

in southern Germany, who also describes how the prohibition of power-boats in the Bight of the "Heitzing Eglsee" (sic) led to a doubling or tripling of the number of Mallard Duck females with young. The presence of anglers on the "Inn" (Hagenauer Bucht) greatly reduced the breeding success of waterbirds, which include the Great Crested Grebe Podiceps cristatus, Little Bittern Ixobrychus minutus, Night Heron Nycticorax nycticorax, Mute Swan Cygnus olor, the Mallard Duck Anas platyrhynchos, Teal Anas crecca, Shoveller Anas clypeata, the Tufted Duck Aythya fuligula, Pochard Aythya ferina, the Moorhen Gallinula chloropus and the Coot Fulica atra.

1.3.1.3

In Canada, Canada Geese (Branta canadensis) have been reported to desert their nest sites when disturbed by tourists prior to or during their breeding season (Hanson et al., 1971). On islands in the Columbia River experience of Hanson et al. showed that human disturbance materially reduced nesting, especially where repeated visits were made by pleasure boaters. In addition, the danger of fire was also related to such visits. Furthermore, shoreline hunting and fishing has displaced wintering waterfowl upriver. Hanson et al. noted that pleasure boaters have gradually driven the birds from most of the study area. During the brood-rearing season the birds moved into the Yakima River delta below Richland, where shallow waters restrict boat traffic.

1.3.1.4

Hansen et al. (1971) noted a significant difference in the mortality of

young Trumpeter Swans (Olor buccinator) in Alaska in areas of differing recreational pressure. The highest mortality was correlated with the highest degree of recreational activity. In the Copper Delta study area several tidal sloughs dissecting the area are navigable by small boats. Both commercial and sports fishermen were frequent visitors. People also travel the full length of a 32 km access road through the delta for photography, hiking, picnicking, hunting, target shooting and other recreational activities. Although the swans may not have been intentionally molested, the varied and more frequent level of human activity seems to have had a detrimental effect, compared to more isolated nesting areas. Moreover, a forced and rapid evacuation of cygnets from one body of water to another less secure from predators, through human intrusion, appeared to be the greatest factor leading to higher mortality rates. An exodus of broods from natal ponds was common when these areas were entered (Hanson et al., 1971).

1.3.1.5

Breeding Little Bitterns (Ixobrychus minutus) in the Netherlands have been observed to be very sensitive to boats and visitors near their nesting sites (Braaksma, 1968; de Zeeuw, 1968, 1976), whilst Purple Herons (Ardea purpurea) also exhibited sensitivity to increasing recreational pressure in their breeding grounds. In both cases it is powerboats which present the greatest threat. However, other cases may also be significant. In Belgium Little Bitterns have been trapped by fishermen. Certain losses may be caused by feral cats, traffic and electric wiring. Braaksma (1968) recommends that mowing and

burning of vegetation in marshland reserves be restricted. Cutting of trees and shrubs should be allowed only in selected parts so as to minimise the risk of disturbance in important breeding and feeding areas.

1.3.2

The lack of published data on recreation/disturbance on wetlands applies also in South Africa. Winterbottom (1960), however, following counts at various wetlands near Cape Town between 1952 and 1958, notes that the White Pelican (Pelecanus onocrotalus) at the Zeekoevlei system had decreased in numbers since the introduction of speedboats (see Appendix F).

1.3.3

It has been noted (Section 1.2.3.12) that following the 1982 Falklands War, British military helicopters stationed in the islands have been specifically routed away from seabird roost and breeding sites (Bound & Strange, 1983).

1.3.4

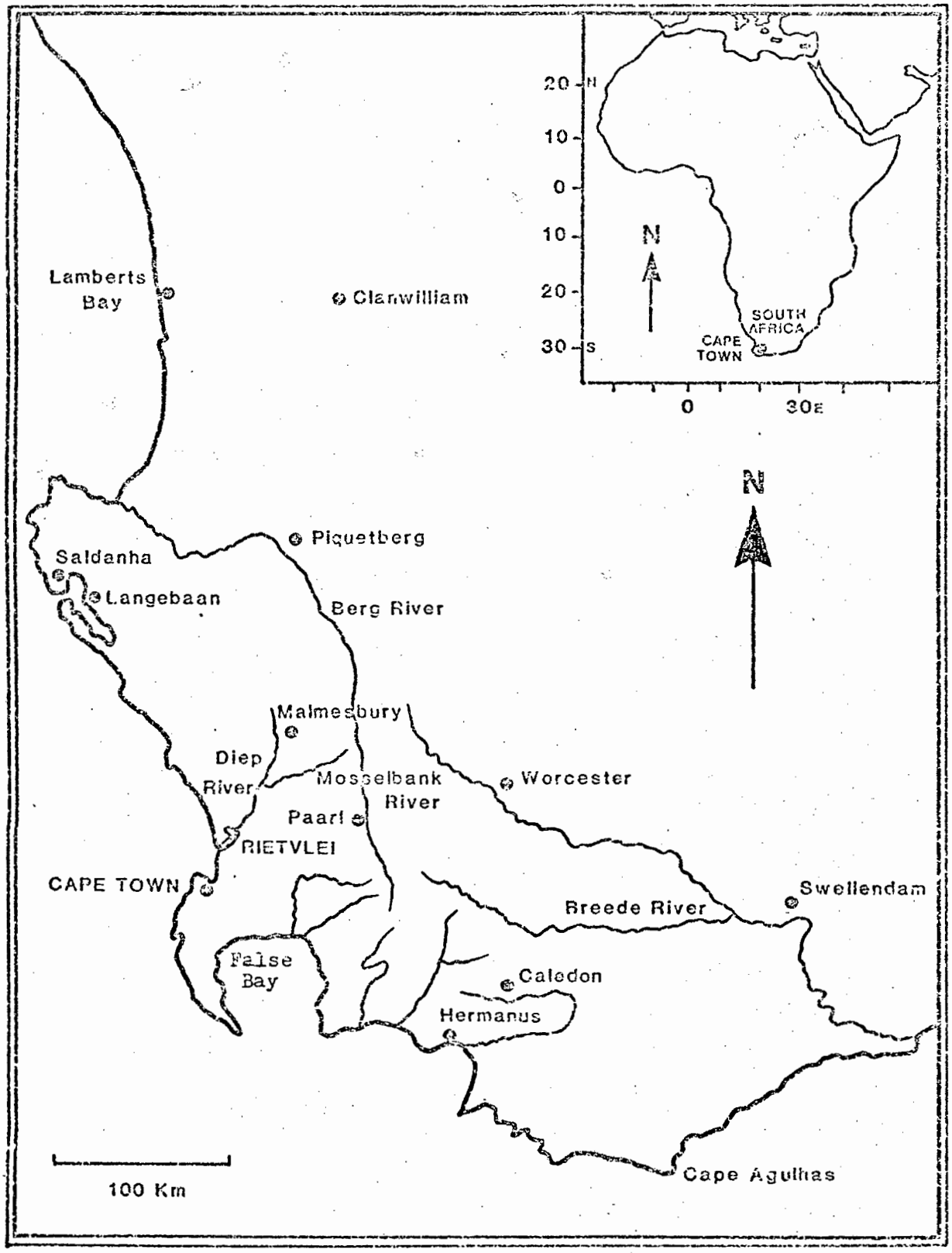
In general, the conservation of terns poses considerable problems, largely because of their vulnerability to disturbance. The major adverse influences on their numbers have been the disruption and displacement of breeding sites through coastal development and public recreation. With the advent of off-road vehicles formerly isolated

beaches have become accessible (Frost & Shaughnessy, 1976). This disruption applies also to roost sites (4.1.10) where flocks of terns at the SW and NW roosts have been disturbed by a single approaching powerboat or sailboard.

1.3.5

J. Harrison OBE (1973) found in England that powerboats were by far the worst form of disturbance, followed by sailing (yachts) and then by fishing from boats, with the long-term effects dependent upon the frequency of disturbance and the availability of other waters nearby. A.R.M. Blake (cited by Harrison, 1973) has studied canal reservoirs around Birmingham in this respect, where a 61 hectare reservoir at Cannock had become practically deserted by dabbling and diving duck since sailing commenced in 1956. At nearby Belvide, where fishing takes place from the banks and from boats, Blake found that waterfowl would not remain within 150 to 200 metres of a boat even if moored, or within 100 metres of an angler ashore.

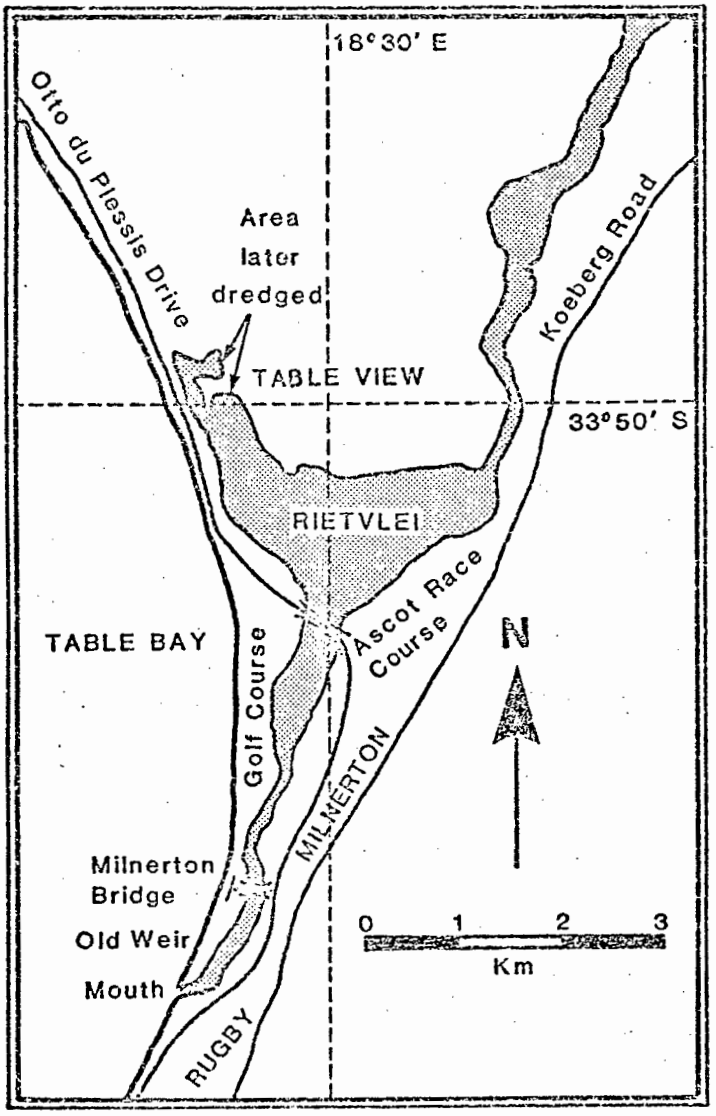
MAP 1



THE GEOGRAPHICAL LOCATION OF THE DIEP RIVER AND RIETVLEI
(after Burman,1970,Grove,1971)

MAP 2

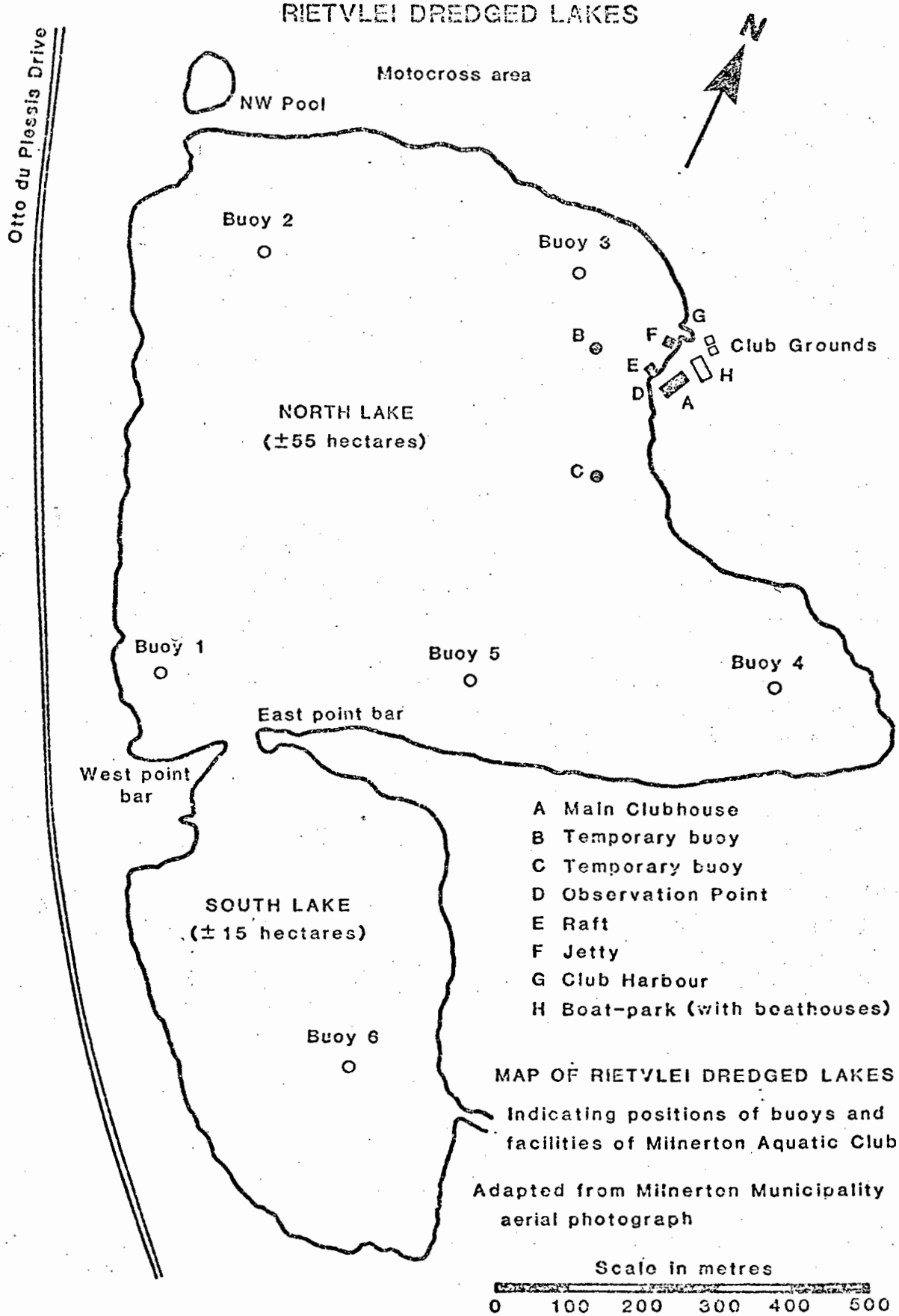
RIETVLEI



Rietvlei and adjacent parts of Diep River.
Adapted from Scott,1954

MAP 3

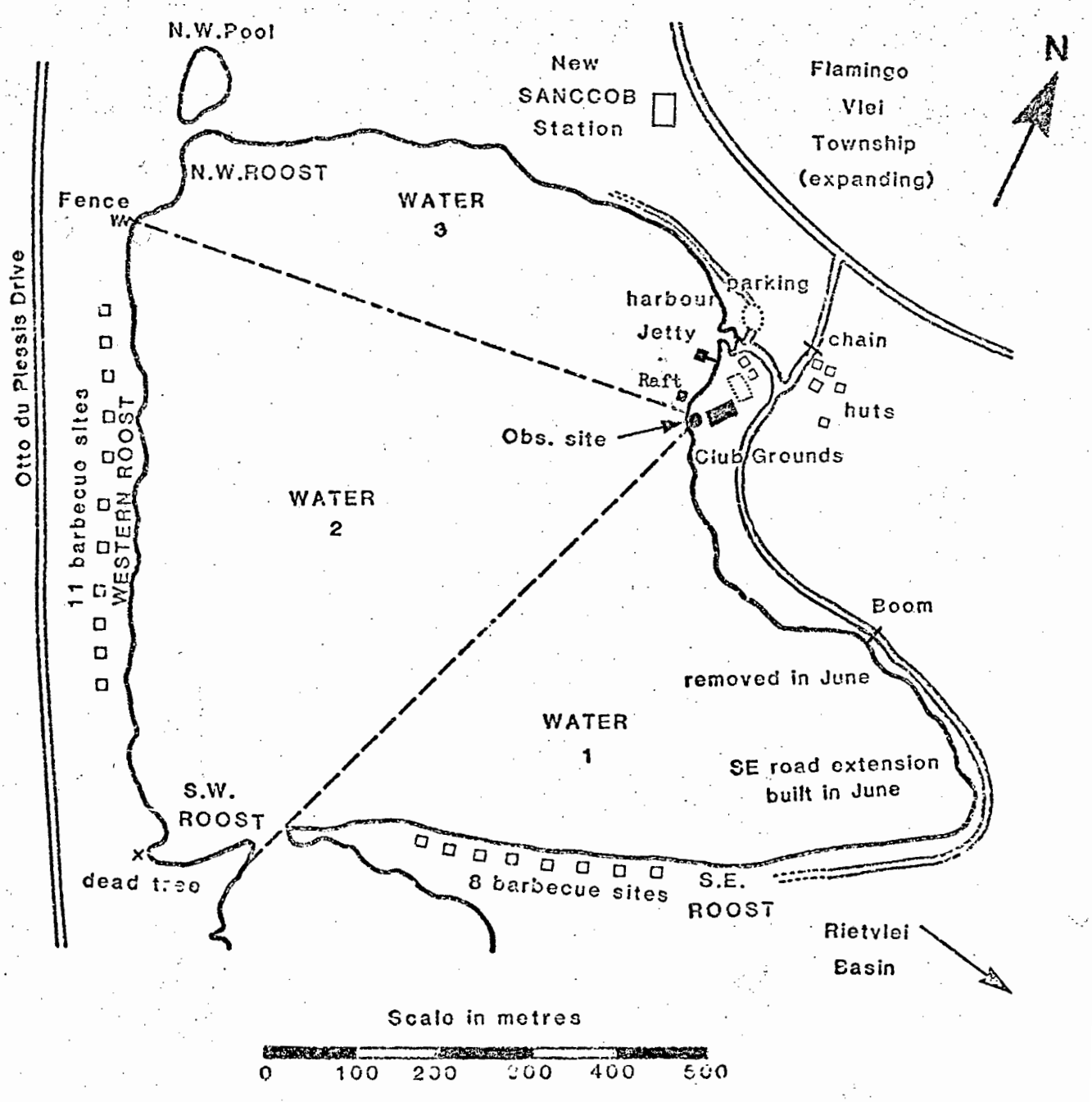
RIETVLEI DREDGED LAKES



MAP 4

NORTH LAKE

Map of North Lake indicating roost sites, water sectors & other phenomena



Adapted from Milnerton Municipality aerial photograph

CHAPTER 2

METHODS

2.1 SITE SELECTION AND DESCRIPTION

The site selected (section 1.1), the northern of two permanent bodies of water at the north-western corner of the Rietvlei wetland system, 33° 53'S 18° 29'E, lies 10 km north-east of Cape Town, South Africa, within the municipal area of the Cape Town suburb of Milnerton (Maps 1 and 2).

Between 1974 and 1976 this area, expropriated by the South African Transport Services, was dredged to provide sand for the reclamation of areas surrounding Cape Town's new Ben Schoeman container basin in the harbour. A large system of two lakes was created. They were separated by a narrow gap between two point bars which during dredging had acted as a pipeline servitude. Known as the North and South Lakes (Section 1.1, Map 3), these cover approximately 70 hectares with an average depth of 9 metres (Milnerton Aquatic Club, 1978).

My reasons for selecting the North Lake as the focal area of analysis are:

a) It contains permanent water unaffected by tidal influence (Appendix A).

b) It attracts large numbers of birds (Sections 1.1, 4.1 and Appendix C).

c) The salinity of 2,5‰ (Appendix C) is adequately low for tolerance by freshwater birds (Section 4.1, Appendix G).

d) It lies close enough to the sea (300 metres) to be frequented by a number of marine species (Section 4.1, Appendix G).

e) Up to 300 people (Section 4.2.1) regularly visit it for various recreational activities (Sections 1.2 and 4.2).

The South Lake (some 15 hectares) was not included in the study area. This shallower lake was not observed to carry the same recreational pressure.

For on-site observations and data collection the North Lake (some 55 hectares) and its shoreline was divided into 8 zones (Map 4) according to the pattern of roost sites, described as follows:

2.1.1 South-Eastern Roost

This is the shoreline along the south-eastern corner, from the club grounds (the boom) to the last of eight barbecue/picnic sites along the southern edge. The latter are accessible only on foot or by boat, though during the dry season a few cars and motorcycles have been able to approach via the Rietvlei Basin (Map 4) beyond.

The main roost area here is a stretch of sandy beach directly in line with a prominent Milnerton block of flats called "Rietvlei" as observed

from the club grounds. This roost was utilised largely by Reed Cormorants, Darter and Redknobbed Coot, the coot crossing the peninsula to the South Lake during periods of heavy recreational activity.

Most of this section was backed by stands of Australian Port Jackson Acacia saligna, interspersed with some patches of Prickly Pear Opuntia ficus-indica and other growth; these, together with the elevation of the eastern point bar behind the barbecue sites, provided some shelter from prevailing south-easterlies.

2.1.2 South-Western Roost

This more exposed area includes both sides of the gap separating the two lakes, including the shore from the westernmost barbecue site in the south to a collapsed dead tree straddling the beach north of the western point bar. This tree was submerged in June. Here, the roost areas are the extremities of the two point bars and the dead tree, frequented mainly by Reed Cormorants, Darter, Redknobbed Coot, Kelp Gulls and terns, the dead tree largely occupied by Reed Cormorants.

2.1.3 The Western Roost

Comprising the major part of the west shore, this lay between the dead tree in the south and a strip of old fencing further north, set up to discourage motorcyclists entering from the motocross area. This

fencing was submerged in June. Here, Reed Cormorants and Redknobbed Coot were the main species, though this area was not as well frequented by birds as other roost sites; birds were scattered, but the fence was often occupied by Reed Cormorants. Between the shore and the Otto du Plessis Drive beyond rose a substantial line of South-west Australian dune acacias Acacia cyclops providing shelter for eleven barbecue sites, accessible also only on foot or by boat.

2.1.4 North-Western Roost

Serving the largest concentrations of birds by far, this is the section from the fence at the northern end of the western roost site, extending eastwards along the north shore to the club grounds, with a detached pool in the north-west corner. The main roost, supporting the principal population of Kelp Gulls, lay on a sandy beach between the pool and the lake itself. Coot, Reed Cormorants, terns and Hartlaub's Gulls frequented the roost in smaller numbers. The detached pool supported a few waders, including Avocets. Small numbers of birds also loafed in groups elsewhere along the north shore. Numbers of coot foraged on grass banks beyond both this and the south-western roost.

2.1.5 Water 1

The North Lake water was divided into three count zones (Map 4). Although this led to unequal sectors, as opposed to a grid system this enabled confident locational accuracy. Birds were either in the water or in flight and included long-legged species such as Spoonbills and

flamingos wading a short distance from the shoreline. Water 1 therefore covered the south-eastern portion, and was frequented mainly by Reed Cormorants, Darter, ducks, Redknobbed Coot and terns.

2.1.6 Water 2

Water 2 covered the central portion, supporting large rafts of Kelp Gulls, which either remained for long periods washing and preening, or took shelter when disturbed from the SW and NW roost sites. Water 2 was also frequented by White Pelicans, Reed Cormorants, Darter, Spoonbills, flamingos, Redknobbed Coot (smaller numbers) and five species of tern.

2.1.7 Water 3

This covered the northern part of the lake, where the predominant species were Reed Cormorants, flamingos (up to 600), ducks and Redknobbed Coot.

2.1.8 The Club Grounds

Counts were taken for this area because it carried the greatest disturbance of a non-aquatic type, i.e. casual visitors, schoolboys on bicycles and picnickers, as well as members in transit with craft. The actual site lay along the shoreline between the boom in the south and the sandy north shore just beyond the powerboat launching harbour in the north, extending inland to the main club service road (which met the shoreline

at the boom) and a branch road leading to a parking area just beyond the harbour. The count area therefore included the new main clubhouse (built in 1978), picnic/barbecue sites (numbering six), boat enclosures, lawns, parking area and all launching-sites for craft.

The club grounds were interspersed with grass patches and stands of Port Jackson trees. A temporary slipway of cement blocks for yachts had been laid in front of the clubhouse (this had to be taken up during July following flooding) while the tiny powerboat harbour was served by a permanent concreted slipway. Between these lay a wooden floating jetty (constructed on 18 drums) installed in March; south of the temporary slipway lay a heavy raft (an old marine harbour-fender) moored to some shale boulders forming a rocky point between two beaches. These boulders served as the main observation site (Map 4).

The club grounds were regularly visited by birds. Whitebreasted and Reed Cormorants, Grey Heron, Little Egret, ducks, Coot and Pied Kingfishers frequented the powerboat harbour area; Reed Cormorants and Coot were found on the raft and jetty, with Coot, Reed Cormorants and Darter at points between the observation site and the vehicle boom. Hartlaub's Gulls were attracted by litter bins while Blacksmith Plovers foraged on the lawns in front of the clubhouse. On 8 March 40 Lesser Flamingos settled briefly on a club beach just south of the observation point.

2.2 OBSERVATIONS AND COUNTS

Field data in 300 count hours was gathered over thirty 10-hour days, selected at random between 23 February and 10 May 1983. This period of review (late summer and autumn) was selected as it included days of heavy recreational activity and "Control" days of least disturbance; the water level of the North Lake was constant prior to the winter rains and migratory species had not yet departed. Seasonable variables were excluded owing to changes in the water level between summer and winter and an expected difference in bird species found - most migrants such as certain terns and waders depart already by mid-May (McLachlan & Liversidge, 1978). While the purpose of this study was to assess the effects of recreational activities on aquatic avifauna, meteorological data were also collected, to allow for possible effects weather conditions could have on waterbird movements. This is considered briefly in 4.3.9.

Scoring sheets (see Appendix E) were designed with advice from Professor L.G. Underhill (University of Cape Town Department of Mathematical Statistics) and Professor R.F. Fuggle (University of Cape Town School of Environmental Studies). Hourly counts, with 8 x 30 binoculars, were carried out for birds and recreation and other disturbance. On each field day, hourly counts were made from 08h00 to 17h00 in terms of the above eight count zones. In addition a score was kept on the number of powerboats active during the ten minutes preceding each count hour, together with the percentage of the ten minutes at least one powerboat was active. These data are recorded on 300 sheets, copies

of which are deposited in the Percy FitzPatrick Institute of African Ornithology and School of Environmental Studies libraries at the University of Cape Town.

Birds were listed according to their serial numbers in Roberts: Birds of South Africa (McLachlan & Liversidge, 1978), while the other phenomena were given fictitious "Roberts Numbers" for computing purposes. Meteorological data included in the data sheets were afforded a separate hourly scoring system, based on the whole area; an anemometer in kilometres per hour for wind-speed measurements was used, and a whirling hygrometer for wet- and dry-bulb air temperatures.

From the observation site the whole lake-shore could be viewed, with the exception of a small strip in the south-east, visible after a short walk. Estimates had to be taken when birds such as Kelp Gulls and flamingos formed closely-packed roosts. Flamingos in flight proved difficult to count as birds constantly altered their position within the flock. In addition, smaller species, such as waders, on the far side, could well have been overlooked, but waders (see species summary, Appendix G) did not occur frequently. During days of heavy recreational activity Mr Cyril Hatton, Safety Patrol and Conservation Officer of the Milnerton Aquatic Club, was in attendance with a patrol-boat to police the area and counts were made from this boat, particularly when dense fog restricted visibility to the club grounds (2 days). From this it was evident that birds were more sedentary during periods of poor visibility.

2.3 COMPUTING AND QUANTITATIVE METHODS EMPLOYED

The computer concerned was a Univac 1100 time-sharing Exec multiprocessor system, situated on the University of Cape Town campus. The data were fed in by means of punch-cards.

The BMDP programs P6D (Bivariate scatter plots), P4F (Two-way frequency tables) and P3S (Nonparametricstatistics - Spearman and Kendall Correlation Coefficients) were used in the analysis of the data (Dixon, 1981). The results are presented in the form of tables and graphs in Chapter 3).

Computing was carried out by Professor L.G. Underhill, Department of Mathematical Statistics, University of Cape Town.

2.4 THE EFFECTS OF WATERSKIING

Although waterskiing (Sections 1.2, 3.2, 3.3, 3.5 and 4.2.5) occurred only on 12 days during the count period, its effects were examined on these days. For this purpose the Coot (Section 4.1.6) and the Greater and Lesser Flamingos (Section 4.1.4) were selected. Coot were the principal indicator, present throughout the count period, and flamingos were chosen for their extreme sensitivity to disturbance.

For each day when waterskiing took place an average number of birds for the ten hours in each sector affected by waterskiing was calculated.

The average number of birds for the count hours in which waterskiing took place in each sector was also calculated. The results are tabulated in Section 3.5 for Coot and for Flamingos. Comparison of the averages indicated the degree of disturbance caused by the waterskiing, on the numbers of birds on that particular sector. The difference between effects in the affected sector and adjacent sectors gives some indication of the distance at which disturbance is caused.

CHAPTER 3

RESULTS

3.1 INTRODUCTION

In this chapter the results of the data analysis, including the statistical analyses by computer, are presented. Although counts were taken in terms of zones, results which follow in Sections 3.2, 3.3 and 3.4 are for the combined site. In Section 3.5 effects in particular sectors are considered. In Section 3.2 with the aid of correlation coefficients, the effects of recreational activity are considered, and the degree of disturbance by separate recreational forms is measured.

The graphs and frequency tables (Sections 3.3 and 3.4) which follow present an indication of the relationship between numbers of birds (indicator variables) and the numbers of people. Meteorological observations are considered briefly in the next chapter, Section 4.3, but do not appear to be of great consequence.

3.2 CORRELATION COEFFICIENTS

In the following two tables, the measure of the highest degree of disturbance is indicated by the highest negative readings. The highest positive levels, which in both cases apply only to the Kelp Gull, indicate the lowest measures of disturbance. Both tables exhibit the same trend, except in two cases. (1) For the Whitebreasted Cormorant the Spearman record for people is higher than for active powerboats, while in Kendall this is lower. However, the margin of difference is only 0,0093 in Spearman and 0,0053 in Kendall. (2) For the Blacksmith Plover the Spearman record for people is higher than for yachts, while in Kendall this is lower. The margin of difference is 0,0371 in Spearman and only 0,0028 in Kendall.

TABLE A

SPEARMAN RANK CORRELATION COEFFICIENTS.

Variable (numbers of:-)	People	Powerboats active	Board-sailors	Yachts	Water-skis	Dogs
White-breasted Cormorant	-0,1761	-0,1668	-0,0781	-0,1415	-0,0421	-0,0674
Reed Cormorant	-0,3396	-0,3487	-0,1580	-0,4128	-0,2957	-0,0149
Darter	-0,3094	-0,3576	-0,2168	-0,3491	-0,3215	-0,0018
Flamingos (both species)	-0,3373	-0,3030	-0,2187	-0,2325	-0,1727	-0,0036
Anatidae (all species)	-0,5544	-0,3703	-0,4903	-0,3857	-0,2067	-0,0833
Red-knobbed Coot	-0,7167	-0,6233	-0,6182	-0,5191	-0,4085	-0,2469
Blacksmith Plover	-0,5945	-0,5157	-0,4089	-0,5574	-0,3623	-0,0476
Kelp Gull	0,0526	0,0200	0,1387	-0,1132	0,0329	0,0680
Hartlaub's Gull	-0,0177	-0,1154	-0,1031	-0,0441	-0,1724	-0,0802
Terns (all species)	-0,3398	-0,3586	-0,2186	-0,3115	-0,2248	-0,1031
Individual Waterbirds	-0,5578	-0,5139	-0,3685	-0,4933	-0,3260	-0,1017
Species	-0,6586	-0,5323	-0,5163	-0,4647	-0,3258	-0,0881

TABLE B

KENDALL RANK CORRELATION COEFFICIENTS.

Variable (numbers of:-)	People	Powerboats active	Board-Sailors	Yachts	Water-skis	Dogs
White-breasted Cormorant	-0,1448	-0,1501	-0,0675	-0,1276	-0,0397	-0,0631
Reed Cormorant	-0,2441	-0,2748	-0,1205	-0,3231	-0,2430	-0,0117
Darter	-0,2347	-0,3011	-0,1748	-0,2952	-0,2815	-0,0013
Flamingos (both species)	-0,2715	-0,2648	-0,1855	-0,2046	-0,1577	-0,0031
Anatidae (all species)	-0,4259	-0,3018	-0,3963	-0,3174	-0,1766	-0,0693
Red-knobbed Coot	-0,5433	-0,4921	-0,4896	-0,4050	-0,3331	-0,2008
Blacksmith Plover	-0,4715	-0,4415	-0,3408	-0,4743	-0,3252	-0,0421
Kelp Gull	0,0438	0,0173	0,1090	-0,0872	0,0269	0,0545
Hartlaub's Gull	-0,0102	-0,0919	-0,0785	-0,0349	-0,1433	-0,0675
Terns (all species)	-0,2454	-0,2862	-0,1642	-0,2449	-0,1854	-0,0856
Individual Waterbirds	-0,4139	-0,4075	-0,2886	-0,3849	-0,2666	-0,0819
Species	-0,5152	-0,4344	-0,4172	-0,3769	-0,2750	-0,0738

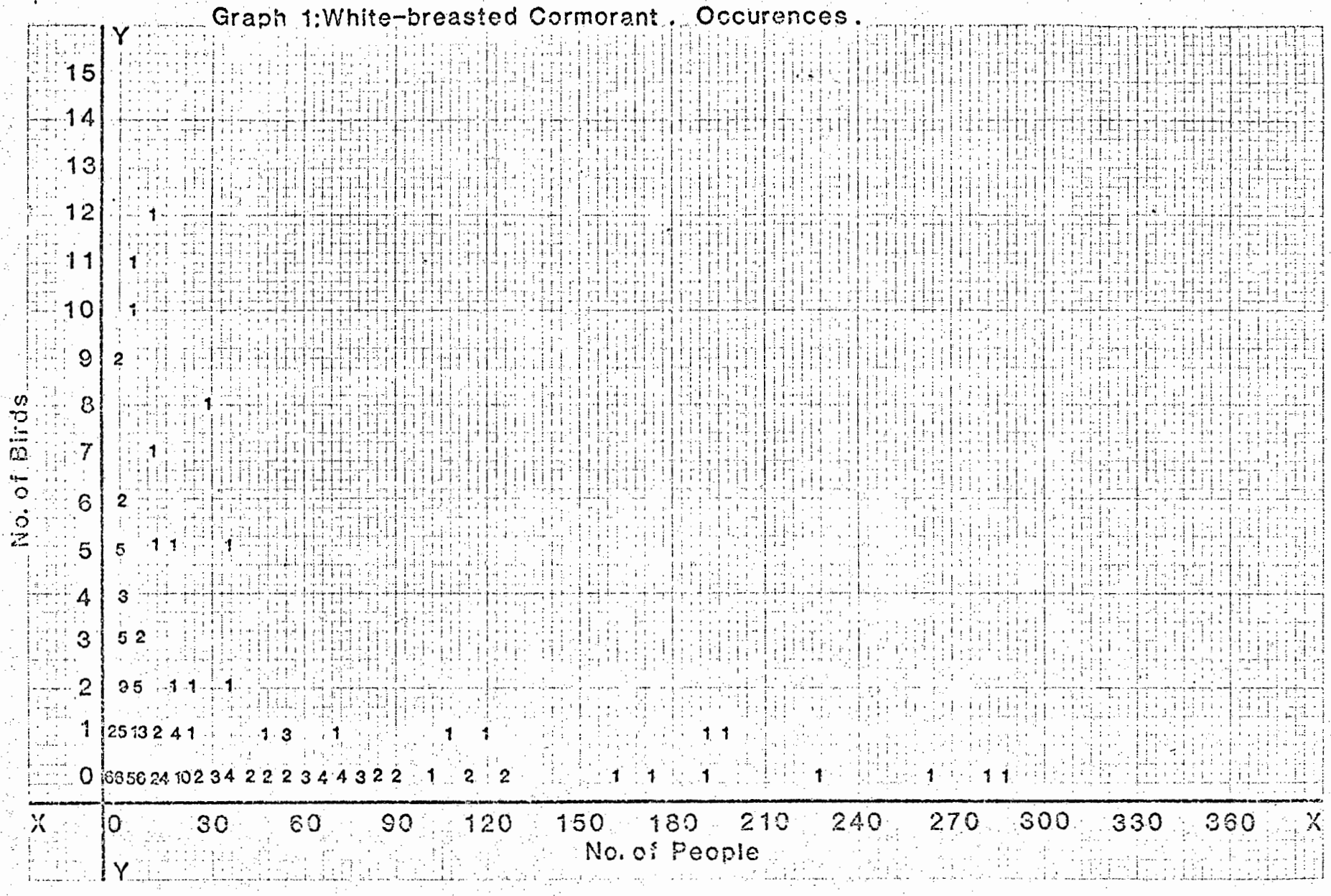
The Redknobbed Coot emerges as the principal indicator species, due to its greater numbers. In comparing the degree of disturbance by different forms of recreation, this for the full number of observed species follows the same pattern as for the Coot and the two tables are arranged accordingly. As with the frequency tables in Section 3.4, the birds are listed according to the classification order in Roberts: Birds of South Africa (McLachlan & Liverside, 1978).

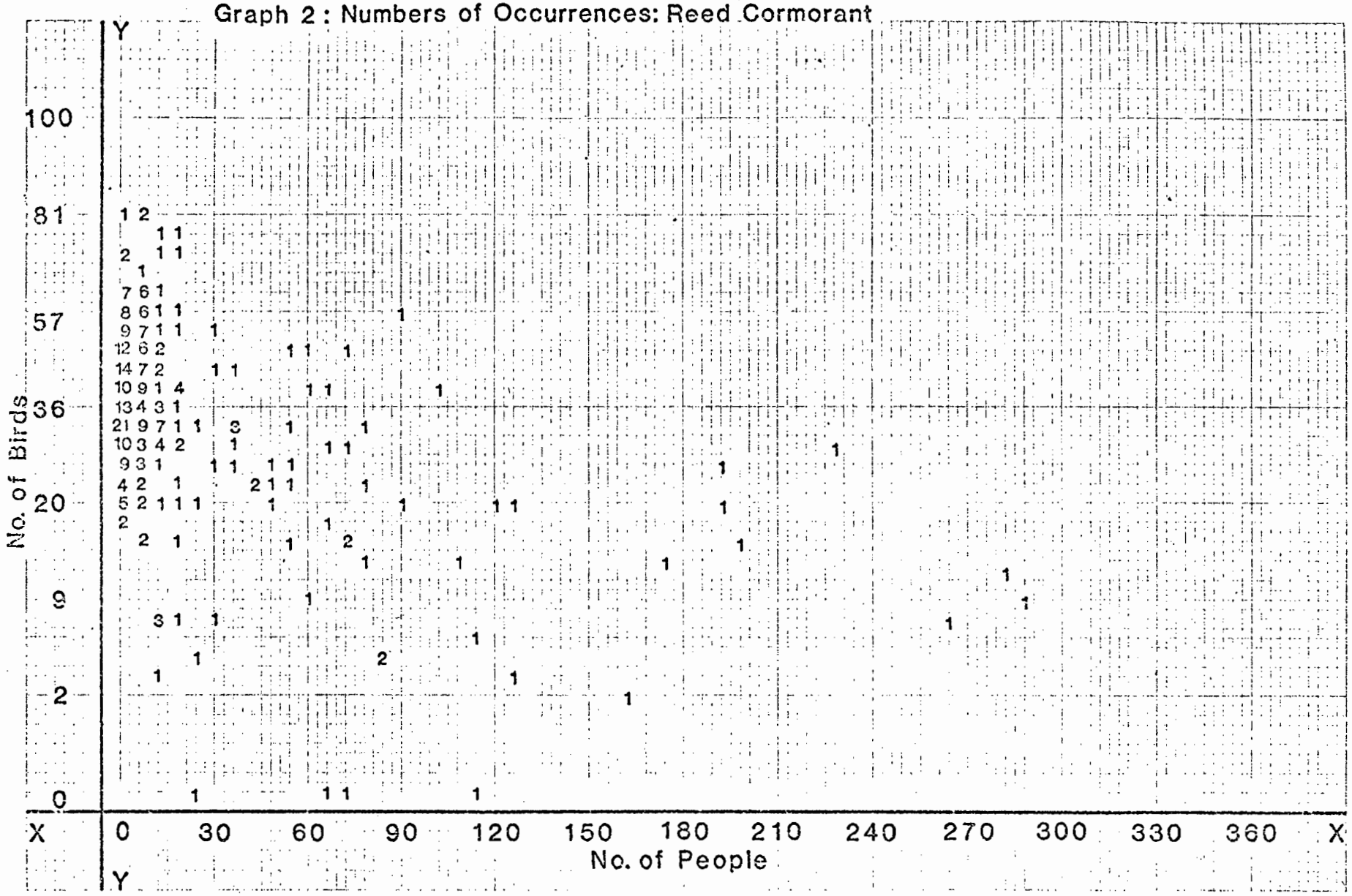
Using the number of people as the most useful measure of disturbance, the variables can be ordered in terms of sensitivity to disturbance on the basis of their correlation coefficients: Coot, number of observed species, Blacksmith Plover, total number of birds, Anatidae, terns, Reed Cormorant, flamingos, Darter and the Whitebreasted Cormorant. The Hartlaub's Gull and Kelp Gull have non-significant Spearman and Kendall correlation coefficients. Note in particular that the small positive correlation for the Kelp Gull is not significant.

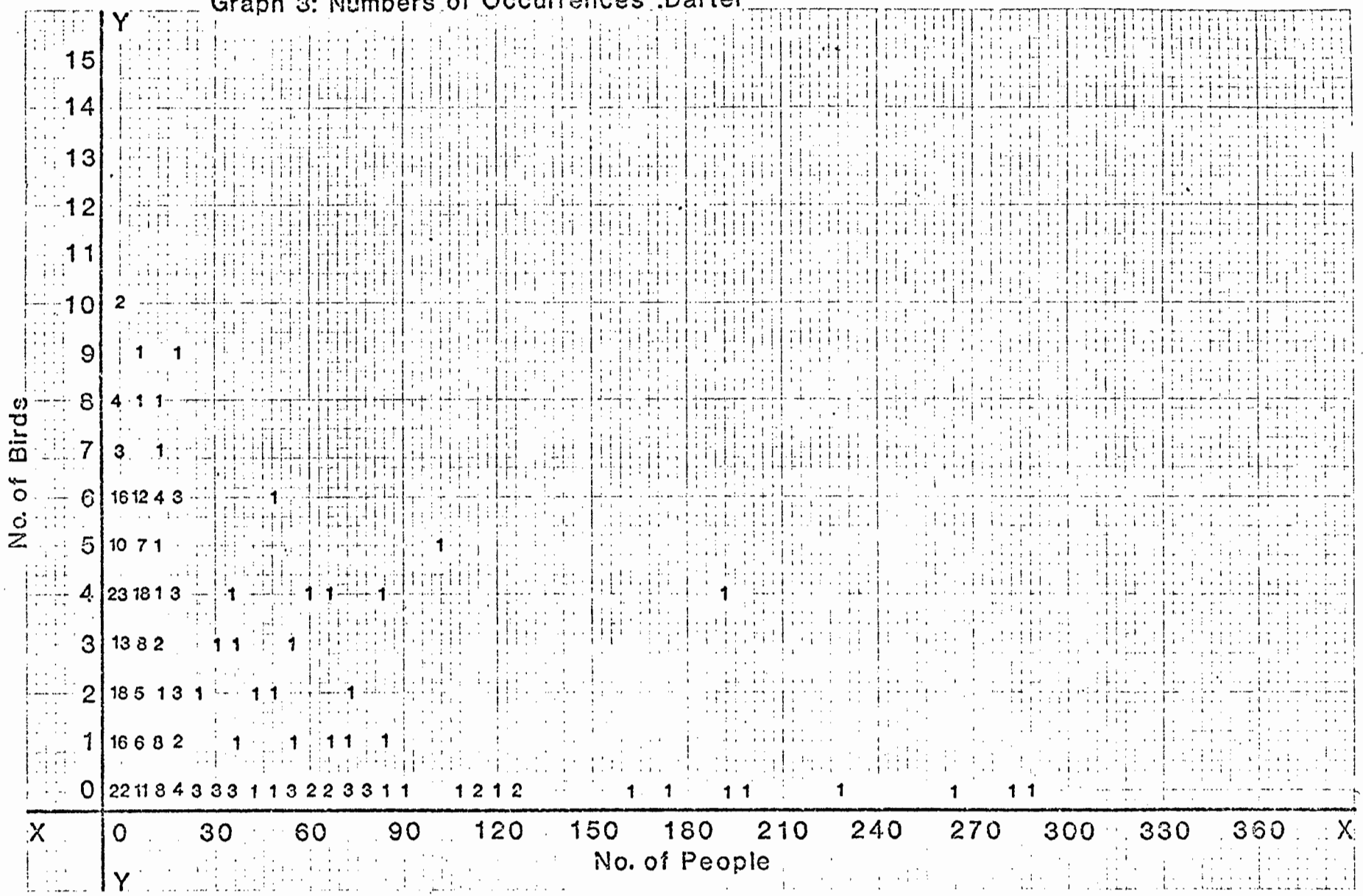
Using the number of Coot and the number of observed species as the indicator variables, the disturbance caused by the recreational activities could be ordered as: powerboats active, sailboards, yachts, waterskis and dogs. This confirms my intuitive ranking of these activities, with the exception that waterskiing came low down because it only occurred on 37 count hours out of 300. Human recreational activity thus is shown to be the greatest disturbance factor, so that the null hypothesis (Section 1.1.1) may be rejected.

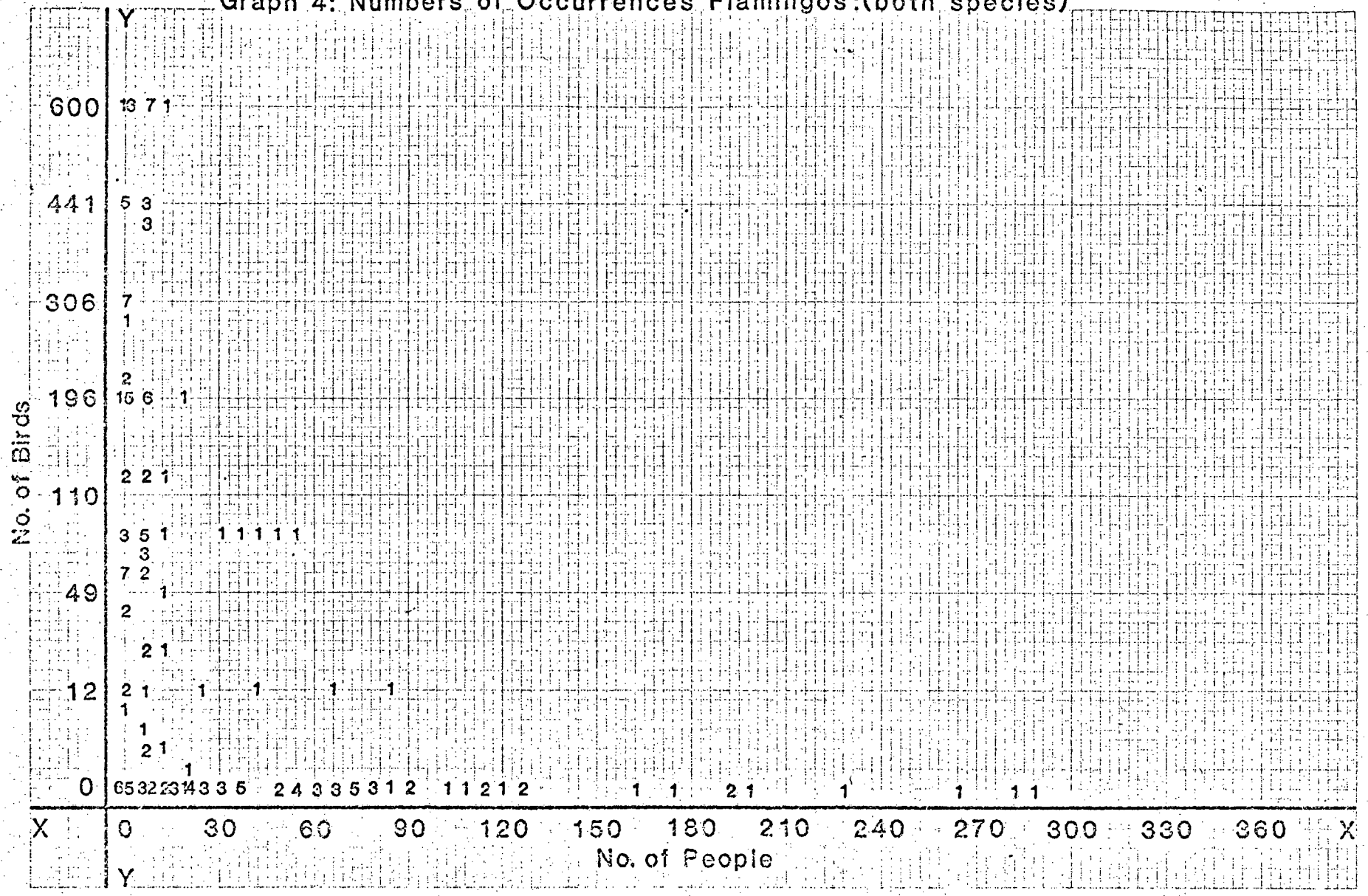
3.3 GRAPHIC REPRESENTATIONS OF RECORDED OCCURRENCES

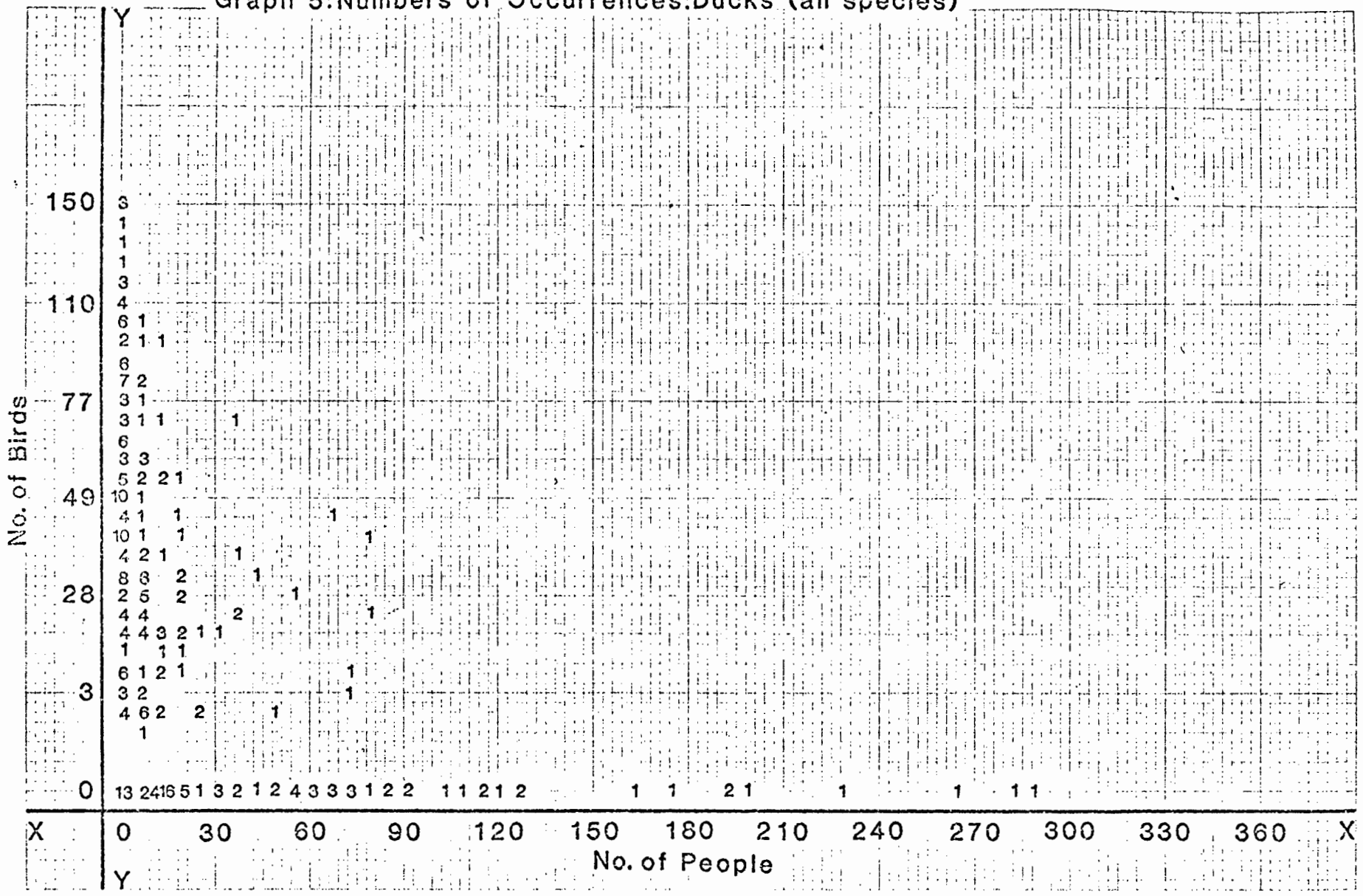
The following set of 12 graphs summarises the frequency of occurrences of a variable, e.g. Coot, recorded in terms of the numbers counted (Y axis) and the number of people (X axis) recorded at the same count.

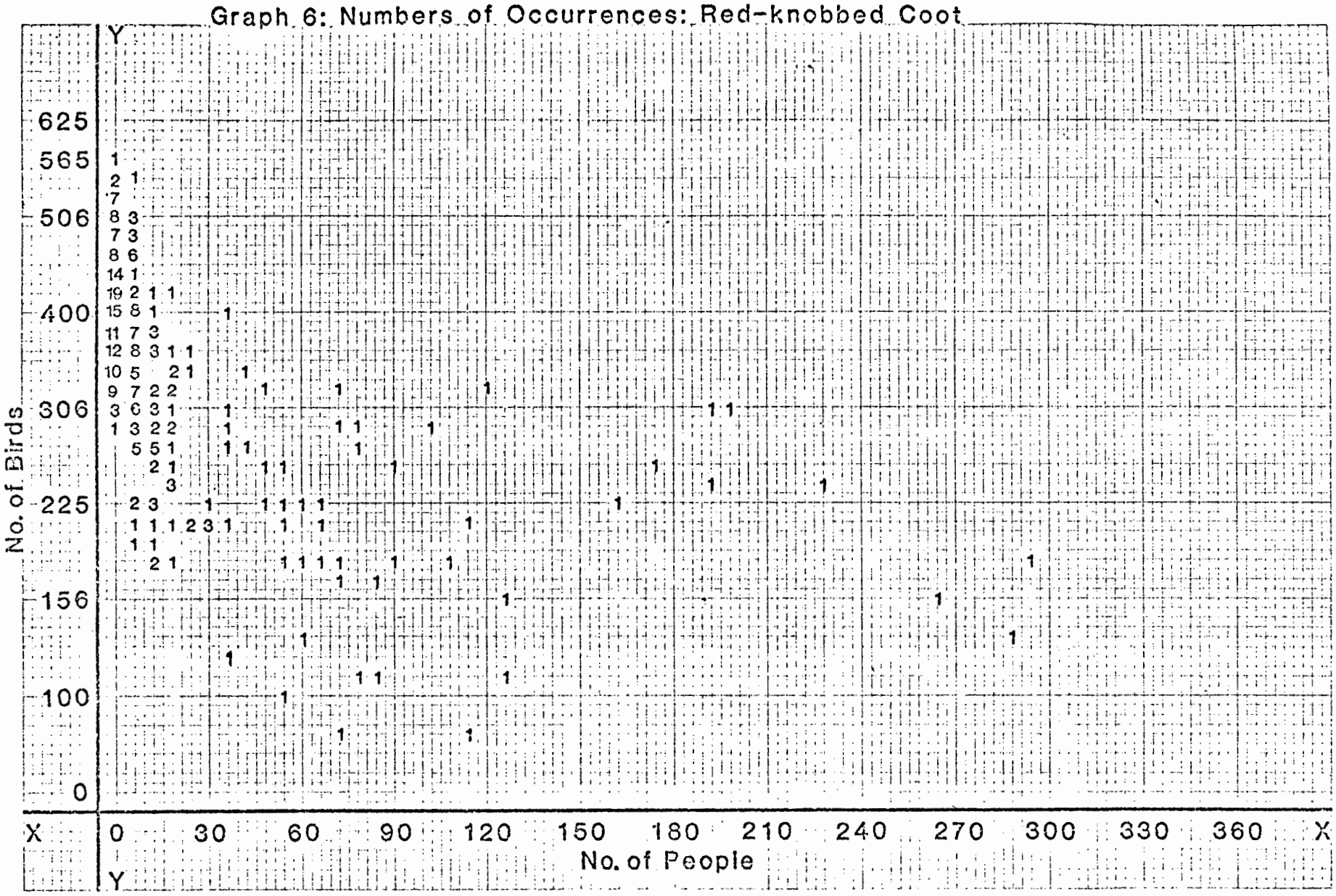

Graph 1:White-breasted Cormorant . Occurences .
Y
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
No. of Birds
1
2
1
1
1
2
1
5 1 1 1
3
5 2
9 5 1 1 1
25 13 2 4 1 1 3 1 1 1
66 56 24 10 2 3 4 2 2 2 3 4 4 3 2 2 1 2 2 1 1 1 1 1 1 1 1 1
X
0 30 60 90 120 150 180 210 240 270 300 330 360 X
Y
No. of People


Graph 2 : Numbers of Occurrences: Reed Cormorant
Y
100
81
57
36
20
9
2
0
No. of Birds
X
0
30
60
90
120
150
180
210
240
270
300
330
360
X
No. of People
Y

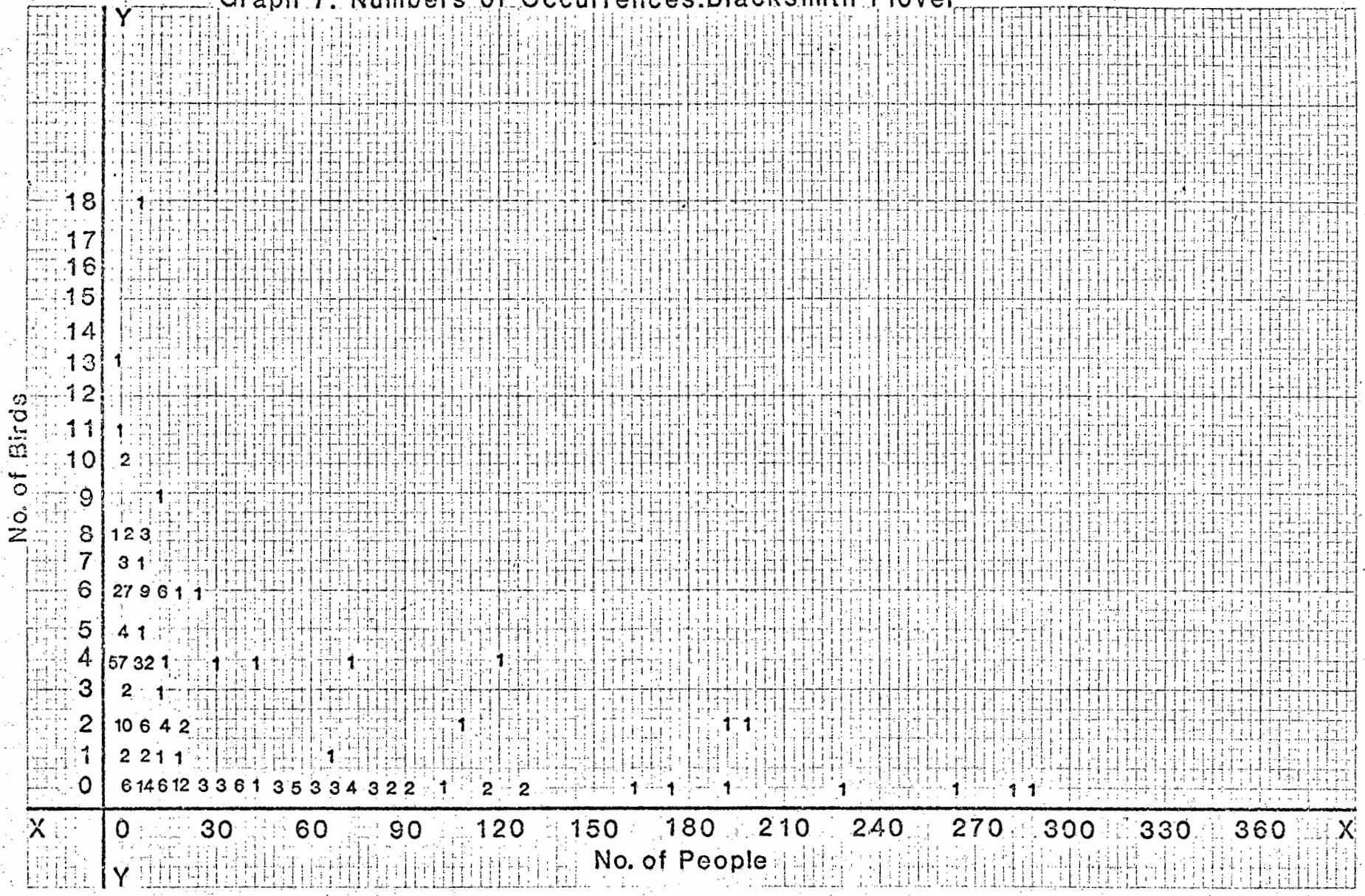

Graph 3: Numbers of Occurrences :Darter
Y
15
14
13
12
11
10 2
9 1 1
8 4 1 1
7 3 1
6 16 12 4 3 1
5 10 7 1 1
4 23 18 1 3 1 1 1 1
3 13 8 2 1 1 1
2 18 5 1 3 1 1 1 1
1 16 6 8 2 1 1 1 1 1
0 22 11 8 4 3 3 3 1 1 3 2 2 3 3 1 1 1 2 1 2 1 1 1 1 1 1 1
No. of Birds
X
0 30 60 90 120 150 180 210 240 270 300 330 360 X
No. of People
Y


Graph 4: Numbers of Occurrences Flamingos:(both species)
Y
600
441
306
196
110
49
12
0
No. of Birds
X
0
30
60
90
120
150
180
210
240
270
300
330
360
X
No. of People
Y

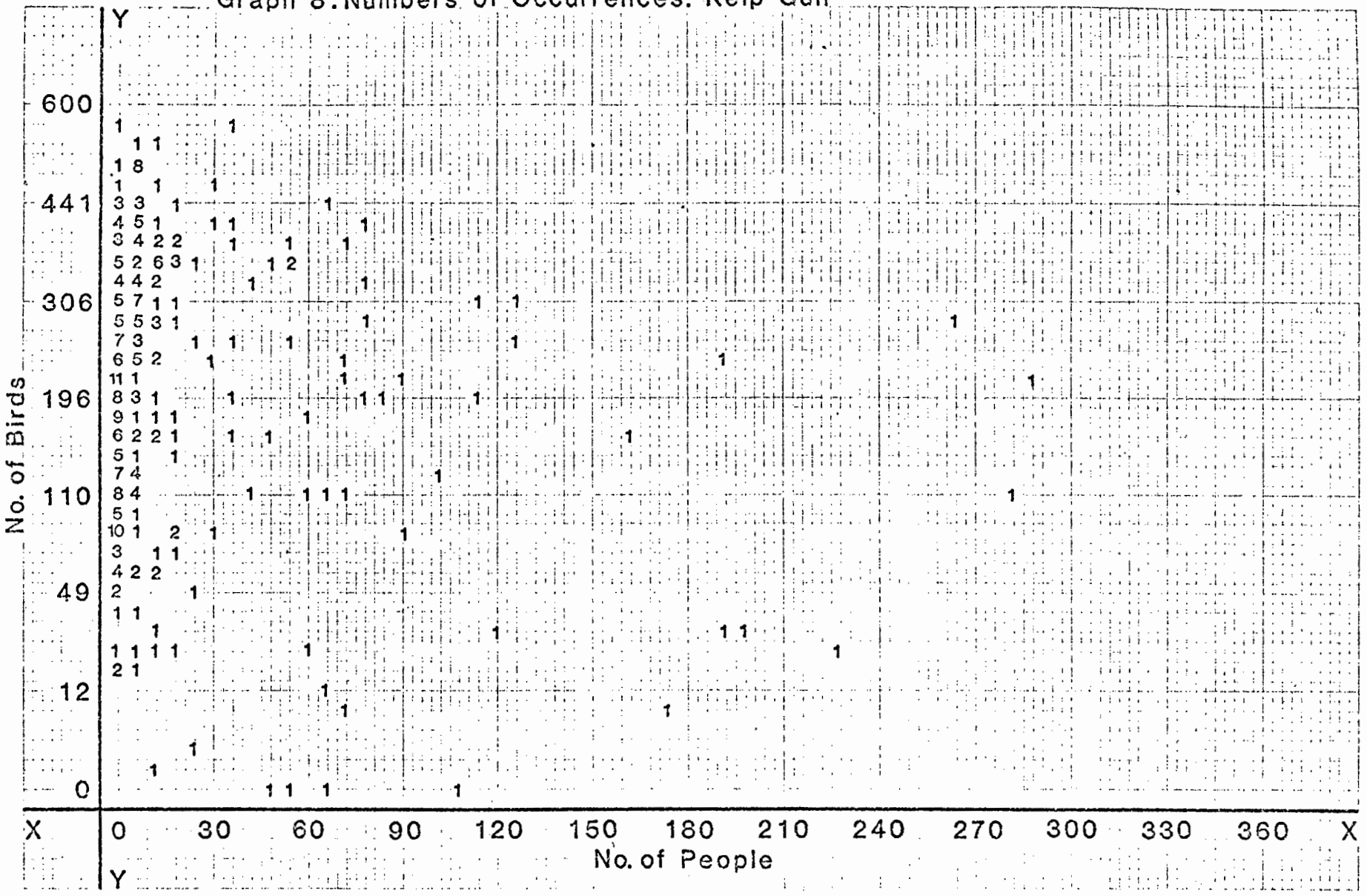

Graph 5:Numbers of Occurrences:Ducks (all species)
No. of Birds
150
110
77
49
28
3
0
Y
X
0 30 60 90 120 150 180 210 240 270 300 330 360 X
No. of People
Y


Graph 6: Numbers of Occurrences: Red-knobbed Coot
No. of Birds
625
565
506
400
306
225
156
100
0
Y
X
0
30
60
90
120
150
180
210
240
270
300
330
360
X
No. of People
Y

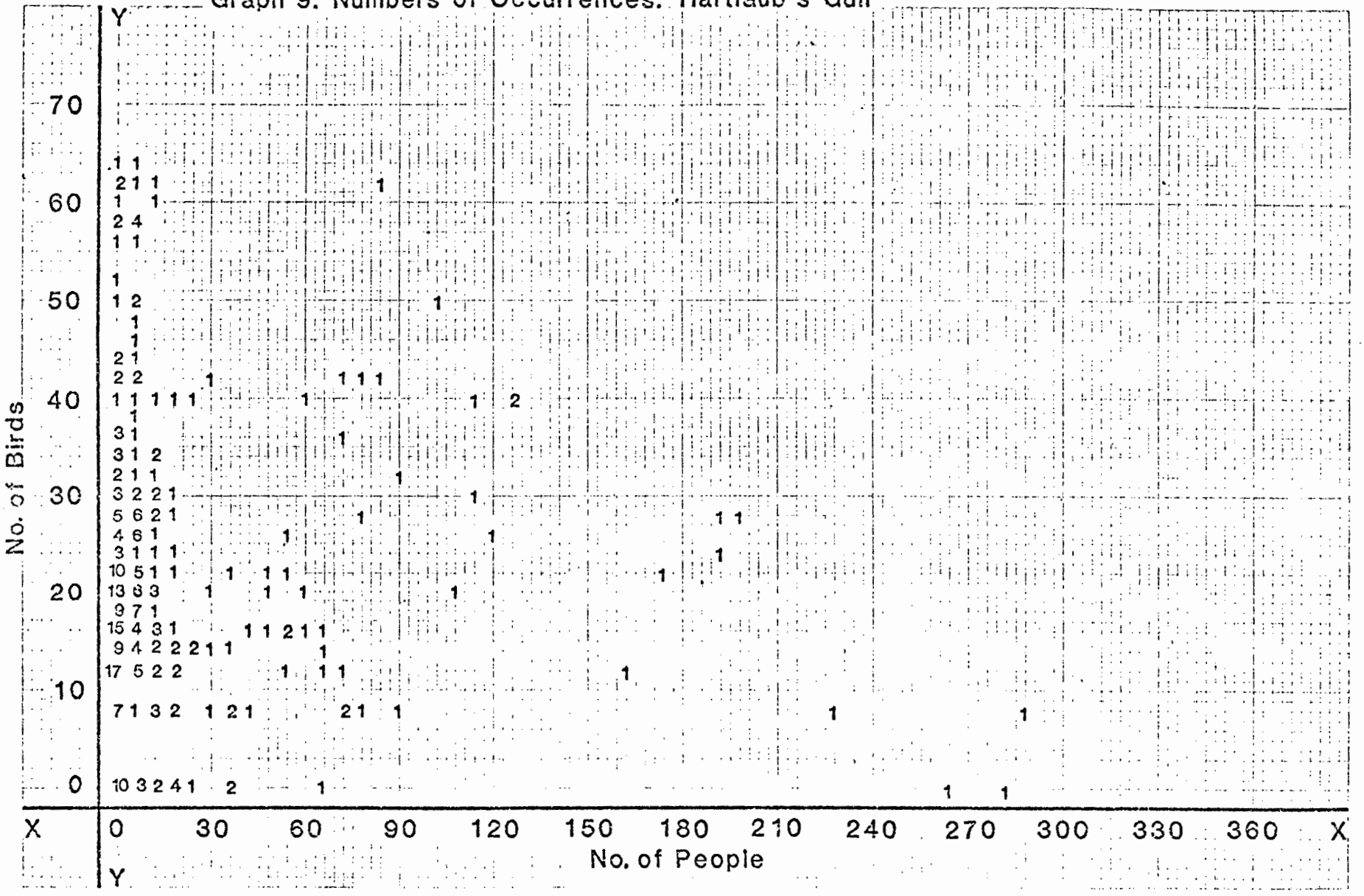
Graph 7: Numbers of Occurrences:Blacksmith Plover

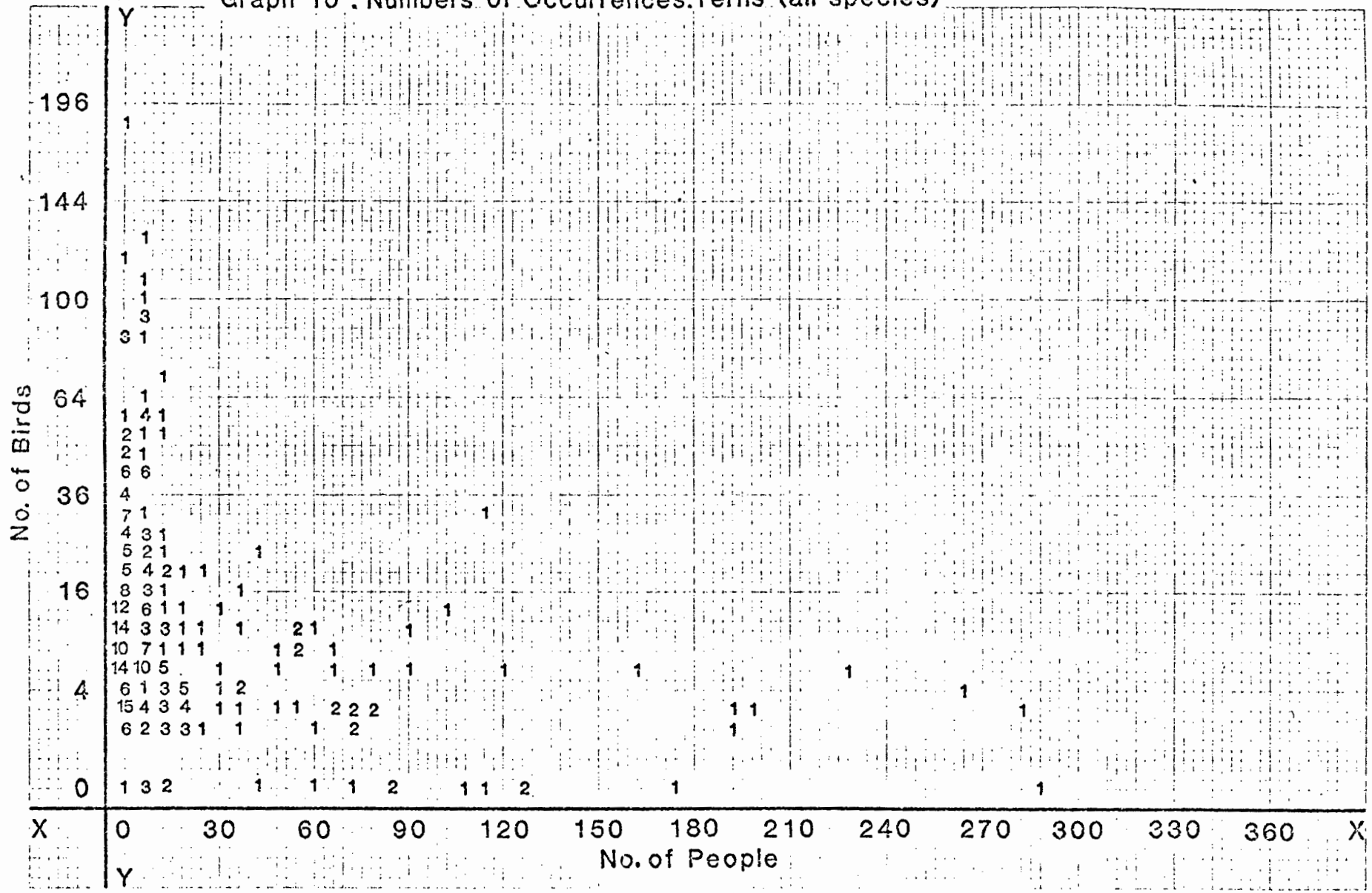


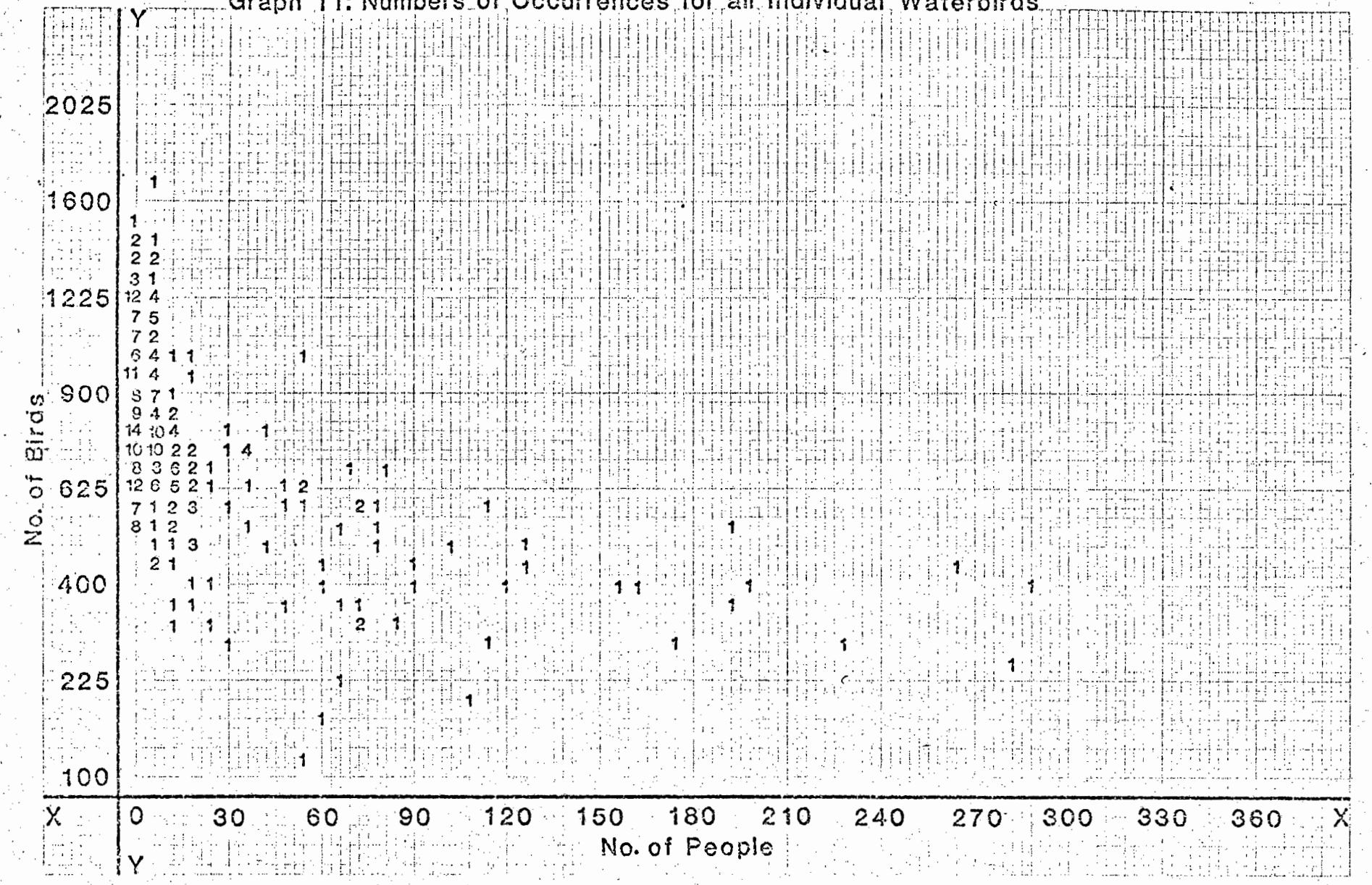
Graph 8: Numbers of Occurrences: Kelp Gull

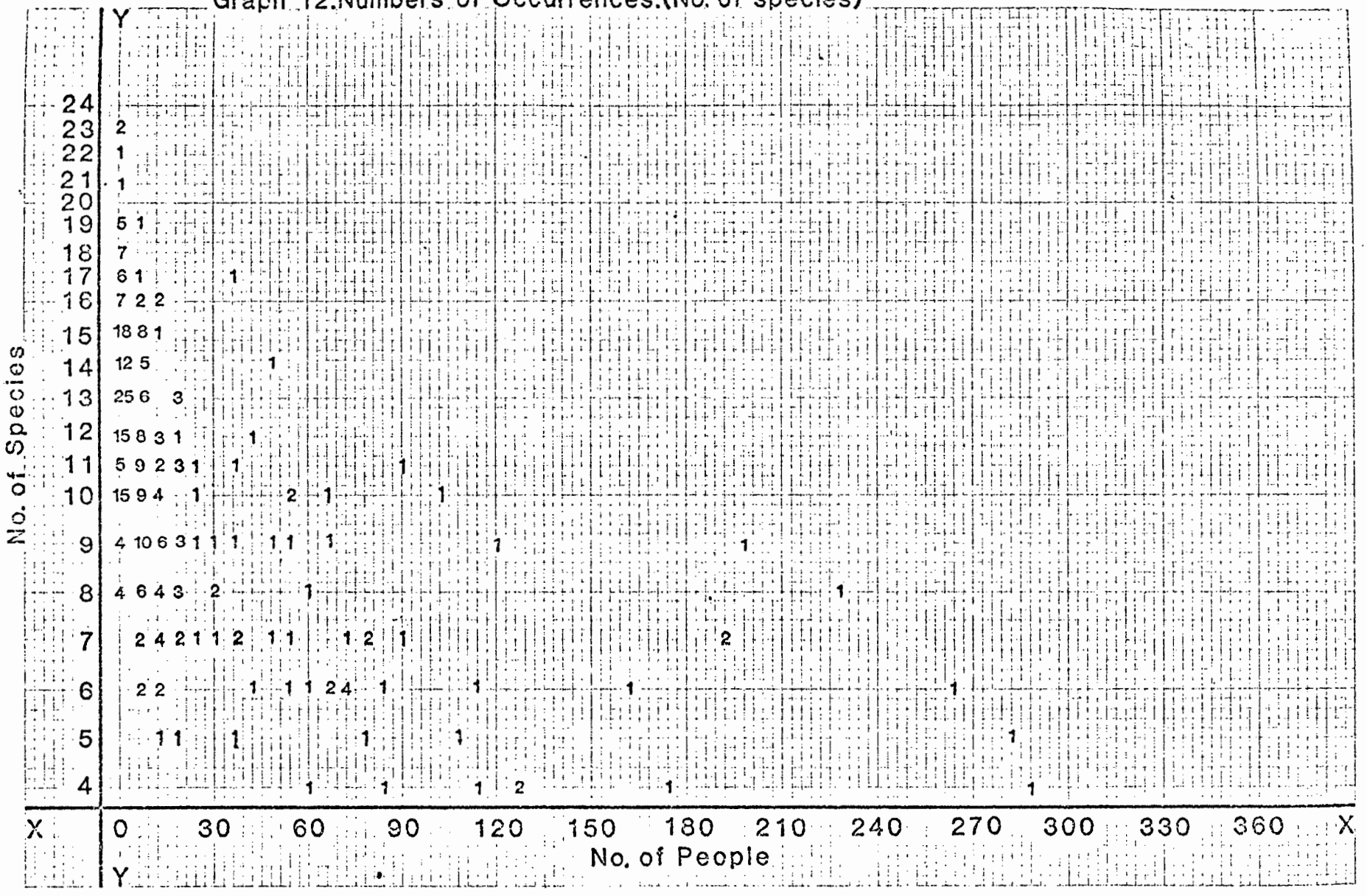


Graph 9: Numbers of Occurrences: Hartlaub's Gull




Graph 10 : Numbers of Occurrences:Terns (all species)
Y
196
144
100
64
36
16
4
0
No. of Birds
X
0
30
60
90
120
150
180
210
240
270
300
330
360
X
No. of People
Y


Graph 11: Numbers of Occurrences for all Individual Waterbirds
Y
2025
1600
1225
900
625
400
225
100
No. of Birds
X
0
30
60
90
120
150
180
210
240
270
300
330
360
X
No. of People
Y


Graph 12:Numbers of Occurrences:(No. of species)
No. of Species
No. of People
Y
X
0 30 60 90 120 150 180 210 240 270 300 330 360
24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4

From all the graphs it is immediately apparent that the greatest bird numbers (occurrences of particular species) were recorded when numbers of people were low, i.e. below 25 people. Beyond 25, bird occurrences tend to decrease, thinning out rapidly. With common species such as the Reed Cormorant, Redknobbed Coot and the two gull species a tolerance to larger numbers of people is indicated.

3.4 FREQUENCY TABLES OF RECORDED OCCURRENCES

The lowest number of people at any observation hour was two. This frequency table analysis has been used as an alternative method of matching disturbance, here measured by the number of people and corresponding numbers of birds. The variable "number of people" is divided into four categories: 2, 3 - 25, 26 - 64, and 65 and over. The birds as indicator variables are each divided into three categories, the cutpoints being made so that roughly a third of the observations fall into each category.

These frequency tables (Tables 1 to 12) are presented together with their χ^2 -value and significance levels. It is seen that all the potential indicator variables are significant, except the Whitebreasted Cormorant (which is near significant) and Hartlaub's Gull. An examination of the frequency table for the Kelp Gull shows that the significance is caused by larger-than-expected Kelp Gull values in the categories: 3 to 25 people and 26 to 64 people and over 250 Kelp Gulls. This confirms the small positive correlation found in Section 3.2

OBSERVED FREQUENCY TABLES

Table 1

WHITEBREASTED CORMORANT: NUMBERS OF PEOPLE

	2	3 to 25	26 to 64	over 64	Total
None	66	92	18	25	201
1 to 2	32	29	5	5	71
over 2	17	9	2	0	28
Total	115	130	25	30	300

(χ^2_6 = 12,17; P = 0,058, possibly significant).

Table 2

REED CORMORANT NUMBERS OF PEOPLE

	2	3 to 25	26 to 64	over 64	Total
None	6	13	5	20	44
1 to 5	43	43	14	6	106
over 5	66	74	6	4	150
Total	115	130	25	30	300

(χ^2_6 = 84,02, P $<$ 0,0001, very highly significant).

Table 3

DARTER NUMBERS OF PEOPLE

	2	3 to 25	26 to 64	over 64	Total
None	20	28	15	22	85
1 to 5	73	73	9	8	163
over 5	22	29	1	0	52
Total	115	130	25	30	300

(χ^2_6 = 54,72; P $<$ 0,0001, very highly significant).

Table 4.

FLAMINGOS (both species): NUMBERS OF PEOPLE

	2	3 to 25	26 to 64	over 64	Total:
None	56	80	18	29	183
1 to 100	14	23	7	1	45
over 100	45	27	0	0	72
Total	115	130	25	30	300

(χ^2_6 = 41,13, P $<$ 0,0001, very highly significant).

Table 5

ANATIDAE (all species) NUMBERS OF PEOPLE

	2	3 to 25	26 to 64	over 64	Total
None	12	47	16	26	101
1 to 10	21	33	4	3	61
over 10	82	50	5	1	138
Total	115	130	25	30	300

(χ^2_6 = 87,38, P $<$ 0,0001, very highly significant).

Table 6

REDKNOBBED COOT: NUMBERS OF PEOPLE

	2	3 to 25	26 to 64	over 64	Total
Up to 200	0	5	6	14	25
201 to 300	2	37	15	12	66
over 300	113	88	4	4	209
Total	115	130	25	30	300

(χ^2_6 = 155,3, P $<$ 0,0001, very highly significant).

Table 7

BLACKSMITH PLOVER: NUMBERS OF PEOPLE

	2	3 to 25	26 to 64	over 64	Total
None	5	36	23	24	88
1 to 5	69	66	2	6	143
over 5	41	28	0	0	69
Total	115	130	25	30	300

(χ^2_6 = 122,10, P $<$ 0,0001, very highly significant).

Table 8

KELP GULL: NUMBERS OF PEOPLE

	2	3 to 25	26 to 64	over 64	Total
up to 125	27	20	4	10	61
126 to 250	54	38	9	12	113
over 250	34	72	12	8	126
Total	115	130	25	30	300

(χ^2_6 = 21,68, P $<$ 0, 001, very highly significant - see explanation in text).

Table 9.

HARTLAUB'S GULL: NUMBERS OF PEOPLE

	2	3 to 25	26 to 64	over 64	Total
up to 5	63	55	16	12	146
6 to 20	38	53	7	9	107
over 20	14	22	2	9	47
Total	115	130	25	30	300

(χ^2_6 = 11,39, P $>$ 0,05, not significant).

Table 10

TERNS (all species): NUMBERS OF PEOPLE

	2	3 to 25	26 to 64	over 64	Total
Up to 4	26	26	11	22	95
5 to 25	64	64	14	7	149
over 25	25	30	0	1	56
Total	115	130	25	30	300

(χ^2_6 = 36,88, P $\angle$ 0,0001, very highly significant).

Table 11:

TOTAL NUMBER OF WATERBIRDS: NUMBERS OF PEOPLE

	2	3 to 25	26 to 64	over 64	Total
Up to 400	0	4	5	14	23
401 to 450	30	49	12	16	107
over 450	85	77	8	0	170
Total	115	130	25	30	300

(χ^2_6 = 109,54, P $\angle$ 0,0001, very highly significant).

Table 12:

NUMBER OF SPECIES: NUMBERS OF PEOPLE

	2	3 to 25	26 to 64	over 64	Total
Up to 15	19	66	21	29	135
16 to 20	69	56	3	1	129
over 20	27	8	1	0	36
Total	115	130	25	30	300

(χ^2_6 = 93,49, P $\angle$ 0,0001, very highly significant).

From the preceding set of graphs, and the preceding set of 12 tables, it is clear that the rate of increase in disturbance declines beyond a total of 25 people (i.e. the largest increase in disturbance is caused by the first 25 people).

If the indicator variables are ordered by their χ^2 values, the order is Coot, Blacksmith Plover, number of birds, number of species, Anatidae, Reed Cormorant, Darter, flamingos, terns, Whitebreasted Cormorant and Hartlaub's Gull (with the Kelp Gull excluded for the reasons given above). Coot come up once again as the most sensitive indicator species of disturbance.

3.5 THE EFFECTS OF WATERSKIING

The following data pertaining to waterskiing (Sections 2.4, 3.2 and 4.2.5) were extracted from the field data. Species selected were the Coot, shown in Section 3.4 to be the principal indicator, and the two flamingos (dealt with together as in Section 4.1.4) as highly sensitive. In the following tables the average number of birds for the day in each affected sector is given under "A", while under "B" appear averages of numbers of birds in the same sector for the count hours when waterskiing was in progress. Except for Day 8 (March 27) when up to three waterskiers occurred at one count, counts were for one waterskier only.

3.5.1 Redknobbed Coot

Coot occurred on all 12 days when waterskiing took place.

Day 1 25 February 1983

	A	B	
Water 1:	162,7	62,5	(Mean of two count hours, 60 and 65)

Day 2 27 February 1983

	A	B	
Water 1:	85,5	81,6	(Mean of three count hours, 110, 55 and 80)
Water 2:	49,3	0	

Day 3 4 March 1983

	A	B
Water 2:	40,4	3

Day 4 5 March 1983

	A	B	
Water 1:	99,5	17,5	(Mean of two count hours, 10 and 25)
Water 2:	18,8	0	

Day 5 13 March 1983

	A	B	
Water 1:	112,0	92,5	(Mean of four count hours, 150, 110, 60 and 50).
Water 2:	25,0	20,0	
Water 3:	74,5	110,0	

Day 6 20 March 1983

	A	B
Water 1:	118,0	100,00

Day 7 21 March 1983

	A	B
Water 2:	34,5	0

Day 8 27 March 1983

	A	B	
Water 1:	97,0	62,0	(Mean of five count hours, 80, 30, 80 60 and 80)
Water 2:	12,4	11,5	(Mean of six count hours, 0, 33, 10, 6, 0 and 20)

Day 9 30 March 1983

	A	B	
Water 1:	157,5	77,5	(Mean of two count hours, 80 and 75)

Day 10 7 April 1983

	A	B	
Water 1:	130,0	105,0	(Mean of four count hours, 110, 110, 100 and 100)

Day 11 8 April 1983

	A	B	
Water 1:	100,7	90,3	(Mean of three count hours, 115, 75 and 81)

Day 12 15 April 1983

	A	B	
Water 2:	72,0	12,5	(Mean of two count hours, 10 and 15)

With the exception of Water 3 on Day 5, a decided drop in Coot numbers is indicated when waterskiers are present. The average decline in numbers was 47.6% while on the only occasion when an anomalous increase was noted it was 44.05%. This anomalous increase might have been related to the presence of dense fog on that day.

3.5.2 Flamingos

Flamingos occurred on 6 of the 12 days when waterskiing took place. Occurrences for the SW and NW roosts are included here, adjacent to powerboat activity in the water sectors. On only two days did flamingos occur in the water sectors concurrently with waterskiing activity.

Day 2	27 February 1983		
	A	B	
SW Roost:	3,3	11,0	(Mean of two count hours of 11, with boat in Water 1)

Day 3	4 March 1984	
	A	B
Water 2	0,2	0

Day 9	30 March 1983	
	A	B
Water 1	1,1	0

Day 10	7 April 1983		
	A	B	
S.W. Roost:	42,9	85,0	(Mean of four count hours of 85, with boat in Water 1)

Day 11	8 April 1983		
	A	B	
S.W. Roost:	1,0	10,0	(One count hour only, with boat in Water 1)

Day 12	15 April 1983	
	A	B
SW Roost:	22,0	0
NW Roost:	22,0	0

For flamingos the decline in numbers with waterskiing present was not definite and appears only in three of the six relevant days. However,

where the average under B exceeds that under A, there was no occasion where waterskiing and flamingos occurred together in the same count zone. On Day 11 flamingos occurred on only one count (10 birds), hence an average of one bird per hour (SW Roost); on the same count hour there was a waterskier in Water 1 while all 10 birds remained at the SW Roost giving an apparently anomalous result. However the sensitivity of flamingos to aquatic recreational activity is clearly indicated by the fact that they never occurred in the same count zone as water skiing.

CHAPTER 4

DISCUSSION

4.1 AQUATIC AVIFAUNA

A full summary of species observed at the North Lake during the February - May 1983 period of review, along with scientific names, appears in Appendix G. For the computer analysis only the following variables were selected, being the most suitable in terms of numbers and consistency of records.

4.1.1 Whitebreasted Cormorant

Although observed between 25 February and 10 May, the highest number recorded was only 12 birds on 8 March (1700 hours); 72 counts were for one or two birds only.

The high disturbance correlation for yachts can only be explained by the absence of this species on 20 March, when a major yachting regatta took place (no other boating was permitted), and on other yachting days, while the Reed Cormorant (Section 4.1.2) was present in numbers up to 54 birds. Whitebreasted Cormorants also occurred when large numbers of people were present, e.g. with 198 people on 13 March.

The Whitebreasted Cormorant did not occur in substantial numbers, and only on 99 of the 300 count hours, though on both quiet and heavily disturbed days. However, of the 30 count hours when over 64 people were present 25 had no Whitebreasted Cormorants, the other five counts totalling one or two birds. On only two observations were there more than two birds when over 25 people were present (Table 1).

4.1.2 Reed Cormorant

Recorded on 256 count hours, throughout the review period, and numbering up to 81 birds (1400 hours on 4 march, a quiet day), this species exhibited a greater tolerance of sailboards, diving on their approach; powerboats and waterskiers flushed the birds. The high degree of disturbance recorded for yachts was unexpected, particularly with the substantial numbers (up to 54 birds) present during the yachting regatta on 20 March. When disturbed by a yacht, as with sailboards, Reed Cormorants dived briefly, emerging about 10 metres to the side. On only 10 occasions were there more than five birds when the people present exceeded 25. Of the 30 observations when more than 64 people were present, in 20 there were no Reed Cormorants and in only four were there more than five birds (Table 2).

4.1.3 Darter

The Darter followed the same disturbance pattern as the Reed Cormorant (Section 4.1.2), where yachts exhibited a higher level than sailboards, and where powerboat disturbance was greater than for numbers of people;

this is ascribed to similar habits to the Reed Cormorant as observed. However, numbers were far lower (a maximum of 10 birds, on 20 March at 1100 hours and 15 April at 1800 hours), as with the Whitebreasted Cormorant (Section 4.1.1). Darters appeared in 215 hours throughout the period of review and their numbers could well have been underestimated owing to a habit of inconspicuously swimming with only the head and neck above the surface. Darters were put to flight by powerboats, generally moving to the South Lake on these occasions. Of the 30 count hours with more than 64 people present 22 had no Darters and on the other eight there were only five birds or less. On only one observation were there more than five birds when over 25 people were present (Table 3).

4.1.4 Flamingos

The Greater Flamingo and Lesser Flamingo are discussed separately in Appendix G, but are dealt with collectively here as their habits and reactions to disturbance on the North Lake were similar. Flamingos were present on 117 count hours, between 27 February (11 Greater Flamingos) and 10 May (250 Greater and 350 Lesser Flamingos) and occurrences of numbers of more than 100 birds of both species exceeded occurrences of numbers of under 100; the highest number for a mixed flock was 600.

The pattern of disturbance levels follows that for the "normal", i.e. Coot and number of species, except that the yachts level exceeds that for sailboards.

Flamingos are very sensitive to disturbance - on no occasion were 100 birds present with more than 25 people. Of the 30 observations when more than 64 people were present, 29 had no flamingos and on the 30th there were only five birds (Table 4). On 12 days when waterskiing took place flamingos never occurred in the water in any of the sectors when the waterskiers were present. On only two waterskiing days were they present in water sectors, even after waterskiing had taken place (Section 3.5.2).

4.1.5 Anatidae

Six species are dealt with here (though separately in Appendix G), viz. the Spurwing and Egyptian Geese, the Cape Shoveller, Yellowbill, Redbill Teal and the Cape Teal. These waterfowl are grouped under their family heading owing to their observed habit of taking cover during the hottest period of the day, foraging early and late.

While the Spurwinged Goose and Cape Teal were rare stragglers to the North Lake during the review period, the principal species was the Cape Shoveller with a maximum of 89 birds (14 April, 1900 hours). Individuals of this family appeared on 199 count hours, between 25 February and 10 May, with the Cape Shoveller present on all occasions. The disturbance pattern is less close to the "normal" than that for flamingos (Section 4.1.4). For this group sailboard disturbance is greater than yachts or powerboats; the powerboat level is exceeded by that of yachts (Section 5.2.2). This is explained in that ducks tended to fly off (unlike Coot which moved aside or to other parts of

the lake, or ashore) when approached by craft of any kind (sailing exceeded powerboating).

As with the Whitebreasted Cormorant (Section 4.1.1) ducks and geese were present on both quiet and disturbed days. However, of the 30 count hours with more than 64 people present 26 had no Anatidae and only one had more than 10 of this group. On only five observations were there more than 10 birds when there were between 26 and 64 people present (Table 5).

4.1.6 Redknobbed Coot

The most abundant on the North Lake and as the principal indicator species Coot were recorded in all 300 observations with a maximum count of 565 birds on 15 April (1200 hours). Unlike Anatidae (Section 4.1.5) numbers (centred mainly in Water 1) built up around midday (on quiet days). Their suitability as a major indicator is enhanced by their habit of regularly occurring in all eight count zones; on 76 count hours Coot were recorded from all zones simultaneously.

The levels of recreational disturbance for this species have hence been taken as the "normal", especially as this coincides with the trend for the number of species. On no occasion when only two people were present were there less than 200 Coot; only on two were there less than 300. On only four occasions did over 300 Coot occur when more than 64 people were present, eight counts when there were more than 25 people (Table 6).

During 12 days when waterskiing took place, with only one exception, the average number of Coot in the relevant sector was markedly reduced for the count hours concerned (Section 3.5.2).

4.1.7 Blacksmith Plover

Blacksmith Plovers appeared on 212 count hours, throughout the period, with the largest numbers (up to 10 birds) in the club grounds. The highest recorded for the lake was 18 birds at 0800 hours on 27 March; with movements between the North Lake and the adjacent residential areas, numbers around the lake should reach between 20 and 30; two birds foraged on a traffic-island in the adjacent Otto du Plessis Drive on 3 May.

Disturbance patterns follow the "normal", except for yachts which indicated the highest level of disturbance (Kendall) or second highest (Spearman). This was unexpected, as Blacksmith Plovers were observed to forage just away from the water - counts for the water sectors were mainly for birds in flight. At the yachting regatta (20 March) only four birds appeared, at the SE roost during the lunch break (1300 hours); as shoreline birds the apparent reaction of Blacksmith Plovers to disturbance on the water can be explained by large numbers of people (up to 103) in attendance ashore.

On no counts did Blacksmith Plovers exceed five when there were over 25 people. Of the 30 observations with more than 64 people 24 had no Blacksmith Plovers and only six had between one and five birds (Table 7).

4.1.8 Kelp Gull

Although reaching a maximum of 580 birds (25 February, 1100 hours), this marine species was not as numerous as the Coot in the long term. Secondmost abundant on the North Lake and recorded on 296 count hours throughout the review period, the Kelp Gull constitutes an anomaly. With the exception of yachts, which show the highest degree of disturbance, all levels are positive as against negative results for all other variables.

Levels for this gull are all close, within a margin of 0,2519 (Spearman) or 0,1962 (Kendall), indicating that recreational activities are well tolerated - see Section 3.4. This is further acceptable in that the Kelp Gull has adapted itself well to man, with which it associates a regular food supply; on eight occasions when more than 64 people were present, there were over 250 birds (Table 8). However, only three times did a single bird enter the club grounds, after scraps, and it is evident that they are attracted to the lakeshore as a roost and loafing area, and the water for bathing, obtaining food mainly from the adjacent Atlantic coastline towards Blaauwberg Strand and Table Bay, and rubbish tips inland, passing over Rietvlei in transit. Movements have been erratic, though at most counts birds were congregated at the NW roost, with numbers fluctuating considerably during this period.

4.1.9 Hartlaub's Gull

Though not as numerous as the Kelp Gull, this marine species was recorded throughout the review period, on 273 count hours with a maximum of 64 at 1200 hours on 4 March. This species entered the club grounds more frequently than the Kelp Gull, taking scraps from bins and even settling on cars. Disturbance levels, although negative, are low, the greatest being that by waterskiers. As with the Kelp Gull this species does not appear to suffer through recreational disturbance, having adapted itself well to man as a source of food; on nine occasions with more than 64 people there were over 20 Hartlaub's Gulls present (Table 9).

4.1.10 Terns

Five species were recorded (four of which marine), from the initial date. Individually covered in Appendix G but discussed here collectively, they are the Caspian Tern (resident, but very rare), "Comic" Tern (Common and Arctic Terns combined, indistinguishable in the field, a migrant frequently occurring through the review period), Sandwich Tern (a migrant, which vanished after 19 April), Swift Tern (common resident, recorded throughout) and the Whitewinged Black Tern (a migrant lake tern, which disappeared after 3 May). Terns occurred on 283 count hours, the "Comic" the most abundant with 150 birds on 25 April (1400 hours), apparently a gathering of departing migrants. These birds are very sensitive to disturbance (Frost, 1976), and levels were highest for active powerboats, which roosting terns could not tolerate. People,

yachts and sailboards, though exhibiting slightly lower disturbance levels, were hardly tolerated more, with birds moving to the South Lake when only one yacht or sailboard approached flocks at the NW roost. Of the 30 count hours when over 64 people prevailed, 22 had only four or less terns and on only one occasion were there over 25 terns. On no counts were there over 25 terns when there were between 26 and 64 people present (Table 10).

4.1.11 Number of Waterbirds (of all 38 species recorded)

Here, disturbance levels follow the "normal", an exception being that yachts exhibit a higher level than sailboards, probably as this is the case for six of the other 11 variables. On no occasions were there less than 400 birds when only two people prevailed. Of the 30 observations with over 64 people there were none with more than 450 birds (Table 11).

In comparison with the number of species (Section 4.1.12) there is a difference in terms of bird numbers. The first 10 variables (Sections 4.1.1 to 4.1.10) represent larger numbers of individuals whilst with species numbers (Section 4.1.12) this includes many species which represent few individuals, hence the difference in the disturbance trend between the number of waterbirds and species numbers.

4.1.12 Number of Species

As with the Coot, the disturbance levels follow the "normal" trend. On

96 out of 115 count hours with no disturbance there were more than 15 species present. On only one out of 30 observations with over 64 people were there more than 15 species (Table 12).

4.2 RECREATIONAL ACTIVITIES/DISTURBANCE

Recreational activities on the North Lake are covered more fully in Chapter 1, Section 1.2. Here, the more significant forms of recreation/disturbance, as presented in Chapter 3, Section 3.2 (correlation coefficients), are discussed.

4.2.1 Number of People

Collectively, human activity has proved the greatest source of disturbance - the highest number on a single count was 289 people (27 March, 1400 hours) - as borne out by levels for the Whitebreasted Cormorant, flamingos, Anatidae, Coot, Blacksmith Plover, numbers of waterbirds and species numbers, i.e. seven variables. The highest levels are for the Coot (the principal indicator species) and this, together with those for waterbird numbers and numbers of species, is clearly apparent. The graphs in Section 3.3 are self-explanatory. Birds are disturbed by people in many ways; these include the recreational activities which follow.

4.2.2 Active Powerboats

Powerboats in motion, with a combination of noise and movement, emerge as the second highest disturbance factor, the greatest form of recreational disturbance. Powerboats occurred on 63 count hours, with a maximum number of nine at 1300 hours on 27 March (see Section 1.2.3.3). For the Darter and Terns powerboats exhibit the highest disturbance levels, second highest for Whitebreasted and Reed Cormorants, flamingos, Coot, Hartlaub's Gull, number of waterbirds and species numbers. With the Reed Cormorant and Hartlaub's Gull disturbance by powerboats has been greater than that by people in general. Powerboats have, in addition, been observed to create wash along the lakeshore to which roosting terns were particularly sensitive.

4.2.3 Sailboards

These come third in general disturbance levels, second only to active powerboats, though in no case did they prove the greatest disturbance. Boardsailors, unlike powerboats and yachts, enjoy greater ease of access - sailboards were present on 120 count hours, throughout the review period (see Section 1.2.3.1.) There are thus many more, 21 in a single count (8 April, 1600 hours), hence the high disturbance levels: sailboard occurrences nearly double those of powerboats and nearly treble powerboat numbers at maximum counts. For Anatidae sailboards present the second greatest disturbance, third in terms of Coot, Hartlaub's Gull and number of species. The effect of sailboards on Coot and number of species, the principal indicators, is only a small margin

below that of active powerboats, less than 0,01 for Coot and less than 0,02 for the number of species.

4.2.4 Yachts

The reactions of various species to yachts has not shown a clear-cut pattern. With the Coot and number of species, yachts generate lower disturbance levels than sailboards. The same applies to the Hartlaub's Gull and the Anatidae, but with Anatidae the level is greater than that for active powerboats. Yachts occurred on 75 count hours, with a peak of 27 (20 March, 1000 hours) at the regatta, with 58 counts for only one to six craft and 54 for one to four yachts. With all other variables yachts exceed sailboards in disturbance levels; in regard to the Reed Cormorant, Blacksmith Plover (Kendall) and the Kelp Gull yachts unexpectedly constitute the greatest disturbance - see Sections 4.1.2, 4.1.7 and 4.1.8 - while for the Blacksmith Plover (Spearman) and Darter disturbance by yachts was the second greatest.

4.2.5 Waterskiing

This disruptive form of recreation, leading birds to vacate large areas of the lake, did not occur as frequently as other activities. Disturbance levels were consequently low, except for the Hartlaub's Gull for which this emerged as the greatest disturbance factor. Counts of powerboats towing waterskiers were for only one in 33 of the 37 count hours recorded, the maximum being three on 27 March (1200 and 1500 hours). Strict regulations apply for this type of sport, which took place only

on 12 of the 30 days of counts. However, with disturbance levels low because of infrequent occurrences, contrary to my intuitive ranking of effects on aquatic avifauna (Section 3.2), the few waterski occurrences were examined in terms of the 12 relevant days only (Sections 2.4 and 3.5). In all but one case Coot were reduced in numbers with waterskiing present. Furthermore, there was no count hour where waterskiing and flamingos occurred together in the same zone (see Section 3.5).

4.2.6 Dogs

Disturbance by dogs, though highly disruptive to roosting birds on occurrence, was minimal, as dogs appeared only on 30 of the 300 count hours with a maximum number of three on a single count (7 April, 1400 hours); of these, 20 observations were for only one dog. Such is due to regulations prohibiting the animals. With the exception of the Whitebreasted Cormorant and the two gulls, dogs generated the lowest disturbance levels, due to the relatively few occurrences.

4.3 WEATHER CONDITIONS

Meteorological data were collected for the North Lake on each count hour for the elements which follow. Further details regarding collection appear in Appendix E, together with the scoring sheets.

4.3.1 Wind Direction

This had little effect upon waterbird movements. The only major change to note was that during strong NW winds (towards winter), numbers of Reed Cormorants and Darters tended to roost on the southern shoreline of the club grounds (Map 4) instead of at the SE roost; these birds returned to the SE roost, or moved into Water 1 between, when disturbed by my arrival before 0800 hours. Although numbers of Kelp Gulls made increasing use of the SW roost as winter approached (May), others continued to frequent the NW roost as usual; on the other hand, in summer, with the wind predominantly from the SE, although fully exposed, Kelp Gulls congregated almost entirely at the NW roost, except for smaller numbers in Water 2. The distribution of Coot on undisturbed days throughout the review period was not affected by wind. People (Section 1.2.3.10), on the other hand, responded to wind direction, e.g. this determined which barbecue sites were more frequented on a given day.

4.3.2 Wind Speed

The highest recorded was a south-easterly gust at 82 kilometres per hour, on 30 March at 1600 hours. Wind speed, although expected, had little effect; Kelp Gulls at the NW roost frequented this site daily regardless of wind direction or speed. Coot numbers remained generally constant on quiet days. Flamingos, however, visited the NW parts of the lake more frequently as winter approached, when the area provided some shelter from NW winds and was less exposed to south-

easterlies. Cormorants and Darters, feeding below the surface, exhibited no evidence of behavioural response to wind speed. In contrast, sailing activities are directly affected; on 20 April (1600 hours) a flat calm forced boardsailors to paddle back to shore.

4.3.3 Dry-Bulb Air Temperature and

4.3.4 Wet-Bulb Air Temperature

From observations no significance in relation to waterbird behaviour was noticed. These two sets of data were obtained to calculate relative humidity (4.3.5). For dry-bulb readings the highest recorded was 35°C on 20 April (1200 hours) and the lowest 13°C on 10 May (1800 hours). For wet-bulb temperatures the corresponding records were 23°C (20 April, 1200 hours) and 11°C (10 May 0800 hours). Air temperatures directly affect recreational activities; see 1.2.3.10.

4.3.5 Relative Humidity

Relative humidity throughout the period of review tended to show a high percentage, mainly between 70 and 100 (see 4.3.7). This is due to the close proximity of the observation point to the water surface; relative humidity can be increased by evaporation (Strahler, 1975). With constant high readings recorded throughout the review period (an exception of 28% occurred on 20 April with hot easterly winds off the interior), no significance could be noted in relation to waterbird movements.

4.3.6 Cloud Cover

This varied throughout the period of review. On cloudy to overcast days more waders and duck were in evidence around noon. Other than this, no behavioural response was observed. The pattern of Coot distribution remained unaltered by fluctuations in cloud cover.

4.3.7 Precipitation

Precipitation occurred mainly as rain (18 count hours, over six days), though dense fog also prevailed (16 count hours, over four days) with a relative humidity of 100%. On 15 April there was rain at 0800 hours and fog at 1600 and 1700 hours. With only nine days of precipitation throughout the period of review, the only waterbird behaviour particularly noted was that birds were more sedentary when visibility was reduced by fog. Movements in rain by waders and duck were similar to those on cloudy days. Recreation in contrast was reduced on wet days, though some waterskiing did take place in dense fog on 13 March.

4.3.8 Water Temperature

This remained generally stable, between 17°C (10 May) and 26°C (23 February). Temperatures from 19°C to 23°C prevailed almost throughout the period of review, records below 19°C occurring only in May. No behavioural response by birds could be noted.

4.3.9

Since fine weather was in general associated with a high level of recreational activity, and bad weather with a low level of recreational activity, it was not possible to separate the effect of weather conditions from the effect of disturbance. Using multiple regression techniques, Professor L.G. Underhill was able to demonstrate that recreational activity was having more effect than weather conditions on numbers of waterbirds.

CHAPTER 5

GENERAL CONCLUSIONS AND IMPLICATIONS FOR CONSERVATION

5.1 GENERAL CONCLUSIONS OF THE STUDY

The study proves that recreation does have a definite effect on aquatic avifauna.

The above statement, however, is rather general and requires further qualification. The level of effect on waterbirds varies according to the particular form of recreation.

5.1.1

Human activity (the number of people, irrespective of how occupied) emerges as the principal source of disturbance (Sections 3.1; 3.1; 3.4; and 4.2.1). The highest rate of increase in disturbance takes place when the number of people present increases up to 25, beyond which the rate decreases.

5.1.2

The greatest recreational disturbance is that by active powerboats (Sections 3.2 and 4.2.2), followed closely by sailboards (Sections 3.2

and 4.2.3). Other forms of recreation had less effect; yachts (4.2.4) exhibited an unpredictable pattern in relation to some species and the effects of powerboats towing waterskiers (4.2.5) and dogs (4.2.6) emerged as minimal over the whole period owing to few occurrences.

5.1.3

Powerboats towing waterskiers were shown, for the 12 days in which they occurred (Sections 2.4 and 3.5), to have created a widespread disturbance. Waterskiing in any water area frequented by birds might well lead to desertion of that area as a whole by birds.

5.1.4

Low-flying aircraft and helicopters, although highly disruptive on occurrence, particularly to flamingos (1.2.3.12; 1.2.3.13 and Appendix G) prevailed at so few counts that disturbance on the North Lake in the long term was insignificant. An increase in occurrences of this non-recreational activity would, however, present a different picture.

5.1.5

The principal indicator species of disturbance was the Redknobbed Coot, owing to its greater numbers (Sections 3.2 and 4.1.6). Flamingos, however, were more sensitive to noise (1.2.3.12; 1.2.3.13 and Appendix G). The two gull species (4.1.8 and 4.1.9) exhibited less sensitivity to disturbance (Section 3.2) owing to having adapted well to man as a food source (Frost, 1976). Terns, in contrast, are very sensitive

(4.1.10), vacating roost sites on the initial sign of recreational activity.

5.1.6

Although meteorological data (Section 4.3) were collected it was evident that weather conditions served more as a brake on recreational activity than a factor determining movements of waterbirds.

This study may serve to draw respective parallels of probable disturbance by recreational activities with other wetland systems in the south-western Cape, elsewhere within South Africa, and overseas. Although unique in its situation - the permanent status of the dredged lakes is artificial - the patterns of birds and recreational perturbations are likely to be comparable with other wetland systems under similar circumstances.

5.2 SUGGESTED IMPLICATIONS FOR CONSERVATION

Considering the role played by phenomena exogenous to the wetland ecosystem in its recent history, three interrelated implications for conservation can be observed from this particular study.

5.2.1

Because of the favourable recreational conditions offered by wetlands, such systems have become subject to increasing interference by man;

there is a need to view avifauna as an important component of the wetland ecosystem.

5.2.2

In order to establish that certain measures of nature management should be implemented, a working knowledge of the effects and interactions of various factors affecting waterbird populations should be at hand.

5.2.3

Through the destruction of their characteristic habitats, avifaunal species may decline or even become extinct. Direct protection by establishing sanctuaries may be necessary to prevent such an outcome from taking place.

De Roos (1981) argues that birds and man, however, are of direct and indirect importance to each other. For example, new habitats such as the dredged lakes can be directly provided as a form of protection; on the other hand, species such as the Kelp Gull have benefited through an indirect interaction with man (see 4.1.8). From this study it is evident that management of the wetland ecosystem and its birds cannot focus on the intrinsic features of conservation-worthy areas in isolation from potential external influences; hidden costs of likely extraneous variables, in particular man's increasing recreational needs and demands, should be carefully considered.

CHAPTER 6

RECOMMENDATIONS

6.1 SPECIFIC RECOMMENDATIONS FOR THE DREDGED LAKES

While the permanence of the dredged lakes is artificial, they form the only permanent bodies of water in the Rietvlei system - see Section 2.1(a). Even though, years ago, before the lakes were dredged, other wetlands provided birds with a permanent water habitat during the dry season, these alternative systems have become heavily utilised (Appendix B). Present recreational levels on the North Lake, however, appear to have no long-term effect upon existing bird populations, though there is the need to exercise care in future management. In view of the role enacted by conditions extraneous to the wetland system, certain recommendations for waterbird conservation on the dredged lakes can be presented.

6.1.1

The South Lake provides an alternative refuge for waterbirds during periods of heavy recreation on the North Lake, and should therefore be set aside permanently as a bird sanctuary. A proliferation of aquatic sports (particularly sailboards and powerboats) in the South Lake should be discouraged.

6.1.2

In order to prevent disturbance of the birds by dogs, adequate fencing, and notices prohibiting the animals should be erected in all areas where either lake would be readily accessible to expanding residential zones. It would be preferable to have both lakes completely fenced in.

6.1.3

The numbers of people should be regulated, through the use of access points, charges, and regulations for specific recreation types and days. It would be advisable for the club to serve as the sole access point.

6.1.4

Vehicle access along the South Lake, and to North Lake sites presently inaccessible to cars should be prohibited, as this would disrupt potential breeding sites. In order to control the number of users of the lakes' shores access to either lake from Otto du Plessis Drive (Maps 3 and 4) should not be made possible.

6.1.5

Powerboats, particularly with waterskiers, and sailboards, should not be permitted to exceed present numbers, especially if the South Lake remains accessible to them. As has been shown in Section 3.5, the effect of waterskiing, though for only 12 of the 30 count days, can be very disruptive and this sport should be carefully monitored.

6.1.6

Low-flying aircraft and helicopters should be routed away from the lakes in order to minimise their noise impact.

6.1.7

Public awareness of the importance of the lakes as a bird conservation area should be promoted, with an emphasis upon public education and the provision of interpretative facilities. For this an education officer should be available to monitor suggestions and make necessary adjustments.

6.2 SUGGESTIONS FOR FURTHER RESEARCH

This study was limited to the North Lake, and therefore was unable to incorporate movements of disturbed birds into other parts of the Rietvlei system or further afield. A further drawback was in that this project covered only the period from February to May. Bearing these limitations in mind, the following suggestions for further research are put forward.

6.2.1

If the North Lake remains the principal aquatic recreational area, observations for the other seasons should be studied to provide a comparative set of data. Roost patterns are subject to fluctuating water levels so for times other than the summer-autumn period different roost patterns could occur.

6.2.2

It would be necessary to investigate the future needs and demands of recreational users of the area, in terms of population growth and increasing pressure. Rietvlei is in a metropolitan area and new forms of aquatic sport are likely to appear.

6.2.3

The impact of new forms of aquatic sports on similar lake systems could be studied in an attempt to anticipate an equivalent impact should such sports be introduced to Rietvlei.

To be able to conceptualise the wetland ecosystem as a complex of inter-relating interdependent parts is emphasized. Only when these inter-relationships are better understood can the full implications and repercussions of different recreational forms on the wetland ecosystem be identified.

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A P P E N D I C E S

APPENDIX A.

THE EXISTING SYSTEM AT RIETVLEI.

Rietvlei, 33°53'S 18°29'E, is one of the great wetland systems of the south-western Cape Province, lying ten kilometres north-east of Cape Town in a flat low-lying basin formed by the Diep River. This river rises in the Riebeeck Kasteel mountains north of Malmesbury, flowing south-westwards for some 60 km to form the Rietvlei system itself (Maps 1 and 2). With its main tributary, the Mosselbank River, (Map 1), the Diep drains a catchment area of over 1400 square kilometres, though there is no flow for most of the year. With numerous areas of marshy ground, and reed-beds, adjacent to and along some reaches, the main flow-channel is far from clearly defined.

Rietvlei is bounded in the north by Table View Township, in the east by the municipal sewage works, Koeberg Road and the Milnerton Race Course, in the south by the housing area of Brooklyn and in the west by a system of coastal dunes forming a peninsula, rising to 16 metres, which lies between Rietvlei and the Atlantic Ocean at Table Bay. Generally low-lying, the maximum elevation of the wetland system is about 2 metres above mean sea level.

South of Table View the main system forms a wide triangular basin (Map 2) of some 500 hectares and approximately 3 km in length along its northern edge; its north-south width is some 1,5 km. This is dry for most of the year, except during winter and for short periods following floods. In the north-western corner the two dredged lakes (Map 3 and Appendix C) form a permanent body of water. At the basin's southern apex (marked by the Otto du Plessis Drive embankment and bridge built in 1961) the flow-channel re-establishes itself increasingly within a narrow flood plain until a wooden road-bridge, which links the Milnerton Golf Course on the

peninsula to Otto du Plessis Drive (Map 2) is reached. Below this bridge, the channel, locally known as the Milnerton Lagoon, is contained along its eastern bank by a concrete wall and is subject to a tidal influence. At the mouth, the remains of an old weir are evident on the western bank; here, the river is cut off at times from the sea by a large sandbank.

Owned by Milnerton Estates and South African Transport Services (formerly South African Railways and Harbours Administration) and lying within the Milnerton municipal area, Rietvlei was nominated in 1982 for declaration as a nature area (Section 1.1).

Negotiations have been in progress for Milnerton Estates to repurchase the north-western dredged areas, previously sold by them to S.A.T.S. (see Section 2.1) who used the material dredged to supply filling for the container-basin extension to Table Bay Harbour; it is evident S.A.T.S. have no further short- or long-term needs for any land at Rietvlei.

The Milnerton Municipality is currently renting a portion of Rietvlei from Milnerton Estates, in turn sublet to the Sports Foundation which provides facilities for yachting and power-boats. Rietvlei functions as a metropolitan recreational area but also provides a habitat for a variety of bird life and other fauna.

Existing land-use in the immediate area can be listed as follows:

(1) The major road network.
(2) Pipeline servitudes.
(3) The Milnerton Race Course.
(4) Golf Course.
(5) Municipal Sewage Disposal Works.
(6) Fertilizer factory (Fedmis).
(7) Petroleum Refinery (Caltex).
(8) Milnerton and Table View Townships.

Pollution is largely from two sources, the Diep River and the Milnerton Sewage Works. From the river, which drains agricultural land, this is in the form of organic and inorganic materials and the silt load is high. Pesticide residue concentrations are not known. From the sewage works pollution is by residual organic material (dissolved and settleable), nutrients such as nitrogen and phosphates, and faecal bacterial concentrates. Nutrient encroachment may also originate from the fertilizer factory while considerable pollution is also possible from non-point sources such as surface runoff.

Fauna and Flora

Rietvlei is a viable ecosystem of adequate size, with a diversity of co-existing biological forms. The shallow conditions support life cycles which range through food chains of invetrebrates, insects, amphibia, fish, birds and small mammals such as Grysbuck, Steenbuck and Duiker. With the general basin shallow, the sun penetrates to the floor in some areas, where photosynthesis can occur, a process which benefits from turbulence and an exchange of water layers brought about by wind. When the water recedes in the early summer wide mudflats exposed attract large numbers of waders. Rietvlei is known to support 158 species of birds (Winterbottom, 1960) and is the best wetland system for breeding waterbird numbers in the south-western Cape; it is also an important collection, pairing and distribution centre for birds prior to the breeding season. Nesting occurs in dense cover along the periphery. Rietvlei's importance to birds is increased by a contrasting variety of supporting habitats such as mudflats, dense reedbeds providing sanctuary, and open water, a combination enhancing species diversity. Further aspects of the importance of Rietvlei to aquatic avifauna appear in Appendix B.

Recreation/History

Rietvlei saw use as a recreation area relatively recently. Early records state use as a cattle post in 1683; formerly, grain from the Malmesbury area was conveyed through Rietvlei by sailing barges at the time of Jan van Riebeeck (1660's). The river mouth has moved north since 1786, and has been in its present position since about 1888 (van der Spuy, 1982). Siltation, leading to diminished flow, has always presented a problem, as indicated by maps drawn in 1846 and 1860. This led to dredging in the Milnerton Lagoon area in 1905 in preparation for rowing regattas; the area has served boating activities since.

For its size, Rietvlei proper generally offers limited recreation potential; the greater part is dry in summer, when only 5% is submerged at the season's height. During the winter (Borgstrom, 1982) up to 95% is covered, but this is too shallow, and choked by aquatic vegetation, for the purpose of water sports. Canoeing has met with some success. Down near the Milnerton Lighthouse, south of the Golf Course, powerboats, camping, barbecues and fishing have been forbidden (Borgstrom, 1982), with the result that water sports have imposed a greater pressure on the dredged lakes in the north-west.

Just south of the dredged lakes the Cape Radio Flyers' Club (leasing the ground) has a small facility from where members operate model aircraft. On one Sunday in May, 1982, M.C. Borgstrom at one time observed 30 cars, and 7 aircraft aloft generating a high noise level. However, these should bear little to no effect upon birds at the dredged lakes as the craft are localised at a radius of 200 metres from the radio controllers.

APPENDIX B.

THE IMPORTANCE OF RIETVLEI TO AQUATIC AVIFAUNA.

Following mention of Rietvlei's importance as a habitat for birds, in Appendix A, the importance of the wetland system can be further borne out by the following five actions, which occurred during the 1950's elsewhere in the Cape Peninsula area.

(1) Wetlands on the Cape Flats have been drained and bulldozed, for use as building sites, farming and so forth. It is interesting to note here, however, that the construction of the N2 freeway has led to the formation of smaller lakes where runoff has been impeded.

(2) Sandvlei (Lakeside) was dredged for boating purposes during 1959 followed by construction of the Marina da Gama, leading to a far greater recreational pressure. Sailboards have proliferated during the last 5 years.

(3) At Zeekoevlei a weir was constructed to maintain water level; subsequently housing development has expanded in recent years.

(4) The Black River Marshes were overbuilt with a freeway, with canalisation of the river.

(5) Rondevlei, though a bird sanctuary, has suffered in recent years a proliferation of invasive grass and other vegetation which has reduced the feeding area for birds along its edge, leading, in 1980, to the introduction of two male hippopotami in an attempt to alleviate the problem. Two females followed in September, 1983.

In contrast, at Rietvlei, bird populations have grown and the immediate area of the wetlands has remained relatively unspoilt. This can be borne

out by a comparison of two sets of Cape Bird Club counts. The first were collected from 1952 to 1958 under Prof. J.M. Winterbottom, the findings recorded in 1960 (Winterbottom, 1960). The second set, commenced in 1980, are still in progress. For the purpose of this comparison the following table, drawn up by U.M. Götz (1982), for the average of the years 1952 to 1958 and for the period April 1981 to March 1982, is appended.

TABLE B.1

A comparison of the numbers of the more common birds found at Riet Vlei, during the period April to March for

i) 1952 - 1958 (from Winterbottom, 1960)

ii) 1981 - 1982

with * denoting migratory birds.

	BIRD \ MONTH		APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR
BIRDS OF THE MUDFLATS	LITTLE STINT*	i	0	0	0	0	0	62	51	560	485	226	68	10
		ii	183	11	0	2	170	586	1700	840	1700	620	580	260
	RUFF*	i	0	0	0	0	51	358	91	700	424	33	1	0
		ii	125	2	0	1	330	400	700	550	650	1250	990	180
	AVOCET*	i	0	0	3	0	0	69	156	240	34	0	0	0
		ii	160	140	60	65	45	80	90	150	200	40	35	30
	STILT	i	0	264	130	98	47	49	48	97	59	0	1	0
		ii	73	629	500	224	228	93	122	64	26	2	5	6
	GREEN-SHANK*	i	0	0	0	0	15	24	43	53	38	0	0	0
		ii	1	2	0	7	2	7	6	10	18	9	8	2
	RINGED PLOVER*	i	3	0	0	0	0	0	0	30	110	55	200	43
		ii	21	0	0	0	0	3	23	23	120	99	113	58
	KITTLITZ PLOVER	i	1	12	3	9	8	9	14	15	7	26	19	5
		ii	303	867	243	56	179	90	183	48	118	455	83	55
	BLACKSMITH PLOVER	i	Only small numbers											
		ii	202	192	166	83	107	60	60	53	120	153	90	52
	CURLEW SAND PIPER*	i	0	0	0	4	0	260	140	757	1205	44	0	0
		ii	205	87	14	0	907	2172	2387	2950	2550	1086	719	377
BIRDS OF THE WEEDBEDS.	RED KNOBBED COOT	i	7	1	400	396	640	264	115	82	1	0	6	6
		ii	1388	1513	1276	2946	1026	1489	869	723	566	682	666	544
	CAPE SHOVELLER	i	0	51	117	160	182	89	69	13	75	0	0	0
		ii	150	652	370	266	99	119	67	365	262	224	198	209
	YELLOW-BILLED DUCK	i	0	570	350	112	68	96	171	274	300	1	0	0
		ii	863	617	442	213	167	138	109	135	180	180	173	459
	RED-BILLED TEAL	i	0	45	0	4	6	17	32	62	21	1	0	0
		ii	125	99	79	239	250	35	83	27	48	22	6	61
	CAPE TEAL	i	0	16	24	0	3	14	3	1	0	0	0	0
		ii	74	145	81	148	259	19	17	4	15	0	1	2
	POCHARD	i	0	0	0	0	1	5	0	1	0	0	0	0
		ii	0	0	29	95	42	20	8	12	0	18	0	0
	SPOONBILL	i	Not seen often.											
		ii	33	10	11	9	43	3	10	21	80	36	7	5

TABLE B.1 (contd.)

	BIRD \ MONTH		APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR
BIRDS OF WEEDBEDS	GREATER FLAMINGO	i	1	40	1	0	0	14	48	70	80	1	0	1
		ii	685	817	1248	641	217	475	625	155	102	0	4	50
	LESSER FLAMINGO	i	9	0	0	0	0	0	5	0	0	0	0	0
		ii	1379	342	166	21	102	46	52	73	15	2	0	120
	EGYPTIAN GOOSE	i	0	12	8	7	7	5	11	10	0	0	0	0
		ii	240	102	128	83	50	26	38	152	463	186	212	245
	CRESTED GREBE	i	Found predominantly at Ronde Vlei											
		ii	4	10	12	14	29	24	33	8	2	4	5	7
MARINE BIRDS + SCAVENGERS	BLACK BACKED GULL	i	8	21	7	8	13	0	3	2	1	2	17	120
		ii	147	82	182	866	76	62	40	140	71	50	283	941
	HARTLAUB GULL .	i	0	5	10	22	49	25	11	2	0	0	0	0
		ii	44	49	61	1020	2116	3147	3598	309	224	374	195	106
	PIED KINGFISHER	i	0	1	1	1	0	0	0	0	0	0	0	0
		ii	2	7	4	1	3	8	2	9	11	3	4	1
	REED CORMORANT	i	0	0	2	5	2	0	2	2	0	0	1	0
		ii	39	86	58	38	17	7	9	11	11	61	51	78
	CAPE CORMORANT*	i	Found occasionally at Ronde Vlei											
		ii	0	0	0	20	0	6	0	0	6	8	4	15
	DARTER	i	Found occasionally at Ronde Vlei											
		ii	12	45	21	26	10	32	3	5	0	6	6	8
	GREY HERON	i	8	3	5	1	4	6	9	8	34	11	11	1
		ii	17	31	9	8	14	6	8	10	19	16	8	5
	YELLOW BILLED EGRET	i	21	4	3	2	4	6	12	7	15	3	0	0
		ii	3	2	6	7	6	1	0	5	5	6	5	8
INSECT HAWKING BIRDS	LITTLE EGRET	i	0	0	0	0	1	2	3	8	10	3	2	1
		ii	8	4	4	5	3	13	22	17	13	17	10	6
	CAPE WAGTAIL	i	10	9	14	5	9	1	5	5	4	6	6	3
		ii	69	77	89	54	45	51	51	30	46	26	36	25
	SACRED IBIS*	i	Only occasionally seen but not counted.											
		ii	11	34	24	119	43	15	0	0	1	6	6	4
	EUROPEAN SWALLOW*	i	4	7	3	3	2	2	4	4	3	3	2	6
		ii	10	0	0	1	1	0	0	53	138	320	3000	106
BIRDS OF PREY	AFRICAN MARSH HARRIER.	i	1	1	2	1	2	3	1	2	4	1	0	0
		ii	0	1	1	2	1	2	1	1	1	2	1	1

Here, we can see that a marked increase has occurred over the thirty year period. Often, where counts in 1952 showed no, or a few, birds (e.g. Crested Grebe) several were seen at Rondevlei. It is suspected that birds are moving across from Rondevlei to Rietvlei in search of new feeding grounds. The reason is not known, but this could have been precipitated by the expansion of weed at Rondevlei.

In addition, Fish Eagles, not featured in the above counts, were present at Rietvlei (1 pair) on five separate days between 8th March and 9th May, 1983 (personal observations).

In the following two tables are posited counts carried out at Rietvlei, Milnerton Lagoon and Paardeneilandvlei (south of Milnerton) for 19th December 1980 and 26th July 1981 (Underhill and Cooper 1982). Besides indicating a drop in the number of species in winter, due to migration (hence my decision not to include winter counts in this recreation/ waterbirds study) these figures bear out the importance of Rietvlei where numbers and diversity exceed that of birds at the Milnerton Lagoon and Paardeneilandvlei.

As the Fish Eagle does not appear in this set of counts either, one can infer that this species has only arrived within the last two years. The same could be said of the Little Grebe or Dabchick, recorded at Paardeneilandvlei in 1980 and 1981 but not at Rietvlei, whereas it did appear during personal observations at Rietvlei's North Lake in April and May, 1983.

TABLE B.2. COUNTS OF WADERS AND OTHER BIRDS AT COASTAL WETLANDS: RIETVLEI, MILNERTON LAGOON and PAARDENEILANDVLEI - (19 December 1980) (Underhill & Cooper, 1982)

	RIETVLEI	MILNERTON LAGOON (Blind Estuary)	PAARDENEI-LANDVLEI	TOTAL
Great Crested Grebe	54	0	0	54
Little Grebe	0	0	20	20
White Pelican	9	0	0	9
Whitebreasted Cormorant	160	4	0	164
Reed Cormorant	9	24	1	34
Darter	9	0	0	9
Grey Heron	10	0	0	10
Purple Heron	1	0	0	1
Little Egret	9	4	2	15
Cattle Egret	21	0	2	23
Blackbacked Night Heron	16	0	0	16
Yellowbilled stork	1	0	0	1
African Spoonbill	8	0	0	8
Greater Flamingo	217	0	0	217
Lesser Flamingo	145	0	0	145
Egyptian Goose	30	2	0	32
African Shelduck	9	0	0	9
Cape Shoveler	211	0	51	262
Yellowbill Duck	105	3	2	110
Redbill Teal	57	3	3	63
Cape Teal	23	12	0	35
Southern Pochard	0	0	3	3
Blackshouldered Kite	5	0	1	6
Steppe Buzzard	1	0	0	1
African Marsh Harrier	1	0	0	1
Purple Gallinule	1	0	0	1
Moorhen	6	0	5	11
Redknobbed Coot	1177	38	448	1663
Painted Snipe	1	0	0	1
Black Oystercatcher	20	0	0	20
Turnstone	7	0	0	7
Ringed Plover	207	8	0	215
Whitefronted Plover	12	2	0	14
Kittlitz Plover	559	42	1	602
Threebanded Plover	13	3	2	18
Grey Plover	2	0	0	2
Blacksmith Plover	166	61	12	239
Ethiopian Snipe	15	3	0	18
Curlew Sandpiper	5791	244	236	6271
Little Stint	2061	24	32	2117

Knot	5	0	0	5
Sanderling	0	16	0	16
Ruff	662	5	28	695
Marsh Sandpiper	66	4	1	71
Greenshank	29	5	1	35
Wood Sandpiper	18	0	0	18
Whimbrel	1	0	0	1
Avocet	28	2	0	30
Blackwinged Stilt	38	7	6	51
Water Dikkop	1	2	0	3
Cape Dikkop	2	0	0	2
Kelp Gull	88	34	4	126
Greyheaded Gull	0	1	0	1
Hartlaub's Gull	209	254	12	475
Caspian Tern	15	1	0	16
Common/Arctic Tern	122	17	0	139
Sandwich Tern	123	19	0	142
Whitewinged Black Tern	4	4	7	15
Pied Kingfisher	18	4	1	23
Cape Wagtail	92	16	16	124
TOTAL	12670	868	897	14435
NUMBER OF SPECIES	56	32	25	60

TABLE B.3 COUNTS OF WADERS AND OTHER BIRDS AT COASTAL WETLANDS: RIETVLEI, MILNERTON LAGOON AND PAARDENEILANDVLEI - (26 July 1981) (Underhill & Cooper, 1982)

	RIETVLEI	MILNERTON LAGOON (Blind Estuary)	PAARDENEI-LANDVLEI	TOTAL
Great Crested Grebe	14	0	0	14
Little Grebe	12	1	14	27
White Pelican	221	11	0	232
Whitebreasted Cormorant	19	8	10	37
Cape Cormorant	20	11	0	31
Reed Cormorant	38	4	31	73
Darter	26	0	5	31
Grey Heron	8	2	2	12
Purple Heron	4	0	0	4
Little Egret	5	5	0	10
Yellowbilled Egret	7	1	3	11
Cattle Egret	2	0	1	3
Blackbacked Night Heron	1	0	0	1
Sacred Ibis	119	2	0	121
Glossy Ibis	8	0	0	8
African Spoonbill	11	33	0	44
Greater Flamingo	641	0	0	641
Lesser Flamingo	21	20	0	41
Spurwinged Goose	40	0	0	40
Egyptian Goose	83	3	0	86
African Shelduck	4	0	0	4
Cape Shoveler	266	45	16	327
Yellowbill Duck	213	2	4	219
Redbill Teal	239	0	0	239
Cape Teal	148	27	0	175
Southern Pochard	95	0	0	95
African Marsh Harrier	2	0	0	2
Purple Gallinule	1	0	1	2
Moorhen	5	0	4	9
Redknobbed Coot	2946	319	182	3447
Black Oystercatcher	0	1	0	1
Whitefronted Plover	0	5	0	5
Kittlitz Plover	0	12	0	12
Threebanded Plover	4	0	1	5
Blacksmith Plover	83	17	2	102
Ethiopian Snipe	7	0	0	7
Greenshank	7	0	0	7
Wood Sandpiper	1	0	0	1
Avocet	43	15	0	58
Blackwinged Stilt	224	26	0	250

Kelp Gull	366	162	9	537
Hartlaub's Gull	1020	370	88	1478
Common/Arctic Tern	5	0	0	5
Whitewinged Black Tern	3	0	0	3
Pied Kingfisher	1	1	3	5
Malachite Kingfisher	3	0	0	3
Cape Wagtail	54	5	0	59
TOTAL	7040	1108	376	8524
NUMBER OF SPECIES	44	26	17	47

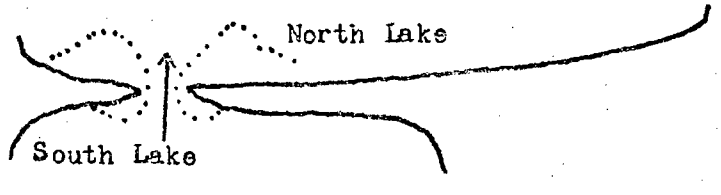
APPENDIX C.

THE DREDGED LAKES.

Following dredging by S.A.T.S. between 1974 and 1976, a fine expanse of permanent water of about 70 hectares with an average depth of 9 metres has been created in the north-western part of Rietvlei. From their situation, the two lakes, linked by a narrow gap between two sandy point bars, are known as the North and South Lakes. Both are a great attraction to bird-life, about 8000 birds are present in any one month, up to 93 species (van der Spuy, 1982) though no waterbirds breed around the North Lake. These populations remain high, irrespective of the water level, with adequate invertebrate fauna as support; a small gastropod Trachycystus vavipli-cata, once considered extinct, has been recently (1982) discovered in the North Lake.

Around the lakes, dunes are covered in stabilizing vegetation; the domi-nants are Acacia saligna and Acacia cyclops from Australia whilst another exotic, Paspalum vaginatum from South America, thrives in water sites with-in the general system. Closer to the water, particularly north-eastwards of the South Lake, lies an emergent zone of sedges, rushes and reeds, fol-lowed by a grass belt where herbs, grasses and shrubs are abundant, ex-tending around the Rietvlei system as a whole. An algal growth is begin-ning to increase in the North Lake.

The South Lake is considerably smaller, and shallower. During the summer, with prevailing south-easterly winds, sediment is carried northwards through the gap, building up the two point bars. Sediment is also conveyed out in-to the North Lake in two cone-shaped areas as indicated below:



Four water samples were collected on 10th May and measured for pH and salinity, as shown in the table below. Figures for tap- and distilled water are included as a comparison. The pH readings were taken by Mr. Dave Bligh in the Environmental Studies Laboratory.

SAMPLE	SALINITY (parts per 1000)	pH
1: NE corner, South Lake	2,5	6,5
2: Water 1 (off SE shore)	2,5	6,0
3: Water 2 (apex at count site)	2,5	6,0
4: Water 3 (along north shore)	2,5	6,5
5: Distilled water	0	4,0
6: Tap water	0	6,0

For salinity readings a refractometer was used. The ephemeral Diep River is brackish due to salts released into the water from decomposing Malmesbury slates within the catchment area. As the tidal influence cannot penetrate to the dredged lakes, this salinity is entirely due to the river, compounded during the summer by evaporation. Despite this, fauna are of freshwater forms capable of tolerating slight salinity variations. Along the north shore in summer a sandy beach has been formed by wave-action during south-easterlies; here, the pondweed Potamogeton (various species) has been thrown up to form large clumps of dry and decaying weed. Each clump supports a thriving little ecosystem, including isopods, arachnids and insects, providing a substantial food supply for wading birds.

From personal observations and earlier reports (Sylvester, 1977) the North Lake supports a large fish population. The two predominant species in 1977 were Mullet Liza ramoda and the Elf Pomatomus saltator, reported seldom to reach full adult size, though several large fish of up to half a metre in length were observed jumping in May, 1983. Large numbers of fingerlings appeared along the shore at the club grounds, a steady food

supply for cormorants, darters and terns. Divers to whom I spoke in April, 1983, at the site confirmed that algal growth was advancing on the North Lake floor; the North Lake water is exceptionally clear, though some discolouring was evident in the north-east part of the South Lake.

R.K. Jardine (1977) reported the following plants in the dredged lakes area. Arthrocnemum africanum (extensive and creeping), Oxalis purpurea, Oxalis natans, Triglochin bulbosa, Triglochin striata, Cliffertia strobilifera, Lampranthas filicaulis, Juncus kraussii, Sporobolus virginicus, Scirpus maritimus, Cotula coronopifolia and Ruppia maritima, a species of Potamogetonaceae submerged in deeper water (on sandbanks).

The low salinity of the North Lake permits its use as drinking-water by various landbirds; these include Dikkop (Stone Curlews), Crowned Guinea-fowl, doves, Cape Thrush, starlings and the ubiquitous Cape Wagtail. Observed at the club grounds were numerous striped field-mice and sand moles.

APPENDIX D.

THE DREDGED LAKES:

GENERAL, CONSERVATION AND FISHING REGULATIONS, MILNERTON AQUATIC CLUB.

1. Swimming is not permitted. The public is warned that the banks drop steeply to 9 metres of water.
2. No radios, tape recorders, record players or other devices which may cause a disturbance may be operated in the area.
3. No organic or inorganic matter of any nature may be deposited or left anywhere within the area. All litter shall be deposited in bins or removed from the area.
4. Fires may only be lit in specified areas.
5. The destruction or damage of any vegetation is prohibited.
6. The destruction or disturbance of all animal and insect life is prohibited. No firearms, weapons or traps may be taken into the area.
7. The netting of fish is prohibited.
8. The use of motor vehicles in the area is restricted to specific roads and parking areas. The speed limit is 10 k.p.h.
9. Power boats may not exceed a speed of 5 k.p.h. in the South Lake.
10. Children are not permitted to play near the slipway or launching ramps.
11. No dogs are allowed in the area.
12. Angling is permitted as a sport and no fish caught in the area may be sold.
13. The only method of angling allowed is with rod and reel. Handlines may not be used.
14: An angler may not use more than two rods at a time with not more than 2 single prong hooks per line.

15. Trolling from boats under way is prohibited.

16. Anglers shall restrict their catches to the number, species and size limits of fish laid down by the committee.

17. All fish not kept shall be returned to the water, unharmed, immediately.

18. Anglers should be in possession of a Provincial Angling Licence.

APPENDIX E.

SCORING SHEETS.

The following scoring sheets (see Section 2.2) were utilized during the North Lake counts between 23rd February and 10th May, 1983.

For the listed birds and the forms of recreation/disturbance, column 1 across the top referred to the "Roberts Number", with Columns 2 to 9 as the count zones.

However, with Powerboat Movements ("Roberts" number 920) and Weather Conditions ("Roberts" number 950), columns No. 2 onwards referred to separate phenomena, which are listed as follows:-

Powerboat Movements

Column 1: The "Roberts" number.

Column 2: The number of powerboats active during the ten minutes prior to a count hour.

Column 3: The percentage of the previous ten minutes when at least 1 powerboat was active.

Weather Conditions

Column 1: The "Roberts" number.

Column 2: Wind direction.

00 = calm; 01 = NE; 02 = E; 03 = SE, 04 = S; 05 = SW, 06 = W, 07 = NW; 08 = N.

Column 3: Wind speed in kilometres per hour.

Column 4: Celsius dry-bulb air temperature.

Column 5: Celsius wet-bulb air temperature.

Column 6: Relative Humidity, expressed as a percentage.

Column 7: Cloud Cover. This was expressed from 00 (cloudless) to 08 (overcast);

Column 8: Precipitation. 00 = none; 01 = rain; 02 = fog.

Column 9: Celsius water temperature at about 50 cms depth, off club grounds raft.

Column 10 was used for computer batch totals on all occasions.

DATE MM DD HH

SPECIES.	1. NO.	2. S.E. ROOST.	3. S.W. ROOST.	4. WESTERN ROOST.	5. N.W. ROOST.	6. WATER (1).	7. WATER (2).	8. WATER (3).	9. CLUB GROUNDS	10. TOTAL.
WHITE PELICAN.	042									
W.B. CORMORANT	047									
REED CORMORANT	050									
DARTER.	052									
GREY HERON.	054									
LITTLE EGRET.	059									
SPOONBILL.	085									
GTR. FLAMINGO.	086									
LSR. FLAMINGO.	087									
EGYPTIAN GOOSE	089									
CAPE SHOVELLER	094									
YELLOWBILL.	096									
REDBILL TEAL.	097									
FISH EAGLE.	149									
MARSH HARRIER.	167									
RED KN. COOT.	212									
OYSTERCATCHER.	231									
T.B. S'PLOVER.	238									
B!SMITH PLOVER	245									
CURLEW S'PIPER	251									
LITTLE STINT.	253									
GREENSHANK.	263									
S.B.B. GULL.	287									
H'LAUB'S GULL.	289									
CASPIAN TERN.	290									
"COMIC" TERN.	291									
SANDWICH TERN.	296									
SWIFT TERN.	298									
W.W.BL. TERN.	304									
P. KINGFISHER.	394									

DATE		MM	DD	HH							
	1	2		3	4	5	6	7	8	9	10
BOARD-SAILORS.	901										
YACHTS.	902										
STATIONARY POWERBOATS.	903										
POWERBOATS IN MOTION.	904										
POWERBOAT & WATERSKI.	905										
PEOPLE.	906										
DOGS.	907										
HELICOPTERS.	908										
OTHER AIRCRAFT.	909										
POWERBOAT MOVEMENTS.	920										
WEATHER CONDITIONS.	950										

APPENDIX F.

ZEEKOEVLEI CIVIC ASSOCIATION

SPEED BOATS - ZEEKOE VLEI.

7 November, 1960

The Zeekoe Vlei Civic Association have endeavoured for many years to prevent speed boats from using and despoiling Zeekoe Vlei, but despite all efforts, speed boats are using the Vlei in ever increasing numbers, including for races and regattas.

Week-ends are a torment to the residents, yachtsmen, rowers, bird watchers, sea scouts, and other peaceful users of the Vlei, and now, in addition, more and more speed boats are using the Vlei during the week and in the evenings. Bird life, particularly, is suffering - one of the "sports" for some speed boaters is to run down the flocks of pelicans - (see report of prosecution Cape Times November 3, where a speed boater paid an admission of guilt for this wilful act). Members of this Association were in this case able to call the Police and identify the boat and pilot - which is normally extremely difficult when the Vlei is crowded with speed boats.

The City Council has recommended certain regulations to govern the use of speed boats on Zeekoe Vlei, but not only does this Association consider that these regulations will be extremely difficult to enforce, but stands firmly by its opinion that these fast-moving craft are a physical danger to the peaceful users and wild life of the Vlei, and are quite out of place on this previously peaceful inland beauty spot - it is clear that if they are not banned altogether, Zeekoe Vlei will eventually be untenable to all but speed boaters, whose numbers increase week by week.

Counsel's opinion is that there is a very good chance of an action being successful, therefore it has been decided to proceed against the City Council to abate the nuisance of speed boats. It is, however, necessary to raise substantial funds, and we are appealing to you to support us with donations of 10/- upwards, as we feel you share with us a desire for Zeekoe Vlei to return once more to the peaceful pleasant place it used to be.

Please post donations to:-

The Secretary,
ZeekoeVlei Civic Association,
P.O. Box 14
GRASSY PARK, C.P.

The above letter was sent to me, then a schoolboy (junior member of the Cape Bird Club) 23 years ago. Access to Zeekoevlei for speed-boats has remained to this day.

APPENDIX G.

WATER BIRDS AT THE NORTH LAKE:

February to May, 1983.

The following is a discussion of 38 species of aquatic avifauna observed at the North Lake between 23rd February and 10th May, 1983. Each is numbered (with nomenclature details) according to "Roberts: Birds of South Africa" (McLachlan & Liversidge, 1978), the numbering used in the computer analysis. Reference is also made to previous observations (Scott, 1954; Winterbottom, 1960; Blaker & Winterbottom, 1968; Underhill & Cooper, 1982) where applicable. See Appendix B. Records by these authors, however, are for the complete system at Rietvlei.

4 GREAT CRESTED GREBE.

Podiceps cristatus (Linnaeus), 1758: Sweden.

Although recorded from Paardevlei, Rietvlei (54 birds on 19th December, 1980 and 14 on 26th July, 1981 - Underhill & Cooper, 1982), Sandvlei and Zeekoevlei, the Crested Grebe is only prominent on Rondevlei, and there only at times (Winterbottom, 1960). It was observed only 6 times on the North Lake in 1983 (no recreation present), from 18th March to 20th April, and then only a single bird on each occasion. It was probably the same individual. On all counts the bird moved (swam) from Water 1 to Water 3 and then disappeared.

6 DABCHICK.

Tachybaptus ruficollis (Pallas), 1764: Holland.

A more common species on all the wetland systems than the Great Crested Grebe, though in 1983 on the North Lake (from 15th April to 10th May) observed on 9 days only, with up to 4 birds at one count (3rd May). Dabchicks

remained on the water, moving between the sectors (Map 4), and were in evidence only on quiet days. Underhill & Cooper (1982) reported 12 birds on 26th July, 1981 (none on 19th December, 1980), suggesting an increase in numbers towards the winter months.

42 WHITE PELICAN.

Pelecanus onocrotalus Linnaeus, 1758: Africa.

Predominantly found on Zeekoevlei and Rondevlei, though Zeekoevlei figures are rarely more than half of those for Rondevlei; numbers have decreased on Zeekoevlei since the introduction of speedboats (Winterbottom, 1960) - See Appendix F. At Rietvlei a maximum of 50 birds was recorded on 22nd December, 1956 (Winterbottom, 1980), 9 on 19th December, 1980 and 221 on 26th July, 1981 (Underhill & Cooper, 1982). On the North Lake in 1983 birds were observed on 13 days (34 count hours), 23rd February to 9th May, but with never more than 18 at any one time (15th and 20th April); most counts were of up to 6 birds, both adult and immature. The general pattern of movement was to arrive from the north-west, forage from Water 3 to Water 1 or the South Lake, and then to depart southwards, on thermals. One landed briefly at the SE roost on 14th March before flying south; others frequented the SW roost and the western shore of the South Lake for up to 4 hours on some mornings. These movements are presumed in transit between their breeding area on Dassen Island and their Rondevlei feeding-grounds; the birds visit all the wetland systems in the SW Cape. This very sensitive species was absent from the North Lake during periods of recreational activity.

47 WHITEBREASTED CORMORANT.

Phalacrocorax carbo (Linnaeus), 1758: Sweden.

See Section 4.1.1. An uncommon species on the North Lake, recorded erra-

tically (99 count hours) 25th February to 10th May, and up to 12 birds at a time (8th March). Single individuals perched in the club grounds (harbour area), SE roost, SW roost and the NW roost, foraging also in all three water sectors (Map 4). Underhill & Cooper (1982) recorded 160 birds on 19th December, 1980 and 19 on 26th July, 1981.

48 CAPE CORMORANT.

Phalacrocorax capensis (Sparrman), 1788: False Bay, Cape of Good Hope.

This marine species is a straggler to wetlands (Winterbottom, 1960). On the North Lake it was recorded only 3 times. Three birds appeared at the NW roost on 25th February; a single bird sheltered in the club grounds, 7 April, near some divers at the observation-site, before moving off; four birds foraged in Water 3 on 14th April. Underhill & Cooper (1982) recorded 20 Cape Cormorants at Rietvlei on 26th July, 1981. In poor visibility at the North Lake this species could have been confused with the much commoner Reed Cormorant.

50 REED CORMORANT.

Phalacrocorax africanus (Gmelin), 1789: River Nile, Egypt.

See Section 4.1.2. A common species, numbering as much as 81 at one count (4th March), and recorded nearly every day throughout the 1983 review period (256 count hours). A closely related marine species, the Crowned Cormorant, Phalacrocorax coronatus, has been reported from Milnerton Lagoon (Brooke, 1983) and therefore could have occurred on the North Lake. See Section 2.1(d). With both similar, for the purposes of this study all long-tailed cormorants were counted as Phalacrocorax africanus. The Reed Cormorant was common at the SE, SW and W roosts, frequenting also the NW roost, club grounds and all three water sectors

(Map 4). Underhill & Cooper (1982) recorded 9 birds on 19th December, 1980 and 38 on 26th July, 1981.

52 DARTER.

Anhinga rufa (Lacepede & Daudin), 1802; Senegal.

See Section 4.1.3. On the North Lake records were similar to the White-breasted Cormorant (215 count hours, throughout the 1983 period of review), though in the club grounds Darters roosted just south of the observation-site. The highest number was 10 birds, recorded on 30th March and 18th April. See No. 54. Underhill & Cooper (1982) recorded 9 birds on 19th December, 1980 and 26 birds on 26th July, 1981.

54 GREY HERON.

Ardea cinerea Linnaeus, 1758: Europe - Sweden.

A fairly regularly-observed species in 1983 on the North Lake (61 count hours), though always solitary, appearing from 25th February to 9th May. Not more than 3 birds (20th March) were recorded on a single hour, one bird to a roost site. Rietvlei figures from Winterbottom (1960) and Blaker & Winterbottom (1968) indicate that numbers increase 4 to 5 months after commencement of flooding. This time-lag probably represents a period of increase in the fish population following the April low and considerable numbers of birds (21 in January, 1964) are attracted to stranded fish when the water level recedes in late summer (Blaker & Winterbottom, 1968); Underhill & Cooper (1982) recorded 8 birds on 26th July 1981, 10 on 19th December, 1980. As with the Reed Cormorant and Darter, this species breeds mainly at Rondevlei. On the North Lake birds frequented the club grounds (harbour), NW, W, SW and SE roosts, absent during recreational activities.

59 LITTLE EGRET.

Egretta garzetta (Linnaeus), 1766: "in Oriente" - Malabergo, northern Italy.

This species occurred on the North Lake (1983) in similar numbers to the Grey Heron (73 count hours, from 7th March to 10th May), utilising the same roost sites. Peak numbers occur from October to December, probably for the same reasons as for the last species (Blaker & Winterbottom, 1968): Underhill & Cooper (1982) recorded 5 birds on 26th July, 1981, 9 on 19th December, 1980. This species foraged along the shore of the club grounds and spent more time in the shallows (of all three water sectors) than the Grey Heron. Absent during recreational activities. The highest count on a single hour (8th and 25th April) was for 4 birds. Breeds at Rondevlei and Strandfontein.

85 SPOONBILL.

Platalea alba Scopoli, 1786: Luzon; probably the Cape of Good Hope.

More common than the Grey Heron or Little Egret when recorded, this species occurred at the North Lake (1983) in 27 count hours, 7th March to 3rd May, and numbered up to 10 birds (pool off NW roost) at a single count on 23rd March. Spoonbills foraged in Water 3 and Water 2, along the shore from near the club's harbour to the NW roost and along the west shore to the South Lake, utilising also the NW, W and SW roosts. There has been a marked increase in numbers and frequency of occurrances at Rietvlei (details in Blaker, 1967, cited by Blaker & Winterbottom, 1968) since first recorded in the SW Cape (3 birds at Rietvlei) by R. Liversidge in 1954 (Winterbottom, 1960); Underhill & Cooper (1982) recorded 8 birds on 19th December, 1980 and 11 on 26th July, 1981. Spoonbills were absent from the North Lake during recreational activity. They have bred

on the Berg River (Kersefontein Farm) since 1956 (Uys, 1983).

86 GREATER FLAMINGO.

Phoenicopterus ruber Linnaeus, 1758: Africa. America. - Bahamas.

See Section 4.1.4 and No.87. Both this and the next species occurred in the South Lake throughout the 1983 review period when absent from the North Lake, their presence in the South Lake indicated by their habit of rising into the air whenever an aircraft or helicopter passed over; both species exhibited a far higher level of sensitivity to noise than other birds, though did not react to traffic on the adjacent Otto du Plessis Highway. In the 1961-7 period, the Greater Flamingo was recorded only on three occasions at Rietvlei though common in 1952-8, a difference probably brought about by the creation of more suitable ecological conditions at Strandfontein rather than changes at Rietvlei (Blaker & Winterbottom, 1968), where Underhill & Cooper (1982) recorded 217 birds on 19th December, 1980, 641 on 26th July 1981. During most North Lake counts, this species was outnumbered by the Lesser Flamingo, with which it mostly occurred in mixed flocks. Greater Flamingos were recorded on 90 count hours, from 27th February to 10th May. In counting the closely-packed birds, estimates were often used; in flight individuals of both species constantly altered positions within the flock and several attempts had to be made to reach a reliable estimate. The highest estimates, in May 1983, were of 250 birds (North Lake only) while in the period 1952-8 counts for the whole of Rietvlei varied from 345 to 600 birds (Winterbottom, 1960). North Lake numbers tended to fluctuate, increasing towards the end of the review period. Both species frequented the SW, W and NW roosts, foraging along the shoreline in the north and west, in Water 3 and Water 2. On certain days both species were in the North Lake from about 0900 hours to about 1530 hours, or until the first sailboard arrived, then returning to the South Lake.

87 LESSER FLAMINGO.

Phoeniconaias minor Geoffroy, 1798: Senegal.

See Section 4.1.4 and No.86. Flocks of over 100 have been recorded from Rietvlei in May and November (Winterbottom, 1960) though not listed by Scott (1954); Underhill & Cooper (1982) recorded 145 birds on 19th December, 1980; 21 on 26th July 1981. For the North Lake (1983) estimates (in May) reached 350 birds, exceeding the last species, suggesting an increase in numbers. Here, where Lesser Flamingos were recorded on 112 count hours, from 4th March to 10th May, movements were as for the last species but on one occasion, around noon on 8th March, a separate flock of 40 birds settled for some minutes in the club grounds (Section 4.1.4) until disturbed by the caretaker's tractor. Both species exhibited a level of nervousness when the North Lake was temporarily frequented by a pair of Fish Eagles.

88 SPURWINGED GOOSE.

Plectropterus gambensis (Linnaeus), 1766: Gambia.

See Section 4.1.5. Nowadays a straggler to the SW Cape wetlands, though said to have bred in the past (Winterbottom, 1960). A regular visitor to Rietvlei, with numbers of 5 to 10 (Winterbottom, 1960) and 6 (Blaker & Winterbottom, 1968) recorded. On the North Lake, in 1983, this species was counted only three times, once on 19th April and twice on 21st April, a single bird, probably the same individual, on all occasions. Underhill & Cooper (1982) however, recorded 40 birds at Rietvlei on 26th July,1981.

89 EGYPTIAN GOOSE.

Alopochen aegyptiacus (Linnaeus), 1766: Egypt.

See Section 4.1.5 Occurs at Rietvlei in its largest numbers soon after the water level begins to rise in May (Winterbottom, 1960), where the wet-

land system probably acts as a collecting and redistribution centre for the birds at the start of the wet season (Blaker & Winterbottom, 1968); Underhill & Cooper (1982) recorded 30 birds on 19th December, 1980, 83 on 26th July, 1981. On the North Lake in 1983, where movements were largely between the NW and SE roosts, via the W and SW roosts or across through the three water sectors, numbers (103 count hours) never exceeded 35 (21st March); birds were observed from 25th February to 10th May.

94 CAPE SHOVELLER.

Anas smithii (Hartert), 1891: Cape Province.

See Section 4.1.5 By far the commonest duck in the dredged lakes, with numbers up to 89 (14th April) in 130 count hours from 25th February to 10th May 1983. Ducks exhibited the habit of fluctuating through the day, with numbers at a major peak between 0800 and 1000 hours, falling sharply through midday and reaching a lesser peak from 1600 hours. This lesser peak prevailed during both quiet and disturbed days. Cape Shoveller and Yellowbill were commonest in Water 3 and Water 1 - as morning progressed birds were to be seen flying southwards in small groups, beyond the South Lake. On occasions small numbers (up to 6) of Shoveller loafed at the W and SW roosts. Rietvlei populations showed a peak in July and a lesser peak in December (Blaker & Winterbottom, 1968). In further support Underhill & Cooper (1982) recorded 211 birds on 19th December, 1980, and 266 on 26th July, 1981. However, at the North Lake in 1983 numbers fluctuated, peaking in April.

96 YELLOWBILLED DUCK.

Anas undulata Dubois, 1837: Cape of Good Hope - near Piquetberg.

See Section 4.1.5. Common, but in the North Lake counts was not as numerous as the Cape Shoveller, though the most abundant and widely dis-

tributed of our ducks (Winterbottom, 1960). Underhill & Cooper (1982) recorded 105 birds on 19th December, 1980 and 213 on 26th July, 1981, further suggesting this species not to be as common as the Cape Shoveller, though its movements on the North Lake in 1983 were similar (see No.94); Yellowbill appeared on 77 count hours, 5th March to 10th May, with a peak of 28 birds on 15th April.

97 REDBILLED TEAL.

Anas erythrorhyncha Gmelin, 1789: Cape of Good Hope.

See Section 4.1.5. Rare on the North Lake counts, observed only in water 3 and at the NW roost, though common at Rietvlei in general where populations in excess of 200 have been reported (Winterbottom, 1960). However, there is a build-up of numbers in May after 4 months during which this duck is virtually absent (Winterbottom, 1960) and this could have just been missed in the 1983 North Lake counts (which ended on 10th May). Underhill & Cooper (1982) recorded 57 birds on 19th December, 1980, 239 on 26th July, 1981, supporting a winter increase. On the North Lake (25th February to 10th May, 12 count hours), however, there was a peak of 10 birds on 25th February.

98 CAPE TEAL.

Anas capensis Gmelin, 1789: Cape of Good Hope.

See Section 4.1.5. Recorded only twice at the North Lake during the 1983 period of review, when a pair appeared on the pool at the NW roost on 3rd May and 10th May. The pattern for this duck is complicated by a variation in numbers from year to year (Winterbottom, 1960) though there is a May-June build-up at Rietvlei (which could also have just been missed in the counts) as suggested by the North Lake counts and by Underhill & Cooper (1982) who recorded 23 birds on 19th December, 1980 and 148 on 26th July, 1981.

149 FISH EAGLE.

Haliaeetus vocifer (Daudin), 1800: Keurbooms River, Cape Province.

Recorded 38 times, especially from 1956 onwards, during the 1952-8 counts (Winterbottom, 1960) though not listed by Scott (1954), Blaker & Winterbottom (1968), nor Underhill & Cooper (1982). Subsequently, on 21st November 1982 it was sighted during a Cape Bird Club Rietvlei outing (Lockhart, 1983). It has bred at Zeekoevlei (Winterbottom, 1960), Berg River and the Cape Point Nature Reserve and observed at Paardevlei and Strandfontein (Winterbottom, 1960). During the 1983 North Lake counts a single pair (presumably the same birds) appeared on five separate days, viz: 8th March, 30th March, 14th April, 19th April and 9th May (11 count hours). Foraging around the SE, SW and NW roosts, this pair caused substantial disturbance amongst coot, flamingos and other species, and was actively mobbed by Blackmith Plovers, Kelp Gulls and Hartlaub's Gulls. The pair always arrived from the south and moved south again after a couple of hours, to beyond the South Lake. The nearest roosts were entirely deserted while the Fish Eagles were in attendance.

167 AFRICAN MARSH HARRIER.

Circus ranivorus (Daudin), 1800: Cape Province.

Listed by Scott (1954) and Winterbottom (1960), but not by Blaker & Winterbottom (1968). Regularly found at Rietvlei, where it has been known to breed (Winterbottom, 1960) but in the 1983 North Lake counts was noted only three times, on 27th and 28th February and on 4th March. On all three occasions a single bird was seen in flight over Water 1 and the SE roost, actively mobbed by a large flock of European Starlings. Its presence was not as disturbing to coot and other waterbirds as was that of the Fish Eagle. Underhill & Cooper (1982) recorded a single bird on 19th December, 1980, and 2 birds on 26th July, 1981 - these,

with the North Lake counts, suggest a single resident pair.

212 REDKNOBBED COOT.

Fulica cristata Gmelin, 1789: Malagasy.

See Section 4.1.6. A regular inhabitant of all wetlands in the SW Cape (Winterbottom, 1960) and extremely abundant at Rietvlei, which has replaced Sandvlei as the species' main refuge in the Cape Peninsula (Winterbottom, 1960). Underhill & Cooper (1982) recorded 1177 birds on 19th December, 1980, 2946 on 26th July, 1981. Abundance has increased by 340% since the 1952-8 counts (Blaker & Winterbottom, 1968) and on the North Lake during the February-May counts in 1983 (all 300 hours) this as proved by far the most common species, reaching 565 birds in a single hourly count (1200 hours on 15th April) and providing the principal indicator of disturbance due to their numbers. Coot have been counted in all areas of the North Lake with the largest numbers centred in Water 1. Along the shores of the club grounds coot were active divers, feeding on strands of Potamogeton obtained from the lake floor just off the edge, remaining submerged for up to 10 seconds. It was particularly noticeable that coot showed little tolerance of sailboards, scattering from the immediate area of the craft. The birds often foraged well away from the water, on grassy flats in the motocross area to the north (Map 3) and on well-grassed banks at the SW roost, as well as in scattered lines along the edge of the water. Disturbed birds crossed the eastern peninsula on foot from Water 1 to the South Lake. In the presence of Fish Eagles this species exhibited tremendous nervousness, deserting large areas of water.

231 BLACK OYSTERCATCHER.

Haematopus moquini Bonaparte, 1856: Africa—Cape of Good Hope.

This bird of coastal habitats was not listed by Scott (1954), Winter-

bottom (1960) nor Blaker & Winterbottom (1968), though Underhill & Cooper (1982) recorded 20 birds on 19th December, 1980. In the 1983 North Lake counts there were two records (of 4 birds) for 25th February, and one record each for 20th March (5 birds), 30th March (3 birds) and 3rd May (also 3 birds). This species frequented the SE and NW roosts and was seen in flight, southwards, across Water 2. It was also seen roosting on the east shore of the South Lake. It is expected these transitory visits were due to the close proximity of the dredged lakes to the sea (some 300 metres) and the availability of lake beaches (as a refuge during recreational disturbance on the neighbouring Atlantic shoreline) before the rise in water level in June.

238 THREEBANDED SANDPLOVER.

Charadrius tricollaris Vieillot, 1818: Africa - Cape Town.

Not listed by Blaker & Winterbottom (1968) but mentioned by Scott (1954) and Winterbottom (1960). This is a mud-lover recorded from all the wetlands in small numbers, with a maximum count of 22 for Rietvlei (Winterbottom, 1960): Underhill & Cooper (1982) counted 13 birds on 19th December, 1980 and 4 on 26th July, 1981. On the North Lake (where it foraged on all shores) during the 1983 counts (27th February to 10th May) this species did not often occur (only 18 count hours) but because of its size it could have been overlooked - it was included in counts made from Cyril Hatton's patrol-boat for the western roost (the highest count, 50 birds, 27th February) where from the observation site at the club it could readily have been missed.

245 BLACKSMITH PLOVER.

Stephanibyx melanopterus (Cretzschmar), 1826: Djedda, Arabia.

See Section 4.1.7. A maximum of 26 was recorded at one count for Rietvlei (Winterbottom, 1960). Underhill & Cooper (1982) recorded 166 birds

on 19th December, 1980 and 83 on 26th July, 1981. Uncommon, not exceeding 18 birds (27th March) on the North Lake at any one time, but recorded on 212 count hours throughout the 1983 period of review. This species, usually numbering 4 to 10 birds, foraged virtually every day on the club lawns during periods of quiet, returning to the lawns almost immediately once disturbance had died down. This species frequented the NW, SW and SE roosts, generally when there was disturbance at the club.

251 CURLEW SANDPIPER.

Caladris ferruginea (Pontoppidan), 1763: Denmark.

Well documented by Winterbottom (1960) and Blaker & Winterbottom (1968) this non-breeding migrant is common at Rietvlei - even when Rondevlei was exceptionally low and presented a more favourable feeding environment Rietvlei supported 44% of the population (Winterbottom, 1960). Underhill & Cooper (1982) recorded 5791 birds on 19th December, 1980. At the North Lake in 1983 birds were common along the north and north-western shores, in Water 1 and Water 3, foraging also at the NW roost and its adjacent pool as well as the club grounds. Birds were recorded from 5th March to 3rd May (60 count hours) with a peak of 84 birds on 7th March.

253 LITTLE STINT.

Caladris minuta (Leisler), 1812: Near Hanay, Germany.

Like the Curlew Sandpiper a non-breeding migrant from the northern hemisphere and almost as numerous (Winterbottom, 1960); Underhill & Cooper (1982) recorded 2061 birds at Rietvlei on 19th December, 1980. This was borne out in the 1983 North Lake counts (37 hours, 5th March to 3rd May, with a peak of 41 on 7th April) for which otherwise the same conditions applied as for the Curlew Sandpiper.

256 RUFF.

Philomachus pugnax (Linnaeus), 1758: Sweden.

The Ruff, also a non-breeding migrant, occurs in 50% or more of the records for Rietvlei, where flocks of over 500 birds have been reported (Winterbottom, 1960), up to 3000 birds in 1954. There has been a slight decrease since 1958 (Blaker & Winterbottom, 1968) of this freshwater species; Underhill and Cooper (1982) counted 662 birds on 19th December, 1980. This is borne out in the 1983 North Lake counts in that it appeared as a mere straggler, a single bird recorded in 4 count hours on 14th, 15th and 18th April, from the club grounds and Water 1, and probably the same individual. There is, however, the chance that this species could have been overlooked.

263 GREENSHANK.

Tringa nebularia (Gunnerus), 1767: Norway.

A widely distributed and abundant bird, though more solitary in habits than other non-breeding waders (Winterbottom, 1960). Rietvlei attracts large numbers, most departing in December-January when the waters shrink, though, as with the Ruff, there has been an inexplicable drop in numbers since 1958 (Blaker & Winterbottom, 1968); Underhill & Cooper (1982) counted 29 birds on 19th December, 1980, and 7 on 26th July, 1981. On the North Lake in 1983 (25th February to 20th April) it was only slightly commoner than the Ruff, recorded on 10 count hours (all for single birds except for 6 counted on 25th February), though less likely to be overlooked owing to its larger size.

269 AVOCET.

Recurvirostra avosetta Linnaeus, 1758: Europe - Sweden.

This breeding wader was numerous at Rietvlei in 1962 and 1964, with a

peak of 148 in November, 1962, whereas only 7 birds were recorded in 1963 and 1965 (Blaker & Winterbottom, 1968), and a large drop in numbers since 1958 can only be due to its erratic occurrence. Underhill & Cooper (1982) counted 28 birds on 19th December, 1980, and 43 on 26th July, 1981. On the North Lake in 1983 it occurred only on odd days, from 7th April, on all occasions (21 count hours) early and late in the day, and only at the pool off the NW roost. Numbers were never more than 6 birds (10th May) and three were once observed to fly south across the lake from the NW pool and disappear.

287 KELP GULL (SOUTHERN BLACK-BACKED GULL, DOMINICAN GULL).

Larus dominicanus Lichtenstein, 1823: Coast of Brazil.

See Section 4.1.8. Primarily a marine species and only a visitor, though regular, to fresh water (Winterbottom, 1960). The Rietvlei pattern indicates a winter maximum and a minimum in late summer and autumn (Blaker & Winterbottom, 1968) which however clashes with the Rietvlei counts for 1952-8 (Winterbottom, 1960). Underhill & Cooper (1982) recorded 88 birds on 19th December, 1980 and 366 on 26th July, 1981. It breeds at Swartklip (False Bay coast) in September and October and from October to January on islands in the Langebaan-Saldanha area. The slight difference in the breeding time for the two areas is possibly associated with changes in numbers at different wetlands in different months - patterns at Rietvlei and Strandfontein for the same period have differed (Blaker & Winterbottom, 1968). On the North Lake in 1983 (296 count hours) this was the second most common species, numbering (on 25th February) up to 580 birds (See Section 4.1.8), with greater numbers recorded in February-March than in April-May. Recorded every day, flocks were congregated mainly at the NW roost, being the main user of that site, and on the water (washing and loafing) in Water 2, later frequen-

ting the SW roost more as winter approached. Smaller groups frequented Water 3, while individuals entered the club grounds and Water 1 or loafed at the SE and W roosts. Large numbers also congregated in the South Lake. No explanation can be offered for fluctuations in movement (Blaker & Winterbottom, 1968) and the North Lake counts do not facilitate this.

288 GREYHEADED GULL.

Larus cirrocephalus Vieillot, 1818: Brazil.

Not reported by Scott (1954), Winterbottom (1960), Blaker & Winterbottom (1968) nor Underhill & Cooper (1982), though the latter reported one from Milnerton Lagoon on 19th December, 1980. This gull is a rare straggler to the western Cape. Only 4 times did it appear on the North Lake during the review period, a single bird each time. On 20th April and 9th May one flew over Water 3 while on 22nd April a bird was observed pecking at a large fish, evidently abandoned by an angler, on a beach in the club grounds between the observation-site and the club's jetty. The fourth record was of a bird in flight over the clubhouse on 25th April. All 4 sightings could have been for the same individual.

289 HARTLAUB'S GULL.

Larus hartlaubii (Bruch), 1853: Cape of Good Hope.

See Section 4.1.9. At Rietvlei, this species was not very numerous, though numbers have more than doubled since 1952-8; here, the peak is in August and the bird is virtually absent from December to April (Blaker & Winterbottom, 1968). Underhill & Cooper (1982) counted 209 birds on 19th December, 1980, and 1020 on 26th July, 1981. The Rietvlei maximum probably relates to breeding birds foraging from their nesting areas (Blaker & Winterbottom, 1968). On the North Lake in 1983

(273 count hours) this gull occurred throughout the review period in small numbers not exceeding 64 birds (1200 hours, 4th March), largely at the NW, W, SW and SE roosts. It frequented the three water sectors and was particularly attentive at barbecue sites just vacated, boldly entering the club grounds to seek scraps when recreational activity was in progress.

290 CASPIAN TERN.

Hydroprogne caspia (Pallas), 1770: Caspian Sea.

See Section 4.1.10. In the 1952-8 counts, this rare resident marine species was recorded only three times from Rietvlei (Winterbottom, 1960). Underhill & Cooper (1982) recorded 5 birds on 19th December, 1980. During the 1983 North Lake period of review, it appeared only on 4 count hours, the first two occasions a pair fishing over Water 3 on 23rd February. The other two counts were of single birds flying south over Water 2 and Water 3 on 13th March and 21st March, respectively. Nesting has been recorded from islands off Langebaan and on the Berg River Estuary, November to January (Hockey & Hockey, 1980), at St. Lucia in July (McLachlan & Liversidge, 1978) and in May-June on the Swartkops Estuary, Port Elizabeth (Geoff Odgers and Luc Hosten, 1983, pers. comm.) and it would be difficult to determine the origin of stragglers over Rietvlei during the non-breeding season.

291 COMMON TERN.

Sterna hirundo Linnaeus, 1758: Europe - Sweden.

and

294 ARCTIC TERN.

Sterna paradisaea Pontoppidan, 1763: Christiansoe, Denmark.

See Section 4.1.10. These two species, indistinguishable in the

field, are dealt with together (the "Comic" Tern) as both occur as visitors from the coast. These non-breeding migrants from Europe tended to drop in numbers as winter approached, but were recorded throughout with a surprising number in June and July (Winterbottom, 1960). Underhill & Cooper (1982) counted 122 birds on 19th December, 1980, and 5 on 26th July, 1981. In 1983 on the North Lake these terns gathered in large flocks of up to 150 (25th April) at the SW and NW roosts, with many fishing throughout the day on both lakes (all water sectors), with birds roosting on all six marker bouys. "Comic" Terns formed mixed flocks at the SW and NW roosts with Sandwich and Swift Terns and were recorded on 252 count hours, thoughout the period of review. After a dive these terns gave a characteristic shake in flight to dislodge water droplets lodged in their feathers.

296 SANDWICH TERN.

Sterna sandvicensis Latham, 1786: England - Sandwich, Kent.

See Section 4.1.10. Of this marine non-breeding migrant from the Palaearctic there were only 4 records from Rietvlei between 1952 and 1958 (Winterbottom, 1960). It is not listed in Blaker & Winterbottom (1968); Underhill & Cooper (1982), however, counted 123 birds on 19th December, 1980, and this species was quite regular on the North Lake in 1983 from 23rd February to 19th April (82 count hours), after which it disappeared. Sandwich Terns frequented the SW roost and fished over all three water sectors, often just off the club grounds. Not more than 4 birds (25th February) were recorded at a single count.

298 SWIFT TERN (CRESTED TERN).

Sterna bergii Lichtenstein, 1823: Cape of Good Hope.

See Section 4.1.10. A resident breeding marine species recorded only 7

times from Rietvlei during the 1952-8 counts (Winterbottom, 1960). Not listed in Blaker & Winterbottom (1968) nor in Underhill & Cooper (1982). Throughout the 1983 period of review (187 count hours), on the North Lake, flocks of up to 80 birds (21st April) were counted, mainly at the SW and NW roosts. Several birds fished in all three water sectors. As with other terns, the Swift Tern was attracted to the North Lake as a feeding area, there being large numbers of tiny fish.

304 WHITEWINGED BLACK TERN.

Chlidonias leucoptera (Temminck), 1815: Shores of the Mediterranean.

On 28th November 1983 up to 150 foraged over the North Lake. See Section 4.1.10. This lake tern was recorded in only 17% of the 1960's counts at Rietvlei (Blaker & Winterbottom, 1968). However, it was quite common during the 1983 period of review at the North Lake, recorded on 144 count hours from 23rd February to 3rd May. Up to 10 birds (7th April) were recorded in a single count, either at the NW roost or fishing over the three water sectors. As the review period progressed birds moulted into breeding plumage. Whitewinged Black Terns seldom plunge-dived like the marine terns, instead skimming the surface of the water for food. Underhill & Cooper (1982) counted 4 birds on 19th December, 1980, 3 on 26th July, 1981.

394 PIED KINGFISHER.

Ceryle rudis (Linnaeus), 1758: Egypt.

Listed by Scott (1954) but not by Winterbottom (1960) nor Blaker & Winterbottom (1968). Underhill & Cooper (1982) however counted 18 birds at Rietvlei on 19th December, 1980, and 1 bird on 26th July, 1981. If numbers are decreasing towards winter, this trend is not borne out at the 1983 North Lake counts, where a maximum of 3 birds was recorded, on 14th April and 2nd May, for a single count, birds recorded sporadically

from 4th March to 9th May on 34 count hours. Pied Kingfishers frequently settled in the club grounds, perching on shale boulders at the powerboat harbour entrance. Other birds were recorded from the SE roost, Water 1, Water 3 and the NW roost.