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**The demography of the Egyptian Goose, its impacts
on cereal crop agriculture on the Agulhas Plain,
Western Cape, South Africa and measures to mitigate
damage to crops by geese.**

by

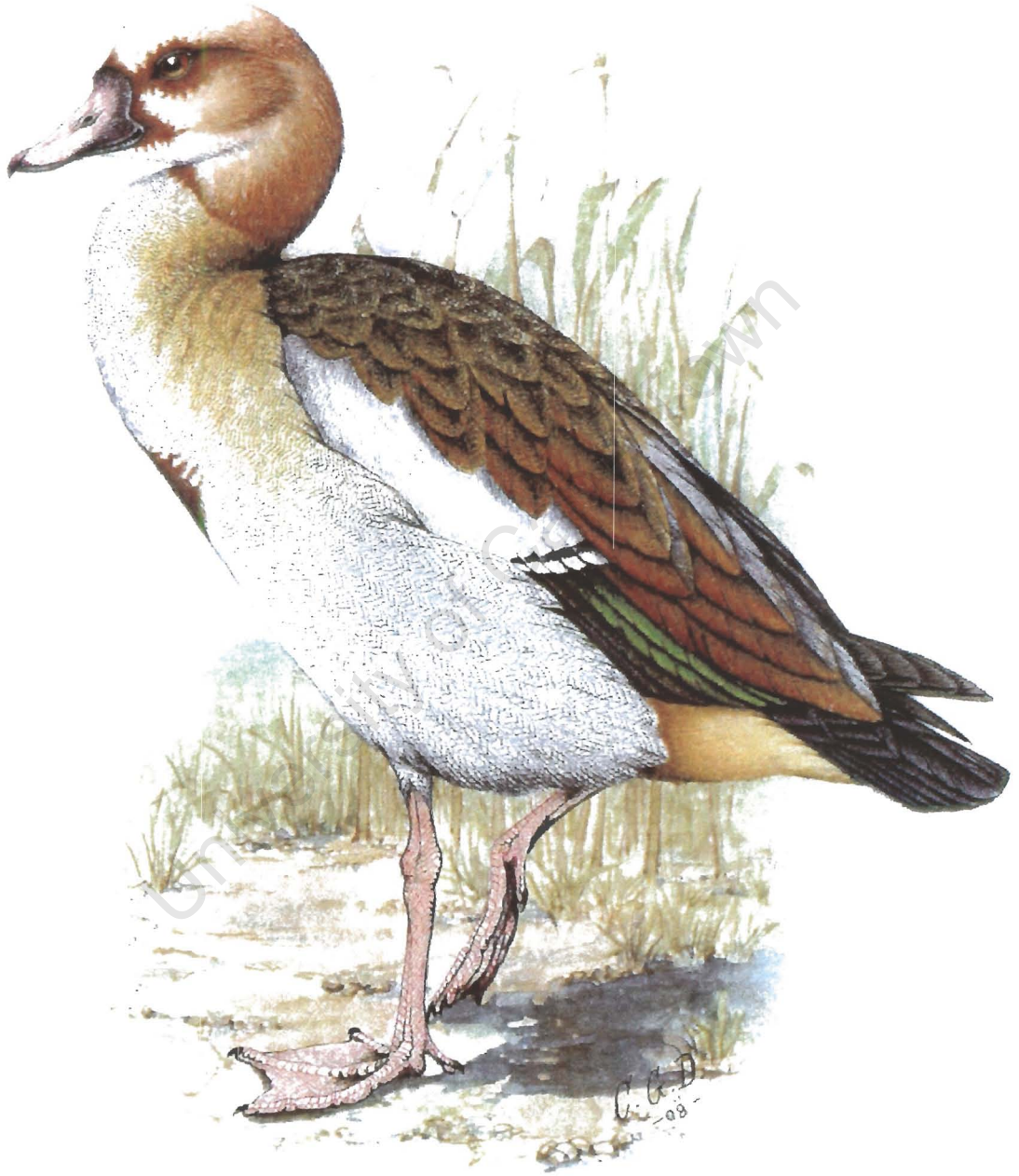
Michael John Mangnall

Submitted in fulfilment of the degree of Master of Science

by dissertation, Department of Zoology,

University of Cape Town

February 2001



The Egyptian Goose *Alopochen aegyptiaca* (Finch-Davies & Kemp 1986: Plate 12)

DECLARATION

This thesis reports the results of original research I conducted under the auspices of the Percy FitzPatrick Institute of African Ornithology, University of Cape Town, between 1997 and 2000. All assistance that I received has been fully acknowledged. This work has not been submitted for a degree at any other University.

Signed by candidate

Michael J. Mangnall

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Abstract: Many southern African crop farmers regard the Egyptian Goose *Alopochen aegyptiacus* as a widespread and major agricultural pest. Cereal crop farmers on the Agulhas Plain in the Western Cape province of South Africa are concerned that populations of Egyptian Geese have increased since the early 1990s, and are causing serious damage to their crops.

This project therefore seeks to address a number of key questions:

1. Have populations of Egyptian Geese increased since the early 1990s in the Western Cape in general and the study area in particular?
2. If so, to what extent may this be attributed to changes in farming practices?
3. What is the spatial and temporal extent of damage caused by Egyptian Geese to wheat and barley crops on the Agulhas Plain?
4. What is the financial impact of goose damage to farmers on the Agulhas Plain?
5. How has intensified agriculture affected farmland bird assemblages and the abundance of Egyptian Geese in the study area?
6. How can biological and ecological information be used to reduce the numbers of geese and the damage they cause to cereal crops on the Agulhas Plain?

Surveys, interviews and count data determined that Egyptian Goose numbers have escalated in the Western Cape since the late 1980s and on the Agulhas Plain since the early 1990s. A substantial increase in the tonnage of barley *Hordeum* spp. sowed and changes in farming practices in the early 1970s attracted a steady annual flow of geese to the area, until numbers “exploded” in 1992.

The Agulhas Plain attracts thousands of Egyptian Geese annually, primarily because of the abundance and availability of nutritious crops such as wheat *Triticum* spp. and barley for food and permanent waterbodies for roosting, moulting and breeding. Egyptian Geese lower the profitability of barley and wheat farming mainly during three main damage periods, viz. soon after sowing (surface seeds); young, developing plants (growing plants); and cut plants stacked in windrows (long, linear piles) to dry. The largest numbers of geese were recorded during June and July when they foraged on growing plants less than 25 cm tall. 89% of barley and wheat seeds were removed from the surface on an extrapolated 175 ha (a loss of about R19 000 = ±US\$ 3 170). Overall, the mean yield loss was 65.6% in 1997 and 63.5% in 1998. By August, geese moved from croplands on to pastures. During October and November, geese once again fed primarily on barley seeds in harvested crops stacked in windrows. In 1997, approximately 270 ha of windrows were affected, amounting to a financial loss of R175 000 (±US\$ 29 000). Estimated goose damage to growing plants of R180 000 (±US\$ 30 000) (174 ha) occurred in 1997 and R420 000 (±US\$ 70 000) (416 ha) in 1998. Damage by geese to farmers was estimated to be > 2.5% and 7% of annual revenue received from barley and wheat farming, in 1997 and 1998 respectively. A financial loss of approximately R 52 (±US\$ 9) and R 120 (±US\$ 20) was incurred per hectare of wheat and barley sown on the 15 farms surveyed in 1997 and 1998 respectively.

The Agulhas Plain has been transformed extensively by the expansion and diversification of crop and pastoral agriculture. Many bird species have consequently been affected negatively by the rapid reduction of habitat suitable for their daily requirements. However, populations of certain bird species, such as the Egyptian Goose, as well as other granivores and omnivores have, as a result of the change in habitat, increased on the Agulhas Plain. Analysis of the demography of the Egyptian Goose and other farmland birds across 13 agricultural landscapes showed that highest avian diversity was recorded at the sites with a mixture of crops and Coastal Fynbos. The presence of 14 species of birds was positively correlated with the presence of Egyptian Geese. A small number of species, e.g. sunbirds, are reliant on the natural Coastal Fynbos for their survival. With the exception of the Mixed vegetation regime that gained 50 species, all the other agricultural regimes have fewer bird species than natural fynbos. To provide more suitable habitat for a greater diversity of birds, it is recommended that mixed landscapes should be maintained, and the further destruction of natural fynbos habitat prevented.

Answers to key questions 1 – 4 listed above, helped to produce management recommendations for Egyptian that should lower their numbers and minimise the damage they cause to the farmlands of the Agulhas Plain. These recommendations include persistent scaring and regular wingshooting of flocks of geese that persistently feed on commercially valuable crops such as barley and wheat.

CHAPTER 1

GENERAL INTRODUCTION

1.1 RATIONALE AND HISTORY

Many southern African crop farmers regard the Egyptian Goose *Alopochen aegyptiacus* as a widespread and major agricultural pest. From the far Northern Province to the most southern tip of Africa and into the eastern part of Mpumalanga there are substantial and apparently ever-increasing numbers of Egyptian Geese allegedly causing significant amounts of damage to agricultural crops (Maclean 1997). The conflict between farmers and geese is long standing, probably as old as agriculture itself. An ancient Egyptian text, written some 3 000 years ago is indicative: “You are worse than the Egyptian Goose of the river bank that abounds in mischief. It spends its summer in destroying the dates, and the winter in destroying the emmer (primitive wheat). It spends its free time of the year pursuing the cultivators, and allows not the seed to be thrown to the ground before it has the wind of it. It cannot be caught by snaring, nor is it offered up in the temple, that evil bird of piercing sight that does no work” (Kear 1990:195). Internationally, many countries have experienced extensive crop damage for decades from a wide variety of geese and ducks (Kahl & Samson 1984; Fledgler *et al.* 1987; Patterson *et al.* 1989; Owen 1990; Ankney 1996).

Since the mid-1990s, Western Cape Nature Conservation Services have received numerous calls from farmers from a range of areas in the former Cape Province complaining that Egyptian Geese were causing damage to their agricultural

lands (K. Shaw – Western Cape Nature Conservation Services – pers. comm.). Most complaints were from the following regions: Caledon, Swellendam, Berg River region, Heidelberg, Paarl and Bredasdorp. In particular, Western Cape Nature Conservation Services were inundated with requests for assistance from farmers of the Agulhas Plain region south of Bredasdorp.

The Agulhas Plain is a major centre for the production of winter cereal crops (Agricultural Research Council 1997). However, local farmers are concerned that the Egyptian Goose may be causing serious damage to these crops. This may be because geese numbers appear to have increased considerably on the Agulhas Plain during the early 1990s. By October 1994, as goose numbers appeared to continue to increase and alleged damage to crops intensified, the farming community, in conjunction with a range of organisations responsible for biodiversity conservation, met to discuss a joint strategy to manage Egyptian Geese. A number of potential control measures were suggested, of which the lifting of all restrictions on bag size and wingshooting season were the most drastic options. However, it was felt that implementing such extreme control measures in the absence of critical data on the biology of the Egyptian Goose and on the magnitude of its negative economic impact on crop agriculture, would not be a responsible management strategy (Shaw 1995a).

Despite the alleged agricultural problems caused by Egyptian Geese, farmers were perhaps also overlooking its potential as a premier gamebird, the wingshooting of which could provide supplementary income to local communities. Indeed, the wary nature of this goose provides wingshooters with a serious challenge to their skill, with attempts at shooting often ending in a ‘wild goose’ chase (Milstein 1993).

1.2 GENERAL DESCRIPTION OF THE STUDY ANIMAL

Despite its name, the Egyptian Goose is not a goose but a shelduck or “sheldgoose” (from the tribe Tadornini) related to the South African shelduck *Tadorna cana* (Maclean 1988). Its nearest living relatives, however, are the Blue-winged Goose *Cyanochen cyanopterus* of Ethiopia, and the montane and temperate South American sheldgeese of the genus *Chloephaga* (including such birds as the Kelp Goose *C. hybrida* and the Magellan Goose *C. picta*) and the distinctive Orinoco Goose *Neochen jubatus* of tropical South America (Delacour 1954; Livesey 1986).

1.2.1 Distribution

The Egyptian Goose is the best known of southern Africa’s waterfowl. It is widespread, conspicuous and adaptable. It was the most abundant waterfowl in Coordinated Waterbird Counts (CWAC) in South Africa between 1992 and 1997 (Taylor *et al* 1999). Its tolerance of human-altered environments and its exploitation of cultivated crops have contributed considerably to its overall success (Milstein 1993), and the expansion of its range within southern Africa (Maclean 1997). It is found throughout Africa south of the Sahara, except in forests or deserts and, even in these areas, it is opportunistic, capitalizing on forest clearance and ephemeral waterbodies created by localized rains in arid regions (Maclean 1988). It occurs from the southern tip of Africa to the Sahel being absent only from the most densely wooded parts of Angola (Dean 2000) and the Congo basin (Chapin 1932), as well as the most arid parts of Namibia and the Horn of Africa (Ash & Miskell 1983).

It once occurred naturally in southern Europe, but present-day European populations are largely the result of subsequent introductions by humans (Cramp &

Simmons 1977). Lensink (1998) describes the successful colonization of the Netherlands by the Egyptian Goose, and Sutherland & Allport (1991) describe the distribution and ecology of this “neglected species” in Britain.

Within southern Africa, the Egyptian Goose is widespread and common in Zimbabwe, Swaziland, KwaZulu-Natal and the Eastern and Western Cape provinces, wherever standing water is available (Maclean 1988; Milstein 1993; Maclean 1997).

1.2.2 Demography

The population of Egyptian Geese in the highveld of the former Transvaal is at least 30 000 birds and individual flocks of more than 1 000 geese can be encountered (Tarboton *et al.* 1987). The largest single South African concentration yet recorded was about 8 000 birds in May 1966 at Voëlvlei Dam (33°23'S 19°03'E) near Paarl in the Western Cape (Siegfried 1967).

Egyptian Geese comprised 12 319 of the 39 232 waterfowl counted over one year at nine widely-spaced large catchment dams in the Free State (Geldenhuis 1975; 1976). Colahan (1984) found that the Egyptian Goose has an index of abundance of 51.2% for KwaZulu-Natal, second only to the Yellow-billed Duck (60.5%).

1.2.3 Habitat

Although it was probably originally an inhabitant of the sandbanks of larger rivers (Irwin 1981), today Egyptian Geese exploit almost any inland waterbody: rivers, dams, lakes, pans, estuaries and sewage ponds, preferably with some exposed shoreline (Maclean 1997). Virtually any waterbody is acceptable, particularly if croplands are nearby (Hockey *et al.* 1989). They often forage in large numbers in farmlands (Halse 1985; Milstein 1993) where they sometimes do considerable

damage to crops and pastures. In particular, farm dams in the form of small catchment ponds for stock watering as well as large irrigation dams, have promoted the success of this species (Guillet & Crowe 1986; Mangnall & Crowe *in press a*). This tendency to utilize dams, especially for breeding, has also been noted in east Africa (Van Someren 1956). Less often, it breeds on offshore marine islands, e.g. Dassen Island (33°26'S 18°05'E), and takes to sea if disturbed (Hockey *et al.* 1989).

1.2.4 Movements

It appears that the Egyptian Goose has considerable, but not well-defined, movements which may be seasonal in nature (Milstein 1975). Massive numbers of birds concentrate on large waterbodies for moulting (known as moult migrations), moving in from more widely scattered breeding localities (Milstein 1975). Of the 7 008 Egyptian Geese ringed, there have been 497 recoveries (Underhill *et al.* 1999). These recovery data suggest that there were many movements between the North West Province and Western Cape and Namibia, and one between the Free State and Mozambique. These movements by Egyptian Geese may, however, be related to geographically non-uniform intensity of ringing effort, i.e. Barberspan (26°33'S 25°36'E) in the North West Province. Oatley and Prys-Jones (1986) recovered 12 Egyptian Geese with movements exceeding 1 000 km. Eight of these were between the Western Cape and southern Namibia. They placed the species in the same category as the South African Shelduck *Tadorna cana*: medium distance disperser. CWAC data suggest a winter influx to Eastern and Western Cape (Taylor *et al.* 1999).

Movements, although regular in timing, may not constitute true migration, but rather are a consequence of regular nomadism in the form of dispersal from moulting sites to whichever habitats happen to be most suitable for breeding after the moult

(Milstein 1993; Taylor *et al.* 1999). Many populations of Egyptian Goose are sedentary and show little or no seasonal movement within southern Africa, since birds can be seen all year round at a range of localities, although their numbers may fluctuate (Maclean 1988).

1.2.5 Breeding

The Egyptian Goose is a monogamous species that can be found breeding during all months of the year in southern Africa. Breeding peaks in May - August in Zimbabwe and in August - September elsewhere (Maclean 1988). Most Egyptian Geese nest on dry ground, but many use holes in trees, or old arboreal nests of other birds (Maclean 1988). Brown *et al.* (1982) reviewed the breeding biology of the Egyptian Goose. An analysis of 654 clutches gives a range of 5 - 11 eggs and a mean clutch size of 6.7. The female incubates the eggs for 28 - 30 days and fledging occurs at about 55 days. The newly hatched young leave the nest after about six hours by jumping in response to a call by the female (Maclean 1993). Both parents care for the young after they leave the nest, although the hatchlings feed on their own from virtually day one (Mangnall unpubl. data). Goslings can fly at about 11 weeks, but may continue to associate with the adults as a family group for several weeks, or even months (Brown *et al.* 1982).

1.2.6 Diet

Maclean (1993) lists the food of the Egyptian Goose as grass, seeds, leaves, grain, crop seedlings, aquatic rhizomes and tubers, and even occasionally insects. Flocks of Egyptian Geese loaf near the shoreline during the day and fly out to feed in the early mornings and late afternoons (Shewell 1959; Halse 1985). Little feeding is

done during the balance of the day, although birds may feed for short periods on aquatic plants if they are available along the shoreline (Milstein 1975). Their preference for young grain crops and seeds has brought them into disrepute with farmers in many parts of southern Africa (Maclean 1988). The highly nutritious food provided by agricultural lands can consequently allow geese to spend less time feeding than under natural conditions (Edroma & Jumbe 1983).

1.2.7 Social Structure

Milstein (1993) reviewed the social structure of the Egyptian Goose. It consists of two alternating phases, linked by an intermediary phase. Phase 1 is the non-breeding season, during which flocks are not restricted to water. The intermediate stage involves establishing pairs, with each pair staking out a territory in the anticipation of breeding. Phase 2 is the period during which eggs are laid and incubated, with the resulting goslings being reared to fledging. The Egyptian Goose is a sociable species despite its aggressive nature when breeding or preparing to breed (Milstein 1993).

Non-breeding flocks can number up to well over 3 000 individuals, sometimes found on a single, continuous length of suitable shoreline. Such large flocks appear to be moult migration congregations, although a varying percentage of birds are capable of flight (Shewell 1959; Milstein 1975). Such moulting sites are usually chosen from a range of available alternatives, due to high visibility and short vegetation near the water (Milstein 1993).

1.3 FINDINGS OF A 1996 SURVEY

Jancikova (1996) interviewed 32 Agulhas Plain farmers during August-September 1996. Of these, 18 experienced problems with Egyptian Geese at some time of the year. Most of the affected farms (83%) experienced problems with geese every year and only three reported problems some years only. All farms in the vicinity of the four largest vleis (lakes) (Voëlvlei, Moddervlei, Soetendalsvlei and Zeekoëvlei) experienced annual problems. She found a clear correlation between Egyptian Geese being regarded by a farmer as a pest and the proximity of farms to the large waterbodies (where geese roost, moult and breed) ($r = 0.81$, $p < 0.05$) (Jancikova 1996).

According to farm owners, the most vulnerable crops are barley, canola, wheat and triticale (all affected at more than 80% of the problem farms where it was grown). Grass and lucerne pastures seem to be preferred over a mixture of lucerne and clover. Wheat and barley were affected during April through December, with a clear peak during the germination (April - June) and harvesting periods (October - December). Pastures seem to be affected mainly during the periods when no, or little, green crops or ripe seeds are available. The geese congregated on stubble land and burnt stubble land in January to April (before sowing) (Jancikova 1996).

To date, attempts by the farmers to protect their crops and control Egyptian Geese entering their lands have been minimal and *ad hoc*. Most of the farmers (14 out of 18) did, however, shoot geese themselves, and many were in favour of the idea of establishing recreational wingshooting enterprises in the area in an attempt to control the geese. This would also generate financial compensation for the damage inflicted to their crops and pastures. Fortunately, all the farmers interviewed

considered the use of poisons to control geese populations to be both dangerous and unethical (Jancikova 1996).

1.4 MAIN AIMS

In late 1996, the local branch of African Gamebird Research, Education and Development Trust (AGRED - Cape) decided to assist local farmers, wingshooters and conservationists by undertaking a three-year research project on the Egyptian Goose. It approached Dr Rob Little and Prof. Tim Crowe of the Gamebird Research Programme of the Percy FitzPatrick Institute to design and implement the project. They, in turn, recruited me to undertake the necessary research as part of my M.Sc. programme.

This project seeks to address a number of key questions:

1. Have the populations of Egyptian Geese increased since the early 1990s in the Western Cape in general and the study area in particular?
2. If so, to what extent may this be attributed to changes in farming practices?
3. What is the spatial and temporal extent of damage caused by Egyptian Geese to wheat and barley crops on the Agulhas Plain?
4. What is the financial impact of goose damage to farmers on the Agulhas Plain?
5. How has intensified agriculture affected farmland bird assemblages and the abundance of Egyptian Geese in the study area?
6. How can biological and ecological information be used to minimise damage by geese and maximise their potential for commercially viable and biologically sustainable use?

The thesis is divided into six chapters. Chapter 1 provides a general description of the Egyptian Goose, covering its distribution, habitat, movements, breeding, and diet and social structure. Chapter 2 describes the principal study area and research methods. In Chapter 3, the population history of the Egyptian Goose in the Western Cape and study area is investigated. Chapter 4 deals with the variation in numbers of Egyptian Geese over space and time on the farmlands of the Agulhas Plain, and the physical and financial damage caused by Egyptian Geese to barley and wheat croplands. In Chapter 5, variation in the demography of Egyptian Geese and other farmland birds across agricultural landscapes on the Agulhas Plain are determined. Chapter 6 makes recommendations as how to manage Egyptian Geese on the Agulhas Plain.

CHAPTER 2

PRINCIPAL STUDY AREA AND RESEARCH METHODS

2.1 STUDY AREA

Research was conducted on the Agulhas Plain between Bredasdorp and Struisbaai (19°30' -20°15'S, 34°30' 34°50'E), in the Western Cape, South Africa (Fig. 2.1). This winter rainfall area is approximately 500 km² in extent and is farmed mainly for barley *Hordeum* spp., wheat *Triticum* spp., oats *Avena* spp., triticale *Triticale* spp. and canola *Brassica* spp.. Extensive lucerne *Medicago* spp., clover *Trifolium* spp. (oilseed) and medics *Medicago* spp. pastures are also grown locally as grazing for the approximately 30 000 sheep and 4 000 cattle (Jancikova 1996).

Using the findings of Jancikova (1996) as a guideline, 15 farms that experienced annual loss of crops through damage by Egyptian Geese were selected for survey. Most of the farms have remnants of natural vegetation, including Strandveld and Coastal Fynbos in the Bredasdorp Mountains to the north, and Coastal Fynbos in the low-lying areas to the west (Cowling *et al.* 1995). According to Campbell (1985), there are three major vegetation types on the Agulhas Plain: two non-fynbos groups (Forest and Thicket, Renoster Shrubland) and fynbos. Four fynbos series (Asteraceous, Restioid, Proteoid, Ericaceous), each with at least one sub-series, were recognised. There are no major areas of forest and thicket in the study area.

There are four large, permanent vleis (lakes) in the study area: Voëlvlei (±40 km² in size), Soetendalsvlei (±60 km²), Moddervlei (±30 km²) and Zeekoëvlei (±20 km²) (Fig. 2.1), which act as important areas of safety for roosting, breeding and moulting geese (Jancikova 1996).

In January 1998, 13 field sites were chosen to represent a range of agricultural and non-agricultural habitats to investigate the impact of agriculture on farmland bird assemblages on the Agulhas Plain. These field sites occurred on eight of the 15 farms selected for survey (Fig. 2.1).

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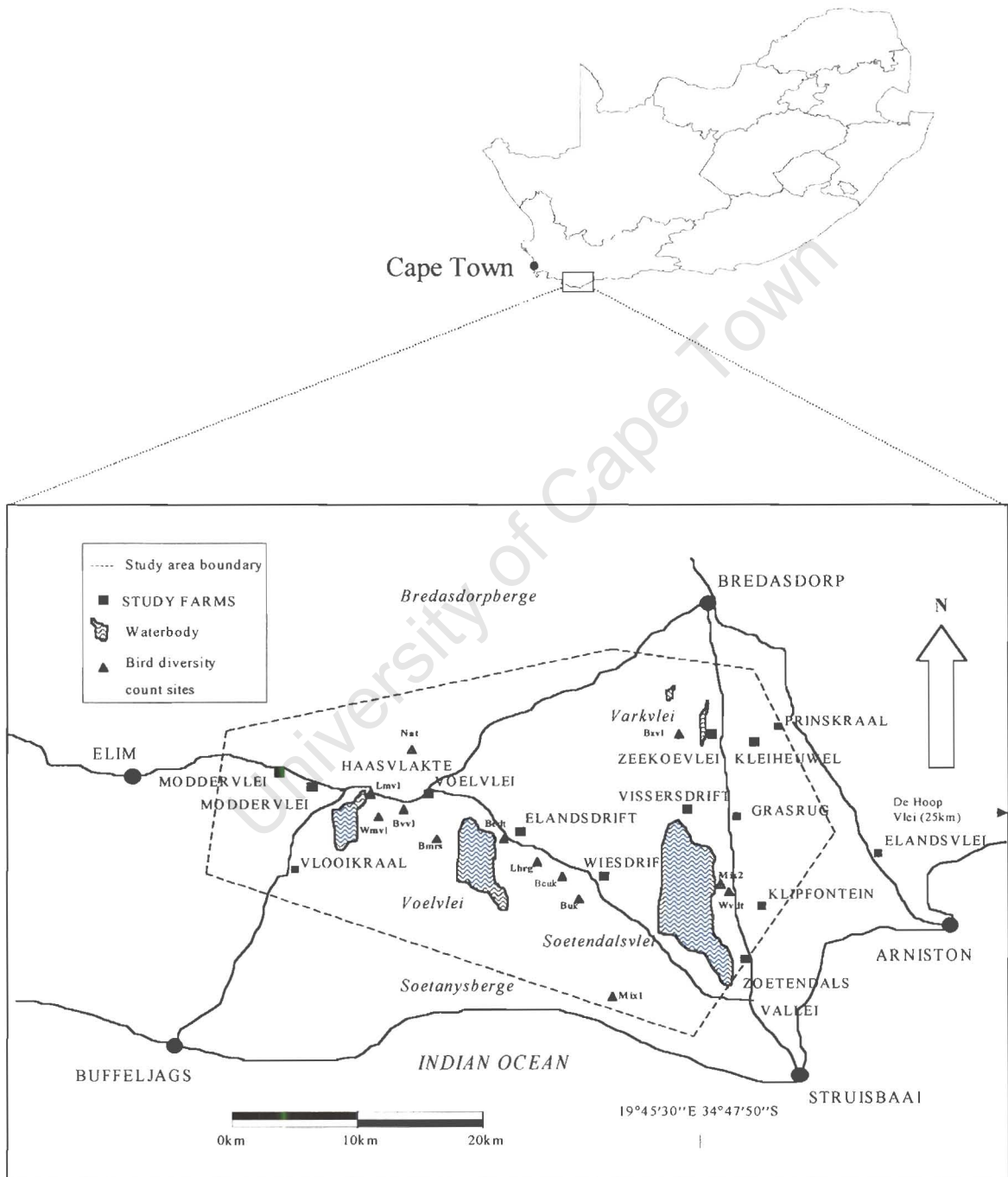


Fig. 2.1. The Agulhas Plain study area, indicating farms surveyed, sites counted and main waterbodies.

2.2 RESEARCH METHODS

2.2.1 Follow-up interviews

To gain an understanding beyond that suggested by Jancikova (1996) as to how and why goose numbers may have escalated since the early 1990s, follow-up interviews were conducted with owners of the selected 15 properties during 1997 and 1998.

Below is a list of the interview questions:

1. Do you have problems with Egyptian Geese on your farm?
2. What is the frequency of the geese problems?
3. When do you experience Egyptian Goose activities on your farm?
4. On what crops/pastures do you experience Egyptian Goose activities?
5. Have problems with geese increased, decreased or remained stable?
6. If increased or decreased, since when would you say?
7. What would you ascribe this increase or decrease to?

2.2.2 Wingshooting records

Reliable wingshooting records kept by D. Human, a farmer on the Agulhas Plain, for the years 1978 – 1998, were also analysed to establish trends in populations of geese in the study area.

As the same number of wingshooters were not always involved, the mean number of Egyptian Geese shot per wingshooter was calculated to establish trends.

2.2.3 Waterfowl count data

Waterfowl count data for the last 30 years from Rondevlei (Retief 1999), Rietvlei (Summers 1998) and Strandfontein Sewerage Works (Summers 1998) were acquired to gain a more broad-scale indication of goose population trends in the province. Waterfowl population monitoring data extrapolated by Hëyl (1993) for the Western Cape was also studied to establish temporal patterns in goose populations.

2.2.4 Farm surveys

During 1997 and 1998, research focused on 15 farms that received regular, annual damage to crops (Fig. 2.1). Field trips were conducted over 6 - 10 days each month over two grain crop seasons (January 1997 - December 1998). For each farm, land-use status and crops and pastures fed on by Egyptian Geese were determined through ± 3.5 -hour morning (starting at sunrise) and afternoon (ending at sunset) surveys. Each farm was surveyed on at least three mornings and three afternoons during a field trip. Surveys were conducted from a light delivery vehicle along fixed routes in the study area. During every survey, the location, size and activity of all flocks of geese feeding were noted.

Once a month, areas outside the immediate study area were searched for larger flocks of geese. Any flocks encountered were also included in the analysis of the spatial and temporal movements of Egyptian Geese on the Agulhas Plain.

To determine at what stage geese shifted the focus of their feeding from crop to pastures, the height of plants in 15 crop fields that were being fed on was measured with a 1 m rule after approximately every 5 cm of growth until being abandoned by the geese.

A “flock” was defined as a congregation of geese, and categorized as a “small” flock if it comprised < 20 geese, a “medium” flock if 21 – 150 geese, a “large” flock if 151 – 500 geese, and a “very large” flock if > 500 geese.

2.2.5 Physical quantification of goose damage

2.2.5.1 Surface seeds and growing crops

1. Observations were conducted on geese foraging; noting the size of the area damaged, flock size, and the amount of time birds spent foraging;
2. Undamaged areas were selected as close as possible to the damaged areas to minimize the effects of potential yield differences between the two caused by natural environmental variation in the field. Areas were not selected for quantification if other birds and other animals were seen to remove seeds. After observing geese foraging on the same area for a minimum of one week, and completing at least three sets of surveys per farm in order to obtain the widest range of fields damaged and numbers of birds causing the damage, a 1 m² quadrat (15 - 20 times) was placed in the damaged and undamaged areas to obtain estimates of the number of seeds (or plants damaged) per m² in both areas.

From sowing tables obtained at the Bredasdorp-Napierse Corporation (BNK), it was possible to determine the amount of seed sown/m². For example, on one of the barley fields on the farm *Zeekoëvlei* (Fig. 2.1) where the broadcast sowing method and Tyne covering implement was used, 100 kg of seed was sown/ha. BNK calculated the crop to have an 85% germination rate, and a 1 000 seeds to weigh 39.4 grams. Therefore, 250 seeds/m² were sown on this barley field of *Zeekoëvlei*.

Besides their tracks, a good indication of significant Egyptian Goose damage was gained from the presence of their droppings and depressions in the soil from where seeds were removed from the surface (as in Patterson 1991). No sampling was done in the diagonal across the middle of the field where double the quantity of seed is sowed.

In each of the foraging areas, four clearly marked 1 m² plots were randomly left standing in growing plants in the damaged and undamaged areas until just before harvesting (October). From these areas, an estimate could be gained of the extent to which the initially damaged plants matured into harvestable crops, i.e. the percentage of yield lost. The number of plants/m² was counted and the status, i.e. height and number of leaves broken, of the plants compared with the undamaged areas was noted.

On revisiting the quadrats before harvesting, the number of plants/m² and ears/plant were counted. A representative sample of ears (15 - 20 ears/m²) of grain was collected and weighed in the laboratory. The number of kernels/ear was then counted and their resulting kernels then weighed. From these figures, the yield differences between the damaged and undamaged areas were estimated, and a maximum damage figure for a specific field could be calculated.

2.2.5.2 Windrows

After the crops were harvested in October 1997, three fields where geese had been feeding on windrows (long, linear piles of ripening crops) were quantified. In each field, three areas of 1.8 m² – 2 m² were measured with a tape measure in the damaged area. To calculate the maximum damage within these areas, sample sites where large amounts of droppings were present and many ears had been eaten were

chosen. Without dislodging any kernels from their ears and not including any ears from outside the demarcated area, crops were picked up and placed into refuse bags. Bags were marked with the field and sample number and size. Three similar-sized areas, as near as possible to the damaged area, were measured out in an undamaged area.

The bags of barley collected were taken to Sensako (one of the grain producers for the Western Cape) in Napier. A mini-combine harvester harvested the collected experimental and control samples for each field. A single-ear thresher was used to harvest the kernels to a finer level. The samples were weighed to the nearest gram on an electronic scale. Since the size of the damage areas sampled was known this measurement allowed the estimation of the yields for each area.

2.2.6 Financial quantification of goose damage

2.2.6.1 Damage to surface seeds

The minimum financial loss incurred due to the removal of surface seeds was calculated by counting the number of seeds/m² on the surface of 13 barley and two wheat damaged and undamaged areas. About 50% of these seeds have the potential to become healthy, harvestable plants (K. Robertson; UCT Botany Department pers. comm.). BNK calculations for 1997 estimated the percentage of sown seed that would survive to become harvestable crops to be 73%. Based on the premise that one seed produces one plant (K. Robertson pers. comm.), and knowing the average number of ears per barley plant (from BNK calculations for the area), ears/m² lost in the damaged areas could be estimated.

From BNK calculations, the average number of seeds on a barley ear was known and so the number of seeds/m² lost was calculated. Knowing the weight of 1 000 barley seeds, the weight of the seeds/m² (and hence for every hectare) was calculated. Knowing that barley was bought for R800/ton in 1997, the minimum financial loss figure was calculated. The weight and subsequent financial value of the seed removed by Egyptian Geese in the quantification areas alone was calculated. In 1997, barley cost R74.50 for a 50 kg bag. From this figure, an estimate of the amount lost due to the removal of seeds was computed.

2.2.6.2 Damage to growing plants

Although the effects of undetected grazing by Egyptian Geese could not be quantified and assessed financially, if the comparative results from damaged and undamaged sites are a fair representation of damage occurring elsewhere in the area, potential goose damage could be estimated for the entire study area. Total damage as well as high (> 75% loss of yield), medium (25 - 75% loss of yield) and low damage (< 25% loss of yield) scenarios was estimated for the study area. “Highest” and “lowest” categories, i.e. those sites that received the least and most loss of yield over the year, sometimes overlapped with the high and low scenarios.

The financial loss incurred due to each damage scenario was estimated by the formula below:

$$\text{Projected Financial Loss} = (T \times R) \left\{ \frac{YL\% \times Ha_s}{PropGH} \right\}$$

Where, *T* is the mean tons/ha of barley and wheat harvested in the study area (assumed to be 2 tons/ha for both wheat and barley), *R* the amount (in Rands) received for every ton of barley or wheat delivered to the BNK, *YL%* the average loss of yield for the particular scenario, *Ha_s* the potential area damaged (extrapolated by dividing the actual number of hectares damaged in the scenario by a proportional potential goose hours figure for the study area which is obtained by multiplying the percentage that sites comprising the particular damage scenario made up of the total number of sites quantified during each year), and *PropGH* the actual goose hours (the number of geese and hours of grazing taken to inflict the particular degree of yield loss) for the scenario divided by the total potential goose hours for the study area (determined by multiplying the mean number of geese in the study area over the developing stage of the crop by the maximum number of days, at seven hours grazing per day, they were observed grazing on these crops).

A Rand:Dollar exchange rate of six was used to convert financial loss figures in 1997 and 1998.

2.2.7 Line transects

The 13 field sites which were selected to investigate the demography of the Egyptian Goose and other farmland birds across agricultural landscapes on the Agulhas Plain were divided into five agricultural regimes, viz. Mixed, Lucerne, Fynbos, Crop 1 and Crop 2. The agricultural regimes included fields used for crop planting and fields used by livestock. Crop 1 and Crop 2 were classified according to the total number of geese recorded at the site. The Mixed regime included those sites that had either a combination of natural and modified landscapes or crops of barley and canola during 1998. The Pasture and Natural regimes represent the lucerne and natural fynbos sites, respectively.

Line transects were used to count birds within each of the 13 field sites. Line transects were chosen due to the relatively large size and uniformity of the sites. The roughly rectangular-shaped sites were approximately 20 000 m² in size. To search areas as thoroughly as possible, approximately 10 parallel transects were conducted at each site. Transects were conducted for a period of 40 minutes on two occasions every month at each site. They were done between 09h30 and 16h00, as close to the middle of the month as possible (January - December 1998). Sampling was not done during adverse weather conditions such as rain or strong wind. A Kowa spotting scope and Pentax 8 x 40 binoculars were used. Assumptions, discussed in Bibby *et al.* (1992), were taken into consideration during each transect. The technique used to avoid double counting was also taken from Bibby *et al.* (1992).

The scientific names of bird species recorded during the study have been included in Appendix 5.1.

2.2.8 Statistical analyses

The Statistica software package (Statsoft 1996) was also used to analyse the differences among samples (damaged and undamaged areas). Utilisation of various land-use situations and crop types was analysed with the Chi-square test. One-way and two-way analysis of variances (ANOVA) and paired and unpaired *t*-tests were used to calculate the differences in yield within and between 1997 and 1998. Mean flock sizes and their standard errors were calculated in Microsoft Excel.

The Primer statistical software package was used to determine which of the 13 field sites shared similar bird assemblages. Cluster analysis was performed using group-average linking of Bray-Curtis species similarities from standardized abundance data (Clarke & Warwick 1990). To investigate the avifaunal similarities, non-metric multi-dimensional scaling (MDS) was performed on the similarity matrix from which ordination plots were produced (Clarke & Warwick 1990).

The measure of diversity used was the *Shannon-Wiener diversity index*:

$H' = - \sum_i \rho_i (\log \rho_i)$, where ρ_i is the proportion of the total count (or biomass etc.) arising from the *i*th species. This incorporates both the species richness and evenness components. *Species richness* is often given simply as the total number of species (*S*), which is dependent on sample size.

CHAPTER 3

HISTORICAL CHANGES IN EGYPTIAN GOOSE POPULATIONS

SUMMARY

Surveys, interviews and count data were used to determine the population history of the Egyptian Goose on 15 farms of the Agulhas Plain and other selected areas in the Western Cape. Egyptian Goose numbers have escalated in the Western Cape since the late 1980s and on the Agulhas Plain since the early 1990s. A substantial increase in the tonnage of barley sowed and changes in farming practices in the early 1970s attracted a steady annual flow of geese to the area, until numbers “exploded” in 1992.

3.1 INTRODUCTION

According to Milstein (1993), there appears to have been only two studies which have indicated an increase in the population of Egyptian Geese in the Western Cape. Siegfried (1965) noted its apparent increase as a breeding species in the Cape Peninsula, and Thesen (1974) attributed the “impressive numbers of Egyptian Geese where there were hardly any before” in the southern Western Cape, to their achieving greater breeding success “in the absence of the black-backed jackal”. It is, however, clear that there is a major gap in the literature regarding the population history of the Egyptian Goose in the Western Cape.

Therefore, the aim of this chapter is to determine whether populations of Egyptian Geese have increased since the early 1990s in the Western Cape in general and the study area in particular, and if so, to what extent may this be attributed to changes in farming practices.

3.2 RESULTS

Long-term monthly waterfowl counts from Rondevlei (presented in Fig. 3.1), Rietvlei and Strandfontein Sewerage Works all suggest an increase in Egyptian Geese numbers in the late 1980s, followed by a decrease in the early 1990s. Waterfowl population monitoring data extrapolated by Hëyl (1993) for the Western Cape indicated that Egyptian Geese numbers more than doubled between 1991 and 1992 (Hëyl 1993). Owners of 13 of the 15 farms on which surveys were conducted also indicated that there had been an increase in geese numbers since 1991. Their views are supported by the fact that reliable wingshooting records kept by one of the farmers

(D. Human) since 1978 indicate a significant increase in the number of Egyptian Geese shot per hunter since 1991 ($t = 5.3, p < 0.01, df = 18$) (Fig. 3.2).

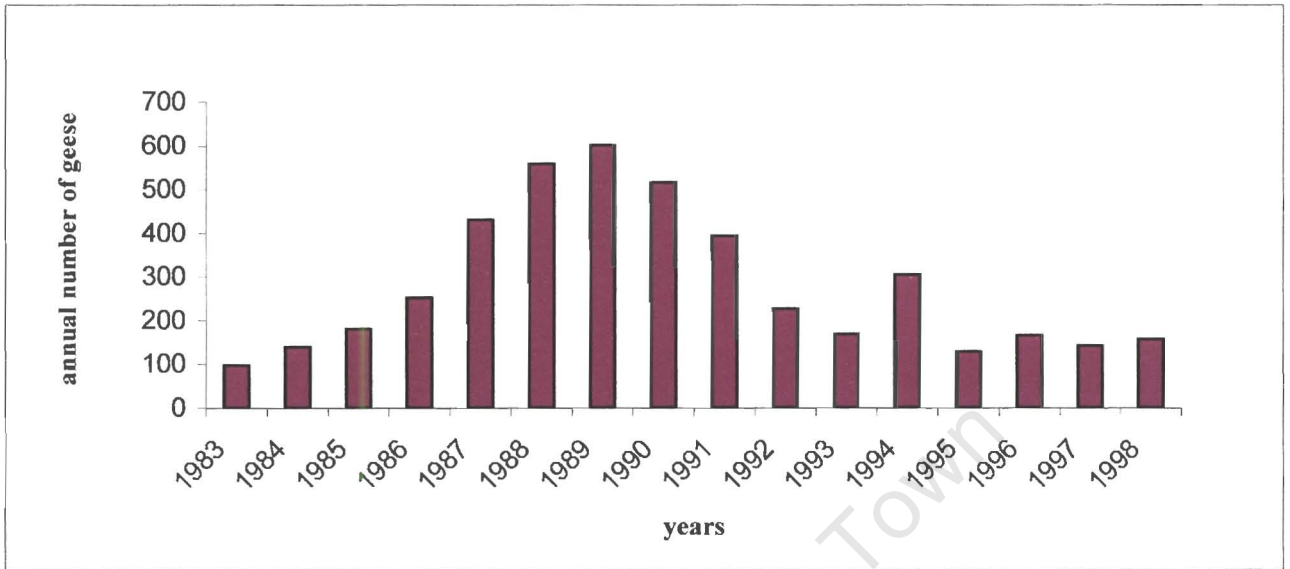


Fig. 3.1. Annual number of Egyptian Geese recorded at Rondevlei, Western Cape (1983- 1998) (Retief 1999).

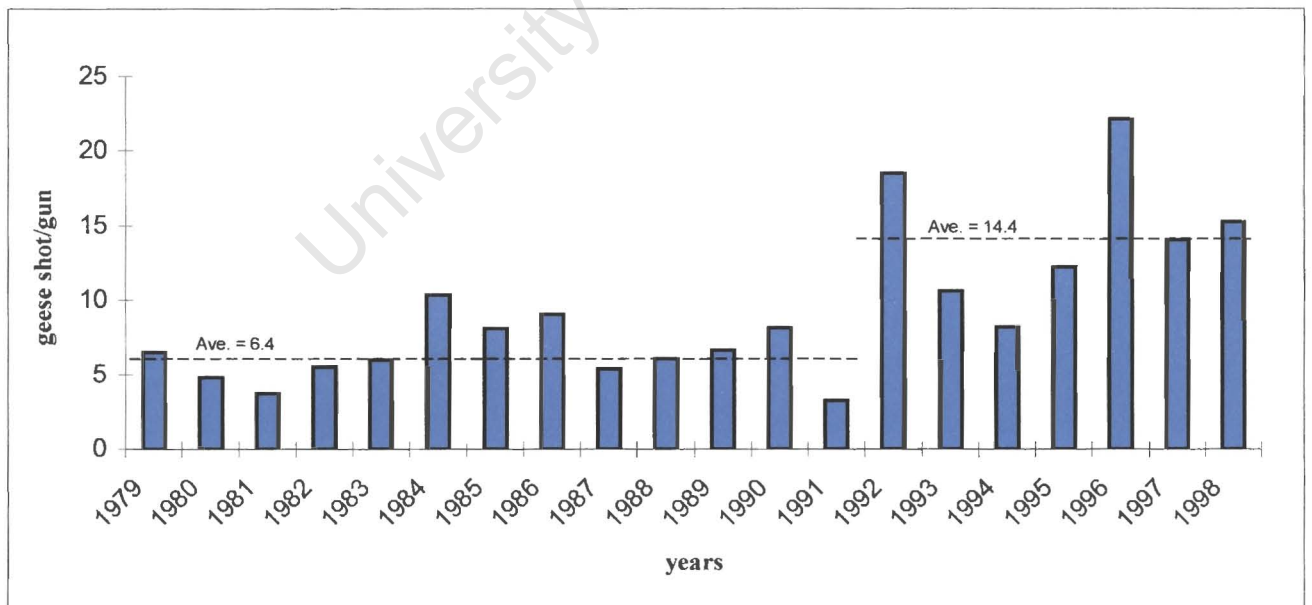


Fig. 3.2. Mean number of Egyptian Geese shot per wingshooter on the Agulhas Plain (1979 - 1998) (Human 1998).

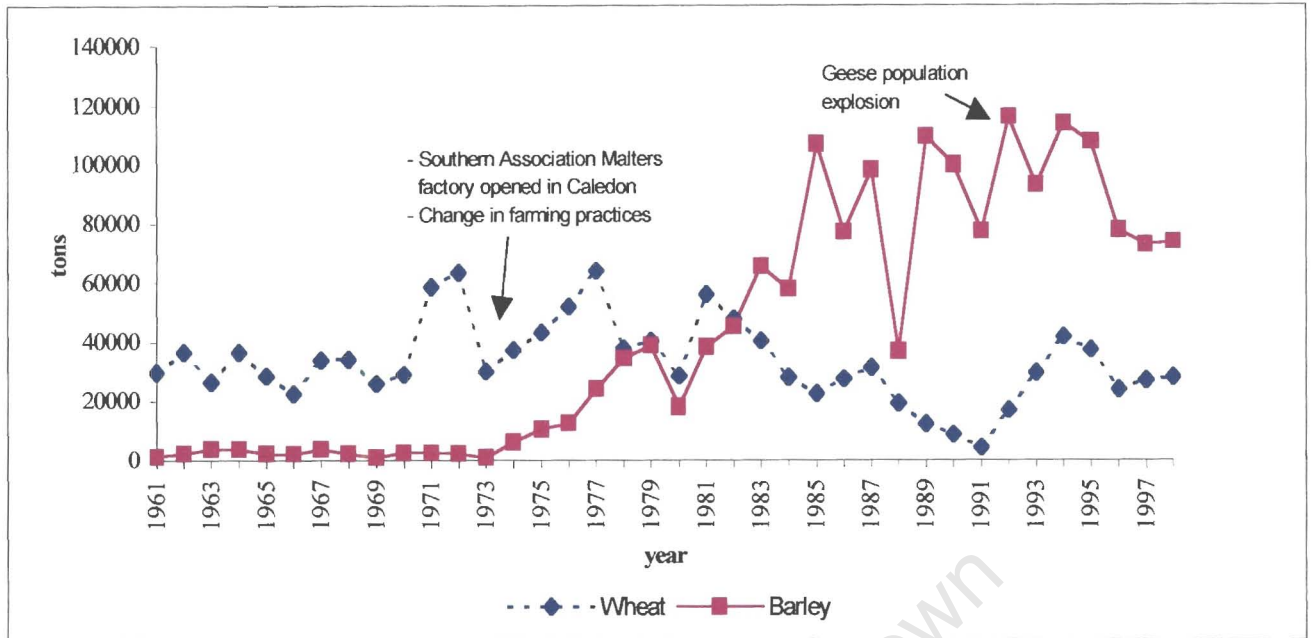


Fig. 3.3. Tonnage of wheat and barley sowed in the Bredasdorp-Napier region (1961 – 1998) (K. Robertson pers. comm.).

3.3 DISCUSSION

Based on results presented in the figures above and interviews with local farmers by Jancikova (1996), and follow-up interviews during this study, it appears that numbers of the Egyptian Goose increased markedly since the early 1990s in both the Western Cape and, especially so on the Agulhas Plain. Numbers of geese appear to have increased drastically in the southern Western Cape in the late 1980s, and in the study area in the early 1990s.

The decline in the numbers of Egyptian Geese at Rondevlei during the early 1990s (Fig. 3.1) has been attributed to expansion of reeds, especially *Typha capensis* and *Phragmites australis*, along the shoreline (K. Retief pers. comm.) which may have made the site less attractive for roosting. This decrease in numbers of geese at

Rondevlei (as well as at Rietvlei and Strandfontein Sewerage Works) could have been a consequence of emigration to the Agulhas Plain and thus explains the increase in numbers in the study area over that period.

After 1992, as populations of Egyptian Geese on the Agulhas Plain presumably reached their carrying capacities, the resultant overflow of geese from agricultural areas to other areas in the southern Western Cape stabilized decreasing numbers of geese in these areas (L.G. Underhill – Avian Demography Unit - pers. comm.).

Data, such as the number of cartridges fired per gun, the effect of local goose wingshooting experience on individual hunter performance, and other data to compare shoots (P. Milstein pers. comm.) were not available. However, according to D. Human, since the same wingshooters have been invited year after year, wingshooting skill levels were similar throughout the 20-year period. Also, shoots were conducted in a similar manner, i.e. shooting with the same ammunition from behind blinds or under windrows (D. Human pers. comm.).

The increases in geese numbers may have been a response to the establishment of the Southern Association Malters factory in the early 1970s which led to a ten-fold increase in the production of barley, the Egyptian Goose's favourite local crop plant (Fig. 3.3) (Mangnall & Crowe *in press b*). Two other changes in farming practice may also have resulted in more barley and wheat seed and ripened crops becoming available to geese. Firstly, broadcast sowing has replaced the direct method of planting seed by standard seed-drills, which led to much more seed being left for geese to eat on bare ground. After being sowed by means of a Tyne implement, a light harrow is used to cover most of the seeds. Second, after being cut, ripe crops were left in windrows to dry for two weeks before being harvested. This practice

concentrated the ripe seed for hungry geese. Consequently, the availability of barley and wheat seeds and plants over space and time increased dramatically for Egyptian Geese, and so to have their numbers since 1991 (Fig. 3.3).

Apart from the super-abundance of nutritious food in cereal lands, the large populations of geese in this area are also attributed to the presence of four large, permanently inundated vleis: Voëlvlei, Soetendalsvlei, Zeëkoeivlei and Moddervlei. These waterbodies provide Egyptian Geese with sites essential for roosting, breeding and moulting. During years when the Agulhas Plain receives heavier rainfall, several, smaller, ephemeral wetlands provide additional roosting areas for geese (P. Albertyn pers. comm.). There are also a few man-made farm dams in the study area. Single pairs of Egyptian Geese however, mainly use these dams for breeding purposes (pers. obs.; Mangnall & Crowe *in press a*).

According to local farmers, in an attempt to protect their young livestock, *ad hoc* predator (Blackbacked Jackal *Canis mesomelas*, Gennet *Genetta genetta* and Yellow Mongoose *Cynictis penticillata*) control programmes have over the years been implemented. These actions have not been monitored quantitatively and could have also promoted the increase in numbers of Egyptian Geese in the study area.

CHAPTER 4

POPULATION DYNAMICS OF THE EGYPTIAN GOOSE AND ITS PHYSICAL AND FINANCIAL IMPACTS ON CEREAL CROP AGRICULTURE ON THE AGULHAS PLAIN

SUMMARY

The Agulhas Plain attracts thousands of geese annually primarily because of the abundance and availability of nutritious crops such as wheat *Triticum* spp. and barley *Hordeum* spp. for food and permanent waterbodies for roosting, moulting and breeding. Egyptian Geese inflict damage during three main periods, viz. soon after sowing (surface seeds); young, developing plants (growing plants); and cut plants stacked in windrows (long, linear piles) to dry. The largest numbers of geese were recorded during June and July when they foraged on growing plants less than 25 cm tall. Overall, the mean yield loss was 65.6% in 1997 and 63.5% in 1998. Fields suffering greatest yield loss in 1997 and 1998 were generally those within 600 m of the roosting sites and had about 300 geese grazing on them on areas of around 2 ha in size for about two months. By August, geese moved from croplands on to pastures. During October and November, geese once again fed primarily on barley seeds in harvested crops stacked in windrows. Damage by geese to farmers was estimated to be > 2.5% and 7% of annual revenue received from barley and wheat farming, in 1997 and 1998 respectively.

4.1 INTRODUCTION

To date, no attempt has been made to quantify the timing and extent of physical or the financial damage caused by geese (or any other waterfowl) to agricultural lands in southern Africa. Internationally, however, a large number of studies have been undertaken to assess the extent of damage caused by geese to farmlands (Kahl & Samson 1984; Fledgler *et al.* 1987; Patterson *et al.* 1989; Owen 1990), and subsequently to quantify the financial loss to farmers. The majority of these studies have shown grazing by geese to cause significant reductions in grain yield (Harrison 1980; Patterson 1991). For example, numbers of Giant Canada Geese *Branta canadensis maxima* and Snow Geese *Chen caerulescens* have increased dramatically over the past 30 years (Ankney 1996), and these geese are causing serious ecological and/or economic problems on breeding and/or wintering areas on farmlands throughout the United States.

There are many other examples of crop losses caused by geese. Conover (1988) found that leaf biomass of rye inside enclosures was 535% higher than in grazed portions of the same field by mid-winter. By spring, leaf biomass was 177% higher inside than outside the enclosures. A single intensive clipping by captive geese during the fall, winter or spring has been shown to reduce yields of wheat grain by 18, 30 and 16%, respectively (Fledger *et al.* 1987). Kahl & Samson (1984) reported that grazing by captive geese reduced yields of wheat grain by 30-78%. Heavy grazing reduced grain yields by 33-98% in eight of 11 trials. Grazing of young wheat in autumn or jointing wheat in late spring caused moderate to severe damage. Similarly, winter grazing by Canada Geese in Maryland reduced wheat yields by 0-13% (Allen *et al.* 1985).

Goose damage, however, may be less than initial appearances suggest due to the ability of the growing plants to compensate for initial damage (Lorenzen & Madsen 1986; Conover 1988). For example, grazing of winter wheat by geese did not reduce yields in Michigan (Pirnie 1954) and Great Britain (Kear 1970).

Over the last three decades, many researchers, using a variety of techniques, have attempted to quantify damage to agriculture lands by geese, with varying degrees of success owing to a number of problems, e.g. variability from factors external to the relationship between the geese and crops (Kear & Rodger 1963). Patton & Frame (1981) demonstrated that there was substantial damage, although their trials were criticised for exaggerating the overall extent of the damage (Patterson *et al.* 1989).

The main aims of this chapter are therefore to:

1. Determine which crops and growth stages are utilized by geese and the months of the year during which crops are damaged;
2. Quantify physical and financial damage to barley and wheat crops by Egyptian Geese on the Agulhas Plain; and
3. Extrapolate the findings across the entire study area.

4.2 RESULTS

4.2.1 Timing of feeding by geese on croplands

In 1997 and 1998, surveys of 15 farms on the Agulhas Plain indicated that numbers of Egyptian Geese present on farmlands peaked during May – June and again during October – November (Fig. 4.1). The highest numbers of geese were recorded during June, and the lowest during September (Fig 4.1).

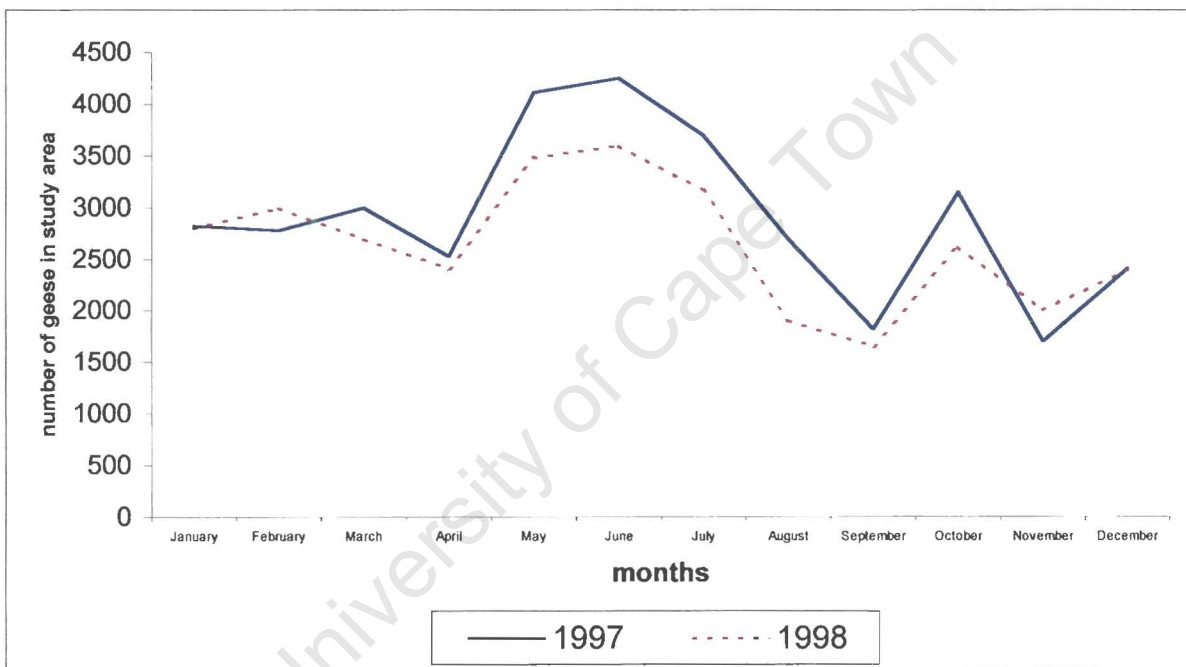


Fig. 4.1 Timing of feeding by Egyptian Geese on croplands of the Agulhas Plain (1997 – 1998).

4.2.2 Land-use status and crops and pastures fed on by Egyptian Geese

Surveys identified five land-use situations on the farmlands of the Agulhas Plain that attracted foraging Egyptian Geese. These were: stubble (December – April), surface seeds (May – June), growing plants (June – July), pastures *Medicago* spp. (lucerne, medics and clover) (August – September) and windrows (October – December). Fig. 4.2 indicates how the numbers of geese in the study area vary according to the availability of the five types of crop/pasture usage that experienced damage by geese. Egyptian Geese also fed on fallow lands (all year round), burnt stubble lands (April) and ploughed lands (April – May) (Table 4.1).

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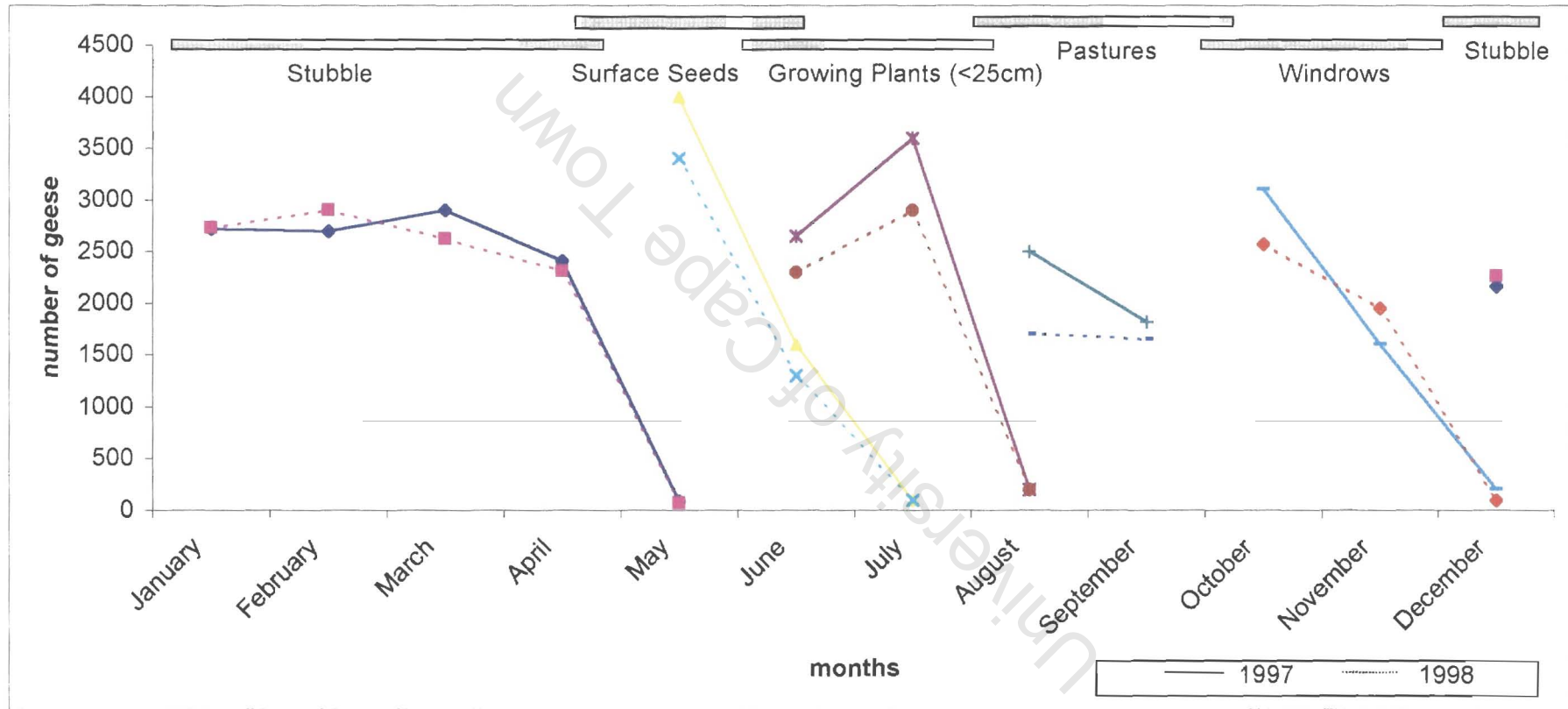


Fig 4.2 Variation in the number of Egyptian Geese according to the availability of various land use situations on the Agulhas Plain.

Table 4.1 Land-use situations that attracted foraging Egyptian Geese on the Agulhas Plain (1997 - 1998).

Land-use situation	1997			1998		
	Total number of geese counted per land-use	Number occasions geese observed in 192 surveys	Mean flock size (\pm SE)	Total number of geese counted per land-use	Number occasions geese observed in 192 surveys	Mean flock size (\pm SE)
Stubble	11526	115	100 (\pm 30)	20636	178	116 (\pm 35)
Seeds*	10882	95	115 (\pm 10)	6560	68	98 (\pm 24)
Growing plants*	18463	135	137 (\pm 25)	13500	81	167 (\pm 16)
Pastures	16293	165	74 (\pm 26)	16901	140	81 (\pm 24)
Windrows*	3750	32	117 (\pm 38)	2025	20	101 (\pm 20)
Fallow land	430	13	33 (\pm 15)	1655	18	92 (\pm 13)
Burnt stubble	260	4	65 (\pm 22)	530	14	38 (\pm 23)
Ploughed	163	6	27 (\pm 29)	605	10	61 (\pm 19)

* Denotes land-use situations in which quantifiable financial loss occurred.

In 1997, 54% of all surveys of Egyptian Geese were made during land-use situations under which quantifiable financial loss occurred, i.e. surface seeds, growing plants and windrows. In 1998, such surveys accounted for 35% of the sightings (Table 4.1).

The following eight crops and pastures were identified as being fed on by Egyptian Geese: barley, wheat, canola, oats, triticale, clover, lucerne and medics (Tables 4.1 and 4.2).

Table 4.2 Crop and pasture utilization by Egyptian Geese during land use situations in which financial loss was incurred (1997 - 1998).

1997									
Crop/ Pasture type	Surface seeds			Growing plants			Windrows		
	Total no. of geese counted/ crop type	Number occasions geese observed in 192 surveys	Mean flock size	Total no. of geese counted/ crop type	Number occasions geese observed in 192 surveys	Mean flock size	Total no. of geese counted/ crop type	Number occasions geese observed in 192 surveys	Mean flock size
Barley	8865	70	127 (± 43)	8124	66	123 (± 28)	2590	23	112 (± 37)
Wheat	1133	15	76 (± 48)	8997	60	150 (± 51)	1160	9	128 (± 23)
Triticale (<i>Triticale</i> spp.)	332	7	47 (± 63)	202	2	101 (± 60)	0	0	0
Oats (<i>Avena</i> spp.)	552	3	184 (± 62)	50	1	50	0	0	0
Clover (<i>Trifolium</i> spp.)	0	0	0	600	2	300	0	0	0
Barley wet area	0	0	0	490	60	8.2	0	0	0
			115 (± 32)			137 (± 24)			117 (± 20)
1998									
Barley	5440	56	97 (± 19)	8380	43	195 (± 16)	1175	11	107 (± 18)
Wheat	560	8	70 (± 33)	1875	14	134 (± 32)	160	2	80 (± 27)
Canola (<i>Brassica</i> spp.)	0	0	0	565	14	40 (± 20)	0	0	0
Triticale	0	0	0	0	0	0	0	0	0
Oats	0	0	0	600	2	300	690	3	230 (± 63)
Clover	0	0	0	0	0	0	0	0	0
Barley wet area	610	4	152 (± 53)	1780	4	44 (± 42)	0	0	0
Canola wet area	0	0	0	300	4	75	0	0	0
			97 (± 22)			167 (± 31)			127 (± 23)

4.2.2.1 Surface seeds

During both 1997 and 1998, more than 80% of the total numbers of geese observed removing seeds from the surface of farmlands after sowing (surface seeds) were feeding on barley lands (Table 4.2). Wheat seeds were fed on less frequently (only around 10% of the surveys) (Table 4.2).

In 1997 and 1998, Egyptian Geese fed on fields with newly sown seeds during May - June. From quadrat analyses, fewer barley and wheat seeds were exposed on the surface of the soil in May 1998 than in May 1997 (Table 4.3). As a result, Egyptian Geese were dispersed throughout the study area in 1998. During sowing in May 1997, flocks of more than 1 000 geese fed regularly in fields with newly sown seeds (Mangnall & Crowe 1999).

Table 4.3 Numbers of exposed surface seeds per quadrat in May 1997 compared to May 1998.

	1997 (n = 15)	1998 (n = 15)
exposed seeds/m ² (SE)	17.6 seeds (± 1.4)	1.3 seeds (± 0.1)

The number of geese in the study area increased by 1 600 to 4 010 geese at the end of May 1997 with the onset of the first heavy rains and the beginning of the sowing period (Fig 4.1). Over the corresponding period in 1998, the population only increased by 1 090 geese to 3 400 (Fig 4.1).

4.2.2.2 Growing plants

During 1997 and 1998, geese were observed primarily on growing barley and wheat crops (Table 4.2). Geese were also observed feeding on other crops and pastures, such as oats and clover, before moving on to barley and wheat plants. Daily surveys showed that around August, when the height of the majority of the crops exceeded 25 cm, geese moved off the crops onto pastures, such as lucerne, clover and medics. At this time, geese became more aware while feeding in croplands (Table 4.4). Fig. 4.3 is an example of a field that was grazed, and then abandoned when the crop reached 25 cm in height.

Table 4.4 Awareness of Egyptian Geese while feeding in crops in relation to the height of the plant (based on counts of 20 different geese each observed for three one-minute intervals)

Plant height (cm)	5	10	15	20	25
Mean number of times individual raised head while feeding/min. (SE)	5.5 (± 0.2)	6.4 (± 0.3)	7.4 (± 0.4)	12.9 (± 0.6)	18.6 (± 1)

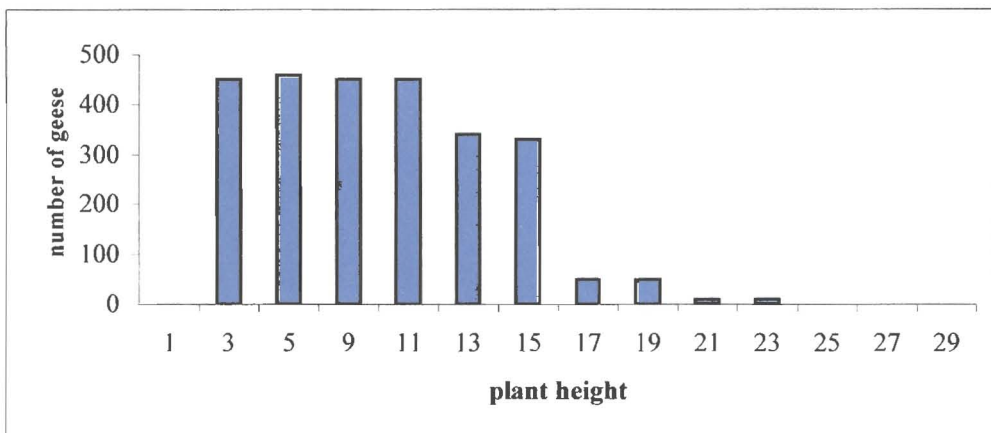


Fig 4.3 An example of a field that was grazed, and then abandoned when the crop reached 25 cm in height.

In both 1997 and 1998, Egyptian Geese numbers were highest during June (Fig. 4.1). Similar numbers of geese were observed on barley and wheat plants in 1997 (Table 4.2). In 1998, however, fewer birds were observed on wheat than on barley lands (Table 4.2).

4.2.2.3 Windrows

Geese damaged ripe crops between October and November. They fed and trampled on the seeds in the rows of drying crops (Fig. 4.2).

Egyptian Geese fed primarily on barley seeds in the drying windrows just before harvesting. However, more than a third of all birds observed on windrows during 1998 were feeding on oats (Table 4.2).

Numbers of geese were lowest during September and November (only 1 600 geese were recorded in November 1997) (Fig 4.1). From December to May, i.e. between harvesting and replanting, Egyptian Geese were scattered throughout the region, feeding off any unharvested seed remaining on the ground (Fig 4.2).

4.2.3 Variation in flock size, and roosting and feeding site characteristics

Except for May and December, the mean sizes of flocks of geese recorded during farm surveys were lower in 1997 than 1998 (Table 4.5). The mean flock size was 105 (± 34) geese during 1997 and 115 (± 24) in 1998. For both years, the largest flock sizes were recorded in July (Table 4.5).

A gradual decline in the size of flocks occurred during the months of December – April. There was an increase of 29 and 36 geese/flock from April - May in 1997 and 1998 respectively. During 1997 and 1998, similar decreases in the

number of geese/flock were noted from July – August (40 and 53) and October – November (52 and 26) (Table 4.5).

Table 4.5 Mean number of geese (\pm SE) observed/flock during the 16 surveys made every month in 1997 and 1998.

Month	1997	1998
January	115 \pm 21	138 \pm 20
February	92 \pm 15	135 \pm 37
March	77 \pm 15	99 \pm 40
April	72 \pm 11	85 \pm 20
May	101 \pm 15	80 \pm 11
June	111 \pm 13	118 \pm 16
July	157 \pm 31	161 \pm 16
August	77 \pm 14	108 \pm 14
September	107 \pm 16	125 \pm 20
October	102 \pm 33	124 \pm 41
November	50 \pm 20	98 \pm 22
December	154 \pm 40	142 \pm 35

The mean distance geese moved from roosting sites was 610 m in 1997 and 500 m in 1998. Thus, croplands closer to roosting sites received more damage than those further away. Geese departed from the roosts at sunrise, returning from the croplands approximately three and a half hours later, and departed again three and a half hours before sunset, returning just before or after dark (Table 4.6)

Table 4.6 Departure and arrival of Egyptian Geese on a typical day (12/2/97) in summer at Voëlvlei roost, Agulhas Plain.

TIME	NUMBER OF GEESE
06h00 (sunrise)	1600
06h30	1000
07h00	400
07h30	80
08h00	80
09h00	80
10h00	500
10h30	1600
11h00	1600
12h00	1600
13h00	1600
14h00	1600
15h00	1600
16h00	1600
16h30	1600
17h00	500
17h30	80
18h00	80
19h00	80
19h30	400
20h00 (sunset)	1000
20h30	1600

Geese were also observed occasionally up to 2.5 km from roosting sites, but only in exceptional cases did they fly further than this. When disturbed by farmers, labourers or wingshooters while foraging, geese flew off to nearby pastures or fallow lands. After waiting 15 - 25 minutes, they flew back to the same field and resumed feeding.

4.2.4 Physical and financial quantification

Egyptian Geese inflicted financial loss to barley and wheat farmlands during three main damage periods, viz. surface seeds, growing plants and windrows.

4.2.4.1 Surface seeds

Of the 61 fields on which geese were observed removing surface seeds in 1997, 53 (87%) were barley fields, which made up approximately 70% of the grain area.

As mentioned previously, few seeds were exposed on the soil surfaces in 1998, therefore no sampling was conducted during this damage stage. In 1997, financial loss for the 96 ha in which surface seed quantification was performed (Table 4.7) amounted to approximately R10 500 (= ± US\$ 1 750).

Table 4.7 Quantification of damage to surface seeds (1997 data only).

<i>Surface seed removed (%)</i>	<i># Seeds/m² removed</i>	<i>#Harvestable plants</i>	<i># Ears/m² lost</i>	<i>Seeds/ha (Kg) Lost</i>	<i>Financial loss (Rands/ha)</i>
89 (±3.8) ^a	15.6 ^b	5.7 ^c	18.4 ^d	136.8 ^e	109.44 ^f
50	8.8	3.2	10.3	76.8	61.44 ^g
25	4.4	1.6	5.1	38.4	30.21 ^h

a If 100 kg/ha of barley is sown, every 1m² should contain approximately 250 seeds. Experimental and control quadrats performed to quantify initial damage by Egyptian Geese to seeds lying on the surface after sowing, found that in 15 fields quantified, geese consumed 89% of the surface seeds. Standard error is in parenthesis.

b The number of seeds/m² on the surface on average was 17.6 within the 15 fields (with a range of 14 - 24, i.e. 5 - 10% of what was sown). In areas where geese had been feeding for more than a week, fields averaged 1.97 seeds/m². Therefore, 15.6 seeds/m² were removed.

c 50% of the removed seeds (7.8 seeds/m²) had the potential of germinating into growing plants (UCT Botany Dept; K.Robertson) of which, according to BNK calculations, 73%

would become harvestable crops (i.e. 5.7 seeds/m²). It is assumed that one seed equals one plant.

d BNK estimated 3.2 ears per barley plant, thus 18.4 ears/m² were removed by geese in the sample areas.

e There were 18.9 seeds on a barley ear on average, therefore 347.2 seeds/m² of potential production were lost. This equates to 136.8 kg of seed removed by Egyptian Geese in every hectare quantified in.

f Barley was sold to the BNK for R800/ton, therefore, minimum financial loss during the surface seed damage stage in 1997 was R109.44/ha.

g & h Apply *a* to *f* to determine financial loss when 50% and 25% of the surface seeds in an area are removed by Egyptian Geese.

4.2.4.2 Growing plants

Three barley and five wheat fields were quantified in 1997, and six barley fields and one wheat field in 1998. The financial loss incurred to geese in these fields was about R70 000 (±US\$ 11 700) (45 ha of damage) in 1997 and R93 000 (±US\$ 15 500) (79 ha of damage) in 1998 (Table 4.8).

Minimum barley and wheat pre-harvest damage, i.e. damage to growing plants, caused by Egyptian Geese in 1997 and 1998 is estimated in Table 4. During both 1997 and 1998, in only two of the fields surveyed, was yield not significantly lower ($p < 0.01$) in grazed versus ungrazed parts of the same fields (Table 4.8). Overall, in 1997, the mean yield loss was 72.7% in barley and 60% in wheat, and in 1998, 65% in barley and 61.7% in wheat.

Table 4.8 Summary of the minimum barley and wheat pre-harvest damage, i.e. damage to growing plants, caused by Egyptian Geese in 1997 and 1998.

	1997 (n = 8)			
	Mean	Range		Standard Error
		Minimum	Maximum	
Damaged area (ha)	6	2	10	1
Hours damaged	356	154	609	54
Geese number	219	100	400	41
Goose hours	80850	15400	157500	18327
Goose hours/ha	20229	3205	54833	6159
% Plants damaged	81	94	67	4
% Seed yield loss	66	27	98	8
Rands/ha lost	1816	1100	3197	261
Field loss (Rands)	8763	2686	14883	1431
		1998 (n = 7)		
Damaged area	9	5	20	2
Hours damaged	224	112	24	20
Geese number	250	150	400	31
Goose hours	56000	22400	73500	8083
Goose hours/ha	6222	1120	7350	812
% Plants damaged	58	81	39	94
% Seed yield loss	63	39	83	6
Rands/ha lost	1229	576	1977	172
Field loss (Rands)	13340	5765	20760	2389

In 1997, the fields that suffered the greatest yield loss were those that had between 200 and 400 Egyptian Geese grazing in areas not much larger than 2 ha between mid-May and early July (329 and 378 hours respectively) (*Vlooiakraal's* “wheat 1” (99%) and “barley 1” at *Elandsdrift* (95%)) (Fig. 2.1). These two damaged areas had been grazed to a height of less than 10% of the height of the plants in the undamaged areas (approximately 2 cm).

The field suffering the least yield loss (27%) in 1997 was *Elandsdrift's* “wheat 5”. Damage was inflicted in a relatively small area (2.4 ha), the number of geese and the time they spent grazing resulted in a total of only 15 400 goose hours.

The owner of the farm *Elandsdrift* suffered the greatest overall financial loss to Egyptian Geese in 1997 and 1998. Geese caused almost R25 000 (±US\$ 4 170)

damage in the three quantification areas on the farm. There were many other areas on the farm that were grazed on, but were not quantified. Surface seed and windrow damage was incurred. Other farms, such as *Moddervlei* and *Voëlvillei*, also suffered annual losses, but damage was, on average, not as severe. Two fields next to the Kars River on the farm *Zeekoëvlei*, received periods of intense annual damage as geese were able to roost where they feed, and vice versa.

There were, however, a number of anomalies in the quantification findings for both 1997 and 1998. An example of this in 1997 is “wheat 3” on the farm *Voëlvillei* (Fig. 2.1) next to a 100 ha seasonal roosting pan. Although it was one of the top three fields in 1997 in terms of hours spent feeding in the quantification area, goose numbers and goose hours, experienced a relatively low 50% loss in yield (and similarly 40% in 1998).

In 1998, anomalies in the quantification findings included “barley 7” on *Zeekoëvlei*, which was grazed on by large numbers of geese for many hours (119), but only suffered 58% yield loss. Initial sampling in “barley 5” of the same farm, found that damaged plants’ had only been grazed down to 61% of the control’s height (15.5 cm). Even after comparatively low geese numbers and grazing hours, 74% yield loss was still suffered by the farmer in a 5 ha area.

4.2.4.3 Windrows

During both 1997 and 1998, Egyptian Geese were responsible for removing a percentage of the drying seeds in the rows of drying barley and wheat in the study area. In 1997, the average loss of marketable grain in the five quantification areas was 40%. In 1998, as other birds, e.g. Spurwinged Geese *Plectropterus gambensis*

were regularly seen feeding with Egyptian Geese in windrows, no areas were suitable for quantification.

4.2.5 Extrapolated financial loss

Eighty-nine percent ($\pm 15\%$) surface seed damage occurred on an extrapolated 175 ha, i.e. R19 000 (\pm US\$ 3 170) loss. At a fifty-percent level of removal of surface seeds, at least twice this hectareage would have been affected.

In 1997, the range of damage by geese to growing plants on the Agulhas Plain was greater than in 1998 (Table 4.9). In 1998, 85% of the recorded damage resulted in “medium” yield loss. If extrapolated to the entire study area, financial loss would have been 57% less in 1997 than in 1998 (Table 4.9). The total potential goose hours for the Agulhas Plain study area in 1998 was approximately a third less than that of 1997.

Table 4.9 Summary of extrapolated financial loss caused by Egyptian Geese to young plants in the study area during 1997 (± 90 days) and 1998 (± 70 days).

	1997 (N = 8) 4000GEESE * 90DAYS = 2 520 000 HRS POT ^N HOURS					1998 (N = 7) 3300GEESE * 70DAYS = 1 617 000 HRS POT ^N HOURS				
Damage Scenario	Entire	Highest	High	Medium	Low/ Lowest	Entire	High/ Highest	Medium	Lowest	
^a Average Damage (%)	65.6 (8.7)	98.6 (1.4)	92 (1.7)	55.5 (9)	27 (8.1)	63.5 (5.9)	83 (3.9)	59.9 (5.1)	39.8 (4)	
^b Potential Area Damaged (ha)	174	5.8	36.5	116.4	50	416.1	92.4	218.2	31.4	
^c Act:Pot ⁿ Damage (%)	25.7	41.8	31.6	26.4	4.9	18.9	11.4	20.2	31.8	
^d Financial Loss (Rands)	182 658.24	9 064.50	53 728.22	103 302.85	21 608.64	422 440.53	122 766.34	209 161.22	19 975.42	

a Average yield loss for a particular damage scenario. “Entire” = damage incurred to all quantified sites. Standard Error is in parenthesis.

b Potential extrapolated area receiving damage to the extent of the particular scenario.

c Actual number of hours geese grazed for in the scenario divided by the potential number of goose grazing hours in the entire study

d Financial loss for each scenario extrapolated to the study area, assuming that on average 2 tons/ha of crop was harvested @ R800/ton.

In both 1997 and 1998, in excess of 3 500 ha of wheat and barley was sown on the 15 farms surveyed. Theoretically, this should have realised the farmers approximately R6 000 000 (\pm US\$ 1 000 000) in annual revenue. However, estimated goose damage of R180 000 (\pm US\$ 30 000) occurred in 1997 and R420 000 (\pm US\$ 70 000) in 1998. In other words, 2.5% and 7% potential revenue was lost to geese in 1997 and 1998 respectively. A financial loss of approximately R 52 (\pm US\$ 9) and R 120 (\pm US\$ 20) was incurred per hectare of wheat and barley sown on the 15 farms surveyed in 1997 and 1998 respectively. Indirect costs, e.g. pesticides, fertilizer and petrol have not been included.

On extrapolating windrow yield loss to the entire study area, approximately 270 ha were affected, equating to a financial loss of R175 000 (\pm US\$ 29 000).

4.3 DISCUSSION

4.3.1 Utilisation of land-use situations, crops and pastures and timing of feeding

The higher frequency and severity of damage to surface seeds in 1997, in comparison to 1998, may in part be explained by the wetter soil conditions in April 1998. Under drier conditions in 1997, geese were more reliant on water in the study area and thus concentrated on waterbodies and their adjacent crops. Furthermore,

with soils being drier, geese could remove substantially more surface seeds than on the wetter, heavier soils of 1998.

First evidence of geese appearing to favour surface seeds to growing plants was observed during mid-April 1997 when a number of oats pastures, one of which was adjacent to a main roosting site (Voëlvlei), had germinated, but geese continued to search for “waste” barley and wheat seed on stubble lands in the district. Furthermore, when barley saplings emerged during mid-May 1997 and 1998, geese continued to feed on surface seeds in nearby fields.

During June of 1997 and 1998, an abundance of protein-rich food in the form of both surface seeds and growing plants was readily available near all the roosting sites. As a result, numbers of geese in the area peaked over this period.

Geese numbers declined in the area over August and September in 1997 and 1998 due to the onset of the breeding season and the scarcity of food. Geese paired and moved out of the study area to establish territories around farm dams in surrounding districts and along the banks and cliffs of the Breede River near Swellendam (P. Albertyn pers. comm.).

The decline in numbers over the windrow stage in November may be ascribed primarily to many goose shoots being organised in the study area. Not only were hundreds of birds directly removed from the population, but numerous geese were also indirectly scared from the study area to less disturbed regions.

Geese are selective feeders and show preferences for plant species low in fibre and high in nitrogen, carbohydrate and protein (Owen 1977). This is presumably why they had a propensity for barley and wheat seeds and plants over the other crops in the area.

When feeding in taller crops (> 25 cm), geese appeared uneasy, perhaps because they were unable to see predators while feeding.

4.3.2 Variation in flock size, and roosting and feeding site characteristics

Geese tend to feed in smaller congregations when food is scarcer (Bell & Klimstra 1970). As a result of this, although more geese moved into the study area during the 1997 sowing period, mean flock sizes were smaller in 1998.

Between December and April mean flock size declined with the availability of unharvested barley and wheat seed on stubble lands in the study area. In May, flock sizes increased with the onset of sowing and the subsequent development of young barley and wheat plants. For periods of up to eight weeks, these croplands provided a source of food that could be systematically grazed until becoming too tall (> 25 cm). Flock sizes decreased in August when geese moved from crop to pastures.

Populations of Egyptian Geese were shot heavily during October and November 1997. This is reflected in the lower numbers of geese recorded in flocks of geese in November.

Jancikova (1996) found a positive correlation ($r = 0.96$, $p \leq 0.05$) between the frequency of damage by Egyptian Geese and proximity to the large waterbodies (roosting sites). In this study, Egyptian Geese fed, on average, approximately 0.5 km from their roosting sites during 1997 and 1998. Although mean distance moved does not necessarily correlate with damage inflicted, it could be argued that pastures and the seeds and plants of most crops in close proximity to the main roosting sites suffered severe annual damage during both 1997 and 1998 (and annually, according to local farmers, prior to this).

Several factors combine to make sites safe and acceptable for roosting (Newton & Campbell 1973; Percival 1993) and feeding (Owen 1973). These include not only the degree of actual disturbance, but also various intrinsic features that conferred safety, like situation, area, openness and distance from human activity. Hence, Egyptian Geese favour the four main roosting sites in the study area. Voëlvlei, which has shallow banks with an abundance of invertebrates in the sandy substrate and aquatic vegetation near the shore, attracted the majority of geese in the area. Geese are traditional in their selection of feeding sites (e.g. Allport 1989; Summers *et al.* 1996; Gill *et al.* 1997). They are restricted by the need for a safe roosting place within daily flight distance of the feeding grounds (Owen 1977; Vickery & Gill 1999).

4.3.3 Physical and financial quantification

4.3.3.1 Surface seed damage

Approximately 50% of seeds lying on the surface germinate to become healthy plants (K. Robertson; UCT Botany Dept. pers. comm.). If provided with suitable soil and weather conditions, this value could become much larger. Some farmers in the study area believe that, by removing the seeds on the surface, geese are encouraging subsequent plant growth by reducing competition for resources such as nutrients, water, oxygen and sunlight. Goose droppings left behind on the soil may provide developing shoots with additional fertilizer resulting in healthier plants (Bell & Klimstra 1970; Fledgler *et al.* 1987).

4.3.3.2 Growing plant damage

Fields suffering greatest loss of yield in 1997 and 1998 were generally those which had ≥ 300 geese grazing on areas of around 2 ha in size for about two months. Young plants in these areas were “mowed” and trampled to such a degree that plants, ears and kernels were unable to recover sufficiently to develop into ripe crops. However, a study by Cooper & Morris (1973) found that geese did not cause major yield loss in fields that suffered very low damage. Kear (1970) even argued that shorter periods of grazing can often promote plant growth.

Most of the fields of *Elandsdrift* (which suffered the greatest financial loss to Egyptian Geese in 1997 and 1998) were positioned adjacent or very close to *Voëlvlei*, the most popular and suitable roosting site of Egyptian Geese in the study area. Consequently, the landowner incurs severe annual damage. The farms *Moddervlei* and *Voëlvlei*, also suffered annual losses, but because nearby roosting flocks were not as large as *Voëlvlei* numbers, damage is, on average, not as severe.

4.3.3.3 Windrow damage

If only part of the field is grazed, the resulting uneven ripening may make it difficult to harvest the whole crop at the same time (Patterson *et al.* 1989). This occurred regularly over harvesting time in the study area during 1997 and 1998. Consequently, farmers spent a great deal of time and associated costs, such as hiring of combine harvesters and petrol to cut around “greener” areas caused by geese, and then harvesting them later.

The trampling of windrows caused many seeds to fall to the ground where the combine harvester could not pick them up. The space between the windrow and the ground was flattened and the moisture levels in the row subsequently rose. After

rains, water became trapped under the row. This continual dampness eventually results in the germination of some seeds within the row. If more than two germinated seeds are found per 25 kg of cereal crop delivered to the Bredasdorp-Napier Corporation, or the moisture content exceeds 13%, the entire delivery is reduced to livestock feed grade, and the value of the crop consequently drops to at least half its market value.

4.3.4 Extrapolated financial loss

If the loss incurred by damage to growing plants is added to that during the windrow stage, a total figure for financial loss suffered to geese would be almost double the R180 000 (\pm US\$ 30 000) and R420 000 (\pm US\$ 70 000) suffered during 1997 and 1998 respectively. Furthermore, if annual input costs and damage sustained to crops by rodents and other birds were included, the total financial loss farmers suffered, especially those around the main roosting sites every year, would be even more considerable.

The results of this study could presumably be extrapolated to farmlands in the greater south Western Cape region under similar agriculture and with comparable crop yields.

4.4 CONCLUSION

Egyptian Geese inflict damage during three main periods, viz. soon after sowing (surface seeds); young, developing plants (growing plants); and cut plants stacked in windrows (long, linear piles) to dry. The largest numbers of geese were recorded during June and July when they foraged on growing plants less than 25 cm tall. Overall, the mean yield loss was 65.6% in 1997 and 63.5% in 1998. Fields suffering greatest yield loss in 1997 and 1998 were generally those within 600 m of the roosting sites, with about 300 geese grazing on roughly 2 ha for two months. By August, geese moved from croplands on to pastures. During October and November, geese once again fed primarily on barley seeds in harvested crops stacked in windrows. Damage by geese to cereal crops was estimated to be > 2.5% and 7% of annual revenue received from barley and wheat farming, in 1997 and 1998 respectively.

The study determined that highest numbers of Egyptian Geese were recorded in June when both surface seeds and growing plants were available to feed on. The four main roosting sites provided safe havens for geese to roost, breed and moult, and to fly from in two daily feeding trips to nearby agricultural lands. Geese fed more on seeds than growing plants, especially barley seeds either on the surface or in windrows. Damage to growing plants occurred mostly in young barley and wheat plants shorter than 25 cm. They also favoured fields closer to water and move on to pastures during August and September. However, because the variables influencing the movements and numbers of geese are not fixed, there are few definite patterns to the spatial and temporal movements of Egyptian Geese.

In particular, the influence of weather needs to be considered when investigating their spatial and temporal movements, attempting to assess and explain resultant damage or suggesting damage mitigation measures. The levels of rainfall in different parts of the study area and surrounding regions vary from year to year. Consequently, numbers of geese entering the study area fluctuate and so do the effects of their feeding on different land-use situations, as well as on crops and pastures. Hence, the financial impact of the damage would also differ.

Extrapolated estimates based on quantification work during 1997 calculated that Egyptian Geese potentially caused a total of R180 000 (\pm US\$ 30 000) damage to Agulhas Plain farmers' wheat and barley crop plants, and an additional R205 000 (\pm US\$ 34 000) to surface seeds and windrows. In 1998, a R420 000 (\pm US\$ 70 000) loss was incurred (damage to growing plants only). However, further research is required to determine the actual economic (not financial) value of the damage caused by Egyptian Geese to barley and wheat farmlands.

Farmers will continue to incur financial losses to Egyptian Geese until concerted within- and between-district measures are taken to mitigate damage by Egyptian Geese in a biological sustainable and economically viable manner.

CHAPTER 5

VARIATION IN THE DEMOGRAPHY OF EGYPTIAN GEESE AND OTHER FARMLAND BIRDS ACROSS AGRICULTURAL LANDSCAPES ON THE AGULHAS PLAIN

SUMMARY

Coastal Fynbos on the Agulhas Plain of the Western Cape has been transformed extensively by the expansion and diversification of crop and pastoral agriculture. Many bird species, e.g. sunbirds, nightjars and mousebirds have consequently been affected negatively by the rapid reduction of habitat suitable for their daily requirements. However, populations of certain bird species, especially granivores and omnivores such as sparrows, larks and pipits, as well as Egyptian Geese and Helmeted Guineafowl have, as a result of the change in habitat, proliferated on the Agulhas Plain. In 1998, twice monthly transects at 13 farmland sites recorded a total of 106 bird species. Fifteen species occurred at 75% or more of the sites. Highest avian diversity was recorded at the sites with a mixture of crops and Coastal Fynbos. Egyptian Geese preferred crops and pastures to Coastal Fynbos areas. The presence of 14 species of birds was positively correlated with the presence of Egyptian Geese. However, the determination of the causal basis of this relationship requires further study. A small number of species, e.g. sunbirds were reliant on the natural Coastal Fynbos for their survival. To provide more suitable habitat for a greater diversity of birds, it is recommended that mixed landscapes should be maintained, and the further destruction of natural fynbos habitat prevented.

5.1 INTRODUCTION

Internationally, crop agriculture and stock farming (= agriculture) in all its forms has had significant, often negative, effects on natural fauna and flora (O' Connor & Shrubbs 1986; Usher 1997). Agriculture affects biodiversity in general, and birds in particular, through the physical transformation of habitats, and indirectly through fragmentation of habitats that disrupts important processes such as gene flow and key ecological forces such as fires (Moll *et al.* 1978).

In Europe and the United States of America, the effects of agricultural changes on the structure and composition of bird assemblages have been well studied (e.g. O'Connor & Shrubbs 1986; Hill *et al.* 1991; Fuller *et al.* 1995). In western Europe, studies have shown that, where agriculture has become intensive, a higher proportion of species decline markedly in farmlands than in any other habitat, and farmland birds form the majority of endangered species. However, generalist species often persist in intensively farmed landscapes, whereas specialists tend to decline in abundance and range. It was also found that the major consequence of intensive, "clean" (= weed/hedgerow-free) farming is the loss of incidental habitats associated with agriculture, and hence reduced biodiversity (Usher 1997).

Changing agricultural practices have led to a consolidation of natural habitats into large farm holdings. Rows of hedges and trees have been removed, and larger fields have been planted to monocultures, reducing avian diversity (Wiens 1989). In many countries, however, while general biodiversity was decreasing, populations of a wide variety of geese and ducks have increased dramatically on farmlands (Usher 1997).

Similarly, in southern Africa, species capable of adapting to agricultural landscapes have benefited from disturbance regimes of grazing, planting and harvesting. A number of species, such as the Egyptian Goose, Spurwinged Goose and Helmeted Guineafowl, have, however, not only adapted to, but are today thriving in, certain agricultural areas (Mangnall & Crowe 1999).

The Cape Floral Kingdom (CFK) has been, and is being, altered extensively by agricultural practices, urban development, and alien plant encroachment (Rebello 1992; Cowling & Richardson 1995; Richardson *et al.* 1996). This transformation is most evident in Renoster Shrubland and Lowland Fynbos that are prominent on the Agulhas Plain (Rebello 1992; van Wilgen 1992; Cowling & Richardson 1995). In the lowlands of the Western Cape, only six per cent of Renoster Shrubland and 14% of Coastal Fynbos are currently untransformed (Boucher 1981).

Macdonald (1989) estimated that up to 25% of South Africa's natural land-cover has been converted to other forms of land-use such as agriculture. On the Agulhas Plain, since 1973, there has been an increase in hectarage devoted to cereal crop agriculture from $\pm 38\ 000$ ha to $\pm 75\ 000$ ha (K. Robertson pers. comm.). It has been widely acknowledged that a substantial part of South Africa's biodiversity occurs on agricultural land (crops and rangeland) and is not represented adequately in current conservation areas (Macdonald 1989). It is therefore important that farmers and others responsible for conservation strive to conserve species within agricultural landscapes.

However, the lack of relevant studies in southern Africa has recently resulted in a major gap in effective biodiversity conservation. Further research is needed to understand the effects of habitat modification that has been occurring at an alarming rate throughout southern Africa for more than a century (Macdonald 1989).

Contrary to popular belief, Hockey *et al.* (1989) found that, in the southern Western Cape alone, populations and distributional ranges of 85 bird species have increased due to anthropogenic habitat transformation.

This chapter investigates the variation in the demography of Egyptian Geese and other farmland birds across agricultural landscapes on the Agulhas Plain, Western Cape.

The aims of this chapter are therefore to:

1. Determine the current structure and status of farmland bird assemblages in the study area;
2. Assess agricultural sites and their associated habitat characteristics according to the numbers of Egyptian Geese and general birdlife they support; and
3. Identify shifts in species composition caused by a response to changes in characteristics of the habitat.

Furthermore, recommendations are made as to how the management of farms or larger areas could be modified to increase their avian diversity.

5.2 RESULTS

5.2.1 Structure and status of bird assemblages

A total of 106 species (Appendix 5.1) were recorded across the 13 sites (Table 5.1), with 23 species occurring only at the Mixed Renosterkop site. Appendix 5.1 provides the scientific names of species mentioned in this chapter. Refer to Fig. 2.1 for the location of the 13 sites in the study area. The basic structure of farmland bird communities on the Agulhas Plain comprised a relatively small group of widespread and abundant birds and a much larger group of less numerous species. The 15 most frequently recorded species (those occurring at 75% or more of the sites) were Cape Sparrow, Redcapped Lark, Grassveld Pipit, Thickbilled Lark, European Swallow, Cape Weaver, Longbilled Lark, Fantailed Cisticola, Orangethroated Longclaw, Fiscal Shrike, Egyptian Goose, Cape Turtle Dove, Levillant's Cisticola, Common Quail and Red Bishop (Appendix 5.1). The Cape Sparrow, Redcapped and Thickbilled Lark, Grassveld Pipit were the most abundant farmland birds in the study area.

Thirteen species were also widely distributed, being found in half or more of the farmland sites. Examples of this group included Yellowrumped Widow, African Marsh Harrier, Helmeted Guineafowl, Spurwinged Goose, Cape Wagtail and Capped Wheatear (Appendix 5.1). For many species in this group, densities were relatively low, but a few, e.g. Pied Starling, were more numerous. Species, such as the Black Crow, Malachite and Lesser Double Collared Sunbird and Speckled Mousebird occurred at very few of the study sites but where they did occur, their diversity indices were relatively high.

Table 5.1 Description of the 13 Agulhas Plain field sites.

Field site (Abbreviation in Fig. 2.1)	Agricultural regime/ Habitat Type	Habitat Description
Natural (Nat)	Natural	93% Coastal Fynbos; 2% Rooikrans <i>Acacia saligna</i> ; 5% <i>Proteacea</i> spp.
Mixed Renosterkop (Mix1)	Mixed	50% oats stubble; 20% Coastal Fynbos; 15% Port Jackson; 5% trees (Milkwoods, Spidergums, Acacias, etc.); 1% succulents; 10% variety of scrubs and bushes
Mixed Vissersdrift (Mix2)		50% fallow; 20% ploughed (emergent weeds etc.) - (70% barley after May 1998); 5% Coastal Fynbos; Spidergums, Milkwoods, short bushes
Barley/Canola (Bcuk)	Mixed	95% barley stubble; replaced by canola in May 1998; 5% natural
Barley Voëlvlei (Bvvl)	Crop1	100% barley or wheat (with one or two fenceline bushes/hedges – <i>Lycium</i> spp.)
Barley Marais (Bmrs)		
Barley Zeekoëvlei (Bzvl)		
Barley Elandsdrift (Bedt)		
Wheat Moddervlei (Wmvl)		
Wheat Vissersdrift (Wvdt)	Crop2	100% barley or wheat (with one or two fenceline bushes/hedges – <i>Lycium</i> spp.)
Barley Uitkyk (buk)		
Lucerne Heuningrug (Lhrg)	Pasture	100% lucerne (varying mixes of lucerne, clover and medics)
Lucerne Moddervlei (Lmvl)		

Using the Pearson Product-Moment Correlation Coefficient, the numbers of thirteen bird species, excluding raptors and aerial insectivores, were significantly correlated ($r > 0.76$, $p < 0.01$) with numbers of Egyptian Geese over the 13 sites. They were (in order of decreasing significance): Grassveld Pipit, Spurwinged Geese, Blackheaded Heron, Thickbilled Lark, Rock Pigeon, Sacred Ibis, South African Shelduck, Spotted Dikkop, Pied Starling, Blue Crane, Blacksmith Plover, Cape Sparrow and Cape Wagtail.

5.2.2 Important sites for Egyptian Geese and general bird populations

The highest total number of geese counted during 1998 were recorded in Crop 1 and 2 regimes (Table 5.2). The Barley/Canola site had the highest diversity index for geese. The two other Mixed sites (Renosterkop and Vissersdrift) also had relatively high diversity indices for geese. The Natural regime had the lowest total number of Egyptian Geese. The two Lucerne sites also had relatively high total numbers of Egyptian Geese.

Table 5.2 Bird species richness and numbers of Egyptian Geese with associated cluster analysis number, as well as Shannon-Wiener indices (SWI) for the 13 field sites and the contribution to this value by Egyptian Geese.

Field site (Site cluster code)	Cluster Number	Bird species	Bird species SWI	Total number of geese counted	Contribution of Egyptian Geese to SWI
Barley Marais (Bmrs)	5	21	12.0	880	1.7
Barley Voelvrei (Bvvl)	6	24	12.7	530	0.9
Barley Elandsdrift (Bedt)	6	23	7.6	430	1.3
Barley Zeekoëvlei (Bzvl)	4	30	16.6	324	0.3
Wheat Vissersdrift (Wvdt)	4	28	13.7	188	0.5
Barley Uitkyk (Buk)	5	16	13.0	80	1
Wheat Moddervlei (Wmvl)	5	21	11.2	35	1
Lucerne Moddervlei (Lmvl)	3	32	19.5	350	1
Lucerne Heuningrug (Lhrg)	3	29	18.9	396	0.8
Barley/Canola (Bcuk)	2	53	45.8	241	2
Mixed Vissersdrift (Mix2)	2	50	53.7	52	1.2
Mixed Renosterkop (Mix1)	1	81	72.2	8	1.4
Fynbos (Nat)	2	49	43.2	2	0

The Mixed Renosterkop site recorded the highest diversity of overall bird life. The other Mixed sites also recorded high diversity indices. The Crop 1 and 2 regimes recorded the lowest totals (Table 5.2).

The cluster analysis grouped the field sites into six clusters (Fig. 5.1). These ranged from sites with the highest avian diversity (Mixed Renosterkop) to those with lowest diversity (Barley Uitkyk, Wheat Moddervlei and Barley Marais). Three larger

clusters, representative of sites with either ≤ 30 species, > 30 species or Cluster 1 (Mixed Renosterkop) that had 80 species, have been outlined (Fig 5.1). Clusters (4-6

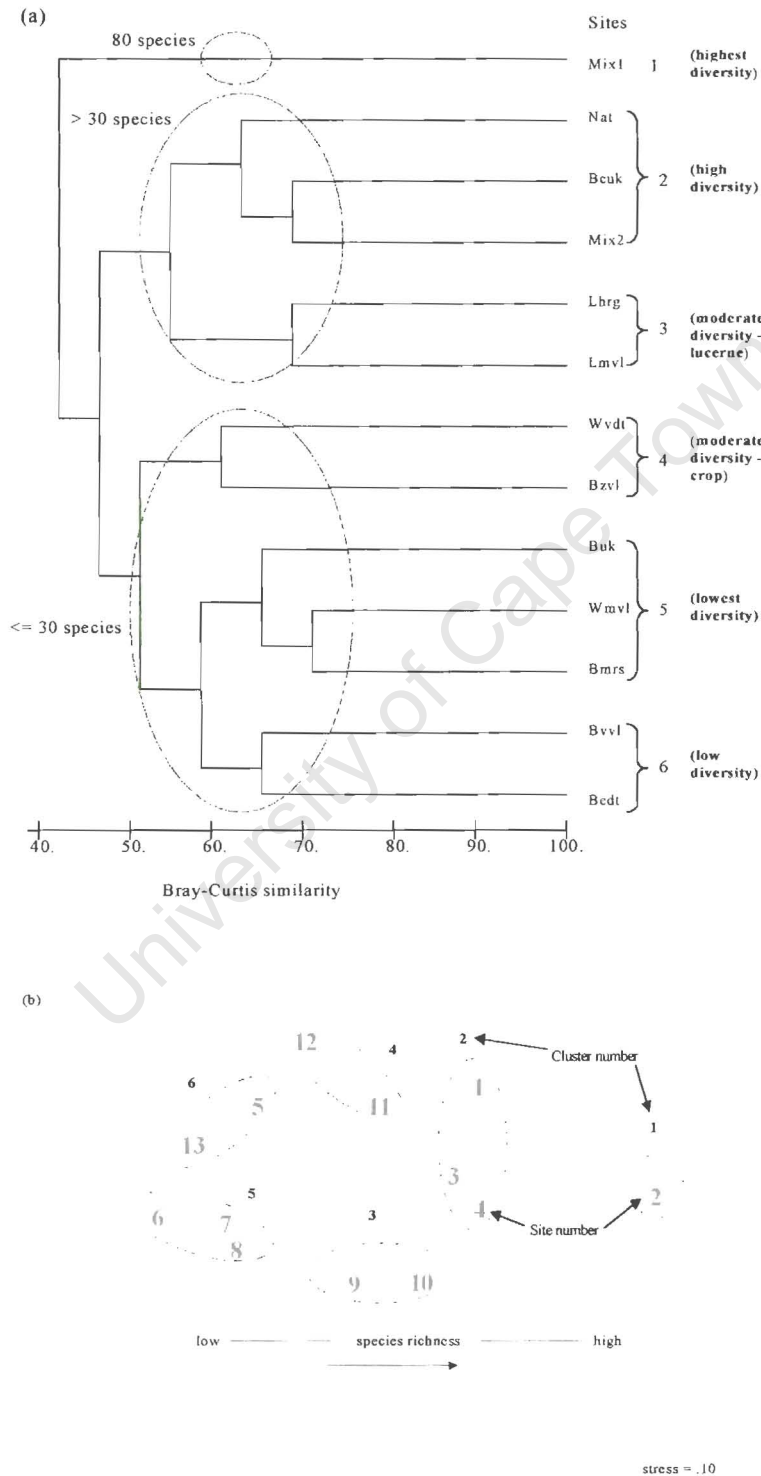


Fig. 5.1 Dendrogram of (a) Bray-Curtis percentage similarities in bird assemblage structure between 13 study sites and (b) multidimensional scaling ordination between sites (MDS)

that had ≤ 30 species, were all wheat and barley lands. The clusters with > 30 species, excluding Mixed Renosterkop, were the Lucerne sites, Natural, Barley/Canola and Mixed Vissersdrift sites.

5.2.3 Shifts in species composition

Table 5.3 shows the impacts of agricultural intensification on bird diversity on the Agulhas Plain. When comparing Fynbos to other regimes, with the exception of the Mixed regime that gained 50 species, all other regimes experienced a loss of diversity. A total of 19 species were lost between the Coastal Fynbos site and a combination of the barley and wheat sites (Crop 1 and Crop 2). The species of higher conservation importance (i.e. those species that are “naturally” rare and those species which have suffered a population decline as a result of human interference (Shaw 1995b)) were the Malachite, Lesser Double-collared and Orangebreasted Sunbird, Cape, Bully and Yellow Canary, Karoo Robin, Burchell’s Coucal, Greybacked Cisticola and Fierynecked Nightjar. When comparing fynbos with pastures (Lucerne regime), an additional four species were lost, viz. Spotted Prinia, Stonechat, Levillant’s Cisticola and Yellowrumped Widow.

Table 5.3 Loss and gain of species diversity between the Natural Fynbos and other regimes.

Comparison	Fynbos to Crop 1	Fynbos to Crop 2	Fynbos to Lucerne	Fynbos to Mixed
Lost	14	26	23	4
Gained	13	8	12	54
Net loss/gain	1 -	18 -	11 -	50 +

When comparing a fynbos-only environment with a Mixed regime, only four species were unique to the former (Table 5.3). On the other hand, 54 species were

gained by the habitat replacement. Eighty-one species were recorded at Mixed Renosterkop alone.

5.4 DISCUSSION

Bird community structure on the Agulhas Plain varies not only with yearly changes in crop type and production system, but also with the seasonal crop cycle succession, climate and time of year. Burel & Baudry (1995) agree that land management may alter the availability of food and suitable nest sites for birds, e.g. by varying the timing of cultivations, mowing or harvesting, or by changing the way such work is done.

Similar to findings by Little & Crowe (1994); Jansen, Little & Crowe (1999) and Ratcliffe & Crowe (*in press*), this study found that the expansion and diversification of farming practices resulted in the proliferation of many bird species, especially granivores and omnivores such as sparrows, larks and pipits, but caused reduction in numbers of other bird species, such as sunbirds, nightjars and mousebirds, that require more specialist habitats. Egyptian Geese, and other gamebirds such as Helmeted Guineafowl, have benefited from both the increase in wheat and barley sown annually, and the change in farming practices (the broadcast sowing method replaced the direct drilling method) that have increased the availability of food sources for these birds to feed on (Mangnall & Crowe *in press b*).

The Cape Sparrow, Redcapped and Thickbilled Lark, and Grassveld Pipit were the most common farmland species on the Agulhas Plain. Sparrows have been the most successful in adapting to agricultural intensification in the area. During both summer and winter, they were able to exploit the fenceline bushes (predominantly

Lycium spp.) for nesting and shelter, and the adjacent fields for feeding. Consequently, the population distribution and size of the species has not been as adversely affected by the ever-changing farming techniques and crop characteristics.

While less common species, such as the Black Korhaan, Pintailed Widgeon, Southern Boubou, Speckled Mousebird and Common Sandpiper, frequent particular fragmented habitats (Maclean 1993), a few species were strongly influenced by farming practice. For example, the Kittlitz Plover is a bird that appears to inhabit only pastoral lands and not croplands. Certain species were present only at a certain stage of the growth cycle of crops. For example, the Whiskered Tern was only present on ripe wheat or barley fields near water during September and October where it fed exclusively on insect larvae on the ears of plants. Migratory birds, such as White Storks and Yellowbilled Kites, occurred in the area only during the summer months.

Many of the birds that correlated significantly with the presence of Egyptian Geese also prefer wide, open areas where they can feed safely (Maclean 1993). The relatively low number of birds to regularly associate with geese may be ascribed to the fact that Egyptian Geese are nomadic species (Milstein 1993), and their movements thus depend on the availability of food and water. As a result, fewer species have the opportunity to co-exist with geese on a regular basis.

Cluster 2 best illustrates the effects of habitat management as it indicates which bird species were present when natural vegetation and crop agriculture were still present on the Agulhas Plain in ratios not detrimental to avian diversity. Subsequently, crops and pastures of various types have for the past 50 years rapidly replaced natural areas. In the process, many species have been restricted in range and have probably declined in abundance. A total of 23 species were lost when comparing the Coastal Fynbos site with a combination of all the crop and lucerne sites

(Crop 1 and Crop 2) (Table 3). Mixed regime sites supported a greater diversity of birds than the Coastal Fynbos site. Endemic and rarely seen species, such as the Orangebreasted Sunbird, White Stork, Fierynecked Nightjar, Greywing Francolin, Burchell's Coucal, robins and canaries, are supported by the remnant fynbos patches, and ever-decreasing mixed environments. Many of these species are reliant on the local natural and mixed ecosystems (Maclean 1993). Only the Orangebreasted Sunbird and White Stork were observed in the Natural and not in the Mixed regime. The White Stork was, however, seen outside the survey periods on lucerne lands during October. Many of the species that featured strongly in Clusters 4-6, such as the Egyptian and Spurwinged Geese, larks, pipits and wheatears, have expanded their home ranges and population sizes at the expense of other more fynbos-reliant species with the growth of the wheat and barley industries in the area.

5.5 CONCLUSION

Mixed regimes and fallow lands should be maintained and even promoted, and fenceline vegetation, such as hedges, e.g. *Lycium* spp., shrubs, e.g. *Cyperaceae* spp. and grasses, e.g. *Cynadon dactylon* should be encouraged. This should provide more habitats for a greater diversity of birds to feed, nest and shelter in. Although wildlife (and birds in particular) seems to thrive in areas of low intensity management, it will not benefit from areas that are simply abandoned (Fry 1991). These areas should be managed at an intensity that prevent them from becoming infested and congested with vegetation not suitable for sustaining healthy populations of wildlife in general, and birds in particular.

While maintaining mixed landscapes enhances avian diversity, a small number of species require natural fynbos habitat to survive. It is therefore essential that encroachment into natural vegetation be strictly controlled.

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Appendix 5.1 Mean Shannon-Wiener indices for each agricultural regime. Birds ordered according to the number of regimes at which they were present (5 = five regimes, 4 = four regimes, etc.).

Species name	Scientific name	Agricultural regime					
		Crop1	Crop2	Lucerne	Mixed	Fynbos	
Cape Sparrow	<i>Passer melanurus</i>	1.06	0.86	1.39	1.48	0.10	5
Redcapped Lark	<i>Calandrella cinerea</i>	1.36	1.01	1.76	0.92	0.10	
Grassveld Pipit	<i>Anthus cinnamomeus</i>	0.94	0.89	1.65	1.98	0.10	
Thickbilled Lark	<i>Galerida magnirostris</i>	1.11	0.80	1.62	1.08	0.69	
Cape Turtle Dove	<i>Streptopelia capicola</i>	0.33	0.23	0.67	1.84	2.47	
Cape Weaver	<i>Ploceus capensis</i>	0.50	0.16	1.10	1.61	1.47	
Orangethroated Longclaw	<i>Macronyx capensis</i>	0.59	0.53	0.63	0.45	1.67	
Fiscal Shrike	<i>Lanius collaris</i>	0.17	0.44	0.90	2.48	2.73	
Egyptian Goose	<i>Alopochen aegyptiacus</i>	0.26	0.21	0.93	1.50	0.10	
European Swallow	<i>Hirundo rustica</i>	0.29	0.10	0.15	1.59	1.14	
Longbilled Lark	<i>Certhilauda brevirostris</i>	0.85	0.50	1.05	0.50	1.35	
Redeyed Dove	<i>Streptopelia semitorquata</i>	0.10	0.22	0.10	1.30	1.39	
Pied Starling	<i>Spreo bicolor</i>	0.10	0.10	0.58	1.92	0.10	
Crowned Plover	<i>Vanellus coronatus</i>	0.23	0.10	1.22	1.40	0.10	
Helmeted Guineafowl	<i>Numida meleagris</i>	0.23	0.32	0.10	1.35	1.90	
Cape Wagtail	<i>Motacilla capensis</i>	0.25	0.10	0.63	1.13	0.10	
Common Quail	<i>Coturnix coturnix</i>	0.10	0.10	0.10	0.10	0.10	4
Blue Crane	<i>Anthropoides paradiseus</i>	0.10	0.40	0.35	0.61	-	
Capped Wheatear	<i>Oenanthe pileata</i>	0.10	0.23	0.87	0.38	-	
Fantailed Cisticola	<i>Cisticola juncidis</i>	1.47	1.48	0.10	0.86	-	
Levaillant's Cisticola	<i>Cisticola tinniens</i>	1.13	0.67	-	1.14	2.74	
Spotted Prinia	<i>Prinia maculosa</i>	0.10	0.10	-	0.17	2.74	
Stonechat	<i>Saxicola torquata</i>	0.50	0.58	-	0.44	0.69	
Yellowrumped Widow	<i>Euplectes capensis</i>	0.10	0.10	-	0.10	0.10	
Black Crow	<i>Corvus capensis</i>	0.17	-	0.60	1.36	2.60	
Cape Canary	<i>Serinus canicollis</i>	0.10	-	0.10	0.57	0.56	
Clapper Lark	<i>Mirafra apiata</i>	0.17	-	0.64	0.10	0.69	
Malachite Sunbird	<i>Nectarinia famosa</i>	0.10	-	0.32	1.48	2.26	
Stanley's Bustard	<i>Neotis denhami</i>	0.10	-	0.10	0.34	0.00	
Steppe Buzzard	<i>Buteo buteo</i>	0.10	-	0.10	0.60	1.61	
Black Swift	<i>Apus barbatus</i>	0.10	-	-	0.10	0.10	
Bokmakierie	<i>Telophorus zeylonus</i>	0.10	-	-	2.15	2.69	
Cape Robin	<i>Cossypha caffra</i>	0.10	-	-	0.77	0.67	
House Martin	<i>Delichon urbica</i>	0.10	-	-	0.93	0.56	
Jackal Buzzard	<i>Buteo rufofuscus</i>	0.10	-	-	0.42	0.10	
Blacksmith Plover	<i>Vanellus armatus</i>	0.27	-	0.10	1.07	-	
Cape Francolin	<i>Francolinus capensis</i>	0.16	-	0.10	0.37	-	
Kittlitz Plover	<i>Charadrius pecuarius</i>	0.42	-	0.61	0.52	-	3
Laughing Dove	<i>Streptopelia senegalensis</i>	-	-	0.10	0.90	0.10	
Yellow Canary	<i>Serinus flaviventris</i>	-	-	0.67	0.20	2.13	
African Marsh Harrier	<i>Circus ranivorus</i>	0.35	0.10	-	0.95	-	
Red Bishop	<i>Euplectes orix</i>	0.63	0.35	-	0.88	-	
Spurwinged Goose	<i>Plectropterus gambensis</i>	0.06	0.10	-	0.68	-	
Common Waxbill	<i>Estrilda astrild</i>	-	0.10	-	0.56	0.10	
Forktailed Drongo	<i>Dicrurus adsimilis</i>	-	0.10	-	0.93	1.66	
Wattled Starling	<i>Creatophora cinerea</i>	-	0.10	-	0.09	0.10	
African Hoopoe	<i>Upupa africana</i>	-	-	-	0.35	0.10	
Blackheaded Heron	<i>Ardea melanocephala</i>	-	-	-	0.83	0.10	
Bully Canary	<i>Serinus sulphuratus</i>	-	-	-	0.10	0.10	
Burchell's Coucal	<i>Centropus burchellii</i>	-	-	-	0.60	0.10	
Greybacked Cisticola	<i>Cisticola subruficapillus</i>	-	-	-	0.10	1.74	
Karoo Robin	<i>Cercotrichas coryphaeus</i>	-	-	-	0.10	1.01	
Lesser Double-collared Sunbird	<i>Nectarinia chalybea</i>	-	-	-	1.55	2.82	2
Yellowbilled Duck	<i>Anas undulata</i>	-	-	-	0.56	0.10	
Alpine Swift	<i>Tachymarptis melba</i>	0.10	-	-	-	0.31	
Greywing Francolin	<i>Francolinus africanus</i>	0.10	-	-	-	0.10	
Fierynecked Nightjar	<i>Caprimulgus pectoralis</i>	-	-	0.10	-	0.10	

Appendix 5.1 Mean Shannon-Wiener indices for each agricultural regime. Birds ordered according to the number of regimes at which they were present (5 = five regimes, 4 = four regimes, etc.).

Species name	Scientific name	Agricultural regime				
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Cape Sparrow	<i>Passer melanurus</i>	1.06	0.86	1.39	1.48	0.10
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Grassveld Pipit	<i>Anthus cinnamomeus</i>	0.94	0.89	1.65	1.98	0.10
Thickbilled Lark	<i>Galerida magnirostris</i>	1.11	0.80	1.62	1.08	0.69
Cape Turtle Dove	<i>Streptopelia capicola</i>	0.33	0.23	0.67	1.84	2.47
Cape Weaver	<i>Ploceus capensis</i>	0.50	0.16	1.10	1.61	1.47
Orangethroated Longclaw	<i>Macronyx capensis</i>	0.59	0.53	0.63	0.45	1.67
Fiscal Shrike	<i>Lanius collaris</i>	0.17	0.44	0.90	2.48	2.73
Egyptian Goose	<i>Alopochen aegyptiacus</i>	0.26	0.21	0.93	1.50	0.10
European Swallow	<i>Hirundo rustica</i>	0.29	0.10	0.15	1.59	1.14
Longbilled Lark	<i>Certhilauda brevirostris</i>	0.85	0.50	1.05	0.50	1.35
Redeyed Dove	<i>Streptopelia semitorquata</i>	0.10	0.22	0.10	1.30	1.39
Pied Starling	<i>Spreo bicolor</i>	0.10	0.10	0.58	1.92	0.10
Crowned Plover	<i>Vanellus coronatus</i>	0.23	0.10	1.22	1.40	0.10
Helmeted Guineafowl	<i>Numida meleagris</i>	0.23	0.32	0.10	1.35	1.90
Cape Wagtail	<i>Motacilla capensis</i>	0.25	0.10	0.63	1.13	0.10
Common Quail	<i>Coturnix coturnix</i>	0.10	0.10	0.10	0.10	0.10
Blue Crane	<i>Anthropoides paradiseus</i>	0.10	0.40	0.35	0.61	-
Capped Wheatear	<i>Oenanthe pileata</i>	0.10	0.23	0.87	0.38	-
Fantailed Cisticola	<i>Cisticola juncidis</i>	1.47	1.48	0.10	0.86	-
Levaillant's Cisticola	<i>Cisticola tinniens</i>	1.13	0.67	-	1.14	2.74
Spotted Prinia	<i>Prinia maculosa</i>	0.10	0.10	-	0.17	2.74
Stonechat	<i>Saxicola torquata</i>	0.50	0.58	-	0.44	0.69
Yellowrumped Widow	<i>Euplectes capensis</i>	0.10	0.10	-	0.10	0.10
Black Crow	<i>Corvus capensis</i>	0.17	-	0.60	1.36	2.60
Cape Canary	<i>Serinus canicollis</i>	0.10	-	0.10	0.57	0.56
Clapper Lark	<i>Mirafra apiata</i>	0.17	-	0.64	0.10	0.69
Malachite Sunbird	<i>Nectarinia famosa</i>	0.10	-	0.32	1.48	2.26
Stanley's Bustard	<i>Neotis denhami</i>	0.10	-	0.10	0.34	0.00
Steppe Buzzard	<i>Buteo buteo</i>	0.10	-	0.10	0.60	1.61
Black Swift	<i>Apus barbatus</i>	0.10	-	-	0.10	0.10
Bokmakierie	<i>Telophorus zeylonus</i>	0.10	-	-	2.15	2.69
Cape Robin	<i>Cossypha caffra</i>	0.10	-	-	0.77	0.67
House Martin	<i>Delichon urbica</i>	0.10	-	-	0.93	0.56
Jackal Buzzard	<i>Buteo rufofuscus</i>	0.10	-	-	0.42	0.10
Blacksmith Plover	<i>Vanellus armatus</i>	0.27	-	0.10	1.07	-
Cape Francolin	<i>Francolinus capensis</i>	0.16	-	0.10	0.37	-
Kittlitz Plover	<i>Charadrius pecuarius</i>	0.42	-	0.61	0.52	-
Laughing Dove	<i>Streptopelia senegalensis</i>	-	-	0.10	0.90	0.10
Yellow Canary	<i>Serinus flaviventris</i>	-	-	0.67	0.20	2.13
African Marsh Harrier	<i>Circus ranivorus</i>	0.35	0.10	-	0.95	-
Red Bishop	<i>Euplectes orix</i>	0.63	0.35	-	0.88	-
Spurwinged Goose	<i>Plectropterus gambensis</i>	0.06	0.10	-	0.68	-
Common Waxbill	<i>Estrilda astrild</i>	-	0.10	-	0.56	0.10
Forktailed Drongo	<i>Dicrurus adsimilis</i>	-	0.10	-	0.93	1.66
Wattled Starling	<i>Creatophora cinerea</i>	-	0.10	-	0.09	0.10
African Hoopoe	<i>Upupa africana</i>	-	-	-	0.35	0.10
Blackheaded Heron	<i>Ardea melanocephala</i>	-	-	-	0.83	0.10
Bully Canary	<i>Serinus sulphuratus</i>	-	-	-	0.10	0.10
Burchell's Coucal	<i>Centropus burchellii</i>	-	-	-	0.60	0.10
Greybacked Cisticola	<i>Cisticola subruficapillus</i>	-	-	-	0.10	1.74
Karoo Robin	<i>Cercotrichas coryphaeus</i>	-	-	-	0.10	1.01
Lesser Double-collared Sunbird	<i>Nectarinia chalybea</i>	-	-	-	1.55	2.82
Yellowbilled Duck	<i>Anas undulata</i>	-	-	-	0.56	0.10
Alpine Swift	<i>Tachymarptis melba</i>	0.10	-	-	-	0.31
Greywing Francolin	<i>Francolinus africanus</i>	0.10	-	-	-	0.10
Fierynecked Nightjar	<i>Caprimulgus pectoralis</i>	-	-	0.10	-	0.10

Yellowbilled Kite	<i>Milvus parasitus</i>	0.10	-	-	0.37	-	2
Blackwinged Stilt	<i>Himantopus himantopus</i>	0.10	-	-	0.10	-	
Common Sandpiper	<i>Tringa hypoleucos</i>	0.10	-	-	0.37	-	
Rock Pigeon	<i>Columba guinea</i>	0.10	-	-	0.43	-	
SA Shelduck	<i>Tadorna cana</i>	0.10	-	-	0.07	-	
Cattle Egret	<i>Bubulcus ibis</i>		-	0.25	0.10	-	
European Starling	<i>Sturnus vulgaris</i>		-	0.10	1.08	-	
Hadeda Ibis	<i>Bostrychia hagedash</i>		-	0.10	0.97	-	
Kelp Gull	<i>Larus dominicanus</i>		-	0.10	0.23	-	
Plainbacked Pipit	<i>Anthus leucophrys</i>		-	0.10	0.50	-	
Sacred Ibis	<i>Threskiornis aethiopicus</i>		-	0.10	0.20	-	
Pintailed Wydah	<i>Vidua macroura</i>	0.40	-	-	-	-	
Whiskered Tern	<i>Chlidonias hybridus</i>	0.10	-	-	-	-	
White Stork	<i>Ciconia ciconia</i>	-	-	-	-	0.10	
Orangebreasted Sunbird	<i>Nectarinia violacea</i>		-	-	-	0.10	
African Sand Martin	<i>Riparia riparia</i>	-	-	-	0.29	-	
Black Duck *	<i>Anas sparsa</i>	-	-	-	0.10	-	
Black Harrier	<i>Circus maurus</i>	-	-	-	0.23	-	
Black Korhaan	<i>Eupodotis afra</i>	-	-	-	0.46	-	
Blackshouldered Kite	<i>Elanus caeruleus</i>	-	-	-	0.86	-	
Cape Bulbul *	<i>Pycnonotus capensis</i>	-	-	-	0.96	-	
Cape Bunting *	<i>Emberiza capensis</i>	-	-	-	0.10	-	
Cape Reed Warbler *	<i>Acrocephalus gracilirostris</i>	-	-	-	0.10	-	
Cape Shoveller	<i>Anas smithii</i>	-	-	-	0.32	-	
Cape Teal *	<i>Anas capensis</i>	-	-	-	0.32	-	
Cape White Eye *	<i>Zosterops pallidus</i>	-	-	-	0.88	-	
European Sedge Warbler *	<i>Acrocephalus schoenobaenus</i>	-	-	-	0.10	-	
Fiscal Flycatcher *	<i>Sigelus silens</i>	-	-	-	0.10	-	
Greater Striped Swallow *	<i>Hirundo cucullata</i>	-	-	-	0.10	-	
Grey Heron *	<i>Ardea cinerea</i>	-	-	-	0.10	-	
Hamerkop *	<i>Scopus umbretta</i>	-	-	-	0.10	-	
Hartlaub's Gull *	<i>Larus hartlaubii</i>	-	-	-	0.10	-	
Malachite Kingfisher *	<i>Alcedo cristata</i>	-	-	-	0.10	-	
Martial Eagle	<i>Polemaetus bellicosus</i>	-	-	-	0.10	-	
Paradise Flycatcher *	<i>Terpsiphone viridis</i>	-	-	-	0.10	-	
Pearlbreasted Swallow *	<i>Hirundo dimidiata</i>	-	-	-	0.10	-	
Peregrine Falcon	<i>Falco peregrinus</i>	-	-	-	0.23	-	
Pied Barbet *	<i>Tricholaema leucomelas</i>	-	-	-	0.34	-	
Pied Kingfisher *	<i>Ceryle rudis</i>	-	-	-	0.10	-	
Redbilled Teal *	<i>Anas erythrorhyncha</i>	-	-	-	0.37	-	
Redchested Cuckoo *	<i>Cuculus solitarius</i>	-	-	-	0.10	-	
Reed Cormorant *	<i>Phalacrocorax africanus</i>	-	-	-	0.21	-	
Sombre Bulbul *	<i>Andropadus importunus</i>	-	-	-	0.06	-	
Southern Boubou	<i>Laniarius ferrugineus</i>	-	-	-	0.88	-	
Speckled Mousebird	<i>Colius striatus</i>	-	-	-	0.10	-	
Spotted Dikkop	<i>Burhinus capensis</i>	-	-	-	0.71	-	
Streakyheaded Canary *	<i>Serinus gularis</i>	-	-	-	0.07	-	
Whitenecked Raven *	<i>Corvus albicollis</i>	-	-	-	0.07	-	

* birds occurring at Renosterkop only

CHAPTER 6

MANAGING EGYPTIAN GEESE ON THE CROPLANDS OF THE AGULHAS PLAIN

SUMMARY

Both internationally and locally, there have been increasingly frequent complaints of agricultural damage to crops by thriving populations of geese. Various methods have been used to minimise this damage and alleviate the resulting financial loss. Most methods were relatively ineffective over the long term or were prohibitively expensive. By answering key questions about the species' biology and ecology, such as its population increase, spatial and temporal abundance, and financial impact on barley and wheat, recommendations are suggested as how to manage the species so as to minimise the damage it causes to the farmlands. These include measures such as persistent scaring and regular wingshooting when larger flocks of geese, i.e. > 150 birds persist for longer than one week on commercially valuable crops such as barley and wheat.

6.1 INTRODUCTION

The conflict between geese and crop farmers has intensified over the last three decades as many goose species, especially in Europe, have increased markedly and have, in some cases, caused serious damage and/or losses to cereal crops (Madsen 1991; Ankney 1996; Vickery & Gill 1999). Associated with these population increases, were complaints by farmers of financial loss and demands that something is done about the damage that these birds were inflicting on their lands. There have been increasingly frequent claims of agricultural damage and various methods have been used and proposed for alleviating the conflict between farmers and geese. Most traditional methods, e.g. scarecrows and propane cannons, were relatively ineffective in the long term or were prohibitively expensive (Owen 1977). Many ways of preventing damage have been proposed and implemented, but most of these alleviate the problem only partly, or were effective for only a short time (Owen 1977; Conover 1989; Aguilera *et al.* 1991). Policy instruments and management measures involved in the alleviation of crop damage conflict should be shaped in a way that they motivate farmers to tolerate geese and respect the fact that farmers are entrepreneurs (Van der Sar 1992).

Van Paassen (1992) argues there are two main approaches to damage mitigation:

1. The individual approach – farmers chase geese or (less often) tolerate them. The degree of success depends on the situation of a farm (intensity of land-use, parcelling of the land, etc.), on the frequency, duration and predictability of goose visits and how quick the farmer's action is in chasing off the birds. Merely

scaring the birds away from crops if no alternative food is available, however, means passing the problem on to other farmers.

2. Area-orientated approach – an integrated management plan should be drawn up to scare birds away from sensitive crops to where they can be tolerated on less sensitive crops. For this approach to work, alternative areas should exist or should be created, and should provide enough food for the birds. The number of geese and the duration of their stay should also be more or less predictable. Less damage will then be done to farmers and they will be more accepting of birds on their lands. It calls for a high degree of consultation and a change in attitude by the farmers towards birds.

In prairie regions of Canada which receive the most severe crop damage in all of North America, there is a crop damage prevention programme which is funded to the tune of \$3 million a year (Van Paassen 1992). In addition, there is a compensation fund of up to \$10 million a year. The government helps farmers locate and secure propane-based scaring devices. Permits were issued to kill birds that were causing damage to farmlands outside the wingshooting season. Farmers often invite hunters to shoot on their lands during the wingshooting season to help scare birds away. “Bait stations” (daily spreading of grain on a roosting/loafing area) and “lure crops” (crops managed to maintain growing or swathed grain in the field to attract geese) were used to attract waterfowl in high concentrations to alternative feeding areas so that they will not move into farmers’ fields. The role of wingshooting in crop damage mitigation in Canada is limited. It can be successful on individual farm fields, but the amount of land that is under grain cultivation is so vast, and the number of

waterbodies so extensive, that wingshooting in one field just forces birds on to the next field with them soon coming back again (Patterson 1992).

Many scaring techniques and devices have been used in the past, with varying degrees of success. A relatively successful scaring plan involves contract workers placing poles in the areas being damaged. Nylon threads were strung along the poles, so impeding the successful landing by geese. Chasing birds several times a day in a way that they will fly to an “accommodation parcel” can aid this scaring plan. The “accommodation plan” determines where the birds will be accommodated and the period of accommodation. Birds were attracted to these areas not for aesthetic reasons, but rather for the increased protein content of the grass when grazed. Plastic decoy geese were used to attract the geese to the parcels concerned (Van Paassen 1992).

Unless the birds have somewhere else to feed undisturbed, none of these methods will be successful for very long (Kear 1963). More sophisticated bird scarers have been developed recently, but their cost and the time involved in servicing and moving them, precludes their widespread use for low-value crops. Scarers remain a valuable tool in the hands of the farmer, but are unlikely to be more than a partial and a short-term solution (Patterson 1992).

In October 1994, the farming community of the Agulhas Plain, in conjunction with a range of organisations responsible for biodiversity conservation, met to discuss a joint strategy to manage Egyptian Geese. A number of suggestions were made at the meeting. These included: the marketing of goose meat, reducing numbers during the moulting season, and instituting a ringing project. The lifting of all restrictions on bag size and wingshooting season was the most drastic option implemented. However, it was concluded that effective management strategies could only be found once critical

data on the biology of the Egyptian Goose and on the magnitude of its negative economic impact on crop agriculture was available (Shaw 1995a).

Consequently, this research project about the Egyptian Goose on the Agulhas Plain was initiated in 1997. In addressing the main aim of this chapter, viz. how Egyptian Geese numbers can be managed so as to reduce the damage they cause to the croplands of the Agulhas Plain, a number of key questions about their biology and ecology have already been answered in Chapters 3 and 4.

6.2 RESULTS

Given the information presented in Chapters 3 and 4, a number of management recommendations have been made below as how Egyptian Geese numbers could be managed so as to reduce the damage they cause to the croplands of the Agulhas Plain.

6.3 MANAGEMENT RECOMMENDATIONS

A local reduction in damage to crops by geese can be achieved best by changing local conditions in relation to those elsewhere. Areas hardly ever used by geese were small fields with trees and tall hedges. Most of these features are not normally compatible with modern agriculture, but their importance cannot be overemphasised, and any hedges and trees that can be left on a farm will help to reduce its attractiveness to geese and may even improve it for other birds.

The problem is not so much repelling geese from the farms, but protecting crucial fields for sensitive periods. Significant damage could be avoided if scaring

could disperse geese. Damage could be reduced if vulnerable crops were grown where geese did not like to feed, e.g. near roads, buildings, and other sources of disturbance. More could be achieved with the aid of scaring devices, some of which could prove efficient when crops are most vulnerable. It is also important to repel birds by shooting or human scaring as soon as they start feeding on a field, for the more they have fed, the more reluctant they are to depart. Any solution to the goose problem on the Agulhas Plain must involve breaking up large concentrations of birds by a number of farmers in the area co-ordinating the timing and positioning of their shooting and/or scaring. An additional help would involve attracting geese to land where damage is economically less important by providing ideal landscapes, freedom from disturbance and with abundant food.

The following recommendations are specific to the three main stages of damage, viz. surface seed, growing plant and harvested-plant (windrow). They are especially relevant to farms near the main roosting sites of the geese.

6.3.1 Surface seed damage

1. Attempt to sow all Agulhas Plain farms simultaneously within two or three days so as to reduce the spatial and temporal availability of vulnerable plants, i.e. those shorter than 25 cm.
2. Revert to more direct sowing methods to prevent large numbers of geese moving into the area to feed on the abundance of exposed surface seed.
3. Roll camps after sowing to reduce the availability of surface seeds.
4. Farmers could do germination tests at different sowing densities, to remove (as far as possible) excess seeds from the surface of the soil that may attract geese.

5. If rotation systems can be adjusted, try not to sow crops next to waterbodies where birds are roosting.
6. Fire a shotgun or rifle at irregular times every day on camps where bird numbers are greatest. Through regular wingshooting, geese should be forced to associate the shotgun noise with killing or wounding. This is a more effective deterrent than stationary scarecrows.
7. For better wingshooting opportunities, erect semi-permanent hides or blinds where most birds are expected.

6.3.2 Growing plant damage

1. If bird numbers are kept low during the surface seed period, damage to young plants should also be less.
2. Low levels of grazing by geese may actually increase the final yield (Kear 1970). After two or three days feeding, ensure that birds stay off specific camps by scaring them off until the crops are too tall to be damaged.
3. Change in the cultivar of barley and wheat – shorter ripening period and/or different taste may decrease numbers of geese feeding on crop (K. Roberson pers. comm.).
4. If geese numbers become extremely high and damage can be shown to be critically severe, all local farmers could band together for a simultaneous shoot to lower geese numbers markedly.
5. Due to either unpleasant taste or smell, the spraying of herbicides and pesticides (at recommended levels) seems to keep geese off fields for three to four days. If possible, spraying could be held back in areas where annual damage occurs until geese start feeding there.

6. Blinds should be erected at frequently fed on or strategically placed fields.
7. Cheaper, strategically placed alternative crops or pastures with a high protein content or component, such as serradella *Ornithopus* spp., may draw geese away from croplands.

6.3.3 Windrow damage

The best measure to minimize damage during the windrow damage period would be to change to a less vulnerable harvesting system, e.g. shocks (stooks) (P. Milstein pers. comm.). The organisation of more-frequent, controlled wingshooting (social or commercial) would also prove to be successful in managing numbers of Egyptian Geese.

6.4 WINGSHOOTING STRATEGY

Wingshooting creates a lot of noise on an irregular basis. It can not only reduce goose damage, but also may find greater favour with local and international wingshooters and attract revenue from commercial wingshooting operations. Egyptian Geese could also be used as a sustainable resource in a number of ways such as contributing to the farmers' incomes and/or providing a cheap source of food for the local communities. The appropriate wingshooting strategy is suggested below.

The ideal time to shoot Egyptian Geese is from May – July and October – December, when they fly into fields to feed on crops and pastures. The flight lines should be observed three or four days prior to the planned shoot, and cover should be examined. The best times to hunt are from dawn until about 09h00 and 16h00 until dusk. When cover is sparse, i.e. times outside October and November when there are

no windrows to lie under, simple hides can be set up. Decoys can be placed on the field in order to make the movement of the birds more predictable and also to bring them into a good position for shooting. The Egyptian Goose does not fly far away after the first shot is fired and, after about 15 minutes, often returns to the same area, which allows the possibility of multiple shoots.

The best sites for wingshooting are usually as far from the main roosting sites as practically possible. This is not always possible because geese often feed on fields close to their roosting sites. A site at a waterbody should not be shot at on more than three or four occasions in a year to prevent a permanent decline in populations of non-target bird species. A 12-gauge, double-barrelled shotgun using no. 3 or 4 cartridges has proved to be the most suitable firearm and ammunition for Egyptian Goose shooting. However, a repeating shotgun, which has a killing potential, should be used if more geese want to be shot over a shorter period of time (P. Milstein pers. comm.).

The rifle may prove to be the most suitable weapon to shoot geese over the large areas of windrows (or shocks) with the limited manpower available per unit area (P. Milstein pers. comm.). A special permit would be required from Western Cape Nature Conservation to use a rifle for this purpose. Fitted with a telescopic sight for greater killing efficiency, various calibers such as a .22 to slightly larger can be used. Such rifles would wound less than shotguns in experts hands, but would be far more dangerous to non-target humans and livestock than any shotgun due to their much greater killing distances, and a high level of discipline would be absolutely essential. Equally essential would be a series of cheap sacking hides, commanding the windrows or shocks, in which the marksman would hide alternately and unexpectedly (P. Milstein pers. comm.).

Although not a recommended action for ethical reasons, a very effective technique to reduce the numbers of geese that are persisting to cause damage in an area would be to shoot moulting birds with a rifle at their roost sites. Shooting would occur in a manner so as to minimize the impact on non-target species. This approach is very controversial, and would require authorization from the local conservation services.

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SYNTHESIS

The Egyptian Geese feeds primarily on grain seeds, growing crops and cut crops drying in windrows. This has brought it into conflict with farmers in many parts of southern Africa. In the Western Cape in particular, many cereal crop farmers on the Agulhas Plain south of Bredasdorp regard the Egyptian Goose as a serious pest. A substantial increase in the tonnage of barley sowed and changes in farming practices have resulted in dramatic increases in goose populations in the Western Cape since the late 1980s, and study area since the early 1990s (Chapter 3).

About half of all farm surveys of geese were during land-use situations when quantifiable financial loss of crops occurred, i.e. soon after sowing; young, growing plants; and cut plants stacked in windrows to dry (Chapter 4). Overall, the mean yield loss in quantified areas in 1997 and 1998 was 65%. Based on extrapolations from areas quantified, the estimated total financial loss of growing-plants to local cereal growers on the Agulhas Plain was R180 000 (\pm US\$ 30 000) in 1997, and R420 000 in 1998 (Chapter 4). The largest numbers of geese were recorded during June and July when they foraged on growing-plants less than 25 cm tall (Chapter 4). By August, geese shifted their attentions from croplands and foraged on less-valuable pastures. The main roosting sites used by Egyptian Geese were large, open waterbodies, which provided safe havens for roosting, breeding and moulting, and all farms surrounding these waterbodies received the heaviest annual crop damage (Chapter 4).

Besides damage to growing plants, after sowing of wheat and barley, 89% of exposed seeds were removed from the surface on a projected 175 ha (a loss of about R19 000). The average loss of marketable grain in the windrow quantification areas

was 40%, which equated to a projected regional financial loss of about R175 000 in 1997 (Chapter 4).

Renoster Shrubland and Lowland Fynbos, which are the predominant natural vegetation types in the study area, have been fragmented and transformed extensively by crop and pastoral agriculture. Many bird species, especially those reliant on natural vegetation, have been negatively affected by the expansion of agriculture (Chapter 5). However, populations of Egyptian Geese have increased enormously on the Agulhas Plain since 1991. Egyptian Geese preferred crops and pastures to Coastal Fynbos areas, and avian diversity decreased as the suitability of crops for Egyptian Geese increased (Chapter 5). To provide more suitable habitat for a greater diversity of birds, it is recommended that Mixed regimes (combinations of agricultural and natural vegetation) should be encouraged and encroachment into natural vegetation strictly controlled (Chapter 5).

It is recommended that when larger flocks of geese, i.e. > 150 birds, persist for longer than one week on commercially valuable crops, such as barley and wheat, mitigation measures such as scaring and/or wingshooting should be taken to lower their numbers and minimize the damage they could potentially cause (Chapter 6).

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