Corella, 1994, 18(3):71-76

THE EFFECT OF REVEGETATION ON SILVER GULL AND SACRED IBIS POPULATIONS AT WINTER SWAMP, BALLARAT

BARRY KENTISH

School of Biological and Chemical Sciences, The University of Ballarat, P.O. Box 663, Ballarat, Vic, 3353

Received 16 November 1992

Winter swamp, 7 km west of Ballarat, was improved as a wetland to encourage breeding birds. Islands, created to enhance the habitat for birds, were quickly colonized by breeding Silver Gulls. Revegetation with trees and shrubs on some islands reduced the breeding population of gulls. Lowest gull nest densities occurred on bare areas and beneath trees. The higher densities were associated with shrubs.

Silver Gulls eventually left the revegetated islands which were later colonized by breeding Sacred Ibis. Ibis nested predominantly in *Melaleuca ericifolia, Acacia melanoxylon* and *Eucalyptus* species. The high nest density of Sacred Ibis eventually killed some supporting plants.

INTRODUCTION

There has been a substantial increase in Silver Gulls *(Larus novaehollandiae)* over the last 50 years (Smith 1992; Smith and Carlile 1993). This is attributed to an increase in the availability of additional food supplies from human refuse depots (Smith *et al.* 1991). The reliance by Silver Gulls on food scraps has contributed to their colonization of non-coastal urban centres (Frith 1969, Blakers *et al.* 1984). Food supply and availability are critical to Silver Gull dispersal patterns (Murray and Carrick 1964).

Sacred Ibis *(Threskiornis aethiopica)* have extended their range since 1901. They have benefited from the development of irrigated agriculture, and like gulls frequent urban habitats foraging on refuse tips (Blakers *et al.* 1984, p. 661). If a suitable breeding habitat is available in proximity to an urban food source, Silver Gulls may utilize these sites to breed. This causes concern for town planners because of the possibility that birds may interrupt the flow of traffic (Skira and Wapstra 1990) and operation of aircraft (Van Tets 1972; Skira and Wapstra 1990; Smith 1992). Gulls have also been suspected of spreading disease and are of concern to public health management (Gould and Fletcher 1978; Iveson 1979; Fenlon 1981; Reilly *et al.* 1981; Butterfield *et al.* 1983; Iveson and Hart 1983; Girdwood *et al.* 1985; Monaghan *et al.* 1985; Smith 1992).

Gull population control by culling only provides a short-term solution (Skira and Wapstra 1990). Limited culls are considered more effective as a management option than extensive culls (Smith and Carlile 1993). However, without any reduction of food availability culls can lead to an increase in reproductive success (Coulson *et al.* 1982; Spaans *et al.* 1987). Non-lethal techniques such as netting cause breeding birds to disperse but require constant maintenance for several seasons to be effective (Skira and Wapstra 1990). Human disturbance is considered effective in reducing breeding density (Smith and Carlile 1993). Egg collecting may achieve the desired effect of reducing breeding but is labour intensive (Skira and Wapstra 1990). However, Smith and Carlile (1993) found that egg removal had little effect on breeding success. It appears that a combination of habitat modification, culling and human disturbance can reduce gull breeding success (Smith and Carlile 1993).

Habitat modification is often considered more effective, in the long term, than any direct methods of population control (Caughley 1977). Revegetation, as a habitat modification technique, could alter the breeding habitat sufficiently to affect breeding populations. This paper outlines Silver Gull and Sacred Ibis colonization of revegetated islands of a modified wetland and the effect on their breeding densities.

STUDY SITE

Ballarat (37°34′S, 143°52′E) is a rural Victorian city of approximately 70000 people. Winter Swamp (37°32′S, 143°47′E), 7 km west of Ballarat, is an 80 ha area of Crown Land with 30 ha of shallow (<2 m deep) wetland (Fig. 1). The swamp is approximately 1.7 km south of Ballarat Aerodrome and was grazed from 1861 but this ceased in 1981 when the Advisory Committee decided to improve the area as a wetland.

Winter Swamp has community value for nature conservation, scientific study, and passive recreation. Since the early 1800s, 22 per cent (104079 ha) of wetlands in Victoria has been lost (Office of the Commissioner for the Environment 1988). In the same time period the area of deep water (>2 m), permanent, open, freshwater bodies has increased by 93 per cent to 87452 ha, whilst 144341 ha of freshwater marshes and meadows (<2 m deep) has been lost. The creation and enhancement of Winter Swamp by management authorities was an attempt to redress this historical imbalance.

Five islands were created in 1982 (Fig. 1) and a revegetation programme prepared for the islands and wetland margin. Each island was approximately 1.5 m above the maximum water level. Their sizes were as follows: Horseshoe (120 m by 12 m), Long (120 m by 10 m), Egg (15 m diameter), North (12 m diameter) and South (13 m diameter). Islands and swamp margins were revegetated with a total of 5000 shrubs and trees of a variety of native, but not local, species. Tube stock were planted and protected from rabbits by plastic or wire mesh.

RESULTS

Population Dynamics of Silver Gulls in Ballarat Area

For the Ballarat region, the first Silver Gull breeding record is from 1917 at Lake Goldsmith (37°32′S, 143°20′E), near Beaufort (approximately 40 km west of Ballarat) (Fig. 1) (R. Thomas, pers. comm.). In the early 1980s breeding was recorded at Merin Merin Swamp (37°15′S, 143°48′E), near Clunes (38 km north of Ballarat) (Fig. 1), although it may have occurred earlier at this site. Lake Wendouree (37°33′S, 143°50′E), a 212 ha permanent lake within Ballarat's residential areas, has a gull population which varied from 41 in 1951

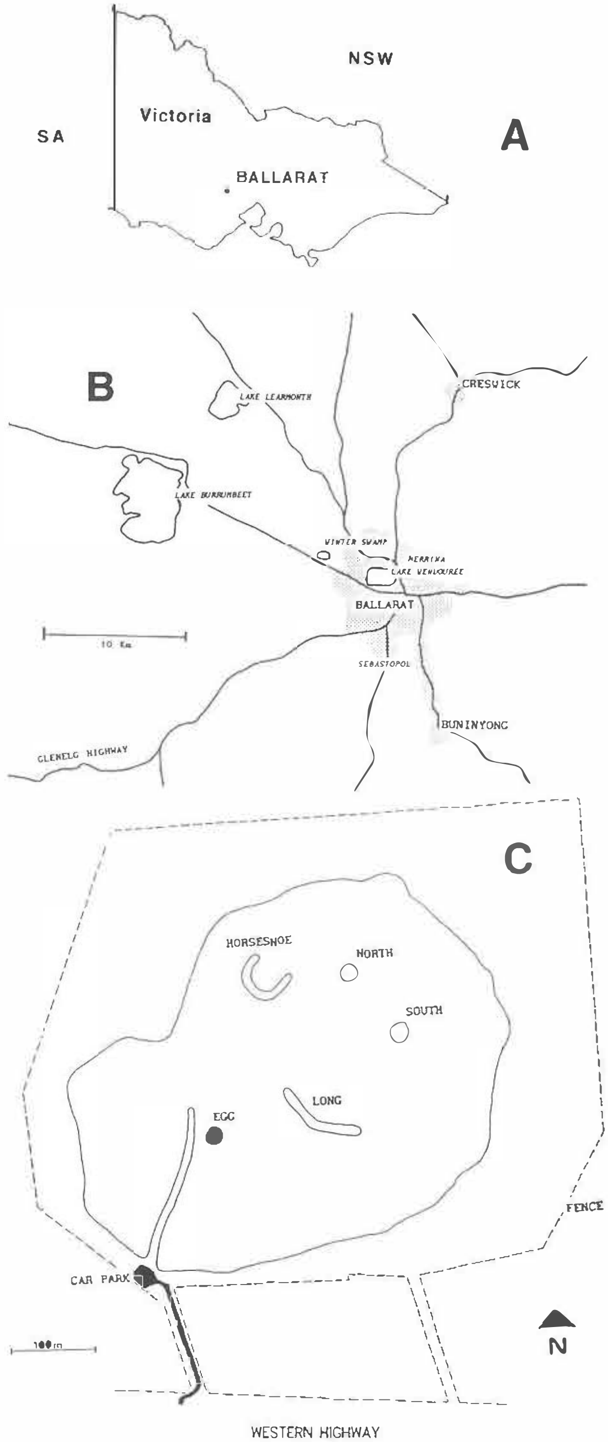

Figure 1. *Locality maps: A — Balarat in Victoria; B — the environs of Ballarat; and C — details of Winter Swamp.*

to 700 in 1985. However, the population change between these years was not consistent (see Appendix 1) (R. Thomas, pers. comm.). Gulls were first observed visiting Winter Swamp in February 1953 (20+ birds) (R. Thomas, pers. comm.). This was prior to establishing the wetland in 1982.

During 1987, during the non-breeding season, the gull population which foraged on the Ballarat district refuse tip at Nerrina (37°32′S, 143°53′E), approximately 5 km north-west of Ballarat city centre, was at least 1 250 (Miller 1987). These birds roosted at Winter Swamp, visiting Lake Wendouree on their return from the tip each night. Nerrina tip closed in December 1987. Subsequently, refuse was buried at the larger regional tip in Sebastopol (37°36′S, 143°51′E), 9 km south of Ballarat city centre. Since January 1988 a larger, seasonally variable population has foraged on the Sebastopol refuse depot. In 1988 and 1989 immigration increased the tip population prior to the start of the breeding season, from 1 500 in February (1988) to 5 000 in July (1988). Some of the population left the tip after the breeding season (Anderson 1988; Baker 1989).

Breeding

Silver Gulls colonized Winter Swamp when it filled in mid-1983 after the 1982–1983 drought. They commenced breeding on all islands in 1983 and by 1987 the breeding population was estimated at 1 400 birds (Miller 1987). By July 1989 the population at Sebastopol regional tip had increased to 6 200 birds (Baker 1989) with a consequent increase in the breeding population at Winter Swamp.

The population increase caused concern for management authorities because of the possible conflict between the birds and aircraft approaching and departing from the nearby aerodrome. The Ballarat Shire Council considered it necessary to investigate techniques to reduce the breeding population.

1. The effect of covering nesting sites

As Silver Gulls favour open nesting sites (Wheeler and Watson 1963) it was thought that breeding birds may avoid covered areas. Egg Island was chosen for experimental treatment and, during the breeding season in July 1987, half of the island was covered with brushwood (*Pinus radiata* cuttings) to a depth of 1 m, while the other half of the island was left uncovered as the control.

TABLE 1

Nest Density/m^2 in covered and uncovered (control) areas. (*The area was covered in July 1987).

	Month	Covered*	Uncovered (control)
1987	July	0.75	0.80
	August	0.34	0.80
	September	1.47	0.60
1988	August	1.50	0.50
	November	0.50	0.30

Table 1 shows that nest densities in early July 1987, prior to the treatment, were similar in the covered and control areas. The addition of the brushwood reduced nest density due to site disturbance and consequent nest desertion. There was no effect on the control site. Nest density on the experimental site increased in September as pairs relaid and incubated second clutches. Additional nest sites became available as the brushwood, matted with gull excreta, provided suitable nesting platforms. Gulls also nested under the larger branches of the brushwood. The increased nest density on the covered site was attributed to the greater availability of suitable nest sites offered by the brushwood. The effect of habitat modification continued to influence nest density in the subsequent breeding season (1988) (Table 1).

2. The effect of habitat characteristics on nesting density

In 1988, a study was undertaken to measure the effect of habitat on nest density (Anderson 1988). Nest density was estimated in 4 m^2 quadrats placed in homogenous habitats on Long, Horseshoe and Egg Islands. Habitats were categorized as either (a) bare — no grass cover; (b) open ground — short grass less than 0.1 m high; (c) brush — added *Pinus radiata* cuttings; (d) shrubs — *Melaleuca squarrosa*, *M. ericifolia*; (e) trees — *Eucalyptus camaldulensis*, *E. pauciflora* and *A. melanoxylon* in a closed canopy 3–4 m high with no understorey.

Habitat significantly affected nest density for both the first ($F = 37.87$, d.f. = 4,128, $p < 0.05$) and second clutches ($F = 20.08$, d.f. = 4,73, $p < 0.05$). Tables 1 and 2 show that breeding density was high where brushwood was added to some of the island. Brush and shrub habitats

TABLE 2

The effect of habitat on nest density/m². ([1]August was the peak period for the first clutch. Number of nests = 129. [2]November was the peak for the second clutch. Number of nests = 74. Data pooled for all islands. Sample size for each habitat = 6).

Month	Bare	Open	Habitat Brush	Shrubs	Trees
[1]August	0.5	0.9	1.5	1.3	0.6
[2]November	0.3	0.4	0.7	1.0	0.2

offered nest protection from inclement weather and aerial predators. Shrubs, such as *M. squarrosa*, were structurally rigid and nests were found under, in and on such plants. The lower nest densities in bare areas and open grassland was due to minimal protection and reduced structural complexity of the habitat.

Nest density under trees was low because of a combination of factors. Parent birds usually attempt to land directly on their own nesting territory avoiding conflict with neighbouring breeding birds. The closed canopy forced adults to land at some distance from their nest and they were obliged to walk through neighbouring territories. Continual conflict with neighbours may have resulted in them deserting their nests. In addition, the area under young, smaller (2–3 m tall) trees (particularly *E. camaldulensis*, *E. pauciflora* and *A. melanoxylon*) were continually swept by the lower branches of the tree. In these sites nests were found concentrated around the base of the trunk where the effect of drooping branches was avoided.

When gulls left the islands, ground cover, particularly weeds, increased making the habitat even less suitable for nesting. By 1990 Silver Gulls no longer bred on the well-vegetated Long, Horseshoe and Egg Islands, although they bred on the smaller, bare, North and South Islands. Although trees were planted on the smaller islands in 1982 trampling by gulls and additional nutrients from excreta probably killed the plants. Gull activity on the smaller islands reduced the vegetation to sparse grass cover (<5 cm high) and extensive areas of Variegated Thistle (*Silybum marianum*).

TABLE 3

Maximum nest[1] density (per m²) each month during the breeding season in 1990 and 1991 on North and South Islands. All nests with eggs were counted and data pooled for both islands. Combined area of both islands was 246 m²).

Month	1990	1991
September	1.70	0.45
October	1.28	0.99
November	0.60	0.42
December	0.11	0.29

The breeding density in 1990 (Table 3) on North and South islands was comparable to that on Egg, Horseshoe and Long Islands in 1987/88 (Tables 1 and 2). The overall decline in gull breeding activity at Winter Swamp between 1987–1992 was attributed to the effect of the successful revegetation programme reducing suitable habitat.

SACRED IBIS ON WINTER SWAMP

Earlier Sacred Ibis records for the Ballarat area were for small (less than 12 individuals) groups. The nearest, recorded, breeding population to Ballarat was at Stockyard Hill (near Lake Goldsmith, Beaufort) where 100 pairs bred (Thomas and Wheeler 1983). In 1988, Sacred Ibis bred unsuccessfully on Winter Swamp, building nests in low *M. squarrosa* shrubs on Horseshoe Island (Table 4) . These clutches were deserted, and the more abundant Silver Gulls laid their eggs in the abandoned ibis nests. In 1990, 37 ibis nests produced 33 chicks (0.89 chicks/nest). This increased in 1991 to 72 nests producing a mean 1.74 chicks/nest. Since 1990 Sacred Ibis have successfully bred on Horseshoe Island, and in 1991, expanded breeding on to Long Island, at which time no gulls bred on either of these vegetated islands.

TABLE 4

Height of Sacred Ibis nests 1988-1992. (No data were collected in 1989.)

Height (m)	Number of Nests 1988	1990	1991	1992
0.0–1.0	3	12	9	16
1.1–2.0	0	14	4 43	94
2.1–3.0	0	11	10	26
3.1–4.0	0	0	10	26
4.1+	0	0	0	8
Total	3	37	72	170

As trees grew taller and the canopy developed Sacred Ibis used the *E. pauciflora, E. camaldulensis* and *A. melanoxylon trees* for nesting with a tendency, but not statistically significant, to use higher sites (Table 4).

The colonial nesting habit of Sacred Ibis has caused concern for the long-term survival of the island vegetation. Excessive nutrients from bird excreta associated with high nest densities in the supporting vegetation, particularly *Melaleuca* shrubs and *A. melanoxylon*, has led to extensive defoliation and consequent death of some plants. The additional weight of the nesting platforms has weakened branches which broke during winter storms. The long-term future of these favoured nest supporting plants is not secure if the ibis breeding population increases in future years.

DISCUSSION

The preliminary results of this study at Winter Swamp showed that breeding densities of Silver Gulls and Sacred Ibis were affected, negatively and positively respectively, by habitat modification. The negative relationship between these species provides further support to the work of Fjeldsa (1985). This study demonstrated that the physical structure of plant species need to be considered before their selection for a revegetation programme on bare islands. Inappropriate choice of plants may encourage undesirable bird species.

If an objective of revegetation is to reduce gulls, shrubs that are dense, supportive and protective of nests, should be avoided. Shrub vegetation provides a screen between neighbouring adults and Smith and Carlile (1993) found that screening between nests decreases aggressive interactions between adults and provides secure sites for chicks. Where trees are preferred for revegetation programmes, species with low sweeping branches should be chosen. Sweeping branches prevent birds building nests under trees and reduces establishment of screening ground vegetation. The density of trees should be sufficient to form a closed canopy, again reducing ground vegetation. Although affecting the size of the breeding population of Silver Gulls and Sacred Ibis may not have been an objective of revegetating Winter Swamp, the changes in the density of both species were seen by the management authority as desirable. The Silver Gull is regarded as an urban 'pest' species because it forages on refuse and may transmit disease, but this is unlikely in Ballarat (Baker 1989). Sacred Ibis forage on refuse yet appear to be more accepted, possibly because they are associated with invertebrate pest control (Blakers *et al.* 1984).

Future population control of both Silver Gulls and Sacred Ibis, in the Ballarat area, can only result if there is improved regional refuse management, in particular, the rapid burial or removal of potential food sources. The combined action of reduced food availability and habitat modification of breeding sites will reduce populations in the long-term (Smith 1992; Smith and Carlile 1993).

ACKNOWLEDGMENTS

I am grateful for fieldwork assistance from Graeme Anderson, Daryl Burns, Darren Burns, Sue Hadden, Andrew Smith, Simone Wilkinson and many other students. Thanks to Roger Thomas who provided his unpublished data. Geoff Smith, Durno Murray and Gavin Cerini gave comments on earlier drafts. Permission for this work was granted by the Department of Conservation and Natural Resources (Permit Number BB-92-005) and Australian Bird and Bat Banding Schemes (Authority Number 830).

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APPENDIX 1

Number of Silver Gulls recorded on Lake Wendouree (1951–1985) (Unpubl. data from R. Thomas and the late J. Wheeler).

Number	Month/Season	Year	Source
41	November	1951	J. Wheeler
100+	March	1952	J. Wheeler
100+	May	1952	J. Wheeler
150–200	Summer	1954–55	J. Wheeler
200+	December	1957	J. Wheeler
0	August	1962	J. Wheeler
500+	June	1963	J. Wheeler
0	September	1971	R. Thomas
6	July	1972	R. Thomas
3	March	1974	R. Thomas
97	February	1977	R. Thomas
425	December	1982	R. Thomas
410	February	1983	R. Thomas
250	October	1983	R. Thomas
101	November	1984	R. Thomas
375	March	1985	R. Thomas
700	June	1985	R. Thomas

HONOURS

The contributions to ornithology of Pauline Reilly and Stephen Marchant have been recognized by awards in the Order of Australia.

Pauline's drive has been the envy of many of us whether it be the study of Silver Gulls, Flame Robins or Little Penguins, or as President of the RAOU, or as an authoress of acclaimed books for children.

Stephen's years as Editor of *Emu* brought the journal to the international status it now enjoys, and his enormous editorial efforts, with Peter Higgins, led to the publication of Volumes 1 and 2 of the *Handbook of Australian, New Zealand and Antarctic Birds*.

They both deserve our sincerest congratulations.

M. D. Murray