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INCREASING NUMBERS OF PIED CORMORANTS BREEDING ON THE ISLANDS OFF PERTH, WESTERN AUSTRALIA AND CONSEQUENCES FOR THE VEGETATION

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There has been an increase in the number of Pied Cormorants *Phalacrocorax varius* nesting on the small islands off the Perth coast, with larger nesting colonies and increased numbers of nesting sites being used simultaneously. Overall the number of nests has quadrupled in recent years when compared with previous decades. The great majority of birds now nest on the island plateaux, on succulents or on the ground rather than on the woody shrubs of the talus slopes that were formerly preferred. This has been associated with a marked change in the vegetation of the islands, particularly the very small islands where native plants are being replaced by annual or biennial invasive weeds. As a result the nesting habitats for burrowing birds such as Little Penguins *Eudyptula minor*, Little Shearwaters *Puffinus assimilis* and Wedge-tailed Shearwaters *Puffinus pacificus* and for ground nesting birds such as Bridled Terns *Sterna anaethetus* and Crested Terns *Sterna bergii* are threatened. In addition the bare earth left after nesting episodes and when annual weeds die off during summer, is prone to erosion.

INTRODUCTION

There is an archipelago of limestone islands off the coast of Perth, extending 80 kilometres and incorporating two large islands (1 000–2 000 ha) and a number of smaller ones (0.5–16 ha). Pied Cormorants *Phalacrocorax varius* have been recorded as nesting on the smaller ones — Penguin, Seal, Bird and Middle Shag Islands in the south and Carnac and Dyer Islands further north (Saunders and de Rebeira 1993; Johnstone and Storr 1998) (Fig. 1). Records for the Shoalwater Islands in the south go back a century (Le Souef 1902). Cormorants nest in the late autumn and winter (chiefly March to July) in the southern part of Western Australia (Johnstone and Storr 1998). The birds generally build their nests on the woody perennial shrub *Nitraria billardierei* growing on talus slopes or offshore stacks, or sometimes on cliff edges on *Acacia rostellifera* (Wooller and Dunlop 1981). However, they are colonial nesters and if the colony is large many of the birds may nest on low succulents or even on bare ground.

Nests are substantial woven platforms of twigs of woody shrubs lined by seaweed and a few feathers. Surrounding the nests there is heavy guano deposition. The vegetation is damaged or killed by the guano and trampling during nesting episodes, and as shrubs die, nesting sites are moved to a different part of an island or to a new island (Serventy *et al.* 1971; Johnstone and Storr 1998). The nesting sites on Carnac Island changed every year between 1976 and 1980 (Wooller and Dunlop 1981). Regeneration of the vegetation may take 4 to 5 years or even longer in periods of drought (Gillham 1961; Wooller and Dunlop 1981). Pied Cormorants also roost on the islands on headlands or cliff tops where they cause bare areas to develop. Vegetation surveys of the islands (Rippey *et al.* 1998) suggested that there had been a recent increase in the number of nesting cormorants and this prompted a more thorough investigation

MATERIALS AND METHODS

Photocopied enlargements or computer generated enlargements of aerial photographs of Carnac Island were obtained from the Western Australian Department of Land Administration (DOLA) for each year from 1970 to 1999 (original scale 1970–1983: — 1:25 000; 1984–2000: — 1:20 000). These were studied for evidence of nesting by Pied Cormorants. The photographs were usually taken in February, six months after nesting, but the devegetated nesting sites on the plateau could readily be identified, although the impact of smaller numbers of nests on the cliffs was less clear.

In 2000, immediately after birds had left their nests, a number of 5 metre × 5 metre (25 sq m) quadrats were examined to determine localized nest densities in terms of nests per square metre. In addition the actual number of nests used that year on Carnac Island was counted and related to the measured area to give an overall nest density.

Flights were made over the islands in a small aeroplane on 6 April 1999 and 16 May 2000, and photographs taken of all of the seabird islands from a mean height of 300 metre. A Nikon F camera with a zoom lens of 28–200 millimetres focal length was used. It was possible to estimate the number of nests being used on the islands from some of these images.

Visits to Carnac Island were made on 23 May 1998; 13, 22 and 29 October 2000, to Dyer Island on 1 April and 6 September 1999 and to the Shoalwater Islands fortnightly during 1999 and 2000. In 2000 the number of nests on the plateaux of Bird and Middle Shag Islands was counted after the nesting period. The final tally of nests was made from a combination of photographic evidence and ground based direct observations. Figures for previous years were taken from published works.

RESULTS

The records available (Table 1) indicate that the total number of nests has increased considerably over the past 60 years. On the Shoalwater Bay Islands the number quadrupled between the early 1940s and early 1960s, reaching some 800. Fewer birds were nesting by the early 1990s, but there was a record 1 300 pairs in 2000. The number of nesting pairs on Carnac Island has more than tripled since the 1970s to 2 650 in 2000. Photocopied enlargements of aerial photographs of Carnac between

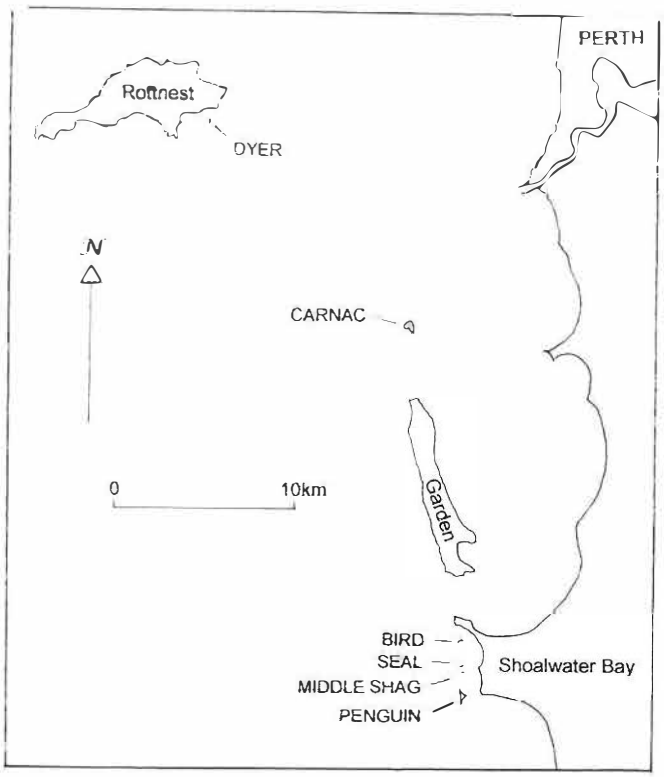

Figure 1. *Seabird nesting islands off the Perth coast.*

1970 and 2000 show that little nesting appears to have taken place on the plateau since the 1970s when roosting and occasional nesting took place on the southern part of the southern peninsula, until more recently. Since 1994 however, an increasingly large rookery can be detected on the plateau moving to a new site each year (Fig. 2).

Figures 2 and 3 show the nesting areas on the various islands for available years, taken from aerial photographs. Pied Cormorants now nest on virtually all these islands each year, sometimes re-using the same nesting areas despite the loss of woody vegetation. On the Shoalwater Bay Islands the cormorants used to nest on a different island each year (Serventy and White 1943; Orr and Pobar 1992), but now they nest on most of the islands each season. Pied Cormorants are now nesting on Penguin Island again, where they have not been recorded for many years (Johnstone and Storr 1998).

The situation has changed with the increase in the cormorant population. Most nesting now takes place on the plateaux of the islands. Nesting areas are increasing in size and are no longer based on the woody *Nitraria billardierei* of the talus slopes but on perennial native succulents such as *Rhagodia baccata* and less frequently *Acacia rostellifera*. The *Rhagodia* is killed but the *Acacia* can regenerate from rootstock. Where the native plants have been supplanted by the biennial European Tree Mallow

TABLE 1
Number of Pied Cormorant *Phalacrocorax varius* nests recorded during the last century.

	Bird Is.	Shag Is.	Penguin Is.	Seal Is.	Bird, Shag or Seal Is.	Dyer Is.	Carnac Is.
1900	0[1]	+[1]	0[1]	+[1]			
1920			+[3]				
1923			+[3]				
1955		+[3]					
1940	20[2]	0[2]	0[2]	0[2]			
1941	0[2]	170[2]	0[2]	0[2]			
1942	160[2]	0[2]	0[2]	0[2]			
1949						40[4]	
1955		+[3]					
1956						120[4]	0[13]
1958							50[13]
1959	260[3]	several 00[3]				70[3]	
1960		100[5]					
1963	300[3]	500[3]					
1968							rookery larger[3]
1974							a few nests[6]
1975						20[6]	0[6]
1976							500[7]
1977–80							450–550[8]
1982						121[4]	
1992					400–500[9]		
1998	25[10]	0[10]	0[10]	250[10]			1400[12]
1999	120[10]	300[10]	400[10]	12[10]		130[10]	1700[12]
2000	300[11]	600[10]	400[10]	0[10]		120[10]	2650[11]

References:
[1] (Le Souef 1902)
[2] (Serventy & White 1943)
[3] pers. comm. R. Johnstone, WA Museum
[4] (Saunders and de Rebeira 1993)
[5] Number of nestlings banded, not nests (Ford 1963)
[6] (Abbott 1977)
[7] (Lane 1979)
[8] (Dunlop and Storr 1981)
[9] (Orr and Pobar 1992)
[10] estimated from our observations and aerial photographs
[11] nests counted individually over whole island after nests abandoned
[12] estimated using size of nesting area observed from aerial photographs and average density of nests in 2000 rookery on Carnac
[13] (Watson 1959)
+ denotes some nests recorded
0 denotes no nests constructed that year on that island.

Note: Nests are not uniformly distributed but occur in clusters in Pied Cormorant colonies. Density ranges from a maximum of two per square metre to a mean of one per three square metres for large colonies, taking into account bare ground between the clusters of nests.

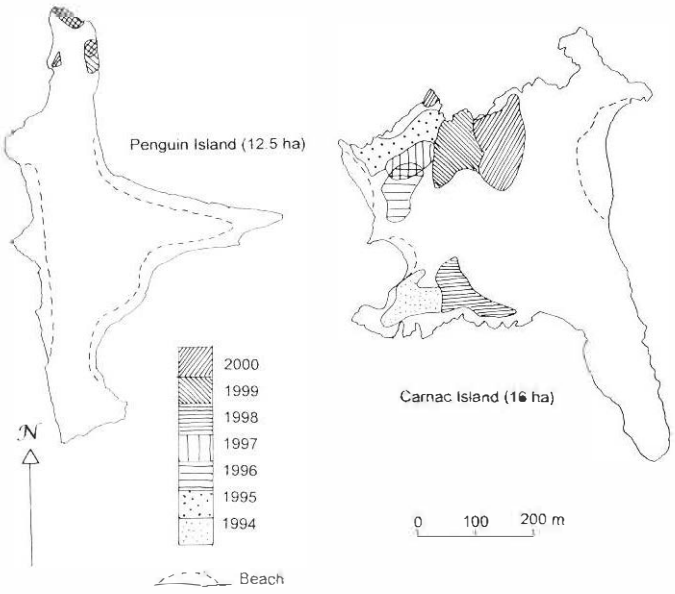

Figure 2. *The larger seabird islands — nesting sites 1994–2000.*

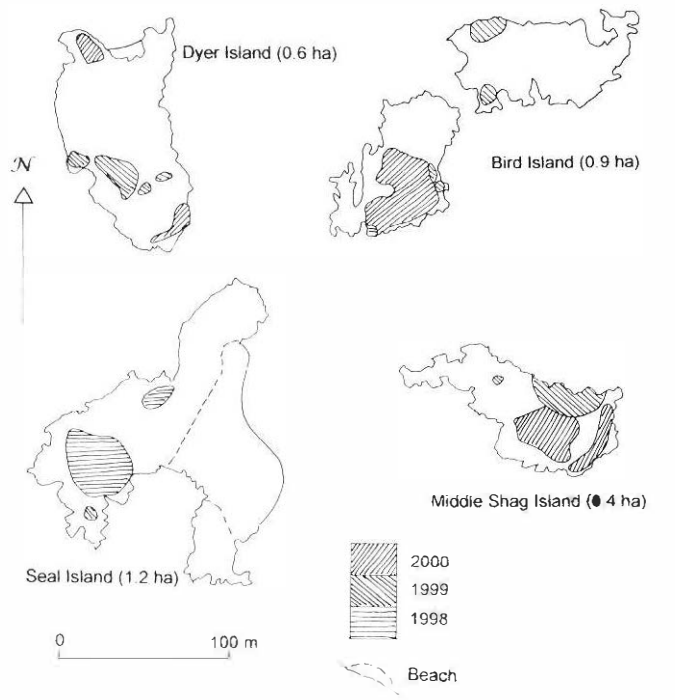

Figure 3. *The smaller seabird nesting islands — nesting sites 1998–2000.*

Malva dendromorpha, the Pied Cormorants nest between the stems.

Over the past three years colonies have nested on the plateaux of Seal, Middle Shag and Bird Islands amongst the European Tree Mallow *Malva dendromorpha*. On Dyer Island cormorants migrated from clumps of *Nitraria* on the west side in 1999 to clumps on the north and eastern cliffs in 2000. On Middle Shag birds nested on remnants of *Nitraria* and bare cliffs in 1999 and in 2000. On Penguin Island they have nested on *Nitraria* and *Pittosporum* on the slopes and on the bare cliff top, with the nesting area for the current year 2000 overlapping the area used in 1999.

It was also noted that on Middle Shag Island the nesting season has been extended into spring, with a dozen young still being fed by their parents on 2 October 2000. This late nesting has been recorded previously on Shag Island (Abbott 1977).

DISCUSSION

The cause for the population increase of Pied Cormorants is not known, but probably emanates from increased food sources in the coastal seas and estuaries of the Perth-Mandurah metropolitan area. These birds are in-shore and estuarine feeders and population increases are likely to be due to recent anthropogenic causes. Cormorants, which are gregarious birds, may have been attracted to Penguin Island by the newly arrived colony of Australian Pelicans *Pelecanus conspicillatus*.

Pied Cormorants spend the first year of their lives up to 320 kilometres from their natal regions along coastlines and within the estuaries, returning to their place of origin in their second year (Ford 1963). Changes in the water quality of the estuaries and bays in the area as a result of human activities are well documented (Hodgkin *et al.* 1985; Cambridge *et al.* 1986; Gerritse 1993; John 1994; Anon. 1999). Water enrichment might not only increase the food supply (benthic fish) available to the birds, but the more murky waters might also assist in the process of catching prey.

Professional gill-net fishermen on the estuaries are permitted to shoot or trap cormorants interfering with their nets during the fishing season (Government Gazette 1981). However, the number of licences issued to professional fishermen to net on estuaries and inlets has been reduced in recent years. In the 1930s there were about 100 such licences for the Peel-Harvey Inlet, in the mid 1980s 44 licences (covering about 50 individual fishermen) and by 2000 there were only 12 licences (about 15 fishermen). Thus a major threat to young cormorants has been reduced while their food supply may have increased.

Historically, cormorants breeding on the limestone islands have nested on the woody shrub *Nitraria billardierei* which grows on the talus slopes. Woody twigs from these bushes were used as their main nesting platform material. There has been a close association between *Nitraria*, which is comparatively guano and salt resistant and Pied Cormorants. Repeated or dense nesting destroys the canopy of the *Nitraria*, killing some plants, which then take some years to regenerate. In the 1960s it was suggested that when a rookery was deserted it was invaded by *Carpobrotus virescens* and the alien *Mesembryanthemum crystallinum*, followed by ornithocoprophilous species such as *Malva australiana* and *Lepidium foliosum*. In due course, unless there was repeated nesting, the climax vegetation of *Nitraria* was re-established (Gillham 1961).

Guano has a Potassium/Nitrogen/Phosphorus (KNP) content approaching that of commercial fertilizer, and the plants of the plateaux, such as the succulent native *Rhagodia baccata* are killed by intense manuring leaving bare earth.

The deserted rookeries have been heavily invaded by weeds, principally Malvaceae, and introduced annual Poaceae, Brassicaceae and Chenopodiaceae. There has also been a marked reduction in the total number of plant species, especially native species, on the islands (Rippey *et al.* 1998; Abbott 2000).

In summary we have recorded a considerable increase in the number of Pied Cormorants nesting on the smaller islands off the Perth coastline. The reasons for this increase, which is unprecendented in the last century, are not entirely clear but include possible increases in food supply and diminished competition and threats from fishermen. Larger colonies of nesting birds have moved from traditional nesting sites on *Nitraria billardierei* on rocky slopes to expand all over the surface of these islands, damaging and altering the natural vegetation and, in the process, rendering them less suitable for use by other nesting seabirds and more prone to erosion.

REFERENCES

Abbott, I. (1977). Observations on the distribution of bird species on small islands near Perth. *WA. Nat.* **13:** 196–199.

Abbott, I. (2000). Long-term change in the floristic composition and vegetation structure of Carnac Island, Western Australia. *J. Biogeograph.* **27:** 333–346.

Anon. (1981). Notice F and W 170/23. Wildlife Conservation Act 1950. Government Gazete No. 86 20 Nov.

Anon. (1999). Audit of the Swan River management strategy: a status report. (Swan River Trust, Perth.)

Cambridge, M. L., Chiffings, A. W., Brittan, C., Moore, L. and McComb, A. J. (1986). The loss of seagrass in Cockburn Sound, Western Australia. II Possible causes of seagrass decline. *Aquat. Bot.* **24:** 269–285.

Dunlop, J. N. and Storr, G. M. (1981). Carnac Island, Western Australia. Seabird Islands No 111. *Corella* **5:** 71–74.

Ford, J. (1963). Dispersal and mortality in the Pied Cormorant in Western Australia. *WA. Nat.* **8:** 177–181.

Gerritse, R. (1993). Soils, land use, nutrient losses and algal blooms in the Swan-Canning estuary. In 'Swan River — the future'. Workshop proceedings. Report No 8. (Swan River Trust, Perth.)

Gillham, M. E. (1961). Alteration of the breeding habitat by sea-birds and seals in Western Australia. *J. Ecol.* **49:** 289–300.

Hodgkin, E. P., Birch, P. B., Black, R. E. and Hillman, K. (1985). The Peel-Harvey estuarine system. Proposals for management. Department of Conservation and Environment, Perth.

John, J. (1994). Eutrophication of the Swan River estuary, Western Australia and the management strategy. In 'Global wetlands: old world and new' (Ed. W. J. Mitsch). (Elsevier Science B.V.)

Johnstone, R. E. and Storr, G. M. (1998). *'Handbook of Western Australian birds.'* (Western Australian Museum, Perth.)

Lane, S. G. (1979). Breeding seabirds on Carnac Island, Western Australia. *WA Nat.* **14:** 134–135.

Le Souef, S. (1902). An interesting outing — white-faced ternlets, nankeen herons etc. *Emu* **2.**

Orr, K. and Pobar, G. (1992). Shoalwater Islands management plan 1992–2002. Department of Conservation and Land Management, National Parks and Nature Conservation Authority, Perth.

Rippey, E., Rippey, J., Dunlop, N., Durant, C., Green, B. and Lord, J. (1998). The changing flora of the Shoalwater Bay Islands. *WA Nat.* **22:** 81–103.

Saunders, D. and de Rebeira, P. (1993). The birdlife of Rottnest Island, 2nd edition. (Eds D. A. Saunders and C. de Rebeira.) (Guildford, Western Australia.)

Serventy, D. L., Serventy, V. and Warham, J. (1971). The Handbook of Australian Seabirds. (AH and AW Reed, Sydney.)

Serventy, V. N. and White, S. R. (1943). Birds of Warnboro Sound, Western Australia. *Emu* **XLIII:** 81–95.

Watson, J. A. L. (1959). The birds of Carnac Island, Western Australia. *WA Nat.* **8:** 185–190.

Wooller, R. D. and Dunlop, J. N. (1981). Itinerant breeding by Pied Cormorants on Carnac Island, Western Australia. *Corella* **5:** 97.