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Range Extensions and the Breeding Seasons of Seabirds in South-western Australia

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Abstract

Southward expansion of the ranges of some tropical seabirds, and the "double" nesting seasons of many seabirds on the mid-western and south-western coasts of Australia are re-examined in the light of recent studies of reproductive periodicity in the Crested Tern *Sterna bergii* and the Silver Gull *Larus novaehollandiae* and observations on other seabirds in south-western Australia. It is suggested that these range extensions and "double" nesting phenomena are influenced by a common environmental change, probably a seasonal influx of tropical water (the Leeuwin current).

There is evidence that the biogeographic origin of species determines their responses to environmental change. Thus species of tropical origin have extended their breeding ranges southwards. Autumn-nesting tropical populations of species secondarily adapted to the sub-tropics have also colonised the south-west, and in some locations nest in sympatry with spring-nesting populations already present. Species from high latitudes and of southern, cool-water origins have extended their breeding period into the autumn and increased their number of breeding attempts within a season.

Introduction

On the western coast of Australia, south of the Abrolhos Islands (Figure 1), three seabird species have been recorded as extending their breeding ranges southwards during this century – the Red-tailed Tropic-bird *Phaethon rubricauda*, the Bridled Tern *Sterna anaethetus* and the Roseate Tern *Sterna dougallii* (Serventy *et al.* 1971, Dunlop 1979). On the same coastline several seabirds have been shown to have double nesting seasons or protracted laying periods lasting more than six months. These are the Little Penguin *Eudyptula minor* (Dunlop and Storr 1981), the Pied Cormorant *Phalacrocorax varius* (Serventy *et al.* 1971), the Silver Gull *Larus novaehollandiae* (Nicholls 1974, Wooller and Dunlop 1979), the Crested Tern *Sterna bergii* (Dunlop 1985) and the Roseate Tern (Serventy *et al.* 1971). In northern Australia most seabirds nest in the austral autumn, between March and June, whereas in south-eastern and southern Australia most laying takes place in spring or early summer, from August to December (Serventy *et al.*, 1971). However, in all the species from south-western Australia with protracted laying, autumn is an important nesting period.

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In this paper we suggest that both range extensions and anomalous breeding seasons stem from common ultimate factors such as oceanographic phenomena and climatic changes, and that differences in the responses of seabird species to these factors appear to reflect their biogeographic origin.

The Seabird Fauna

The seabird species involved can be divided into four groups on the basis of their apparent origins:

1. *Phaethon rubricauda* and *Sterna anaethetus* both have tropical distributions. The proximal populations of *Sterna dougallii* also occupy tropical seas but the species probably originated at higher latitudes in the North Atlantic (Serventy 1956).
2. *Sterna bergii and Phalacrocorax varius* are of tropical origin (Serventy 1956, Serventy *et al.* 1971) but have become secondarily adapted to cooler, subtropical waters.
3. *Larus novaehollandiae* is also secondarily adapted to the subtropics. Serventy *et al.* (1971) suggested that it was originally of tropical origin but, in a recent revision of Silver Gulls, Johnstone (1982) traced *L. novaehollandiae* to *L. hartlaubii* and *L. cirrocephalus* of southern Africa. Ultimately the lineage is probably connected to the *Larus ridibundus* group of northern higher latitudes.
4. *Eudyptula minor* belongs to the southern cool water avifauna (Serventy *et al.* 1971).

Seabirds of Tropical Origin

The three tropical species in group 1 are the only ones to show any change in their distributions. Both *Phaethon* and *Sterna anaethetus* are restricted spring/summer breeders in the region and are migratory, being absent from their breeding grounds in autumn and winter (Serventy *et al.* 1971).

Colonies of *Sterna dougallii* have been reported breeding in both autumn and spring at the Abrolhos Islands (Serventy *et al.* 1971), North Fisherman Island (Johnstone 1978a), and in autumn at Green Islands, Whittell Island and the Cervantes Islands (Ford 1965), and South Fisherman Island (Johnstone 1978b). At Lancelin Island the species breeds in spring and is absent during autumn (Dunlop 1979). The peak months for egg laying by *S.dougallii* appear to be April and November.

The most recent station colonised by *S.dougallii* was the Fremantle group of islands. Between 1979 and 1983, *S.dougallii* in nuptial plumage were observed in small numbers around Rottnest Island, Carnac Island and in Shoalwater Bay and Warnbro Sound. The species was only observed in the area from February through to June. On 28 April 1982 a colony of approximately 15 pairs was discovered on Second Rock in Warnbro Sound. Of five nests examined, one was empty, three had 2-egg clutches and one contained a

freshly-hatched chick and an egg about to hatch, indicating that laying started early in April (D. Montague, pers. comm.). The site was re-occupied in 1983 and nesting took place over the same seasonal period.

The two most recent and most southerly colonies formed by *S.dougallii*, at Lancelin Island and on Second Rock, showed different seasonal patterns. Laying at Lancelin occurred in November and the birds were absent in autumn and probably during winter also. In the Fremantle area, in contrast, laying took place in April and the species was absent from July to January. Thus all three tropical seabirds which now have breeding populations in south-western Australia are migratory. Distinct autumn and spring nesting populations of *S.dougallii* have colonised islands in the region.

Subtropical Seabirds of Tropical Origin

The breeding regime of a sedentary population of *Sterna bergii* in the Fremantle area was studied between 1979 and 1984 (Dunlop 1985). Laying was markedly bimodal with peaks in autumn and spring involving similar numbers of breeding pairs. Individuals showed essentially circannual cycles and tended to lay in the same sub-season in successive years. The population was therefore effectively divided into two sub-populations nesting in autumn and spring, with very little overlap of individuals between the two temporal groupings.

Interestingly, Storr (1964) in his paper on the birds of Rottnest Island does not record laying by *S.bergii* before July and indicates that there were smaller numbers of this species in the past. It is unlikely that the synchronous and noisy colonies of this tern would have been overlooked by this author who spent considerable time observing birds on Rottnest Island during the autumn months of 1958, 1959 and 1962 (G.M. Storr, pers. comm.). Possibly the broadly circannual but seasonally non-specific reproductive cycles of *S.bergii* become entrained at the time of hatching, in much the same way as age-specific plumages. If this were so, then young from autumn breeding populations would be expected to make their first breeding attempt in autumn, and those from spring breeding populations to breed first in spring. One suggestion is that parallel to the invasion of tropical seabirds into south-western Australia there may have been recruitment from tropical, autumn breeding populations of species already present in the region. This would account for the apparent changes in breeding and numbers of *S. bergii* in the Fremantle area in the last twenty years.

Phalacrocorax varius, like *S.bergii*, has both autumn and spring nesting colonies in south-western Australia although not on the same islands (Serventy *et al.* 1971). In the Fremantle area autumn nesting is the rule, with laying recorded from February to early July. Unlike *S.bergii*, there have been no reports of breeding at times other than autumn in the Fremantle area.

Subtropical Seabirds of High Latitude Origin

On Carnac Island, in the Fremantle area, *Larus novaehollandiae* had a breeding season which normally extended from late March or early April through to late October. There

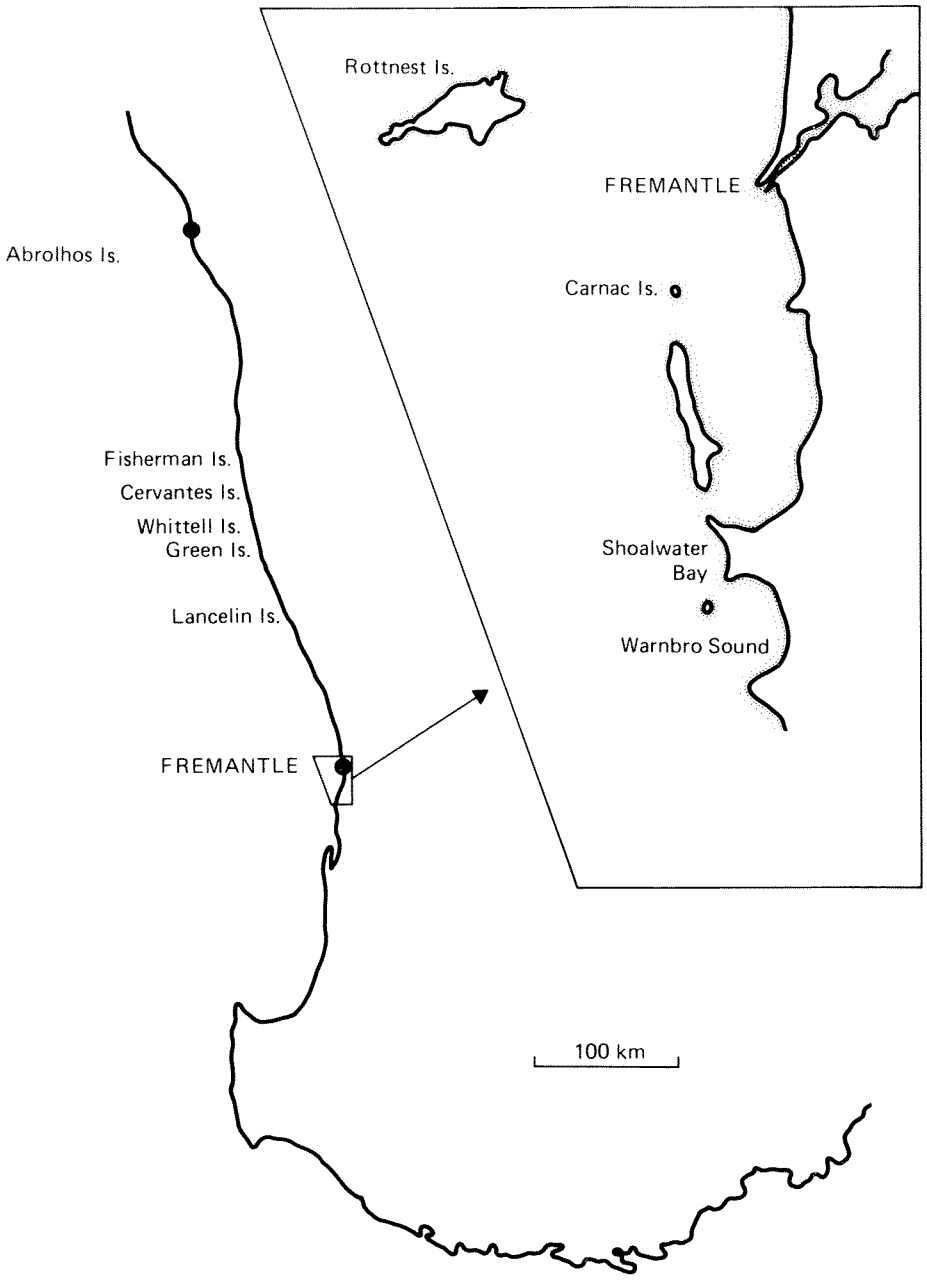

Figure 1 Outline of the coast of south-western Australia showing the positions of islands mentioned in the text.

was some variability in the start of laying and some other colonies in the region began laying as late as June (Wooller and Dunlop 1979). Breeding was protracted with individual pairs often producing several clutches during the year. Pairs successful early in the season have been observed to produce and rear a second brood in the same year (Nicholls 1974, Wooller and Dunlop 1979). In *L. novaehollandiae* the termination of breeding activity and the timing of basic moult (from October to March) were highly seasonal (Dunlop and Wooller, in prep.).

Seabirds of Southern Origin

The breeding regime of *Eudyptula minor* appears very similar to that of *L. novaehollandiae*. Protracted laying extends from May to late November but with some clutches as early as March. The first laying peak appears to occur in June (Dunlop and Storr 1981). A second clutch is laid by birds successful early in the season (Montague 1982) although complete double-brooding by this species has not been confirmed in south-western Australia. Although displaced seasonally, the pattern of reproduction by *E.minor* in south-eastern Australia is essentially similar (Reilly and Cullen 1981).

Conclusions

This examination of what is known of the biology of seabirds in south-western Australia which have either shown a significant southward extension of their range or show anomalous breeding seasons, allows a tentative explanation to be advanced. Common factors underlying changes in breeding range and anomalous breeding seasons are probably related to the trophic effects of the Leeuwin Current (Cresswell and Golding 1980, Legeckis and Cresswell 1981), a seasonal intrusion of tropical water from northwestern Australia that flows southward along the western Australian continental shelf.

In tropical species there has been an extension of breeding ranges southwards, with all populations being strictly migratory. In *Sterna dougallii* this has involved a contemporaneous expansion of distinct autumn and spring nesting populations. In subtropical species of tropical origin, such as *Sterna bergii*, autumn breeding populations from the north have colonised south-western Australia and at some colonies nest sympatrically with those spring-nesting populations which have always been present. In both *Larus novaehollandiae*, adapted to the subtropics but of high-latitude origin, and in *Eudyptula minor*, of southern cool water origin, there has been a similar response. In both species in the region, laying periods have become very protracted and both seabirds are potentially able to produce two broods in a year.

Further north on the Western Australian coastline, in the region between the Lacepede Islands and Shark Bay, more seabird species are reported to have double nesting seasons. This area may have been colonised by autumn nesting tropical populations which have, as yet, not expanded into south-western Australia. Additional range extensions into the study area by tropical species may have occurred in the recent past prior to ornithological

records. For example, the Fairy Tern *Sterna nereis* in south-western Australia is strongly migratory with centres of population in north-western Australia.

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