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PLUMAGE DIMORPHISM IN WEDGE-TAILED SHEARWATERS *Puffinus pacificus* IN SHARK BAY, WESTERN AUSTRALIA

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Although many Wedge-tailed Shearwaters *Puffinus pacificus* in northern hemisphere populations have white underparts, almost all members of this species around Australia have uniformly blackish-brown plumage. The exception is Wedge-tailed Shearwaters on islands in Shark Bay, on the central coast of Western Australia, where in 1972 about 20 per cent of an estimated 600 pairs had white breasts. We visited these islands in December 1997 and February 1998 and estimated both the overall population size and proportion of white-phase individuals as unchanged after 25 years. White-phase Wedge-tailed Shearwaters are unknown at much larger colonies north and south of Shark Bay, and only recorded at sea within a 200–300 kilometre radius of Shark Bay. This unusual, isolated population and its plumage dimorphism appear stable, but would repay further investigation.

INTRODUCTION

Shearwaters are the most abundant seabirds around the coast of continental Australia (Ross *et al.* 1995). The Wedge-tailed Shearwater *Puffinus pacificus* breeds in tropical and sub-tropical areas of the Pacific and Indian Oceans (Marchant and Higgins 1990). About 85 per cent of Australian Wedge-tailed Shearwaters breed on at least 70 islands off the coast of Western Australia (Ross *et al.* 1995), from Rottnest Island, near Perth (32°S), north to Ashmore Reef (12°S) (Johnstone and Storr 1998). All of these shearwaters have a blackish-brown plumage except for some islands in Shark Bay (26°30'S) near the centre of their breeding range. Here Wedge-tailed Shearwaters with white underparts were first noted by Carter (1917) and later by Serventy and Storr in 1943, 1965 and 1971 (in Serventy 1972). We report here a visit to Shark Bay in the summer of 1997/98 to confirm the continued existence of these anomalous white-phase shearwaters.

METHODS

Islands in Shark Bay were visited from 9–13 December 1997 and from 9–11 February 1998 during the incubation and early nestling stages of the breeding cycle of Wedge-tailed Shearwaters (Marchant and Higgins 1990). In addition to the islands visited by earlier workers (Serventy 1972), namely Friday, Slope, Freycinet, Double and Baudin Islands, we also visited Three Bays, Wilds, South Guano, North Guano, South Smith, North Smith and Salutation Islands. Burrows were checked only during daylight hours, for safety and logistical reasons, using a burrowscope camera (Dyer and Hill 1991). Birds removed from burrows by hand were weighed, measured (wing length, beak length, tarsus length) and details of their plumage were noted. They were then banded and replaced. Burrows were marked and counted on each island visited.

RESULTS

Of the five islands documented by Serventy (1972) as breeding sites for shearwaters, Slope Island is now little used, presumably due to ongoing human activity there. Baudin Island, formerly a breeding site, is also little used by shearwaters. Double and Friday Islands, earlier estimated to contain about 50 breeding pairs each, appeared to sustain similar populations in 1997. We recorded a similar breeding population on South Guano Island although Serventy did not record breeding shearwaters on this island in 1972. The largest number of shearwaters was on Freycinet Island, where the 238 pairs (December 1997) and 246 pairs (February 1998) we estimated were very similar to the 250 pairs estimated by Serventy (1972). The total of about 600 pairs of breeding shearwaters in Shark Bay of Serventy (1972) mirrors the 580 pairs of Burbidge and Fuller (2000) and represents a very small population compared with more than one million Wedge-tailed Shearwater pairs estimated to breed on the Houtman Abrolhos island group 200–300 kilometres further south (Fuller *et al.* 1994). Our findings from December 1997 and February 1998 as regards shearwater distribution are also consistent with those of Burbidge and Fuller (2000) who visited the same Shark Bay islands in May and September 1997.

Of the 28 different adult shearwaters captured, five (18%) were white-phase, with white breasts and pale underwings; another two individuals appeared to be intermediates between pale and dark phases. On four occasions, two individuals were found simultaneously down a burrow and could be assumed to represent pairs. Half of these pairs contained one white and one dark-phase; in the other two pairs both partners were dark-phase. One mixed pair occurred on Freycinet Island and the other on Double Island. The limited measurements of beak, wing and tarsus lengths did not differ significantly between the two phases, nor between shearwaters at Shark Bay and those on Lowendal Island (20°30'S), further north, or the Abrolhos Islands and Rottnest Island to the south.

During surveys aboard the CSIRO oceanographic research vessel R.V. *Franklin* (Dunlop *et al.* 1988, 2001), white-breasted Wedge-tailed Shearwaters were noted just north of the Abrolhos, but nowhere else. Of 38 Wedge-tailed Shearwaters recorded within 200 kilometres of Shark Bay, 37 per cent were white-phase birds, as were 19 per cent of 85 shearwaters seen up to 317 kilometres from Shark Bay; none were recorded further afield.

DISCUSSION

The plumage dimorphism of the small population of Wedge-tailed Shearwaters in Shark Bay appears to have persisted for at least 80 years in relative isolation. No other white-phase individuals are known from the Indian Ocean, although rare examples of white-phase shearwaters have been reported from eastern Australia (Lane 1972) and New Zealand (Falla 1962). North of the equator, in the Pacific Ocean, the proportion of white-phase individuals increases with latitude to 99 per cent in all breeding colonies north of 10°N and 100 per cent on islands in the far north of the Pacific (King 1974; Warham 1990). It is unclear whether the white-phase shearwaters at Shark Bay are the descendants of individuals from these northern hemisphere populations or originated independently.

Plumage polymorphisms occur widely among birds and detailed studies of geese (Cooke 1987) and skuas (O'Donald 1987) have demonstrated the role of mate selection and assortative mating in maintaining these polymorphisms. The presence of not only two distinct morphs among the Shark Bay Wedge-tailed Shearwaters, but also some variable intermediates, hints at a genetic polymorphism similar to the Arctic Skua *Stercorarius parasiticus* (O'Donald 1987) or the New Zealand forms of the Pied Cormorant *Phalacrocorax melanoleucos* (Dowding and Taylor 1987). It seems unlikely that the differences in plumage coloration are of adaptive significance, as suggested for Red-footed Boobies *Sula sula* (Le Corre 1999). Nor were the light and dark morphs reproductively isolated, as in the Herald Petrel *Pterodroma heraldica*, in which they may constitute separate species (Brooke and Rowe 1996).

Substantial numbers of Wedge-tailed Shearwaters have been examined on Rottnest Island (Garkaklis *et al.* 1998), the Abrolhos islands (Surman 1997, 1998) and on islands of the North West Shelf (Nicholson 2002; Dunlop *et al.*, in press), yet none of these had white breasts. Observations at sea appear to confirm that white-phase individuals are confined to Shark Bay. The movement of individuals between northern hemisphere populations, where white-phase birds are common, and Shark Bay alone seems highly improbable. Therefore, the small population of shearwaters at Shark Bay appears relatively isolated from others and the proportion of white-phase individuals within it has remained around 20 per cent for several decades. This unusual population would merit further investigation and perhaps greater protection.

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