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LARGE MORTALITY OF SHORT-TAILED SHEARWATERS *Puffinus tenuirostris* IN AUSTRALIAN AND NEW ZEALAND SEAS IN OCTOBER 2000

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A major mortality of Short-tailed Shearwaters *Puffinus tenuirostris* occurred in October and November 2000 as the birds returned to their breeding colonies in southern Australia. Beachwashed birds were found along the east coast of Australia, from 400 kilometres north of Brisbane to southern Tasmania, and west to New Zealand. Autopsies showed that the most likely cause of death was starvation. This lack of food was probably due to large-scale variation in water currents as the major mortality coincided with unusually warm east coast Australian sea surface temperatures. Such large mortalities are natural irregular occurrences among Short-tailed Shearwaters, but their impact on the population is difficult to gauge.

INTRODUCTION

The Short-tailed Shearwater *Puffinus tenuirostris* is regarded as Australia's most abundant seabird (Serventy *et al.* 1971). It is a trans-migratory seabird that only breeds in southern Australia and migrates to the far Northern Hemisphere in the austral winter. The shearwaters return to Australian waters from September, and it is not uncommon to see carcasses beachwashed (Reid 1999). On occasion, large mortalities occur that have invoked attention since first reported in 1851 (North 1898; Hindwood 1940, 1949; Iredale 1930; Serventy 1941, 1943, 1967).

In October and November 2000, dead birds were found from 400 kilometres north of Brisbane to southern Tasmania, and west to New Zealand. In this paper I describe this large mortality, look at possible underlying causes and assess the impacts on the breeding of Short-tailed Shearwaters.

METHODS

Counts of beachwashed Short-tailed Shearwaters were made along, Australian mainland, Tasmanian and New Zealand beaches. A small sample of birds was also collected for autopsy in Victoria.

The percentage of burrows occupied by a shearwater in mid-December compared to the total counted, or burrow occupancy, was compared between years. Burrow occupancy has been monitored since 1997 as part of the long-term Short-tailed Shearwater management programme in Tasmania (Skira 1996) on several colonies in the Furneaux Group (40°S, 148°E, situated off north-east Tasmania). One of the counts is in December during the incubation period. Egg laying in Short-tailed Shearwaters is synchronous between years and occurs between 20 November and 3 December (Serventy 1963). In each colony, counts follow the methods described in Skira and Wapstra (1980) and are done along three 100 × 2 metres transects on the same transect lines as in previous years. Breeding data was also gathered from the small Short-tailed Shearwater colony (up to 100 pairs) on Fisher Island in the Furneaux Group, as part of a study that began in 1947 (Serventy 1977).

To study the oceanographic influences on shearwaters, east Australian current sea surface temperature data were obtained from the Australian Oceanographic Data Centre website (www.aodc.gov.au).

RESULTS

Beach counts

New South Wales

First casualties were reported in early October. On 11 October 2000, 80 beachwashed birds were counted along a 500 metre stretch of beach near Eurunderie Lagoon, Myall Lakes. Live birds in an emaciated condition were still being washed ashore during the count. Also on the same day, 60 shearwaters were found on the beach at Mungo Brush, opposite Broughton Island, (Ian McAllan, pers. comm.). The previous day there were no shearwaters at either location.

The major mortality probably occurred on the central and north coasts (Table 1). The highest number of dead birds was recorded near South West Rocks north of Port Macquarie, with 1 820 birds per kilometre over 4.5 kilometres on 25 October 2000, which was the largest mortality of shearwaters along that section of coast for at least ten years (Ken Shingleton, pers. comm.). South of Sydney to Batemans Bay, the count was 64 birds per kilometre over 1.5 kilometres near Bawley Point south of Ulladulla, and 74 birds per kilometre over 2 kilometres of beach at Depot Beach, also south of Ulladulla (Lindsay and Janice Smith, pers. comm.).

Victoria

In Victoria it was reported that '100s of short-tailed shearwaters washed up on the eastern Port Phillip Bay beaches' (Ruth Connell, pers. comm.).

Tasmania

Large mortalities were noticed approximately one week after that in New South Wales. Beach counts were spread across Tasmania and gave a rate as high as 420 birds per kilometre (Table 2). Similar large mortalities occurred on beaches on the west coast (Ocean Beach) as for the east coast (Clifton Beach).

TABLE 1

Counts of beachwashed Short-tailed Shearwaters in northern New South Wales, October to November 2000 (Narelle Swanson pers. comm.). (1 Sawtell; 2 Tuckers Rock; 3 Boambee; 4 North Beach; 5 Bonville; 6 Coffs Jetty; 7 Sturts Point; 8 Moonee; 9 Emerald; 10 Woolgoolga Beach; 11 Woolgoolga Headland).

Date	Beach	Length (km)	Number found	Number/km
20 Oct	1	3.0	1 800	600
27 Oct	2	0.2	100	500
31 Oct	3	6.0	2 000	333
1 Nov	4	8.0	1 600	200
5 Nov	5	0.05	15–25	300–500
15 Nov	6	1.0	200	200
15 Nov	7	0.15	15–25	300–500
16 Nov	8	3.0	430	143
16 Nov	9	1.0	168	168
17 Nov	10	3.0	454	151
17 Nov	11	1.0	160	160

TABLE 2

Counts of beachwashed Short-tailed Shearwaters in Tasmania, October to November 2000. (1 Waubs Bay; 2 Eaglehawk Neck; 3 Richardson; 4 Swanwick; 5 Calvert's; 6 Lighthouse; 7 Bellerive; 8 Clifton; 9 Eaglehawk Neck; 9 Marion; 10 Roaring; 11 Safety Cove; 12 Cremorne; 13 Hope; 14 Seven Mile; 15 Ocean; 16 Carlton; 17 Cressy; 18 Lufra; 19 Pirates Bay; 20 Primrose Sands; 21 Roaring; 22 Sloping Main; 23 Bayleys; 24 Connelly's Marsh; 25 Susan Bay; 26 Taroona; 27 Fortescue).

Date	Beach	Length (km)	Number found	Number/km
18 Oct	1	0.5	20	40
20 Oct	2	3.0	230	78
20 Oct	3	2.0	120	60
20 Oct	4	1.5	60	40
22 Oct	5	2.0	111	55
24 Oct	6	1.0	50	50
25 Oct	7	1.0	52	52
26 Oct	8	2.0	507	259
26 Oct	2	2.0	202	101
26 Oct	9	4.0	167	42
26 Oct	10	1.0	81	81
26 Oct	11	1	9	9
27 Oct	8	2.0	260	130
27 Oct	12	1.0	180	180
27 Oct	13	5.0	470	94
27 Oct	14	10.5	3 350	319
29 Oct	15	20.0	200	10
29 Oct	16	2.5	250	100
30 Oct	16	2.5	250	100
30 Oct	17	0.5	15	30
30 Oct	18	1	200	200
30 Oct	19	2.0	50	25
30 Oct	20	1.5	120	80
30 Oct	21	1.0	20	20
30 Oct	22	3.0	100	34
1 Nov	23	3.0	300	100
1 Nov	5	0.5	210	420
1 Nov	24	1.0	74	74
2 Nov	25	1.0	38	38
3 Nov	26	1.0	3	3
7 Nov	27	0.5	59	118
11 Nov	2	2.0	42	21
11 Nov	10	4.0	46	12
11 Nov	22	1.0	89	89
12 Nov	27	0.5	116	232

New Zealand

Many dead birds were found spread along areas of New Zealand's coast. Fishers saw birds dead at sea, and the ones on beaches were very emaciated and in poor condition (Henrik Moller, pers. comm.). The total count of beachwashed birds reported for all the beaches walked was almost 1 000, with 523 of them from Invercargill and the bottom end of the South Island, and the remainder from all around the North Island (Phil Rhodes, pers. comm.).

Burrow occupancy

The percentage of burrows occupied compared to the total, in December 2000, varied between colonies by as much as 20 per cent (Table 3). Variation also occurred between years. For example, on Big Green and East Kangaroo Islands, in December 2000, burrow occupancy was down by 20 per cent compared to December 1999. These two islands are within 5 kilometres of each other. On all colonies monitored, burrow occupancy was greater in December 2001, one year after the major mortality.

TABLE 3

Percentage of Short-tailed Shearwater burrows occupied during the incubation period in December on some colonies in the Furneaux Group.

Island	1997	1998	1999	2000	2001
Great Dog	68.9	57.7	56.8	61.3	54.5
Little Dog	—	65.4	50.2	60.8	73.3
Little Green	—	71.3	46.6	58.9	72.8
Big Green	66.1	67.1	70.2	48.0	78.0
East Kangaroo	64.5	62.4	65.0	45.0	80.4
Fisher	55.6	45.0	58.0	40.8	67.2

Fisher Island colony

The percentage of burrows occupied compared to the total during incubation in December 2000 was 41 per cent compared to 58 per cent in 1999–2000, 45 per cent in 1998–1999, 50 per cent in 1997–1998 and 48 per cent in 1996–1997. Another measure of the effect of mortality is recruitment into a breeding population. Data from Fisher Island show that 10.1 per cent of the shearwaters breeding in 2000–2001 had never been previously recorded on Fisher Island (Table 4). In the 2001–2002 breeding season, 16.4 per cent of the shearwaters were new birds to the island, and since the 1982–1983 breeding season, mean annual recruitment of new breeding birds has been 6.8 ± 1.7 per cent (±2SE).

TABLE 4

Annual percentage recruitment of new breeding Short-tailed Shearwaters into the Fisher Island population from December 1982 to December 2001.

Year	New Breeding Birds (per cent)	Year	New Breeding Birds (per cent)
2001	16.4	1991	5.4
2000	10.1	1990	7.7
1999	9.0	1989	8.5
1998	7.2	1988	9.9
1997	5.8	1987	13.4
1996	1.4	1986	7.3
1995	3.8	1985	5.7
1994	4.1	1984	0.9
1993	4.7	1983	8.0
1992	2.2	1982	3.9

Autopsy

In October 2000, five short-tailed shearwaters were collected in Victoria for examination (K. Harrigan, School of Veterinary Science, Melbourne University, pers. comm.). All birds were in emaciated condition. Four of the birds were males weighing 320 grams, 380 grams, 400 grams and 410 grams respectively, while the single female weighed 345 grams. The proventriculus of two birds contained a pilchard-like fish, some 12 centimetres in length. The gizzard part of the birds contained pieces of gravel (4 birds), plastic (2), and one bird had a moderately large number of cestode eggs.

East Australian current sea surface temperatures

The large mortality of October 2000 coincided with unusually warm sea surface temperatures in the east Australian current. Sea surface temperature for 16 August 2000 shows an intrusion of water warmer than 22°C at 31°S, 154°E, extending down the coast of New South Wales. This warm water was then replaced by cooler water until its reappearance on 19 September 2000. It then continued to extend in size, and rose in temperature to more than 25°C pushing out cooler water of less than 19°C from eastern Bass Strait. In contrast, sea surface data for 1998 and 1999 show cold water of less than 19°C as the main water bodies along the New South Wales coast up to mid-November. In 1999 water warmer than 22°C first appeared on 13 October 1999, but did not displace water of less than 19°C along much of the New South Wales coast until mid-December. In 1998, a small intrusion of water of more than 22°C remained from 16 to 30 September 1998 then reappeared on 21 October to remain for the rest of the shearwater breeding season. As in 1999, it did not displace cooler water of less than 19°C along the New South Wales coast until mid-November 1998.

DISCUSSION

Beachwashed Short-tailed Shearwaters are found along Tasmanian beaches as early as the beginning of September (Green and Scarborough 1985). According to Serventy *et al.* (1971), large mortalities rarely extend into Tasmania despite it containing 81 per cent of the population (Skira *et al.* 1996), and no large mortalities on the scale of October 2000 have been noted since at least 1975. The rate of 420 Short-tailed Shearwaters per kilometre compares with an annual mortality rate of 5.3–7.0 Short-tailed Shearwaters per kilometre based on counts from 1992–1998 (Reid 1999). There are no counts available for years previous to 1992. Large numbers were also washed up in New South Wales, although the mortality south of Sydney to Batemans Bay was only marginally greater than in previous years (Lindsay and Janice Smith pers. comm.). Other shearwater species were also affected. Narelle Swanson (pers. comm.) observed that Wedge-tailed Shearwaters *Puffinus pacificus*, returned later to the breeding colony on Muttonbird Island near Coffs Harbour, and were approximately 20–30 grams lighter compared to other years. In New Zealand, Short-tailed Shearwaters are not commonly encountered (Veitch 1980; Powlesland and Pickard 1992). The mortality rate measured as birds per kilometre was not available for the 2000 mortality, but during 1943–1988, the mean number of shearwaters reported was 8.07 Short-tailed Shearwaters per kilometre with the highest total count of 864 birds in 1986 (Powlesland and Pickard 1992). The 2000 mortality appears to have approached the mortality rate of 1986.

It is not known which age groups were most affected. Short-tailed Shearwaters can be aged into broad categories (Sugimori *et al.* 1985), but none were. The major mortality did affect breeding considerably. However, it is difficult to proportion the cause, particularly when similar, irregular large mortalities occurr when Short-tailed Shearwaters are in the Northern Hemisphere part of their migration (Baduini *et al.* 1999). Nevertheless, the variation in percentage of burrows occupied between years when no major mortality was recorded was much less than compared with December 2000. The lower occupancy on Fisher Island compared to other colonies may be a direct result of regular human disturbance by researchers. Adult shearwaters are handled on Fisher Island to read band numbers, sex and to be banded as required. On other colonies, no birds are handled as burrow occupancy is gauged by checking a burrow with a hand or a stick. On Fisher Island, the large proportion of new breeding birds in the total breeding population for the island in 2001, 2000 and in 1987, suggests that major mortality could be a mechanism that brings about gene flow between shearwater colonies. Austin *et al.* (1994) and Bradley *et al.* (1999) describe how gene flow in short-tailed shearwater colonies occurs through rare, large-scale movements of individuals. Despite being strongly philopatric (Serventy *et al.* 1989), populations of Short-tailed Shearwaters recover quickly from large mortalities.

Autopsies revealed that birds were emaciated and dehydrated. Similar results were found by Taroonga Zoo veterinarians on autopsies of eight Short-tailed Shearwaters (Karrie Rose, Australian Registry of Wildlife Health at Taronga Zoo, pers. comm.). The most likely cause of death was starvation (North 1898; Hindwood 1949; Gibson and Sefton 1955; Hindwood and McGill 1955; Serventy *et al.* 1971; Green and Scarborough 1985) and that intestinal parasitism contributed only minimally to their debilitation and subsequent death. Hindwood (1940) and Serventy (1943) speculated that this lack of food was due to large-scale variation in hydrographic factors, particularly water currents. The large mortality in October 2000 coincided with unusually warm east coast Australian sea surface temperatures. The main diet of shearwaters in September and October is primarily the euphausiid *Nyctiphanes australis* (Montague *et al.* 1986; Skira 1986). The optimal temperature range for this euphausiid species is from 12 to 18°C, and it is most abundant from July to September (Blackburn 1980). *N. australis* moves diurnally and is restricted to the continental shelf (Blackburn 1980). There is evidence that numbers of this species fluctuate from year to year, because its distribution is tied to water masses and major current systems. In July 2000 water warmer than 18°C was already present along the east Australian coast and extending over the continental shelf. It persisted for the remainder of the year. If Short-tailed Shearwaters are heavily dependent on krill for food immediately on their return to Australian seas, warmer currents which are unproductive for krill and result in food shortages, are most likely the cause of large mortalities (Skira 1986).

The impact of large mortalities on Short-tailed Shearwater populations is difficult to gauge without having access to long-term data sets. More than fifty years of data are available on Short-tailed Shearwaters on Fisher Island, but the small breeding population makes it difficult to determine whether large-scale climate influences or other factors are influencing the population. Nevertheless, such data serve as a starting point. Seabirds are important indicators of changes in global climate. The occurrence of warmer water in 2000 may be a result of the El-Nino Southern Oscillation (ENSO). Murphy (1936) and Duffy (1989) both described the effects of ENSO on seabird populations with long-term data sets being the crucial answer to the problems of seabird population fluctuations.

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REFERENCES

Austin, J. J., White, R. W. G. and Ovenden, J. R. (1994). Population-genetic structure of a philopatric, colonially nesting seabird, the Short-tailed Shearwater (*Puffinus tenuirostris*). *Auk* **111:** 70–79.

Baduini, C. L., Hyrenbach, K. D. and Hunt, G. L. (1999). Anomalous weather events in the southeastern Bering Sea: the condition of Short-tailed Shearwaters in 1997 and 1998. Pacific Seabird Group, 26th Annual Meeting, 24–28 February, 1999. Abstracts P. 4.

Blackburn, M. (1980). Observations on the distribution of *Nyctiphanes australis* Sars (Crustacea, Euphausiidae) in Australian waters. *CSIRO Division of Fisheries and Oceanography Report* Number **119**.

Bradley, J. S., Gunn, B. M., Skira, I. J., Meathrel, C. E. and Wooller, R. D. (1999). Age-dependent prospecting and recruitment to a breeding colony of Short-tailed Shearwaters *Puffinus tenuirostris*. *Ibis* **141:** 277–285.

Duffy, D. C. (1989). Seabirds and the 1982–1984 El Nino-southern Oscillation, In 'Global Ecological Consequences of the 1982–83 El Nino-Southern Oscillation' (Ed. P. W. Gwynn). Pp. 395–415. (Elsevier: Amsterdam.)

Gibson, J. D. and Sefton, A. R. (1955). Mortality of shearwaters. *Emu* **55:** 259–262.

Green, R. H. and Scarborough, T. (1985). The August seabird wreck. *Tasmanian Nat.* **81:** 1–2.

Hindwood, K. A. (1940). The sea-birds of Sydney. *Proc. Royal Zool. Soc. NSW* 6–24.

Hindwood, K. A. (1949). Sea-bird mortality. *Aust. Museum Mag.* March **30:** 329–332.

Hindwood, K. A. and McGill, A. R. (1955). Sea-bird mortality in coastal New South Wales during July, 1954. *Emu* **55:** 148–156. 329–332.

Iredale, T. (1930). Avian sea-toll. *Aust. Zool.* **6:** 112–114, Plate xiii.

Montague, T. L., Cullen, J. M. and Fitzherbert, K. (1986). The diet of the short-tailed shearwater *Puffinus tenuirostris* during its breeding season. *Emu* **86:** 207–213.

Murphy, R. C. (1936). 'Oceanic Birds of South America'. (Macmillan and American Museum of Natural History: New York.)

North, A. J. (1898). In 'Handbook of Sydney and the County of Cumberland.' (Ed. W. M. Hamlet). Pp. 114–115. (Australasian Association for the Advancement of Science.)

Powlesland, R. G. and Pickard, C. R. (1992). Seabirds found dead on New Zealand beaches in 1998, and a review of *Puffinus* species recoveries, 1943 to 1988. *Notornis* **39:** 27–46.

Reid, T. (1999). Seabirds found dead on Australian beaches in 1995 and 1996. *Australasian Seabird Group Newsletter* **34:** 10–16.

Serventy, D. L. (1941). Mating in petrels. *Emu* **41:** 88–89.

Serventy, D. L. (1943). Sea-birds and fisheries. The problem of mutton-bird deaths. *Fisheries Newsletter* 2(2): 12–15.

Serventy, D. L. (1963). Egg-laying timetable of the Slender-billed Shearwater, *Puffinus tenuirostris*. *Proc. XIII International Ornithol. Congress*, 338–343.

Serventy, D. L. (1967). Aspects of the population ecology of the Short-tailed Shearwater *Puffinus tenuirostris*. *Proc. XIV International Ornithol. Congress*, 165–190.

Serventy, D. L. (1977). Seabird Islands. No. 49. Fisher Island, Tasmania. *Corella* **1:** 60–62.

Serventy, D. L., Serventy, V. and Warham, J. (1971). 'The Handbook of Australian Sea-birds.' (A. H. and A. W. Reed: Sydney.)

Serventy, D. L., Gunn, B. M., Skira, I. J., Bradley, J. S. and Wooller, R. D. (1989). Fledgling translocation and philopatry in a seabird. *Oecologia* **81:** 428–429.

Skira, I. J. (1986). Food of the Short-tailed Shearwater, *Puffinus tenuirostris*, in Tasmania. *Aust. Wildl. Res.* **13:** 481–488.

Skira, I. (1996). Aboriginal people and muttonbirding in Tasmania. In 'Sustainable Use of Wildlife by Aboriginal Peoples and Torres Strait Islanders.' (Eds. M. Bomford and J. Caughley). Pp. 167–175. (Australian Bureau of Resource Science, Canberra).

Skira, I. J., Brothers, N. P. and Pemberton, D. (1996). Distribution, abundance and conservation status of Short-tailed Shearwaters *Puffinus tenuirostris* in Tasmania, Australia. *Marine Ornithol.* **24:** 1–14.

Skira, I. J. and Wapstra, J. E. (1980). Occupation of burrows as a means of estimating the harvest of Short-tailed Shearwaters in Tasmania. *Emu* **80:** 233–238.

Sugimori, F., Oka, N. and Ishibashi, Y. (1985). The degree of skull ossification as a means of aging Short-tailed Shearwaters. *J. Yamashina Inst. Ornithol.* **17:** 159–165.

Veitch, C. R. (1980). Seabirds found dead in New Zealand in 1970, 1971 and 1972. *Notornis* **27:** 369–385.