Conservation assessment of the Sooty Oystercatcher *Haematopus fuliginosus*

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Australian oystercatchers have received relatively little attention compared with their international counterparts. Few studies have dealt specifically with the biology or ecology of Sooty Oystercatchers *Haematopus fuliginosus* and have tended instead to focus on population counts and movement patterns. Nevertheless, several key aspects of their biology are well established. Sooty Oystercatchers have proved to be widespread at low densities. They typically inhabit rocky shores, which are used for both foraging and nesting. Breeding is largely restricted to offshore islands and reefs, where rocky headlands and platforms provide nesting habitat. Outside the breeding season many feed and roost on muddy and sandy shores, often in areas where nearby rocky habitats are absent (e.g. Corner Inlet, Victoria). Like their sympatric counterpart, the Australian Pied Oystercatcher *Haematopus longirostris*, they are long-lived and appear to form monogamous pair bonds for life. There is concern expressed in Australian literature that, because so little is known about this species especially the northern subspecies, the conservation status of populations is not sufficiently known. Count site trends suggest that populations are secure, but in the absence of detailed information from breeding sites, we cannot make accurate predictions of population viability or trajectories. Government environment departments in New South Wales and Queensland have commissioned occasional reports for the purpose of elucidating threatening processes relevant to the management of local areas. However, these reports are relatively uncommon and information contained within them is not necessarily relevant to other parts of the country. Nevertheless, while the majority of population assessments to date may not be representative of the entire range of the species, they are the best available estimate. On this basis, we make management recommendations for conservation planning.

TAXONOMIC STATUS

There are two subspecies, the nominate race *H. f. fulginosus* (Gould 1845), which occurs predominantly south of the Tropic of Capricorn, and *H. f. opthalmicus* (Castelnau and Ramsay 1877) [Photo A].

LIFE HISTORY AND FOOD

Sooty Oystercatchers are relatively long lived (several 20-year-old marked birds have been recaptured or re-sighted) and form monogamous pair bonds (presumably) for life. The breeding season in southeast Australia is typically October through to February (Marchant & Higgins 1993, Smith *et al*. 2002) and in northwest Australia is from July to early September (Johnstone & Storr 1998). There is no data on age at first breeding but the start of breeding is likely to be delayed for several years after maturity, as in the sympatric Australian Pied Oystercatcher.

Sooty Oystercatchers nest in a shallow scrape in sand or on rocks, which may be lined with pebbles and or vegetation, near or above the tide line. Between one and three eggs are produced per clutch (usually two − Wakefield 1988), which are incubated by both sexes (Marchant & Higgins 1993). Typical egg size of *H. f. fulginosus* is 63.1 mm in length and 42.8 mm in width, and typical mass is 57.8 g (Marchant & Higgins 1993). Incubation period, time to fledging and other information like juvenile and adult survival are unknown. However, studies in Tasmania found both hatching and fledging success to be low; usually only a single chick was fledged regardless of the number successfully hatched (Wakefield 1988). Parental care of young is shared by both sexes (Marchant & Higgins 1993). In southern New South Wales (NSW), fledglings and adults move from breeding territories on offshore islands to mainland non-breeding territories around 7–8 weeks after chicks have hatched. Young remain with their parents until about the age of eight months, after which time they are ousted and join flocks containing other juvenile birds (Smith *et al.* 2002). [Photo B.]

In a study conducted in northern NSW 12 resident birds (six pairs) were monitored over the period 2003 to 2005 (Harrison 2009). Breeding success was found to be higher than that reported from earlier Tasmanian studies (ranging from 0.8–1.0 young per pair per year) (Harrison 2009). Twelve resident birds (six pairs, 15% of population) at-

Photo A. Adult Sooty Oystercatcher (nominate subspecies *fuliginosus*) on Philip Island, Victoria, Australia, 9 December 2009 (photo: David Hollands).

tempted to breed each season and rigorously defended territories along the 186 km section of shoreline monitored. Egg-laying occurred during October and November, and breeding was largely confined to the islands within the Solitary Island Marine Park (Harrison 2009). Breeding success has similarly been reported to be reasonably good on the south coast of NSW, with a peak egg laying period in November (Keating & Jarman 2003). Nesting density on the south coast of NSW was reported to be three pairs/hectare and the breeding population contained 78 pairs (Jarman 2006, Jarman & Keating 2006).

Cover appears to influence breeding success. Chicks which are well hidden while parents are foraging or otherwise absent have higher fledging success (Wakefield 1988). In their study of breeding patterns of both oystercatcher species in the Furneaux Group (predominantly Flinders Island), Lauro & Nol (1995b) found that Sooty Oystercatchers preferentially nested on smaller rocky islands, compared with Australian Pied Oystercatchers which could also be found to nest along the shores of Flinders Island, which is larger with sandy beaches (Lauro & Nol 1995b). At these breeding sites, Sooty Oystercatchers tended to use vegetation to hide nests from diurnal, visual predators (gulls at this site); in contrast, Australian Pied Oystercatchers placed their nests in the open (Lauro & Nol 1995a). It was noted that Sooty Oystercatcher nest placement choices were independent of the location of suitable foraging substrates.

Sooty Oystercatchers feed on items typically found on rocky shores, including a variety of molluscs (mussels *Modiolus*, *Austromytilus* and *Trichomya*, limpets *Cellana tramoserica* and *Patella peroni*, chitons *Ischnochiton* and other gastropods *Turbo*, *Dicathais* and *Nerita* spp.), but also polychaetes, crustaceans, echinoderms (sea urchins), terrestrial insect larvae, ascidians and occasionally fish (Considine 1979, Chafer 1993, Marchant & Higgins 1993, Aplin & Cockburn 2012). In southern NSW, the ascidian *Pyura stolonifera*, was found to constitute 40–60% of the dry mass dietary intake per tide (Chafer 1992, 1993). In a more recent study in the area region, limpets (19%) and polychaete worms (28%) were the most common prey classes observed taken by foraging pairs (Aplin & Cockburn 2012). A variety of feeding modes reflect the different prey items taken, including pecking/probing (Lauro & Nol 1995a), stabbing, prising, levering, hammering, scissoring and stitching (Considine 1979). Diet is similar in northern NSW to elsewhere in Australia, and includes gastropod molluscs (*Cellana*, *Siphonaria*, *Turbo*, *Dicathais* and *Nerita* spp.), chiton molluscs (e.g. *Onithochiton quercinus*), bivalve molluscs (*Saccostrea*, *Catomerus* and *Tesseropora*), ascidians (*Pyura stolonifera*) and crustaceans (various species of crab) (Harrison 2009). Peak feeding period in northern NSW was found to occur in the two hours before low tide.

Sooty Oystercatchers are sexually size dimorphic, with females being significantly larger and heavier than males in all age classes (Hansen *et al*. 2009) (Table 1). Bill length is the most discriminating biometric parameter of sex and may reflect adaptive differences in foraging mode by each sex and differences in local habitat use by males and females at overwintering sites (Lauro & Nol 1995a, Hansen *et al*. 2009). This was confirmed in a recent foraging study in southern NSW by Aplin & Cockburn (2012), where they demonstrated that intrasexual differences in dietary preference and foraging behaviour resulted in higher energetic rewards for paired males and females, dependent on tide. An earlier study of foraging ecology on rocky intertidal shores in southern NSW found that dietary preferences varied significantly between sites containing predominantly flocks of birds compared with sites inhabited by pairs (Chafer 1993). Furthermore, significant differences were found between the sexes (adult females tending to take ascidians *P. stolonifera*

Photo B. Adult and juvenile Sooty Oystercatcher (nominate subspecies *fuliginosus*) (photo: Glenn Ehmke).

whilst males chose gastropod molluscs and sea urchins) and between age classes (immature birds tending to take more polychaetes than adults) (Chafer 1993). Patterns of foraging noted in each sex of the Australian Pied Oystercatchers in the Furneaux Group (Flinders Island) showed no dimorphism in feeding habitat choice and prey selection compared with Sooty Oystercatchers (Lauro & Nol 1995a).

In southeastern Australia, adult Sooty Oystercatchers begin moulting at the end of the breeding season (January) and complete their primary moult in *ca.* 160 days (Hansen *et al*. 2009). Second year birds both start and complete their primary moult approximately two months earlier than adults. The relatively prolonged period of moult compared to other oystercatcher species reflects the non-migratory nature of Sooty Oystercatchers (Hansen *et al*. 2009). In northwest Australia, primary moult duration is estimated at 150–180 days and appears to be completed around April (Hansen *et al*. 2009).

HABITAT

Sooty Oystercatchers typically occur on rocky and sandy shores (Considine 1979, Marchant & Higgins 1993). In southern Australia they have been recorded on inlets, estuaries and mud flats, rocky intertidal platforms, rocky outcrops, sandy shores, offshore rocky islands, and reefs. They rarely occur on parts of the coast where rocky shores and offshore rocky islands are absent, for example the Gulf of Carpentaria in the northern part of the country (Lane 1987). They almost never move inland. Sooty Oystercatchers co-occur with the Australian Pied Oystercatcher at non-breeding and most breeding sites. [Photo C.]

In Corner Inlet (where the largest congregations occur in Victoria), birds use extensive estuaries and tidal mudflats during the non-breeding (overwintering) seasons. In Tasmania, birds may occupy sandy mudflats in sheltered bays whilst moulting (Marchant & Higgins 1993). In northwest

Table 1. Comparative biometric measurements of male and female adult Sooty Oystercatchers in Victoria and northwest Australia. Values are mean ± standard deviation (sample size in brackets). All measurements are in millimetres except weight, which is in grams. Data modified from Hansen *et al.* (2009).

Measurement	Sex	Southeast Australia	Northwest Australia
Bill	Males Females	73.4 ± 3.3 (297) 87.1 ± 3.9 (172)	65.4 ± 2.4 (26) 73.4 ± 2.7 (23)
Head-bill	Males Females	123.9 ± 5.2 (299) 136.2 ± 5.1 (162)	112.6 ± 2.5 (26) 120.9 ± 2.7 (24)
Wing*	Males Females	295.1 ± 7.6 (205) 297.0 ± 7.5 (106)	272.2 ± 5.6 (17) 276.6 ± 6.9 (15)
Weight	Males Females	806.7 ± 62.2 (301) 826.7 ± 61.3 (163)	605.3 ± 33.4 (25) 652.6 ± 54.9 (23)

*sample size from northwest Australia was too small to allow the distinction between newly moulted wings and old wings. Therefore, wing length data from southeast Australia is averaged for comparative purposes.

Photo C. Adult Sooty Oystercatcher (northern subspecies *opthalmicus*) and three Australian Pied Oystercatchers *Haematopus longirostris* at Tattler Rocks, Broome in northwest Australia, on 17 April 2003 (photo: David Hollands).

Tasmania, flocks of (apparently) non-breeding birds (40+, some immature) may frequent high tide roosts on coastal islands during summer, at sites where breeding by Australian Pied Oystercatcher occurs simultaneously (B. Hansen & P.S. Lansley unpubl. data). In NSW, the distribution of birds seems likely to be dictated by the availability of foraging space and offshore breeding sites (Chafer 1993, Harrison 2009). Large-scale features, such as the presence of islands and number of rocky headlands are the main predictors of presence in this region (Harrison 2009). In northern Australia, they will frequent coral cays and reefs and their distribution in these regions may be determined by the presence of coral reefs (Marchant & Higgins 1993).

Breeding habitat

Sooty Oystercatchers typically breed on offshore islands among rocky substrate and on reefs (more so in the northern half of the country). Breeding records stem mostly from southern offshore islands, especially in Bass Strait, the northern coast of Tasmania and around southeastern South Australia (Considine 1979, Marchant & Higgins 1993, Lauro & Nol 1995b, Barrett *et al.* 2003, Jarman 2006). During the New Atlas of Australian Birds reporting period (1998–2002), breeding records were collected from Cairns, northern NSW, Esperance (on the Nullarbor), Spencer Gulf near Port Lincoln, King Island, the islands in St Vincent Gulf, and Mallacoota in Victoria's far east (Barrett *et al*. 2003). Records for the northern subspecies were from the Lacepedes Islands and Lombadina in northwest Australia, Darwin West and off the northeast coast of Arnhem Land (Marchant & Higgins 1993, Barrett *et al*. 2003).

Sites containing significant numbers of breeding pairs include the Furneaux group (Flinders and other Islands) in Bass Strait, the northern and southern coasts of Tasmania, Kangaroo Island and surrounds (South Australia), Albany region (Western Australia), the Whitsunday Islands and Moreton Bay (Queensland), Newcastle region in New South Wales (Marchant & Higgins 1993) and Five Island Nature Reserve along the south coast of NSW (Jarman 2006, Jorgensen and Dunn 2008). In Bass Strait, there are several small granite islands located just off Wilson's Promontory, Victoria (between 2−20 km offshore) that contain breeding pairs of Sooty Oystercatchers. There are also breeding records from rocky islets off King and Flinders Islands, which include Low Islets Nature Reserve, Northern Fosters Islet and West Fosters Islet, Penguin Islet and Cat Island (*http://www.laurieford.net/bassman.htm*).

In northern NSW, the presence of soil and low vegetation, and absence of Silver Gulls *Larus novaehollandiae* were the best predictors of island suitability for nesting (Harrison 2009). One additional island (currently not used for nesting) has been identified as a potential breeding site in northern NSW, which is predicted to become occupied if numbers of Sooty Oystercatchers were to increase in the future. Lack of occupation of this island suggests that the population in currently under capacity (Harrison 2009). Only islands greater than 2 ha in area were used for nesting on both the south coast (Keating and Jarman 2003) and north coast of NSW (Harrison 2009).

DISTRIBUTION

Sooty Oystercatchers are widespread throughout coastal Australia but at low densities (Marchant & Higgins 1993,

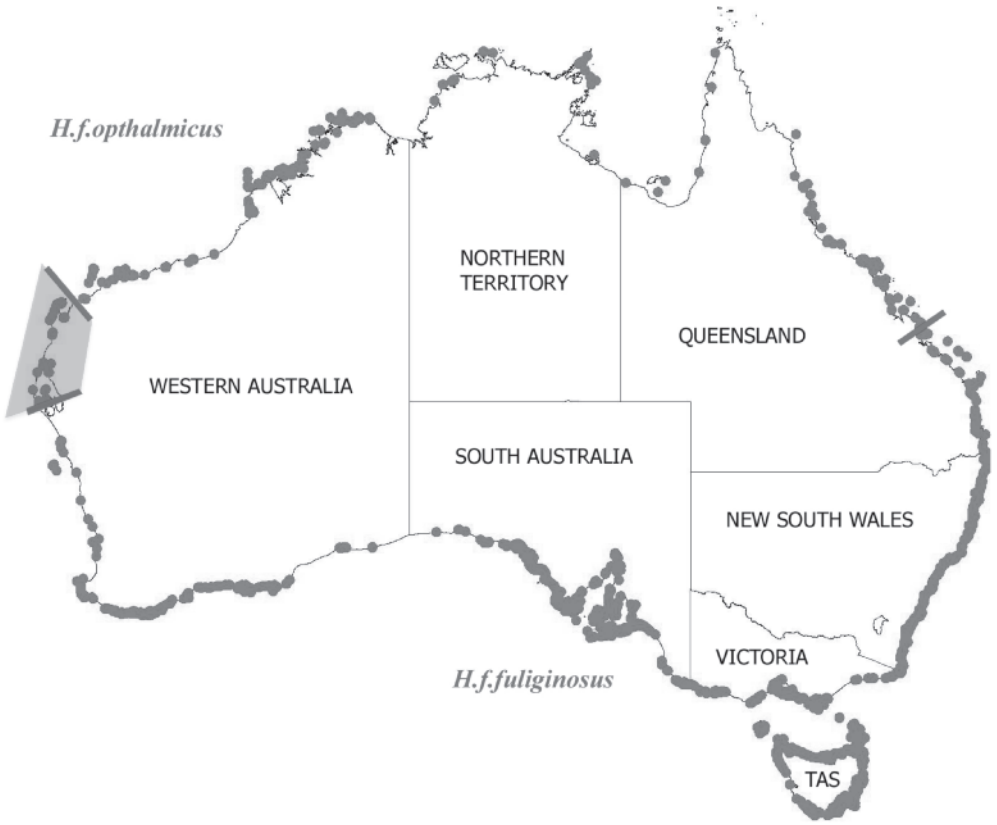

Fig. 1. Map of Australia showing the location of Sooty Oystercatcher records from the *New Atlas of Australian Birds* 1998 to 2008 reporting period (grey dots). The approximate location the northern and southern subspecies intergrade is shown with dark-grey lines. The western contact zone (through Shark Bay) is characterized by hybrids (Ford 1987) and is illustrated with grey shading. Map figure sourced (and modified) from the Birds Australia New Atlas Project 1998–2008.

Weston *et al*. 1995). They are strictly marine coastal, occurring on rocky shores and embayments, offshore islands and rocky reefs. The largest numbers from counts are from northern Tasmania, Bass Strait islands and southern Victoria. Offshore islands are probably the primary source of birds in mainland populations (Lane 1982). There are fewer records from northern Australia and far offshore.

H. fulginosus fulginosus occurs mostly in the southern part of Australia from Carnarvon/Shark Bay area in Western Australia, along the southern coast and becoming more abundant eastwards to Victoria and Tasmania, and then lessening again in numbers northward to Mackay in Queensland (Fig. 1). Corner Inlet (in Victoria) holds a significant portion of the mainland's population, having a maximum non-breeding population of up to 400 birds with occasional individual flocks of over 100 birds being encountered. Sooty Oystercatchers are common on the largest Bass Strait islands of King and Flinders, and also occur on almost every other island in Bass Strait (large and small) in the breeding season. They occur on the large near-shore island of Kangaroo in South Australia and on Beagle Island in Western Australia. Information relating to their residency on these islands during the non-breeding season is difficult to obtain, suggesting that detailed non-breeding surveys rarely occur.

Table 2. Maximum counts in a single year in six regions (generally holding 40 birds or more, or a minimum of 1% of the flyway estimate of *H. f. fuliginosus*) having relatively regular counts over a 30-year period. Data are extracted and summarized from the AWSG national count database. S denotes counts conducted during the Austral summer.

Region / State	2008	1998	1988
Corner Inlet, Victoria	325	370	224 S
Cape Portland, NE Tasmania	68 S	35 S	27 S
Derwent, SE Tasmania	48	65	16
Botany Bay, New South Wales	18 S	*11	2
Roebuck Bay, Western Australia	32 S	19	**20 S
Robbins Passage, NW Tasmania	255 S	291	225 S

* Where data were not available for that year, the next closest year's maximum count was used, in this case 1997 instead of 1998.
** Where data were not available for that year, the next closest year's maximum count was used, in this case 1990 instead of 1988.

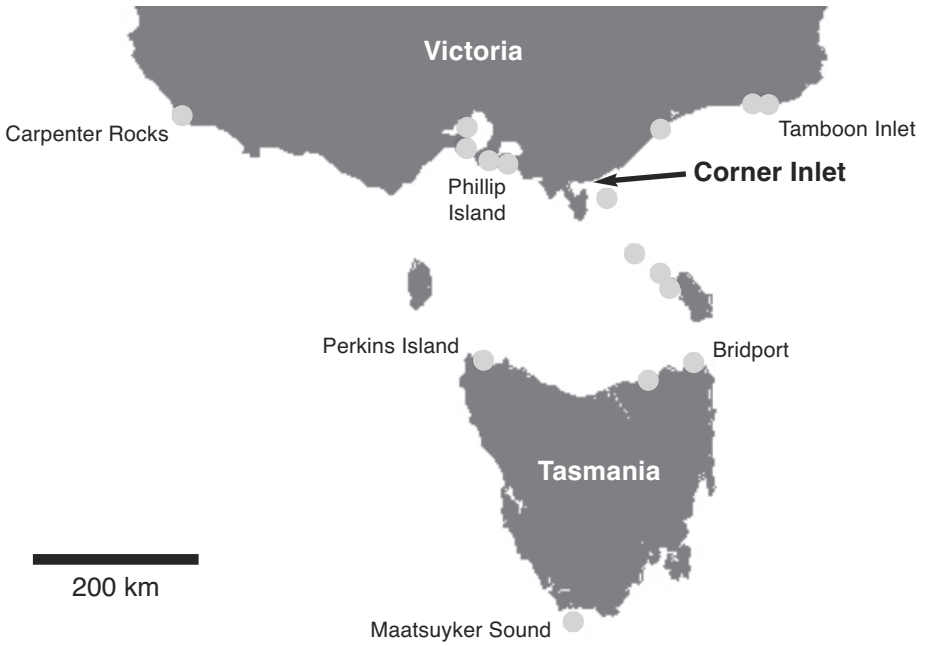

Fig. 2. Map of southeast Australia showing sites of banding recoveries (light-grey dots) of Sooty Oystercatchers first encountered in Corner Inlet. An approximate scale bar is shown.

H. f. opthalmicus occurs in tropical Australia from Shark Bay north to the Kimberley (and on offshore islands and reefs), east to Cape York, and south to Mackay (Fig. 1) (Marchant & Higgins 1993). They occur irregularly from Cape York to the central coast of Queensland. They occur also on islands in the Gulf of Carpentaria and rarely, on the Torres Strait Islands. The two subspecies intergrade between Shark Bay and Pt Cloates in the West where hybrids may be found (Ford 1987).

MIGRATION / MOVEMENTS

Sooty Oystercatchers are largely sedentary and dispersal is limited (Hayman *et al*. 1986). Dispersing juveniles return to the mainland and join non-breeding flocks. Adults may return to the mainland but some are thought to remain on breeding territories in non-breeding season (Marchant & Higgins 1993, Hansen *et al*. 2009).

In Victoria, most recorded movements are between flocking areas (particularly Corner Inlet) and breeding areas, including nearby Bass Strait Islands and, less frequently, King Island and the northern coast of Tasmania (Fig. 2). The longest recorded movement for this species was a single bird from Corner Inlet, which was re-sighted on Maatsuyker Island off the southwest coast of Tasmania, *ca.* 500 km to the south. Some birds also move eastwards from Corner Inlet along the Victorian coast and rarely into southern NSW. Westward movements have occasionally been recorded, the farthest of these being to Carpenter Rocks in southeast South Australia.

In northwest Australia, a single bird from Roebuck Bay in Broome was observed on the Lacepede Islands where it bred (*ca.* 100 km off the northern coast) and was subsequently re-sighted in Broome. A bird caught in Roebuck Bay was re-sighted in the Kimberley, *ca.* 250 km northeast (A. Boyle pers. comm.).

POPULATIONS: SIZES AND TRENDS

The current population estimate of *H. f. fulginosus* is 4,000 (Watkins 1993, Delany & Scott 2006) and of *H. f. opthalmicus* is 7,500 (Delany & Scott 2006). The previous population estimate of *H. f. opthalmicus* was 1,000 (Watkins 1993). The relative rarity of Sooty Oystercatchers across large areas of northern Australia compared with southern Australia and the infrequent presence of flocks exceeding 40 birds in northern Australia, especially in regions where they are regularly studied (northwest Australia; CDTM pers. obs), casts doubt on the most recent population estimate revision.

In the breeding season the majority of Sooty Oystercatchers are spread out along rocky coasts and on offshore islands, with mostly immature birds present in a relatively small number of flocks (compared with the non-breeding season). Outside the breeding season the flocks are larger but they nevertheless tend to occur at relatively few localities (many fewer than for Australian Pied Oystercatcher). The largest congregations of non-breeding birds tend to occur in the southern half of the Australia, with only few records of large flocks (40+) stemming from more northerly latitudes. Annual counts from these regions show a large amount of variability and the maximum count in any one year is not consistently associated with the same season (Table 2). We present these figures in Table 2 to give an indication of relative population sizes in each region and to demonstrate that populations have remained reasonably stable overall, but we advise caution in using them as absolute estimates. As count effort and coverage varies from year to year and site to site, it is difficult to make general inferences about population trends from single year counts. This highlights the importance of conducting consecutive annual counts at the same number of sites within a region, at the same time within each season.

In southeast Tasmania counts made in the austral winter between 1965 and 1982 recorded a decline in numbers of 30–40% at two important local sites in the Derwent/Pittwater region, Pipeclay Lagoon and South Arm Neck (Newman &

Park 1982). Subsequent published counts for the Derwent/Pittwater regions between 1982 and 1989 reported two general trends, one) winter counts (16–61) significantly higher than summer counts (0–18), and two) a relatively stable local population size indicated by numbers recorded during seven consecutive winter counts (Hewish 1990). Robbins Passage (and islands therein) in northwest Tasmania is a region holding a significant portion of the southern Australian population. AWSG winter counts for that region do not indicate any substantial positive or negative trends since 1988, although there appears to be general upward trend for summer counts (Fig. 3). However, as there are large fluctuations in seasonal total counts presumably due to variation in count effort and the absence of count data for some years, this trend may simply be an artefact of sample bias.

In Corner Inlet, Victoria, where count effort has been relatively consistent and over a long time period, there has been a steady increase over 28 years (Fig. 4). Exploratory analyses of summer count data from Corner Inlet indicated an average annual increase of 14.9% ($p < 0.0001$, Intercept=71.5 (SE 30.94), slope=10.7 (SE 1.86); Fig. 5). Similarly, there appears to have been an increase of 5.6% based on winter counts (p=0.0007, Intercept=147.2 (SE 35.27), slope=8.29 (SE 2.12); Fig. 6). While these data were found not to meet the assumptions of simple linear regression, transformation of the data produced essentially the same results and therefore, transformed data are not presented here (Birds Australia unpubl. data). It is clear that the number of Sooty Oystercatchers recorded during annual summer counts has been increasing since those counts began in 1980. The contrast between summer and winter count trends suggests that either: (a) Sooty Oystercatchers use different sites at different times of the year; (b) there are biases with the sampling design; or (c) the unusually large counts during the austral summer 2006 are distorting longer-term patterns in population size fluctuations. Analyses of re-capture data from adult banded birds have indicated a significant bias towards males early in the year (January to April) compared to later in the year (May–July), when the tertiary sex ratio is at parity (Hansen *et al*. 2009). It is therefore possible that differences in trajectories of summer and winter counts reflect differential movements by adult males and females in different seasons. However, to unequivocally demonstrate this seasonal pattern, data from birds sexed using molecular methods is required to verify the conclusions based upon sexing criteria developed using bimodally distributed biometric data (Hansen *et al*. 2009). This should be the focus of future research on Sooty Oystercatchers.

Counts from the Mackay region, central Queensland, between 1985 and 1989 indicated a different winter/summer pattern to those in the south, namely, birds were only recorded in a single winter count (1989) compared with summer counts, where birds were consistently recorded over the five count years (Hewish 1990). The summer counts from this period indicated a decreasing trend, although numbers of birds counted were comparatively small compared with other regions (3–21) (Hewish 1990). Later counts, from November 2002 to February 2004, indicated slightly larger count totals, which varied from a minimum of 10 in November 2002 to a maximum of 40 in January 2003 (mean=30±12, n=5) (Harding 2004).

Studies on Sooty Oystercatchers resident in the northern NSW region suggested an increase in population size in the last decade (Harrison 2009). During the period 2003–2005,

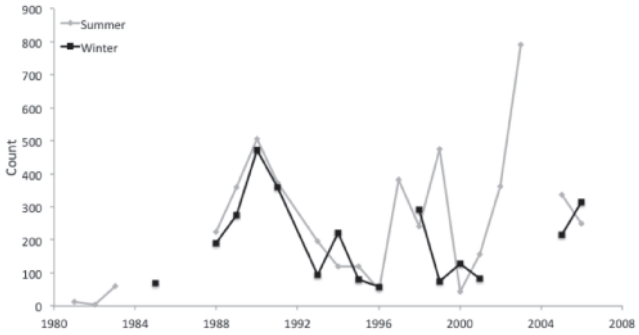

Fig. 3. Austral summer and winter counts of Sooty Oystercatcher in Robbins Passage, northwest Tasmania, from 1981 to 2006.

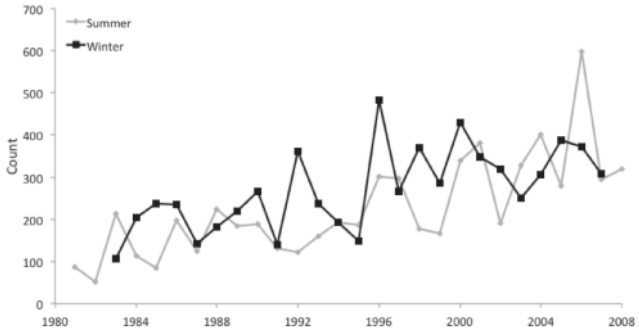

Fig. 4. Austral summer and winter counts of Sooty Oystercatcher in Corner Inlet, Victoria, from 1981 to 2008.

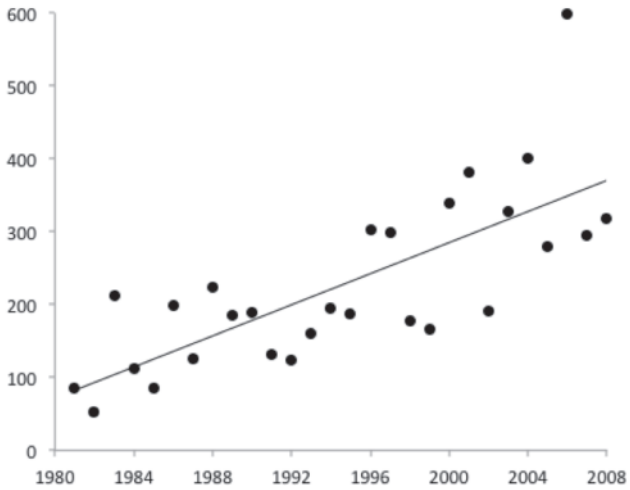

Fig. 5. Regression plot of total count (y axis) versus count year (x axis) for austral summer counts of Sooty Oystercatcher in Corner Inlet, Victoria. This represents an average increase of 14.9% per year ($P < 0.0000$), Intercept 71.5 (SE 30.94), slope 10.7 (SE 1.86).

a maximum population of 45–59 individuals was recorded on the north coast of NSW, between Ballina and Sawtell (Harrison 2009). This included the consistent presence of 26 resident adults, of which only six pairs bred. Comparing AWSG count data and other data (Lane 1987, Smith 1991) with Harrison's (2009) population estimate indicated that the population remained fairly constant over nearly two decades. There have been other reports of potential increases in numbers in the Richmond district of northern NSW, with group sizes increasing from the 1970s through to 1990s (1973–1989: average 1.6 individuals, 1990–1998: average 3.6 individuals; Gosper & Holmes 2002). Similarly, reports also indicate a significant increase in breeding pairs on the

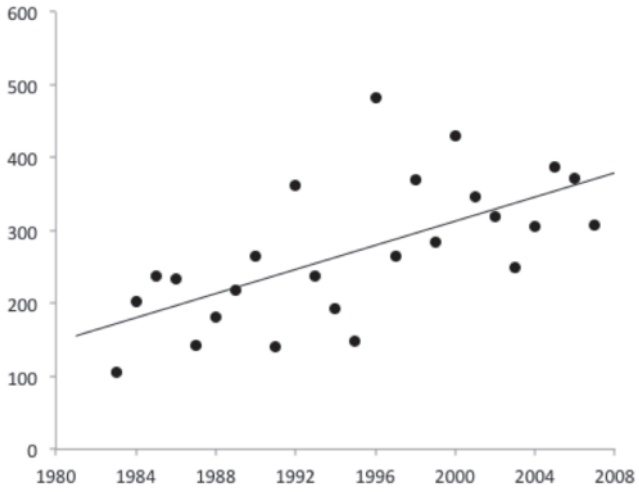

Fig. 6. Regression plot of total count (*y* axis) versus count year (*x* axis) for austral winter counts of Sooty Oystercatcher in Corner Inlet, Victoria. This represents an average increase of 5.6% per year (P = 0.0007), Intercept 147.2 (SE 35.27), slope 8.29 (SE 2.12).

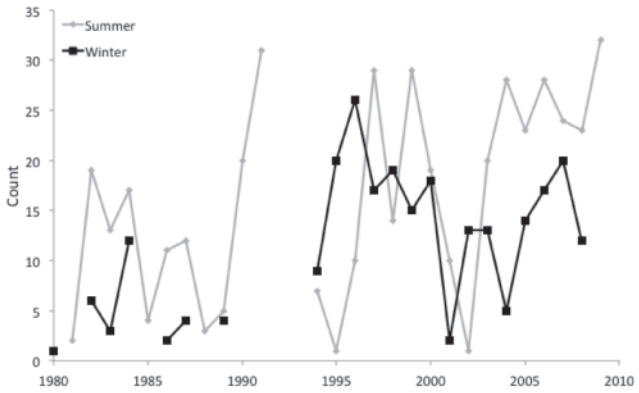

Fig. 7. Austral summer and winter counts for the northern subspecies of Sooty Oystercatcher (*H. f. opthalmicus*), from 1980 to 2009. Counts represent the sum of the maximum seasonal count at each of four sites: Bowen, Mackay, North Darwin and Roebuck Bay (Broome). Count coverage varies between years and sites, and therefore, no trend can be inferred from these data. Counts from nine other sites are not included as they were conducted in only four (or less) separate years.

south coast of NSW in recent years (Keating & Jarman 2003). However, a recent review of Sooty Oystercatchers has been undertaken by the NSW government Department of Environment and Climate Change (DECC), and found that there was insufficient evidence for a change of conservation status in the state (S. Debus pers. comm.).

The most recent Waterbirds Population Estimate (Delany & Scott 2006) stated that there had been a substantial upward revision in the numbers of the northern subspecies *H. f. opthalmicus*. This estimate was based upon Garnett & Crowley (2000) who commented that their estimate of breeding birds of the northern subspecies (5000) was low in reliability. Low reliability estimates were defined as usually being within 100% of the figure stated based on the area of occupancy and other available data on density (which was, in this case, personal communications). It is therefore highly probable that these estimates are inaccurate, because the patchy distribution of this species means that there are many areas along the coast where few birds occur. Fig. 7 shows a plot of total count per season averaged by the number of sites counted, from across the range of the northern subspecies. Although count effort varied markedly and not all sites were counted in every season, the reported increase in population estimate from 1993 to 2006 does not appear to be reflected in a similar increase from national count sites. The patterns detected here require a thorough investigation to resolve this apparent contradiction. It is clear however, that more detailed information is required to assess the status of populations of *H. f. opthalmicus* accurately.

DEMOGRAPHIC AND MECHANISTIC CAUSES OF POPULATION CHANGE

Monitoring data from count sites is the best available data from across the range of the species for inferring population trajectories, although these data have proven to be difficult to extract detailed population trends from owing to variability in count effort. Nevertheless, general count trends suggest overall stability in populations of both subspecies over about three decades of monitoring. Reports of predation impacting breeding success stem from only a few localities, and all of those are in NSW where the species is listed as vulnerable. The extent to which disturbance at nesting sites (either from human traffic or predation) has significant impacts on regional population trajectories remains to be demonstrated. Virtually no data are available from breeding sites on offshore islands which would allow an assessment of local changes to population sizes through breeding success or failure.

IUCN CONSERVATION STATUS

'Least Concern' (BirdLife International 2008).

THREATS

The Sooty Oystercatcher was regarded as a species of special concern in Watkins' summary of its status (Watkins 1993). This concern was reiterated by Weston *et al*. (1995) in their commentary on count trends and knowledge gaps. There was some concern that numbers had reduced in the Derwent/Pittwater area (Hewish 1990) in the period 1965−1982. A similar pattern of decline was detected in the late 1980s from the Mackay region (AWSG unpub. data). However, The Action Plan for Australian Birds 2000 (Garnett & Crowley 2000) stated that the conservation status of Sooty Oystercatchers is of 'Least Concern'. This would suggest that the trends reported in areas like Derwent/ Pittwater are isolated local declines, and that the overall pattern across the southern part of the country is one of relative stability. In particular, one of the largest monitored mainland populations (Corner Inlet) has experienced an increase in numbers over the last 25 years.

We therefore suggest that the current conservation status of Sooty Oystercatchers does not require any revision at this time. However, there is relatively little data on population sizes or trajectories for the northern subspecies. The most recent population size estimate suggests this subspecies has increased significantly in size (Delany & Scott 2006), but strong empirical data supporting this increase is lacking. Increases in count coverage for northern regions and investigation of the breeding success for the northern subspecies would be warranted to determine the nature of these reported increases.

There is little information available on threats to vital rates of Sooty Oystercatchers. On the basis of the distribution of the species, it is unlikely that birds suffer disturbance at nests due to agricultural activities, as is the case with oystercatcher species in other countries. Information on chick survival and mortality is lacking, although the coincidence of some breeding sites with areas used for human recreation may result in increased chick mortality as a result of activities such as beach use of vehicles or trampling by walkers. Targeted research on life history and vital rates are required to fill these knowledge gaps.

Weston *et al*. (1995) noted in their paper on Sooty Oystercatcher populations that information on the northern subspecies was extremely poor and that more comprehensive investigations in population sizes were urgent. Since that time, *H. f. opthalmicus* has received little research attention and our knowledge of Sooty Oystercatcher population dynamics in tropical Australia has barely advanced in 13 years. This should be viewed as a crucial research priority.

New South Wales

In NSW, Sooty Oystercatchers are listed as a vulnerable species (*Threatened Species Conservation Act 1995*). Disturbance at nesting sites and introduced predators are listed as key threatening processes by the NSW Department of Conservation and Environment (further information available at *http://www.threatenedspecies.environment.nsw.gov.au*). Sooty Oystercatchers in the region appear to be highly sensitive to disturbance by people and predators, and visitation to Green Island (south coast of NSW) for nest monitoring purposes has been implicated in an incidence of vacation of the island by adult Sooty Oystercatchers (Jorgensen & Dunn 2008).

The Southern Oceans Seabird Study Group (SOSSA) in association with the National Parkes and Wildlife Service have been monitoring the numbers and breeding biology of Sooty Oystercatchers on the south coast of NSW since 1994 in an effort to gain much needed information on basic biology and ecology (Smith *et al*. 2002). Fourteen islands (less than 100 m and up to 7 km offshore) have been found to contain up to 78 breeding pairs of Sooty Oystercatchers, the most significant concentrations found on the small islands of Flinders and Belowla, and on the larger islands of Brush and Montague (Jarman 2006). SOSSA monitoring in Five Islands Nature Reserve (Flinders, Bass, Martin and Big 1 & 2) has found generally low predation rates, although Kelp Gulls *Larus dominicanus* and Australian Ravens *Corvus coronoides* were observed to take eggs from nests (Smith *et al*. 2002).

The presence of Black Rats *Rattus rattus* on Brush Island was thought to be associated with low breeding success and an intensive rat eradication program was undertaken and successfully completed in 2005 (Jorgensen & Dunn 2008). However, no subsequent increase in breeding success was detected and monitoring of nest sites indicated avian predation was also occurring (Jorgensen & Dunn 2008). Ravens are implicated in predation of both oystercatcher and Hooded Plover *Thinornis rubricollis* nests, and control programs were planned for the 2008/09 breeding season. The outcomes of this program are not yet known.

In southern NSW, competition for prey items such as ascidians *Pyura stolonifera* between Sooty Oystercatchers and fishermen (who harvest *Pyura* for bait) resulted in a significant depletion of this food resource along a 250 km stretch of coast (Chafer 1993). There has been no subsequent investigation into food web dynamics, so the longer-term impact of food resource changes on oystercatcher populations in the area is not known.

Threatening processes reported from the region are listed as follows:

- ❑ Disturbance to coastal feeding, nesting and roosting areas through beach-combing, fishing, dog-walking, horse-riding and four-wheel off-road drive vehicles.
- ❑ Potential predation of eggs and chicks by foxes, dogs, cats and rats (all of which can gain access to islands at low tide), and raptors and ravens.
- ❑ Habitat destruction as a result of residential, agricultural and tourism developments.
- ❑ Hydrological changes to estuaries and similar water bodies causing modification or removal of important areas of suitable habitat.
- ❑ Increasing frequency of storm events (which may be climate change related) that exacerbate nest loss.

Queensland

In Queensland, the Coastal Bird Monitoring Strategy for the Great Barrier Reef World Heritage Area (Turner 2008) identifies the need for addressing key knowledge gaps to assess the conservation status of the species accurately. These knowledge gaps include breeding success at selected sites, understanding of effects of predation, the relative importance of island versus mainland breeding sites and the effects of human disturbance. In particular, information about important breeding sites is needed from the Hinchinbrook District, and the Whitsunday Islands and coast, all of which are areas of high tourism value.

Bass Strait

On the Bass Strait islands of Foster and Penguin, increased visitation to the islands by day boaters is highlighted as a potential threat to nesting shorebirds and seabirds, including Sooty Oystercatchers (Bass Strait Nature Reserves Management Plan; *http://www.laurieford.net/bassman.htm*).

The following sections summarize information relevant to specific threats that may impact or have potential to impact Sooty Oystercatchers.

Disturbance. In general, breeding birds do not regularly occur in areas experiencing high human use, as the majority of breeding sites occur on offshore islands where human visitation is minimal. Nevertheless, in areas where breeding birds do coincide with human recreation (for example, Flinders and Foster Islands, beaches of northern NSW and Phillip Island in Victoria) there are potentially detrimental consequences as a result of anthropogenic disturbance (Watkins 1993, Harrison 2009). In these areas, vehicles, human foot traffic, domestic dogs, camping and other forms of human recreation may result in nest loss and / or breeding failure.

Habitat Loss. Loss of intertidal areas due to reclamation and urban development is predicted to impact local populations

of Australian Pied Oystercatcher in southeast Tasmania. The extent to which these impacts threaten Sooty Oystercatchers are not known, but are likely to be minimal as the majority of birds occurring in these areas are immature, non-breeding birds that have joined winter flocks. Annual counts in these areas will be important to monitor any changes to populations as a result of ongoing coastal development.

Predation. Oystercatchers are vulnerable to predation from introduced predators such as the Red Fox *Vulpes vulpes* and Black Rat. Predator-free islands are crucial to maintaining breeding success. Most islands used for breeding by Sooty Oystercatchers are free of introduced predators, largely as a function of their size and isolation. Nevertheless, it is important that these islands are regularly monitored and that human visitation, which could potentially introduce new predators, be strictly controlled.

Climate Change. It is unlikely that climate change will have significant impacts on Sooty Oystercatchers over the time period of current climate predictions (30–50 years). Nesting failure may be exacerbated by increased frequency and intensity of storm events (Smith *et al*. 2002), which may be climate change related. The only other foreseeable impact could occur as a result of sea surface temperature rises, potentially impacting on foraging success through trophic cascades (Congdon *et al*. 2007). As empirical data supporting these predictions is limited to Australian tropical reef systems and species exhibiting pelagic foraging behaviours (e.g. terns), this proposition remains to be tested for this (or any other) oystercatcher species in Australasia.

RECOMMENDATIONS FOR CONSERVATION RESEARCH AND MANAGEMENT

At present, Sooty Oystercatchers are not threatened. The greatest potential threat is predation at breeding sites. Offshore islands are important as breeding sites and regulation of human visitation to small islands and protection of breeding areas on large islands is vital. Foxes, which are known to have a negative impact on Australian Pied Oystercatcher breeding success (in Victoria) as well as impacting other ground-nesting shorebirds, need to be rigorously controlled at breeding sites through ongoing eradication programs. Where developments are proposed that coincide with breeding territories, exclusions zones may be necessary during the breeding season to reduce disturbance at nests.

There is a paucity of information on potential threatening processes on the northern subspecies. Survey information from breeding sites across the range of the species is critical for addressing this key knowledge gap.

National count effort has proved to be highly variable (especially in the early years of counting) and many sites are either counted on a sporadic basis or counted at different times of the year. Furthermore, count duration may vary with some sites being counted during a single day in one year (or one season) and then subsequently counted over multiple days in another. This has resulted in a largely uninformative database from which long-term population trends are difficult to infer. It will be critical that future counts are conducted in a more systematic manner and that a sound statistical basis to the survey design is developed.

The following recommendations are made on the basis of the above information:

1. **Ongoing monitoring of breeding areas** for the purpose of introduced predator detection, and the implementation of control programs where introduced predators are known to occur.

2. **Protection of currently used breeding islands and reefs** throughout Australia. This may require restrictions to visitation by the public.

3. **Detailed surveys of suspected or known breeding sites** in the northern part of the range. This should particularly focus on offshore sites (for example, reefs).

4. **Continued monitoring at annual count sites** (preferably with improved survey design) to elucidate long-term population trends.

5. **Banding of young birds** to determine fledging success and survival to breeding age. Additionally, detailed studies on age at first breeding and long-term breeding success, especially in northern Australia, are required to fill key knowledge gaps.

6. **An investigation into the population ecology of the northern subspecies** to elucidate regional demographic trends, potential threatening processes and landscape features / land uses influencing habitat use and spatial distribution.

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APPENDIX 1. OVERVIEW OF RECENT STUDIES AND RESEARCH

There is a paucity of detailed information on Sooty Oystercatcher life history. Most work on Sooty Oystercatchers has been restricted to the southern half of the country and limited to a few individual and largely isolated studies. There has been some work of limited duration and spatial extent conducted on Sooty Oystercatchers on Chalky Island (part of the Furneaux group, off the north coast of Tasmania) and on eight islands of the Furneaux Group between 1976 and 1990 (Wakefield 1988, Lauro and Nol 1995a, 1995b). These studies provided some information about life history parameters and largely focussed on breeding interactions with sympatric Australian Pied Oystercatchers. In the late 1970s, a detailed dietary study was conducted on Phillip Island and the Bass Coast (Considine 1979). A later study (during the early 1990s) into foraging ecology was conducted in southern NSW (Chafer 1993). The Southern Oceans Seabird Study Group (SOSSA) in New South Wales, in association with NSW National Parkes and Wildlife Service, has been monitoring the numbers and breeding biology of Sooty Oystercatchers on the south coast of NSW since 1994 in an effort to gain much needed information on basic biology and ecology (Smith *et al*. 2002, Keating & Jarman 2003, Jarman & Keating 2006, Jorgensen & Dunn 2008).

The Victorian Wader Study Group (VWSG) and the Australasian Wader Studies Group (AWSG) have been monitoring Sooty Oystercatchers at key flocking locations (see below) since 1977. Colour-marking studies have been conducted in southeast and northwest Australia by both groups. These studies have contributed significantly to our understanding of distribution and extent of movements, as well as adding to information on life history traits of Sooty Oystercatchers (Hansen *et al*. 2009). Most recently, studies on the northern coast of NSW incorporating detailed habitat modelling has increased our understanding of the fine-scale spatial distribution of Sooty Oystercatchers (Harrison 2009). Finally, Birds Australia has undertaken some preliminary analyses of national count data, which is presented here, along with reporting records from the *New Atlas of Australian Birds* (1998–2002).

APPENDIX 2. LEGISLATIVE STATUS

Sooty Oystercatchers are not listed under federal threatened species legislation (*Environment Protection and Biodiversity Conservation Act 1999*) nor are they listed under any state legislation, with the exception of New South Wales, where they are listed as a vulnerable species (*Threatened Species Conservation Act 1995*).

APPENDIX 3. KEY CONSERVATION SITES

Important sites for Sooty Oystercatcher are determined on the basis of either maximum counts on any single day in any single year from regions holding 40 birds or more, or a minimum of 1% of the flyway estimate of *H. fuliginosus* (Table A). In the case of the northern subspecies *H. f. opthalmicus*, regions included are those holding 10 or more birds. Data is extracted (and summarized by region) from the AWSG / Birds Australia national count database.

Table A. Key sites for Sooty Oystercatchers in Australia based upon the 1% flyway population criterion or on maximum daily austral summer and winter counts.

Region / State	Largest count (1978–2008) Summer	Largest count (1978–2008) Winter
Corner Inlet, Victoria	378	298
Shallow Inlet, Victoria	50	54
Flinders Island, Tasmania	238	-
Cape Portland, NE Tasmania	47	45
Robbins Passage, NW Tasmania	790	473
Derwent, SE Tasmania	37	124
West Eyre Peninsula, South Australia	530	53
Kangaroo Island, South Australia	62	75
Ceduna to Venus Bay, South Australia	124	28
Nuytsland Nature Reserve, Western Australia	64	44
Roebuck Bay, NW Australia	32	26
Mackay, Queensland	19	6