# Conservation assessment of the Australian Pied Oystercatcher *Haematopus longirostris*

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Taylor, I.R., Newman, O.M.G., Park, P., Hansen, B., Minton, C.D.T., Harrison, A. & Jessop, R. 2014. Conservation assessment of the Australian Pied Oystercatcher *Haematopus longirostris*. *International Wader Studies* 20: 116–128.

The Australian Pied Oystercatcher *Haematopus longirostris* is restricted to Australia, Southern New Guinea and the Aru Islands. Within Australia the highest densities are in the southern, temperate climate states of Tasmania, Victoria and South Australia; significant populations also occur in subtropical and tropical areas of Queensland, Northern Territory and northern Western Australia. The coasts of New South Wales and most of Western Australia support low densities. Population sizes in New Guinea and Aru Islands are unknown. In the first decade of the 21st century, population size in Australia is probably in the order of 12,000–14,000 individuals and 4,000–5,000 breeding pairs. A thorough, comprehensive, nationwide assessment of population size is needed to confirm this. There is no evidence of recent declines in the most important parts of the range in Tasmania or Victoria but the northern New South Wales population is in decline. The IUCN conservation status of the species is Least Concern. The main current and potential threats include coastal development, habitat loss, human recreation disturbance, fox predation, clam harvesting, kelp harvesting from sandy shores and rising sea levels with an increased incidence of storm surges associated with global climate change. The species has been much less well studied than the Eurasian Oystercatcher with many aspects of its ecology poorly understood. More detailed research is needed into almost all aspects of the species' population ecology, but in particular, into survival and the factors that affect it.

**Sources of information**

Compared with many other oystercatchers relatively little has been published on the Australasian Pied Oystercatcher. However, at the time of writing a number of long- and short-term projects were underway. This report has drawn heavily from these studies but it is recognised that the material has not been subject to proper peer review. We have therefore attempted to include only material that we believe to be substantiated and that will be published later. The main long-term studies are being conducted in the most important parts of the species' range; in Tasmania (foraging ecology, breeding ecology and relationships with clam and kelp harvesting – Iain. R. Taylor; breeding, survival, and movements – Mike Newman & Priscilla Park), in Victoria (morphometrics, population sizes, movements and breeding –Victorian Wader Study Group, VWSG, led by Clive Minton) and in northern Australia (morphometics and movements – Australasian Wader Study Group, also led by Clive Minton). A short-term study was conducted on the ecology of a small New South Wales population (Annette Harrison). Just over half of the total Australian population occurs within Victoria and Tasmania and this account emphasizes results from these states. We were unable to locate any information on this species from those parts of its range outside Australia (Papua New Guinea and the Aru Islands).

## TAXONOMIC STATUS

Only a single species, *Haemantopus longirosrtris longirostris* [Photo A] is currently recognized. There is considerable size variation within its range: birds in northern Australia have significantly longer bills but shorter wings and lower body masses than those in southern Australia (Table 1, Kraaijeveld-Smit *et al.* 2001, 2004).

## LIFE HISTORY

The Australian Pied Oystercatcher shows slight but statistically significant sexual dimorphism with females being heavier and having longer bills and wings than males (Marchant and Higgins 1993, Kraaijeveld-Smit *et al.* 2001, 2004, O.M.G. Newman unpubl.data; Table 1). They form long-term monogamous pair bonds and both members of the

**Photo A.** Adult Australian Pied Oystercatcher on Coochiemudlo Island, Queensland, Australia (photo: Rod Warnock).

pair defend nesting and feeding territories [Photos B and C]; individuals show almost complete fidelity to breeding sites (Newman 1992, O.M.G. Newman unpubl. data). There is also strong site fidelity to winter feeding and roosting areas but some individuals also move considerably within and between estuaries (in Victoria, VWSG unpubl. data; in Tasmania, Newman 1982). There is no evidence of regular migration in any part of the species' range but local movements occur from summer breeding areas on exposed ocean beaches into sheltered estuaries and bays in Tasmania and some parts of Victoria in winter (Weston & Heislers 1995; Fig. 1). This may be in response to more severe weather conditions and reductions in food availability on exposed coasts in winter; in the more sheltered Corner Inlet there is evidence that many pairs remain on their territories throughout the year (VWSG unpubl. data).

Young are semi-precocial and post-fledging parental care occurs, but its full duration has not been quantified. Birds are sexually mature at 3–4 years but delayed reproduction is normal; the mean age of first breeding for 33 colour-banded birds in south-east Tasmania was 6.9 years with females starting to breed significantly earlier than males (6.3 compared with 7.6 years), but the age composition of a small colour-banded breeding population studied over 20 years was considerably greater than this (Fig. 2). For 27 Tasmanian colour-banded birds the mean distance from natal to breeding site was 9.2 km with a maximum of 30 km. None bred on their natal territory but 29% bred within 5 km of their hatching site (O.M.G. Newman unpubl. data; Fig. 2). Some long distance movements have been recorded for birds banded as immature or adult birds in flocks in southern Victoria, to Tasmania, South Australia (as far as the River Murray mouth) and New South Wales (as far as Ballina, in the north of the state, (Minton 1988, VWSG unpubl. data). It is not known if these represented dispersal of birds hatched in Victoria to breed elsewhere or return of birds to natal areas that had moved to Victoria post fledging. Movement to Victoria of a few birds banded as chicks in south-east Tasmania has been recorded (O.M.G. Newman unpubl. data).

Pairs are single brooded but up to two replacement clutches may be laid (Newman 1983). The timing of the main laying season of first clutches varies with latitude: October−November in Tasmania and Victoria (Newman 1992, I.R. Taylor unpubl.data, VWSG unpubl. data), August–September in northern New South Wales (A. Harrison unpubl. data) and July–September in the Northern Territory and north-west Western Australia (Chatto 2003, AWSG unpubl. data). The incubation period is 28–30 days and young fledge in 49–56 days (Newman 1992). Breeding success is low in all areas that have been studied, but generally within the range shown by other species of oystercatchers worldwide (Hockey 1996). Mean clutch size (first clutches) on a sheltered bay in the Derwent Estuary in Tasmania was 1.86 and hatching success, including replacement clutches was 30% (Newman 1992). The mean number of young fledged was 0.25/pair in 1998/90 and 0.3/pair in 2003/04 (n = 8 in both years, Newman 1992, O.M.G.

**Table 1.** Morphometric data for Australian Pied Oystercatchers. Data are presented separately for populations in Victoria and north-west Australia, showing geographic variation. *All wing lengths are for 'new' wings (all primaries are newly moulted) except for first-year birds and second-year birds from north-west Australia, the latter having old (outer primary old) and new wing lengths combined. Source: Kraaijeveld-Smit *et al.* (2001, 2004).

| Region / sex | Age | Bill length | Head-bill length | Wing length | Weight |
|---|---|---|---|---|---|
| Victoria / male | 1 | 70.9 ± 4.8 | 116.1 ± 5.0 | 277.9 ± 8.3 | 668.4 ± 57.4 |
| | 2 | 70.6 ± 3.6 | 115.2 ± 4.3 | 282.7 ± 7.4 | 689.3 ± 55.5 |
| | 2+ | 71.4 ± 3.7 | 116.4 ± 4.3 | 287.1 ± 7.3 | 732.8 ± 56.1 |
| Victoria / female | 1 | 76.7 ± 5.2 | 121.6 ± 5.3 | 282.1 ± 8.4 | 692.7 ± 59.5 |
| | 2 | 78.9 ± 4.0 | 123.2 ± 4.6 | 285.0 ± 7.4 | 729.3 ± 58.7 |
| | 2+ | 79.8 ± 4.1 | 124.9 ± 4.7 | 290.7 ± 7.4 | 763.5 ± 58.4 |
| NW Australia / male | 1 | 73.3 ± 3.7 | 115.7 ± 4.1 | 261.2 ± 7.5 | 545.8 ± 48.5 |
| | 2 | 76.0 ± 2.9 | 118.2 ± 3.2 | 264.5 ± 7.6 | 604.3 ± 73.3 |
| | 2+ | 75.6 ± 3.6 | 119.0 ± 4.1 | 273.4 ± 7.4 | 628.7 ± 62.1 |
| NW Australia / female | 1 | 84.5 ± 4.3 | 127.1 ± 4.5 | 267.4 ± 7.7 | 575.8 ± 51.2 |
| | 2 | 83.9 ± 3.2 | 126.7 ± 3.4 | 273.8 ± 7.8 | 621.8 ± 75.4 |
| | 2+ | 82.7 ± 3.9 | 125.7 ± 4.3 | 275.8 ± 7.6 | 641.5 ± 63.3 |

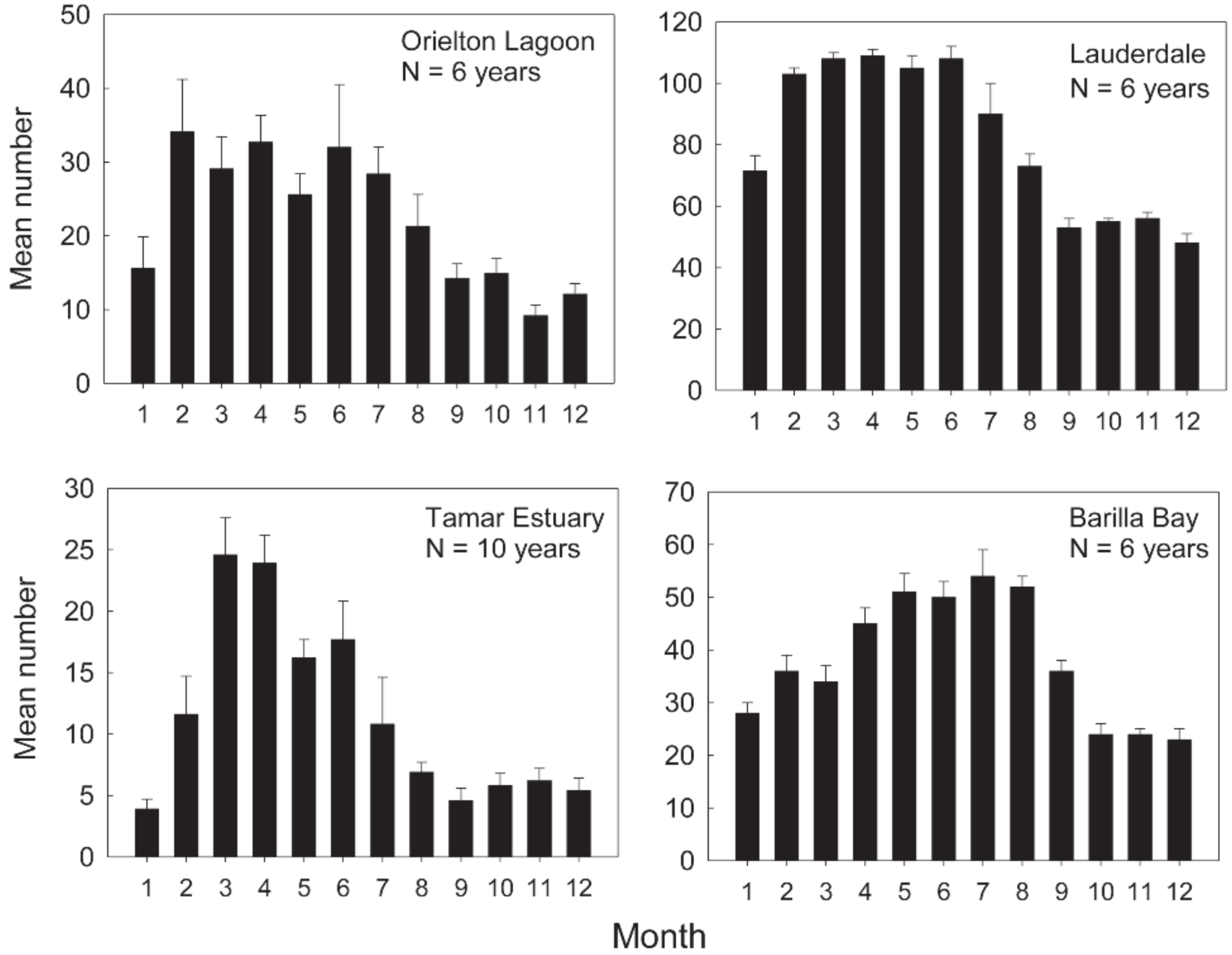


**Fig. 1.** Seasonal change in mean numbers (± se) of Pied Oystercatchers in four sheltered coastal sites in Tasmania, showing movement into the sites at the end of the breeding season (February/March) and out again at the start of breeding (August/September). Birds remaining during summer (October–January) were mostly non-breeders. Data collected by P. Park, O.M.G. Newman, P. Crofts, R. Patterson, R.&B. Cooper, I.R. Taylor; data analysis by I.R. Taylor.

Newman unpubl. data). This contrasts sharply with a productivity of 0.54/pair for the same eight territories averaged over nine years from 1977 to 1985 (Newman 1985). In a more extensive study of all breeding pairs on beaches, bays and lagoons in the Derwent Estuary area in 1991/92, a mean productivity of 0.27 fledged young per pair (n = 110 pairs) was recorded (Newman and Park 1992). On exposed ocean beaches in north east Tasmania the mean number fledged was 0.28/pair in 1995/96 (n = 54) and 0.24/pair in 1996/97 (n = 67, I.R. Taylor unpubl. data). Productivity on these beaches was significantly correlated with beach morphology and the density of washed-up kelp; beaches with narrow berms and on average 0.8% cover of washed up kelp fledged 0.1 per pair in 1996/97, whereas beaches with wide berms and an average of 1.6% kelp cover fledged a mean of 0.5 per pair (I.R. Taylor unpubl data.). In northern New South Wales hatching success on ocean beach and estuarine habitats combined was 46% and productivity averaged 0.6/pair (n = 42 territories averaged over 3 years, 2003–2005, A. Harrison, unpubl. data). In this study the productivity on ocean beach territories was close to that recorded for similar habitats in Tasmania (0.31/pair compared with 0.26/pair, Taylor, above) but the productivity in estuarine territories was much higher at 0.9/pair. Productivity in southern New South Wales for pairs nesting predominantly in estuaries and coastal lagoons was 0.56/pair in the 2005–06 season (n = 30, Jarman 2006), 0.67/pair in 2006–07 (n = 39, Dunn & Jorgensen 2007) and 0.69/pair in 2007–08 (n = 51, Dunn & Jorgensen 2008). These sites were the subject of an intensive management program involving fox control, fencing, public education and direct guarding of nests. Causes of breeding failure have not been fully quantified for any study area. In most areas the birds tend to nest relatively close to high tide level. The reasons for this are not understood but sites giving a clear view of approaching predators seem to be selected which often means being close to the high tide line (Lauro & Nol 1993).

This nest selection behaviour leaves them especially vulnerable to losses from flooding and high winds. On Flinders Island, Tasmania, up to 73% of first clutches laid in locations exposed to the prevailing wind direction were lost directly to flooding. Additional losses arose by wind undercutting the sand dunes on which nests were sited (Lauro & Nol 1993). In the Derwent estuary, 23% of clutches were inundated by high tides (Newman 1992). Unusually high tides assisted by strong winds regularly produce this magnitude of loss in the area and some long term nesting places in front of fore dunes are no longer in use (P. Park unpubl. data, O.M.G. Newman unpubl data). High clutch losses from inundation and wind-blown sand have also been recorded in Corner Inlet, Victoria (VWSG unpubl. data). By contrast, on the ocean beaches in north-east Tasmania which faced away from the prevailing wind direction and where pairs could nest higher above the tide line on low fore dunes only two nests losses from inundation occurred out of a sample of 121 breeding attempts (I.R. Taylor unpubl. data). Predation of clutches and small young by a range of species including gulls, Laridae, ravens, Corvidae, feral cats *Felis catus* and Red Foxes *Vulpes vulpes* has been recorded but the effects on productivity have not been fully quantified (O.M.G. Newman, P. Park, A. Harrison, I.R. Taylor, VWSG all unpubl. data). The greatest loss during breeding seems to occur between hatching and fledging with 77% mortality at Mortimer Bay (Newman 1983), comparable to estimates for other species of oyster-catchers (Safriel *et al.* 1996). In addition to predation, starvation of chicks during periods of frequent human disturbance, or during wet and windy weather conditions are also possibilities that have yet to be examined. On a Tasmanian beach chicks took cover among sand dunes and parents stopped providing food for a mean of 23.0±2.2 minutes (n = 38) in response to a single person or couple walking slowly along the shoreline (I.R. Taylor unpubl. data). In extreme cases the reaction of the birds started when the walkers were almost 400 m away from the edge of the birds' territory. No chick feeding was observed for periods of up to 1 hour 50 minutes when individual recreational fishermen stood at the tide line within territories (n = 5). Abandonment of clutches has been recorded in Tasmania and Victoria during strong winds which blow sand over nests (I.R. Taylor unpubl. data, VWSG unpubl. data).

Severe winter weather, known to be a major source of mortality of species such as *H. ostralegus* in the northern hemisphere (Swennen & Duiven 1983, Davidson & Clark 1985, Kersten & Brenninkmeijer 1995), does not occur in any part of the range of *H. longirostris*. As a consequence, juvenile and adult survival rates are possibly higher than those recorded for *H. ostralegus,* but there are limited data. The oldest known individual in Tasmania was at least 34 years, and 12 of 16 individually known breeding birds in 1989/90 were still alive 10 years later, suggesting an annual survival well in excess of 90% (Newman 2008, O.M.G. Newman unpubl. data). In Victoria the oldest known banded individual was 29.5 years old (VWSG unpubl. data).

**Photo B.** Pair of adult Australian Pied Oystercatchers on Stockton Sandspit, New South Wales, Australia (photo: Rod Warnock).

**Photo C.** A local breeding pair of adult Australian Pied Oystercatchers chasing non-breeders from their territory, Stockton Sandspit, New South Wales, Australia (photo: Rod Warnock).

## HABITAT AND FOOD

The species' range extends from temperate climate habitats in Tasmania to tropical habitats in the north and the prey available and species taken in the diet varies accordingly. The Pied Oystercatcher has not been recorded hammering open shells as described by Norton-Griffith (1967) and others for *H. ostralegus*, and this has a profound effect on its foraging compared with most other pied oystercatcher species. Foraging ecology has been studied in detail only in Tasmania and New South Wales.

**Tasmania** (mainly from I.R. Taylor unpubl. data): Feeding habitats in Tasmania include ocean beaches, estuaries and coastal embayments. Ocean beaches vary considerably in their morphology from low energy dissipative beaches, which have high densities of washed up kelp to high energy reflective beaches with little kelp. Estuaries vary from small barrier estuaries that are rarely open to the ocean to those with extensive intertidal areas, and all lack mangroves. Overall, bivalve molluscs are the predominant prey but a wide range of intertidal invertebrates are taken, and species composition of the diet depends on habitat and the prey available (Table 2). On estuaries and sheltered coastal bays there is usually tidal variation in prey selection related to zonation of potential prey. The small gastropod *Salinator fragilis* and the bivalve *Anapella cycladea* are often taken in the upper 50–150 m zone. Thereafter several species of bivalves predominate with a succession of species and size within species down the shore (I.R. Taylor unpubl. data). Because birds do not hammer shells they rely on stabbing partly open, feeding bivalves and most are tide line followers when feeding in estuaries. The clam *Katelysia scalarina*, which in many ways is ecologically equivalent to the European cockle *Cerastoderma edule*, is the main species taken, and the most profitable. Other species, such as *K. rhytiphora* and *Paphies* spp. Mussels (Mytilidae), are not important prey and polychaetes are usually a minor component, especially in biomass, of the diet at most sites. On some coastal embayments where large bivalves are scarce the gastropod *S. fragilis* and sand snails *Conuber conicus* and *Polinices didymus* may predominate. On ocean beaches where there is no washed up kelp bivalves are usually the main prey, including the large *Mactra rufescens* and the much smaller *Paphies elongata*, which are swallowed whole (Taylor & Taylor 2005). On such beaches, the birds are able to feed only at low tide. By contrast, on beaches with large amounts of washed up kelp birds show a strong preference for feeding among the kelp (95% of their feeding time), taking mostly amphipods, oligochaetes and beetle larvae that live among and feed upon the decomposing kelp, and can feed throughout the entire tidal cycle (I.R. Taylor unpubl. data)

Amplitudes between high and low tides in Tasmania tend to be small and as a result the length of time intertidal areas are exposed for feeding varies greatly over the neap and

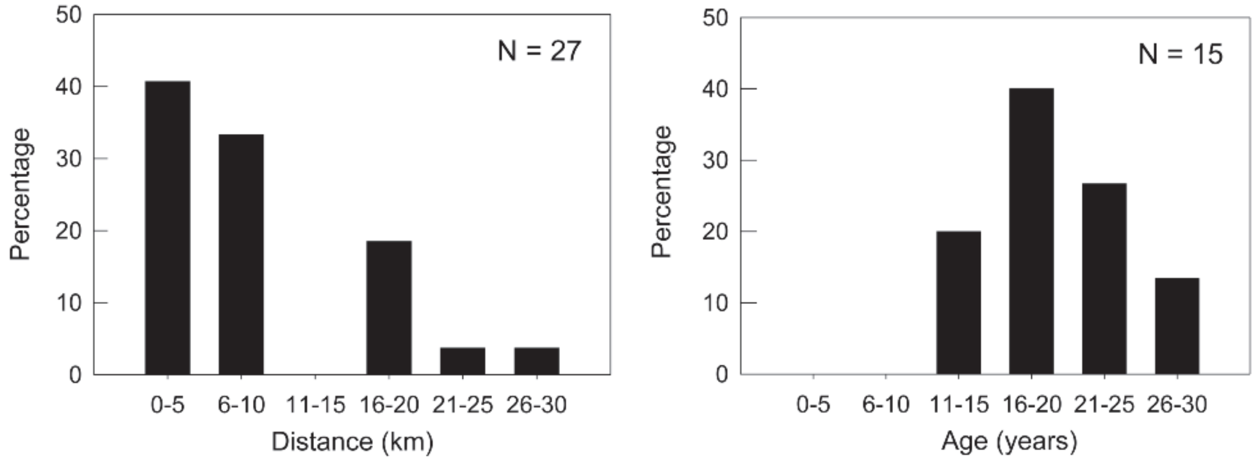


**Fig. 2.** Minimum age of colour-ringed breeding birds and dispersal distances from natal to breeding site for a population of Pied Oystercatcher in the Derwent Estuary, Tasmania. Data from Newman (1992, 2008).

spring tide cycles. On some neap tides in, for example, the Derwent Estuary feeding areas may not be exposed for several days in succession. Spring tides with lengthy exposure periods tend to occur at night when the birds are forced to feed in darkness. It is likely that the birds may be under regular periodic nutritional stress during neap tides (I.R. Taylor unpubl. data). A similar situation has been reported for *H. ostralegus* feeding on mussel beds on the Exe Estuary, UK, and a modelling exercise predicted higher mortality rates in winter on neap tides than on spring tides (Goss-Custard *et al.* 1996). The ability of Australian Pied Oystercatchers to survive the loss of habitat from coastal development or rising sea levels may depend critically on what happens during neap tides.

**New South Wales:** The main components include bivalves, especially *Donax deltoides*, the crustaceans *Mictyris longicarpus, Ocypode cordimana*, gastropods and polychaetes (Owner & Rohweder. 2003, A. Harrison unpubl. data).

**Victoria:** The main species taken on estuaries and ocean beaches are the bivalves *Katelysia scalarina*, *Donax deltoides*, *Mactra rufescens* and *Paphies elongata* (Weston 1991, I.R. Taylor, unpubl. data).

**Inland foraging:** Inland foraging is not a usual aspect of Australian Pied Oystercatcher feeding ecology because for most of the year Australian soils are dry and hard. However, feeding by small numbers of birds on golf courses and other watered recreation areas has been recorded occasionally in Victoria and New South Wales (Minton 1998, 1999). In eastern and southern Tasmania, the species has been recorded feeding on pastures and grassy recreation areas close to the shore, taking earthworms, but only during or immediately after heavy rainfall (Park unpubl. data, I.R. Taylor unpubl data, E. Znidersic unpubl. data, A. Harrison unpubl. data). Because of the dryness of paddocks outside the winter period, Australian Pied Oystercatchers could not rely on pastures as feeding or breeding habitat as occurs in Eurasian Oystercatchers (Goss-Custard 1996) or in the New Zealand South Island Pied Oystercatcher *H. finschi* (Baker 1973). South-eastern Australia is likely to experience reduced rainfall and higher evaporation rates in future (CSIRO 2007) further reducing the significance of this type of habitat.

## DISTRIBUTION

Current breeding distribution covers most of the coastline of Australia from temperate climatic zones of the southern states to the tropical climatic zones of the northern states (Fig. 3). The species is absent from major areas of rocky or cliff habitat such as occur in the Great Australian Bight in South Australia. It is resident on the Aru and Kai Islands and in southern New Guinea but its breeding status in these areas is unknown (Marchant & Higgins 1993).

## POPULATIONS: SIZES AND TRENDS

The only total population estimates are from Watkins (1993) based on data collected in 1981–1985 by the Australasian Wader Studies Group. Watkins (1993) provided a global total of 11,000 birds with an Australian population of 10,313 birds. The highest densities were in southern states: Tasmania, 27.5% of total; South Australia, 21.3% and Victoria, 13.6%. The northern tropical state of Queensland, 14.1%, and the Northern Territory, 11.6%, also supported substantial numbers. New South Wales supported 2% of the national total. Methods used to derive these estimates were not well described so the assumptions inherent in them are unknown. They were based predominantly on counts at communal roosts but no details are available of the percentages of roosts included or for the protocol for estimating the numbers of birds that did not join communal roosts. A proportion of beach nesting breeding pairs and pairs in sheltered estuaries seem not to join roosts at any time of year (Weston & Heislers 1995, I.R. Taylor unpubl. data, VWSG unpubl. data). It seems likely that estimates given by Watkins (1993) were conservative and this is supported by more thorough surveys conducted slightly later. For example, Chatto (1993) surveyed the whole of the Northern Territory, a region with many inaccessible islands and shorelines, using boats, helicopters and fixed wing aircraft. His estimate was a minimum of 1,700 birds compared with 1,200 given by Watkins (1993). Similarly, an estimate for Tasmania which includes areas known not to have been covered by the Watkins estimates gave a total of 3,400 (Ashby 1991, Schulz 1993, Schulz & Kristensen 1993, AWSG unpubl. data) compared with 2,800 given by Watkins. The estimate for Corner Inlet, Victoria, was 840 birds (Lane 1987), derived from ground surveys, which were known not to have been comprehensive. A later survey by helicopter, that included areas not covered earlier, gave a total of 1178 (Taylor & Minton 2006). Numbers in Corner Inlet remained relatively unchanged between the surveys (Fig. 4**)** suggesting the disparity between the two estimates arose from differences in protocol and not from a population increase. It seems likely that the total Australian population in the 1980s and early 1990s may have been 20–40% higher than the estimates given by Watkins (1993) and probably in the range of 12,000–14,000 birds. [Photo D.]

Using the revised minimum of 12,000 birds for Australia and a total global population minimum of 13,000 birds, 24 areas can be recognized within Australia that have regularly supported in excess of 130 individuals, meeting the Ramsar 1% criterion for defining sites of international importance for the species (Fig. 3). This is only one site less than those listed by Watkins (1993) based on a global population estimate of 11,000. These "sites" include breeding and non-breeding areas and form good ecological units upon which to base conservation priorities. Together, they support about 80% of the Australian population and are concentrated in both southern and northern regions. The importance of the state of Tasmania is shown by having nine of the sites. The absence of any sites in New South Wales is also notable, although recent winter numbers at Port Stephens qualify (Stuart 2011). The most important sites within Australia are Corner Inlet (Victoria), the Derwent estuary (Tasmania) and north-west Tasmania, which together support about 22% of the national total.

The above figures relate to the total population. The size of the breeding population can only be estimated indirectly using the relative proportions of breeding to non-breeding to birds. At Corner Inlet 40.5% and 24% of the population were non-breeders in 1996 and 2005, respectively (Minton 1997, Taylor & Minton 2006), in south east Tasmania and north-east Tasmania 28% and 36% respectively were non-breeders (I.R. Taylor unpubl. data). Assuming these values are applicable nationwide suggests a total Australian population of 4,080–4,760 breeding pairs based on the revised total population estimate given above. There has been no evidence of significant population change since the 1980s, so it is likely that these figures also apply 2010s.

The first counts of Pied Oystercatchers in Australia were in the early 1980s and were undertaken for only a few areas. In Tasmania no changes are apparent from counts at winter roost sites at three localities but there was a significant increase in the Derwent Estuary area during the 1990s, followed by a slight decline during the 2000s (Fig. 5). The increase period coincided with widespread illegal over-harvesting of the species' main prey in Tasmania, *K. scalarina*, during the early 1990s (Taylor 1995) and it is possible that birds moved from exploited sites to the Derwent where no clam harvesting occurred. At Corner Inlet, the most important area in Victoria for Pied Oystercatchers, counts made twice per year in standardized sample areas show no evidence of long-term change with winter counts being very similar to summer counts except for a short period from 2000–2006 (Fig. 4). There was some evidence that the number of breeding pairs may have increased from 1996 to 2005 in Corner Inlet (Minton 1997, Taylor & Minton 2006). The small breeding population of northern New South Wales seems to have undergone a substantial increase during the late 1990s but has subsequently decreased from about 200 individuals in 1999 to 112 in 2005. This decrease involved both breeding and non-breeding birds (A. Harrison unpubl. data). No information is available for populations in the remainder of the species' range.

In order to predict the effects of habitat loss arising from coastal developments and from rising sea levels associated with global climate change it is important to understand the factors responsible for limiting the densities of oystercatchers. In particular, density-dependent effects in relation to food supply need to be understood as densities will inevitably increase, at least in the short term, as a result of habitat loss. This has been investigated for *H. ostralegus* (Goss-Custard *et al.* 1996) but not for *H. longirostris.* The situation for breeding and non-breeding populations needs to be considered separately. During the non-breeding season densities of Pied Oystercatchers on different stretches of ocean beach along the northern New South Wales coast were significantly related to variations in the density of Pipi *Donax deltoides*, the species' main mollusc prey in the area (Owner & Rohweder 2003), suggesting a mechanism that adjusts local densities in relation to food supply. The Eurasian Oystercatcher

**Table 2.** Percentage numerical composition of the diet of Pied Oystercatchers at six sites in Tasmania 1995–1997. Site characteristics: A and B – intertidal sand and mudflats in estuaries; C and D – sandy substrates in sheltered coastal embayments; E – ocean beach site with little washed-up kelp; F – ocean beach site with large quantities of washed-up kelp. Source: Taylor, unpubl. data.

| Site type | Bivalves | Gastropods | Polychaetes | Oligochaetes | Amphipods | Insects | Others | N |
|---|---|---|---|---|---|---|---|---|
| Estuary: A | 87 | 0 | 5.8 | 0 | 0 | 0 | 7.2 | 378 |
| Estuary: B | 92.7 | 0 | 0 | 0 | 0 | 0 | 7.3 | 151 |
| Bay: C | 97.2 | 0 | 2.8 | 0 | 0 | 0 | 0 | 1002 |
| Bay: D | 17.5 | 61.1 | 12.6 | 0 | 0 | 0 | 8.8 | 159 |
| Bay: E | 94.6 | 0 | 5.4 | 0 | 0 | 0 | 0 | 172 |
| Bay: F | 12.7 | 0 | 16.5 | 5.2 | 48 | 17.5 | 0 | 212 |

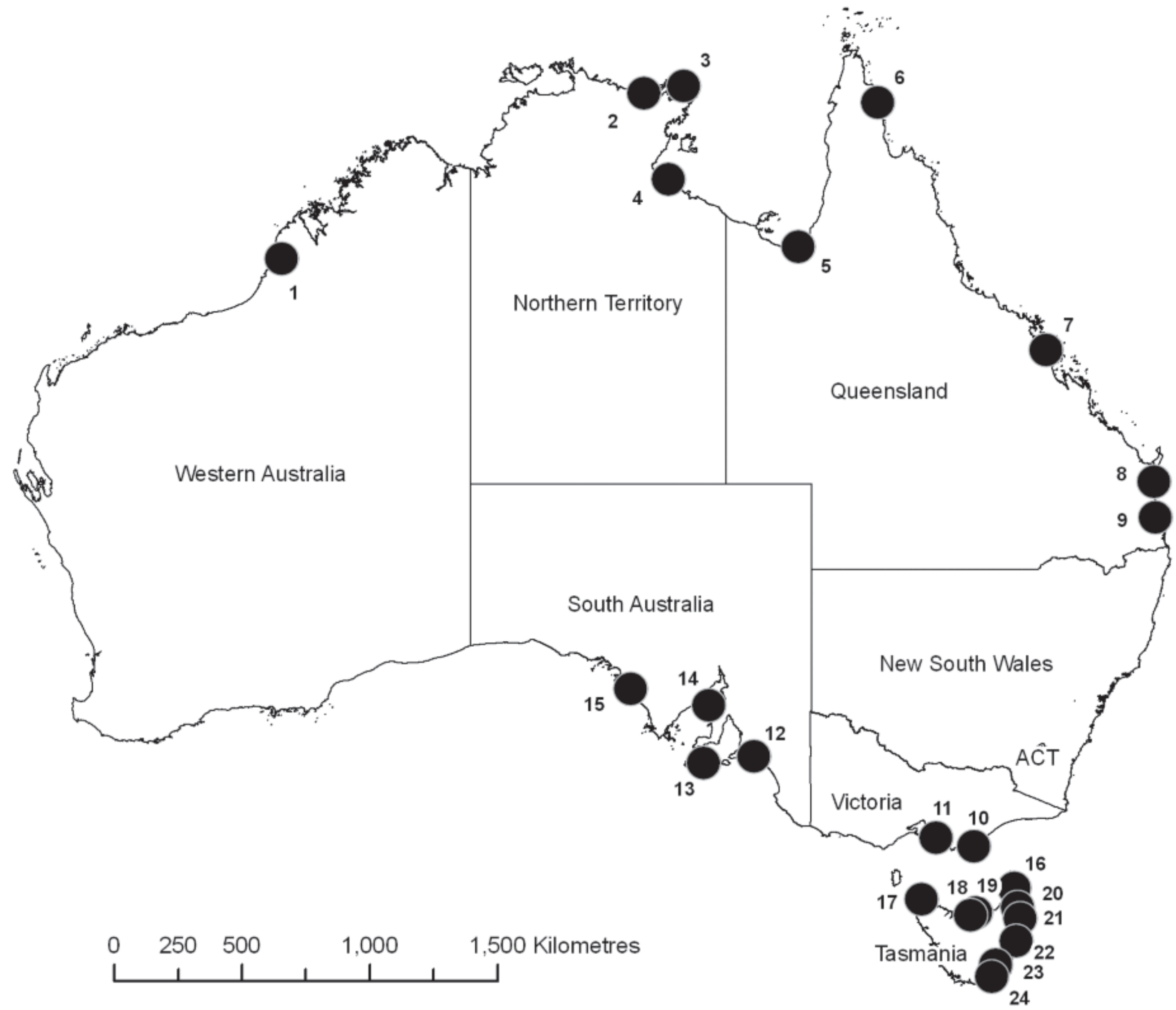


**Fig. 3.** Distribution of sites within Australia that have supported more than 130 Pied Oystercatchers and that can be ranked as internationally important based on the 1% Ramsar criterion and assuming a total global population of 13,000 individuals. Based on data in Lane 1986, Watkins 1993, Chatto 2003 and other sources; analysis by I.R. Taylor. 1 Roebuck Bay; 2 coasts and islands around Millingimbi; 3 Coast and islands around Buckingham Bay and Arnhem Bay; 4 Coast between Limmen Bight River and Port McArthur; 5 South-east Gulf of Carpentaria; 6 Northern Great Barrier Reef; 7 Mackay area; 8 Great Sandy Strait; 9 Moreton Bay; 10 Corner Inlet; 11 Westernport Bay; 12 The Coorong; 13 Kangaroo Island; 14 Spencer Gulf; 15 West coast, Eyre Peninsula; 16 Furneaux Islands; 17 North-west Tasmania ; 18 Tamar Estuary; 19 Port Sorell; 20 North-east Tasmania; 21 George's Bay; 22 Freycinet and Moulting Lagoon; 23 Derwent Estuary-Pittwater, especially Ralph's Bay; 24 Bruny Island.

is one of the few species globally for which there is experimental evidence that the density of breeding pairs is limited by territorial behaviour. Removal of breeding birds was immediately followed by replacement with birds from non-breeding flocks (Harris 1970, Heg *et al.* 2000). The existence of non-territorial non-breeding birds of breeding age is usually regarded as strong indication of limitation of density through territorial behaviour (Newton 1998). Non-breeding birds occur in all *H. ostralegus* populations that have been studied and also in all *H. longirostris* populations (see above). The presence of breeding age birds among these non-breeders has been confirmed for at least seven populations of *H. ostralegus* that have been studied in detail (Ens *et al.* 1996) and in *H. longirostris* from colour-banded birds in the Derwent Estuary, Tasmania (O.M.G Newman & P. Park unpubl. data) and in Corner Inlet, Victoria (VWSG unpubl. data). Breeding Australian Pied Oystercatchers are strongly territorial (Marchant & Higgins 1993) and it is to be expected that densities are limited by territorial behaviour in the same way as in *H. ostralegus* populations.

## IUCN CONSERVATION STATUS

The species is listed as being of 'Least Concern' (IUCN 2008).

## THREATS

### Human disturbance

Four-wheel drive vehicles and trail bikes are used frequently on beaches in the most populous states such as New South Wales and parts of Queensland during part of the birds' breeding season in December and January, when many pairs have replacement clutches or broods (A. Harrison unpubl. data). This poses a threat through disturbance of feeding and nesting birds, possible killing of adults (recorded in northern New South Wales, A. Harrison unpubl. data) and chicks, and adverse effects on mollusc prey populations through the compaction of intertidal substrates. There has been a general increase in recreation activities along coastlines, including those in remote and previously undisturbed areas such as the Bay of Fires in Tasmania and around Broome in Western Australia, where government policy is to encourage tourism. The possible risks from this include an increase in the loss of eggs and chicks to predators as adults are kept off the nest, and reduced feeding rates of chicks (see above). Within the Seven and Five Mile Beach Reserve, Tasmania, no breeding success was recorded in 41 pairs over three years up to 1992 (Newman & Park 1992). Prior to 1986 success was significantly higher (Newman & Patterson 1986). In the intervening period there was an unregulated and large increase in human recreation in the area, including equestrian and beach sports, walking and dog exercising.

## Habitat loss

Housing, marinas, oyster farming, tourist and other developments continue to increase around much of the Australian coastline causing the loss of feeding and breeding habitat and increased disturbance and predation from humans and their pets. In Australia generally there is relatively little threat to important oystercatcher areas through extensive land claim for industry or farming.

## Losses to predators

Australia is an island, albeit a large one, and this has prevented natural colonization by most placental predators. Nevertheless, generalist marsupial predators such as the Thylacine *Thylacinus cyanocephalus,* which included birds in its diet, once occurred across much of the country and became extinct in Tasmania as recently as the 1930s (Guiler & Godard 1998, Long *et al.* 2002, Johnson 2006). The Dingo *Canis lupus dingo,* also a generalist predator that includes birds in its diet, was introduced from south-east Asia at least 3,500–4,000 years ago and occurred over most of the country except Tasmania before Europeans arrived (Corbet 1995). Thus, Australian oystercatchers have coexisted with mammalian ground predators and are not equivalent to ground nesting species on small oceanic islands that evolved in the absence of ground predators and hence were vulnerable when such species were introduced by humans (Newton 1998). Australian Pied Oystercatchers show behavioural traits that in other species have been shown to be adaptations to reduce predation by mammals (Newton 1998). They generally nest in locations which afford good views of approaching predators (Lauro & Nol 1993); the nests themselves are cryptic, and when ground predators approach, incubating birds tend to slip off the nest unobtrusively without calling (I.R. Taylor unpubl. data). They are aggressive towards potential mammal predators and to humans in the vicinity of nests and chicks, including distraction displays, persistent calling and direct attacks (e.g. Schultz 1988, I.R. Taylor unpubl. data).

It has been suggested that predation of eggs, chicks and perhaps also adults by Red Foxes introduced from Europe in the 1850s has had a detrimental effect on Australian Pied Oystercatcher populations (Smith 1991, Minton 1997, Taylor & Minton 2006). Following their introduction, foxes spread rapidly across Australia, possibly assisted by the decline of the Dingo from human persecution (Jarman 1986). There is no doubt that foxes are predators of Pied Oystercatcher eggs and chicks in Australia (e.g. Dunn & Jorgensen 2008, A. Harrison unpubl. data). However, high predation rates of eggs and chicks, especially in their first week or so, are quite normal for most oystercatcher species that have been studied and for waders in general (Hockey 1996). The important question is whether or not losses to foxes reduce the size of the breeding population. Large numbers of non-breeding non-territorial birds, including individuals of breeding age, have been identified in all populations which have been studied throughout the range of *H. longirostris*. This suggests that the size of the breeding population is not limited by productivity and that any predation on eggs or chicks by foxes or other predators, even though

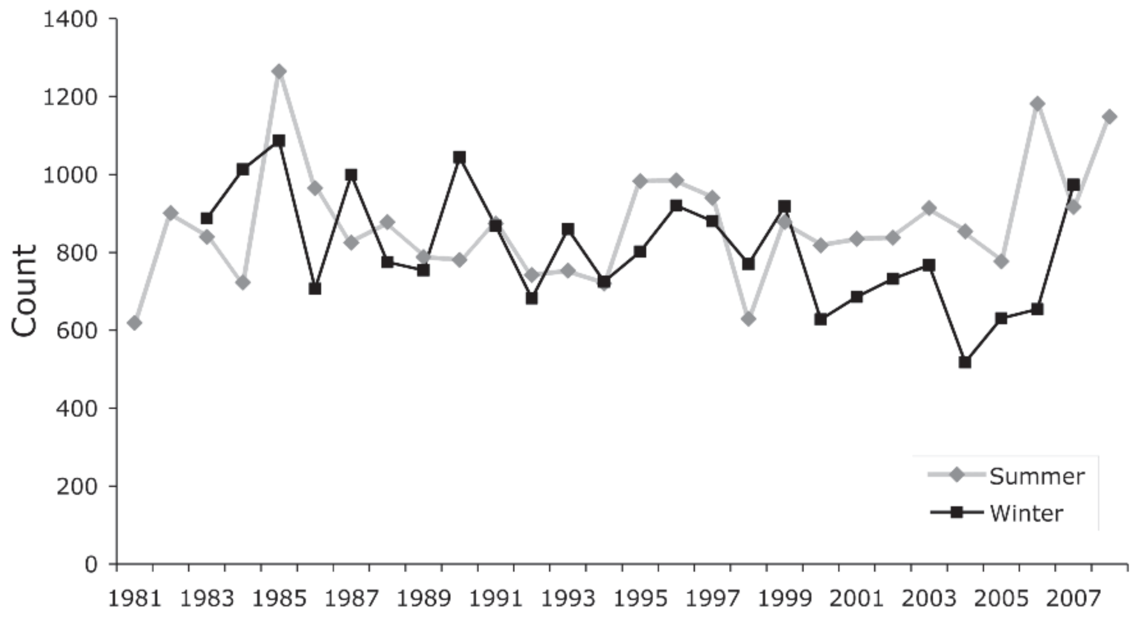


**Fig. 4.** Numbers of Pied Oystercatchers counted in winter (late June/early July) and summer (late January/early February) in sample areas of Corner Inlet, Victoria.

it might be substantial, does not limit the size of the breeding population. The large non-breeding populations are consistent with the hypothesis that breeding numbers are limited primarily by territorial behaviour rather than by predation (Newton 1998), but there have been no removal experiments of territorial pairs in Australia to test this. However, rapid replacement of members of pairs lost during the breeding season has been recorded (Newman 1992). The percentage of populations made up of non-breeding birds in areas where foxes occur, and presumably also where fox predation occurs, is remarkably similar to those in Tasmania where there was no history of fox predation (see Life History, above).

There will undoubtedly be local exceptions to this idea and one such seems to occur in Corner Inlet, Victoria, where Pied Oystercatchers nest on numerous small islands as well as on the adjacent mainland. Sunday Island, which has about 20 km of shoreline, and has been free of foxes and feral cats since the 1970s, supported an exceptionally high density of 115 breeding pairs in 2005, disproportionately large in relation to the total length of shoreline in the bay on which the birds could have nested (Taylor & Minton 2006). A fox eradication program on other islands was associated with an increase in the number of breeding pairs of Pied Oystercatchers on islands separated from the adjacent mainland shores by deep channels but not on those separated by only shallow channels. It is reasonable to suggest that the deeper channels formed a better barrier to re-colonization by foxes whereas the shallow channels were probably ineffective barriers (Minton 1997, Taylor & Minton 2006) and that the presence of Red Foxes reduced the number of breeding pairs nesting on the islands.

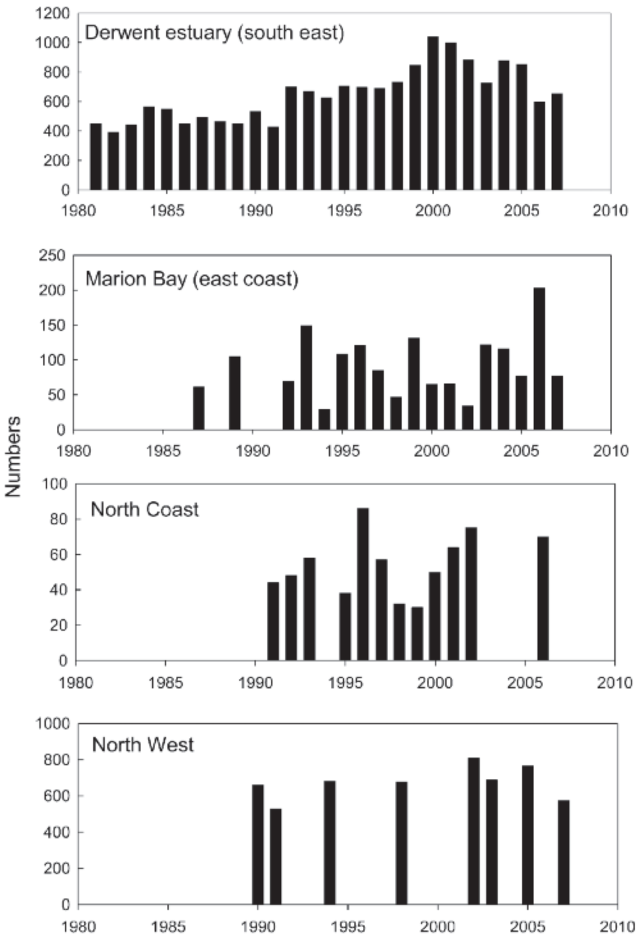


**Fig. 5.** Numbers of Pied Oystercatchers counted at winter high-tide roosts in four areas of Tasmania. Counts were done in late January/early February each year. Data supplied by P. Park (AWSG); analysis by I.R. Taylor.

In northern New South Wales fox control measures were introduced in 1997. Prior to then 16 Pied Oystercatcher territories studied over three years produced only a single fledged young. After fox control from 2003–2005, the mean productivity from a larger sample of 42 territories was 0.66 fledged young per territory, an exceptionally large value for the species. Despite this the size of the total population declined during the period of fox control from 202 individuals in 1998 to 112 in 2005 (A Harrison unpubl. data). Clearly, fox control failed to stop the decline suggesting that factors other than fox predation were important.

## Clam harvesting

Inappropriate harvesting of clams *Katelysia scalarina* is a potentially serious threat to Pied Oystercatcher populations across southern Australia (Taylor 1994, 2004). The same might apply to the harvesting of other species such as *Donax deltoides* farther north. Following the introduction of commercial harvesting of the clam *Katelysia scalarina* in Anson's Bay, north east Tasmania, the average number of Pied Oystercatchers feeding during the summer months decreased from 50 in 1994 to 12 in 1997, whereas numbers on two adjacent control estuaries not subject to harvesting did not decline. The diet of birds feeding at Anson's Bay changed from predominantly *K. scalarina* to the small, less profitable, gastropod, the Southern Mud Creeper *Bittium lawleyanum*. The decline in oystercatcher numbers was associated with a reduction in the density of *K. scalarina* within the size class range taken by the birds (26–45 mm) from 150/m$^2$ to 53/m$^2$, accompanied by a lack of recruitment of first year shellfish. The latter may have been caused by the harvesting method, which involved disruption of the substrate across most of the bay including throughout the season of spat settlement. Harvesting did not occur in the spring and summer of 1997 and in that year there was a high recruitment of first year clams, whereas in the previous two years there was almost no recruitment. At a control site where there was no harvesting, a high recruitment of first year clams occurred each year from 1994 to 1997 (I.R. Taylor unpubl. data). Harvesting at the site did not take place between1997 and 2007. In 2008 the numbers of Pied Oystercatchers feeding in the bay in summer had returned to a mean of 48, close to 1994 levels (E. Znidersic unpubl. data). Although *K. scalarina* is not harvested outside Tasmania the species occurs in suitable estuarine habitat across most of southern Australia and consideration has been given to harvesting it commercially in Victoria. A spread of harvesting could be a potentially serious threat.

## Kelp harvesting

Kelp harvesting occurs mainly in Tasmania for the alginate industry and has been mostly restricted to rocky shores because of a requirement that dried kelp should be sand-free. There is no evidence that harvesting from rocky shores is detrimental to Pied Oystercatchers because the areas involved are small and not the preferred feeding habitat. However, there is a growing interest in using kelp for organic fertilizers and as food supplements for livestock for

**Photo D.** Flock of Australian Pied Oystercatchers in flight, Corner Inlet, Victoria, Australia, 15 September 2012 (photo: Bruno Ens).

which there is no requirement for collected kelp to be sand-free, opening up the possibility of collecting washed up kelp from sandy shores. Removal of washed up kelp poses a potentially serious threat to breeding Pied Oystercatchers and to other species such as the Hooded Plover *Thinornis rubricollis* whose conservation status is defined as Near-threatened (Garnett & Crowley 2000). On many ocean beaches these species rely heavily for their food supply on the invertebrate communities that live within decomposing kelp. The density of breeding pairs and the breeding success of Pied Oystercatchers are related to the density of kelp washed up (see sections above, I.R. Taylor unpubl. data). It is likely that nutrients from the decomposing kelp are also essential to the trophic status of beaches away from the immediate vicinity of the kelp clumps and that their removal would reduce the overall productivity of the beaches (Brown & McLachlan 1990).

## Global climate change and rising sea levels

The average global rise in sea level during the 20th century has been estimated at 1.8±0.3 mm/year but with a significant increase to 3.3±0.4 mm/year between 1990 and 2006, which remains the current rate of increase (Church *et al.* 2004, Leuliette *et al.* 2004, Bindoff *et al.* 2007, Domingues *et al.* 2008). Sea level rise around Australian coastlines has been below the global average at a rate of 1.2 mm/yr over the 20th century (Church *et al.* 2006) but the entire eastern and much of the northern seaboard is predicted to exceed global averages in the future (CSIRO 2008). Predictions of global rises in sea level to the end of the 21st century are in the range 18–59 cm (90% confidence intervals) but there are concerns that this estimate is too low and that accelerated melting of glaciers may lead to higher values (Meehl *et al.* 2007, Church *et al.* 2008). Supporting this, sea level rise from 1990 has been at the very upper end of the projections (Rahmstorf *et al.* 2007). Associated with climate change, the frequency of intense storms and storm surges creating exceptionally high sea levels has also increased substantially over the 20th century on Australian coastlines and is predicted to increase even further (Church *et al.* 2006).

Rising sea levels could affect Pied Oystercatchers in Australia in several ways; by decreasing the extent of intertidal areas and hence reducing the feeding time available, by inundating nest and roost sites and by altering coastal morphology, which would change the suitability of nesting areas and affect invertebrate food supplies. In some areas coastlines may be able to move inland so that the overall effect may be negligible. However, there are many areas where this will not be possible because of existing and ongoing coastal development and defences and in many areas new coastal defences will probably be constructed.

Many Pied Oystercatchers in Australia, particularly those nesting in estuaries and low-lying islands, select nest sites close to the high tide line and significant numbers lose their clutches to exceptionally high tides and strong winds (Newman 1992, Lauro & Nol 1993, Minton 1997, P. Park unpubl. data, VWSG unpubl. data). The rate of loss has increased in recent years in the Derwent Estuary in Tasmania (P. Park unpubl. data). Continuing sea level rise and increasing storm surges could exacerbate this problem. On ocean beaches Pied Oystercatchers normally nest on the low fore dunes. Rising sea levels and especially exceptional storm surges tend to remove these fore dunes creating a steeper dune face; the beach at Moruya in New South Wales took over 20 years to form a new fore dune system after a storm surge in 1974 (McLean & Shen 2006). In some parts of Tasmania high tide roost sites have become inundated more frequently in recent years and as the sites are in built up areas, birds have been forced to roost on adjacent roads where they risk becoming traffic casualties (P. Park unpubl. data).

Depending on the extent of future sea level rises, it is possible that some intertidal areas may not be exposed long enough for the birds to meet daily energy requirements in some parts of their range in Australia. For example, in Tasmania current tidal amplitudes between high and low tides are low. The length of time intertidal areas are exposed varies greatly over the neap/spring tide cycle and on the peak of the neap part of the cycle intertidal areas may not be exposed at all. In the Derwent Estuary of Tasmania with current sea levels Pied Oystercatchers are unable to feed for several days in succession during neap tides (see above) and this period will be extended with rising sea levels. It is likely that the birds may no longer be able to survive on some estuaries.

## RECOMMENDATIONS FOR CONSERVATION RESEARCH

### 1. Improve surveys

Most past surveys have involved counting numbers at roosts and the last attempted survey of the entire population in Australia was in the early 1980s. There is a need for more extensive surveys covering as much as possible of the species' distribution and especially of breeding populations and of numbers in more remote areas which have not previously been included in surveys. An effective long-term monitoring program of breeding numbers and of non-breeding birds should be developed. Research is needed into the distribution ecology of the species and especially of the effects of tidal cycles and weather on the use of roost sites to establish the best ways of standardising counts.

### 2. Population dynamics

Improved understanding of almost all aspects of the species' population dynamics is needed, especially in the most important parts of its range in Tasmania, Victoria, South Australia and Northern Territory. Knowledge of breeding success is poor except for a few localities and for a limited sample of years, and information on survival both of pre-breeding and breeding birds is particularly poor. The basic mechanisms of population change are not understood. This includes determining causes of breeding success/failure and mortality of all age groups, and quantifying density dependent relationships in the breeding and feeding areas and any interactions among them. Intensive studies in selected areas across the species' range using large samples of colour marked individuals is probably the best approach to quantifying survival rates. The species occupies many different climatic and habitat types throughout its range and population parameters and mechanisms may show considerable variation. Long term studies of dispersal from natal to breeding sites and breeding site fidelity using the colour-banded individuals are also needed.

### 3. Climate change

Long-term effects of climate change, especially on breeding success and the extent and quality of feeding areas needs to be assessed. Consideration should be given to the application of individual-based population models developed elsewhere (e.g. Goss-Custard *et al.* 1995, Sutherland *et al.* 1996) to quantify the effects of sea level rise and habitat loss on a population scale.

### 4. Effects of predation by Red Foxes and other introduced species

Evidence available at present suggests that the removal of Red Foxes from islands results in an increase in the density of breeding Pied Oystercatchers. However, the effect of fox predation on mainland populations is poorly understood and needs to be investigated more rigorously. This may be particularly important for the island state of Tasmania where foxes did not occur until illegal introductions took place in the late 1990s and 2000s (Saunders *et al.* 2006). Controlled, replicated removal experiments of foxes are needed at a number of locations across the oystercatcher's range, alongside detailed ecological studies of their behaviour. In particular, the role of the quality of nest habitat in relation to predation risk should be assessed. Many coastal areas in Australia also have populations of feral cats and dogs and native predators such as gulls and crows in addition to foxes and there may be interactions in predation by these species. Parallel studies of other predators should be done in conjunction with studies of fox predation.

### 5. Effects of human disturbance

The effects of all forms of human disturbance need to be quantified in representative parts of the species' range. This includes the use of vehicles on beaches and dunes, and recreational activity such as fishing, walking, horse riding, dog exercising, camping and picnicking along beaches where Pied Oystercatchers breed and feed. The effects of newly developing "ecotourism" enterprises, taking visitors into previously undisturbed areas needs to be quantified.

## RECOMMENDATIONS FOR MANAGEMENT

### 1. Protection of internationally important sites for the species

At present a high percentage of the internationally important sites (i.e. sites that regularly support at least 130 individuals) for the species are given no special protection. Because the species is non-migratory its habitat is not protected by any of the international conventions and agreements relating to either waders or to migratory species. As a matter of priority all 24 internationally important sites for the species shown in Figure 3 should be recognized by all states and protected from coastal development that would be detrimental to the species. This action would protect 80% of the global population of the species.

### 2. Predator control

The experiences on islands at Corner Inlet, Victoria (see above) suggest that in some situations the removal of foxes can lead to an increase in the number of nesting Pied Oystercatchers. Adopting a precautionary principle approach to management would suggest that fox control should be continued in such situations.

### 3. Clam harvesting

Clam *Katelysia scalarina* harvesting using existing methods is probably damaging both to clam stocks and to oystercatchers. Harvesting should be strictly controlled by ensuring that the quantities harvested are not detrimental to oystercatcher populations, and existing harvesting methods need to be replaced by non damaging methods. For example, to avoid the severe reductions in clam recruitment associated with current harvesting methods, rotational, zoned harvesting might be employed in which only part of the exploited area is harvested at sustainable levels each year. Also a closed season, probably from October to January is needed to enhance spat settlement.

### 4. Disturbance from human recreation

There is a need to maintain extensive areas within protected areas such as national parks and coastal reserves in which there is minimal human disturbance. The trend towards encouraging visitor access to remote areas of coast by the provision of privately operated tourist lodges, as is happening, for example, in Tasmania, should be discouraged. The objectives of such protected areas should be returned primarily to a nature conservation role rather than a tourism role. The use of vehicles and horses on beaches and adjacent areas needs to be controlled more vigorously. Existing regulations that prohibit vehicles on beaches need to be enforced and policies that permit vehicle use should be reconsidered. Driving above the high tide line should be prohibited everywhere during the birds' breeding season and speed limits imposed below this level. Public education programs to avoid disturbance to breeding birds should be encouraged.

### 5. Kelp harvesting

The increasing pressure for approval to harvest washed up kelp from sandy beaches, especially in Tasmania, to meet an increasing demand for organic fertilizers and horse food supplements is a potentially serious threat to breeding oystercatchers and to other species such as the Hooded Plover. These species rely heavily for their food supply on the invertebrate communities associated with decomposing kelp. Breeding success is related to the density of kelp washed up on the beaches on which these species breed. It is likely that nutrients from the decomposing kelp are also essential to the trophic status of beaches away from the immediate vicinity of the kelp clumps (Brown & McLachlan 1990). More research is needed into the dynamics of deposition and decomposition of the kelp to assess the sustainability of kelp harvesting from beaches and the effect on beach nesting waders. Until such studies are completed harvesting from beaches on which Pied Oystercatchers breed should not be permitted. Should harvesting be allowed after such studies have been completed, a ban on harvesting during the birds" breeding season (September to April in southern Australia) and a year round ban within all internationally important sites for the species would be judicious.

## ACKNOWLEDGEMENTS

Iain Taylor wishes to thank Moragh McKay and Kerry Whitworth for their help in the field and in analysing samples in the laboratory, Simon Macdonald for his help with Figure 3 and the Institute for Land, Water and Society, Charles Sturt University, for funding his work on oystercatchers. Members of the Victorian Wader Study Group wish to thank Coast Action/Coast Care for grants to study Oystercatchers in Corner Inlet and Susan Taylor and Bruce Atkin, of the Victorian Department of Natural Resources and Environment, and Graeme Davis, Ross Williamson and other members of the staff of the Victorian Parks and Wildlife Service at Foster for advice and much practical support, especially via boat transport.

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