Conservation assessment of the Variable Oystercatcher *Haematopus unicolor*

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The Variable Oystercatcher *Haematopus unicolor* is a polymorphic species endemic to New Zealand. There are no recognized subspecies. Plumage varies, apparently continuously, from a black-and-white pied morph, through a series of intermediate stages, to an all-black morph. Where they co-occur, the different phases interbreed freely and randomly. The breeding biology of the species is outlined, but there have been few detailed studies. The species is non-migratory. Some juveniles remain at their natal sites and some disperse. Once paired and established on a territory, adults are typically site- and mate-faithful. There have been no detailed demographic studies, but preliminary data from one region suggest that the population has the potential to grow at about 4% per annum.

Variable Oystercatchers are almost entirely coastal in distribution. They are found around much of the mainland of New Zealand and its offshore islands, but are sparsely distributed in some regions. They have not been recorded from outlying island groups. Over the past 40 years, the population has increased rapidly and is currently thought to number about 4,500–5,000 individuals. Counts from different regions suggest that the increase has occurred throughout the range of the species. Like other oystercatchers in New Zealand, *H. unicolor* was previously shot for food, and legal protection is thought to be the main reason for the increase.

The species is ranked 'Least Concern' by BirdLife International, and 'At Risk (Recovering)' under the New Zealand threat-ranking scheme. The main threat to the species is currently believed to be predation, particularly of eggs and chicks, resulting in low average productivity. Adults are generally long-lived. Human activities in the coastal zone result in loss or degradation of habitat, with recreational activities on beaches causing high levels of disturbance in some areas during the breeding season. In the longer-term, the potential impacts of climate change on this and other coastal-breeding shorebird species are substantial.

Conservation-relevant research which needs to be undertaken includes a definitive resolution of the relationships of all Australasian oystercatcher taxa, long-term monitoring of increasing human impacts in the coastal zone, and assessment of the potential consequences for this and other coastal species of climate change. The Variable Oystercatcher is increasing in numbers and has a relatively low threat ranking; dedicated management is therefore currently not undertaken by national or regional government agencies, although a small proportion of the population benefits from management of other shorebird species. *H. unicolor* can however be managed successfully by community groups, and this activity should be encouraged.

TAXONOMIC STATUS

The confused history of the taxonomy of New Zealand oystercatchers was summarized by Falla (1939) and Baker (1972); the latter noted that the systematic status of the Variable Oystercatcher was particularly uncertain. The confusion was probably largely caused by the range of plumage states (from pied through a series of intermediate plumages to all black), exacerbated by the existence of a cline in colour morphs, and the presence of another (pied) species.

The literature includes a wide range of historic treatments. Falla (1939) reviewed earlier descriptions, and tentatively recognized two species, *H. reischeki* (in which he included an assemblage of pied, intermediate, and all-black birds) and *H. unicolor* (only all-black birds), but noted a lack of 'reliable material' with which to compare the all-black birds. Oliver (1955) considered all-black birds to be one species (*unicolor*) and pied birds in the North Island and Chatham Islands to be a subspecies of another (the Australian Pied Oystercatcher *H. longirostris*), with intermediate birds being regarded as hybrids between the two where their ranges overlapped.

However, the Checklist Committee (1970) recognized that *H. unicolor* was apparently polymorphic, with pied birds commoner in the north and black birds dominant in the south; it also commented that research was required on the status of *reischeki*. Heppleston (1972) proposed that *H. unicolor* included two subspecies, the Black Oystercatcher *H. u. unicolor*, and Variable Oystercatcher *H. u. reischeki*. Baker (1972) suggested that Black Oystercatchers in New Zealand may have arisen from an invasion of *H. longirostris*, which became melanistic, followed by a second invasion of the same species, with hybridization between the two giving rise to the intermediate forms.

The current checklist (Checklist Committee 2010) recognises three oystercatcher species in New Zealand: the smaller

Photo A. Pair of Variable Oystercatchers, one all-black, one fully pied. Rangitoto Island, New Zealand, November 2013 (photo: John Dowding).

South Island Oystercatcher *H. finschi*, which breeds inland, the geographically isolated pied Chatham Islands Oystercatcher *H. chathamensis* on the Chatham Islands, and the polymorphic Variable Oystercatcher *H. unicolor*. No subspecies of *H. unicolor* are currently recognized.

Recent research suggests very little genetic difference between the currently recognized New Zealand taxa. Banks & Paterson (2007) found no differences between a single black-phase Variable Oystercatcher and one South Island Oystercatcher, in spite of the obvious morphological and behavioural differences. Although *H. unicolor* and *H. finschi* are largely reproductively isolated (*unicolor* is coastal and *finschi* normally breeds inland), there is inter-breeding (producing viable offspring) by a few pairs in a small area of the North Canterbury coast (Crocker *et al.* 2010); this ability to inter-breed is consistent with the suggestion that the two species have diverged recently, and possibly within the past 15,000–30,000 years (Banks & Paterson 2007).

Other common names for the Variable Oystercatcher include torea pango, torea tai and VOC (Dowding 2013).

BIOLOGICAL DATA

Description

The largest of the three oystercatcher species in New Zealand, with plumage varying from a pied morph (black head, neck and upper parts, with white breast and belly; Photo A), to entirely black morph (Photos A & B), with an apparently continuous range of intermediate 'smudgy' birds (Photos C, D & E). There is a marked cline in these forms, with the frequency of black birds increasing with latitude, from 43% in the northern North Island, to 85% in central New Zealand, and 94% in the southern South Island and Stewart Island (Baker 1973a). Where they co-occur, the plumage phases inter-breed freely and non-assortatively (Baker 1973b). Baker (1973b) proposed a genetic model in which black birds were homozygous recessive, pied birds homozygous dominant, and intermediates heterozygous (with modifying genes responsible for the wide range of intermediate phenotypes); Marchant & Higgins (1993) noted however that not all of the data were consistent with such a model.

In adults, the bill is long and bright orange, with a paler yellow-orange tip; the iris is deep red, and the eye-ring is orange. The feet are stout, and vary in colour from grey in juveniles to a bright coral pink in adults. As in other juvenile oystercatchers, the bill of first-year birds has a dark tip, the dorsal plumage is dark brown (rather than black), and the iris and eye ring are dark. In some adults the irides have an obvious dark fleck, but it remains unclear whether this is gender-related, as has been shown for *H. bachmani* (Guzzetti *et al*. 2008). Detailed descriptions of the various morphs and the differences between young birds and adults are given by Marchant & Higgins (1993). Females are heavier than males on average and have longer bills, but there is overlap in both metrics. Discriminant functions for sexing *H. unicolor* from bill dimensions were given by Baker (1974).

Measurements and weights of adults, immatures and juveniles from museum specimens and live birds are shown in Marchant & Higgins (1993). Baker (1972) noted that there was geographic variation in size of black-phase birds across the range of the species. In a North Auckland study area, a sample of 50 unsexed breeding adults averaged 730 g (SD 53.3, range 598–820) (J.E. Dowding unpubl. data).

Life-history

Egg measurements (mm) in two samples averaged 58.6 (SD

Photo B. Pair of Variable Oystercatchers, both all-black, on the beach of Otago Peninsula, South Island, New Zealand, 21 January 2007 (photo: Hans Schekkerman).

1.9, n=36) × 40.9 (SD 2.7, n=36) (Baker 1969) and 59.9 (SD 2.7, range 54.0–65.6, n=98) x 40.4 (SD 1.1, range 37.5–42.6, n=98) (J.E. Dowding unpubl. data). Clutch size is normally 2–3, averaging 2.4 (SD 0.6, range 1–4, n=208) (Marchant & Higgins 1993). Incubation averages 28.4 days (SD 3.9, range 25–32, n=15) (Baker 1969). Both sexes incubate and brood chicks. The species typically breeds later in the season than other endemic shorebirds. In North Auckland (36°20'S), the earliest known clutch in recent seasons was laid about 07 September in 2010 (E. Lagnaz pers. comm.), but most first clutches are found in October or early November (Marchant & Higgins 1993, J.E. Dowding unpubl. data). At Kaikoura (42°30'S), the earliest nest was on 19 October, but most eggs were laid in November (Rowe 2008). [Photo F.]

Double-brooding has not been recorded, but at least two replacement clutches can be laid after loss, and it is not uncommon for chicks to fledge as late as February or March. Young chicks are fed by the parents; where disturbance levels are high, chicks often remain concealed (commonly among vegetation, rocks or driftwood), with adults carrying food to them. As they age, chicks increasingly forage for themselves, but often continue to beg for food (and be fed) after fledging and into their first winter.

The only published growth data suggest that bill length increases by about 0.9 mm per day between hatching and fledging (Rowe 2008). In North Auckland, mass increase appeared close to linear from 9–40 days, with an average increase of about 13 g daily (J.E. Dowding unpubl. data). There is often a discrepancy in size between siblings, probably because hatching is not always synchronous and the first-hatched chick gains an advantage; in one case, two siblings about 4 weeks old weighed 410 and 270 g (J.E. Dowding unpubl. data).

The fledging period is normally 40–50 days, but is sometimes longer. Adults defend nests and chicks with distraction displays typical of other shorebird species (e.g. 'broken-wing') (Marchant & Higgins 1993), with some individuals undertaking vigorous (and often vocal) aerial attacks ('dive-bombing') (Dowding 2013).

Movements

Information on movements has been summarized by Marchant & Higgins (1993) and Dowding & Moore (2006). The species is non-migratory.

Many juveniles leave their natal site in autumn and join flocks, typically at nearby estuaries, but a few stay with parents on their natal territory for much of their first winter; these birds are normally evicted no later than early August. Flocks normally consist mainly of young, non-breeding birds, but some local breeding adults occasionally join them. Juvenile movements vary in extent, with some birds remaining at or near their natal site, and others dispersing widely. Birds banded as chicks around Dunedin were recorded as far away as Christchurch (*c*. 310 km) (P. Schweigman –pers. comm.), and birds banded as chicks at Kaikoura have been seen in the Nelson area (*c*. 135 km) and at Christchurch (*c*. 150 km) (Rowe 2011). One bird from Tasman Bay moved to Dunedin (576 km) (Melville *et al*. in press).

In North Auckland, some birds bred at their natal site, while others dispersed up to 105 km to breed (J.E. Dowding unpubl. data). Adults were generally sedentary; established pairs showed high breeding-site fidelity and many appeared to remain on or near their territories year-round. Pair-bonds were commonly long-term, with one pair breeding together for at least 12 consecutive seasons, and another for 11 seasons.

Photos C, D & E. From top to bottom: A. Intermediate phase Variable Oystercatcher, plumage towards the pied end of the range. Wenderholm, North Auckland, New Zealand, September 2007. B. Typical intermediate phase Variable Oystercatcher. Wenderholm, North Auckland, New Zealand, September 2007. C. Intermediate phase Variable Oystercatcher, plumage towards the all-black end of the range. Wenderholm, North Auckland, New Zealand, September 2007 (photos: John Dowding).

Divorce was occasionally recorded, however (J.E. Dowding unpubl. data). Two examples of breeding dispersal, when established adults moved 21 km and 40 km respectively to new breeding sites, followed divorce and death of a mate respectively (Dowding & Moore 2006).

Moult

Published moult data are few, and are apparently limited to those shown in Marchant & Higgins (1993), which were based on examination of *c*. 30 museum specimens. These specimens indicated that adult primary moult is descendant, with 1–2 feathers active at a time. Secondary moult is ascendant, from two or three centres. Timing of moult was not clear, but specimens in active primary moult occurred from December to July (Marchant & Higgins 1993).

Data from North Auckland suggest that most breeding adults appear to start pre-basic moult between mid-January and late February, that 1–5 primaries may be in active moult at one time, and that moult may overlap with chick-rearing (and occasionally with incubation in the case of late clutches). Secondary moult typically starts when the primary moult score is in the range 25–30 (J.E. Dowding unpubl. data).

Population viability

There have been no large-scale demographic studies, but some data are available from a study at four unmanaged sites on the North Auckland east coast between 1994 and 2001 (J.E. Dowding unpubl. data). In that study, productivity averaged 0.51 chicks per pair per season. In a study at Kaikoura, productivity was similar at 0.47 chicks per pair per season (Rowe 2008). Productivity at managed sites is probably higher on average (Marchant & Higgins 1993). Some reports (e.g. Fleming 1990, Michaux 2013) have documented high productivity (in the order of 1.00 chick per pair), but the average at unmanaged sites is undoubtedly lower.

There are no published data on pre-breeding survival rates. There appears to be considerable variability in age of first breeding. Marchant & Higgins (1993) noted "Probably do not start pairing or breeding until third year". In the North Auckland study area, most birds did not breed until five or six years old (with one at eight years), although in some cases colour-banded birds formed pairs and held a territory for a season, before breeding in that territory the following year (J.E. Dowding unpubl. data). There is a record from the northern South Island of breeding by two birds at two years of age (Cook *et al*. 2007), but this is now thought to be atypical (D.S Melville pers. comm.).

In the North Auckland study area, annual adult survival of colour-banded birds averaged 0.95 (J.E. Dowding unpubl. data), and the oldest known bird (originally banded by A.J. Baker, re-banded by J.E. Dowding) reached 32 years.

Preliminary modelling of the North Auckland data suggests that r is strongly positive (*c*. +0.042), and the population has the potential to increase at about 4% per annum (J.E. Dowding unpubl. data). This local population may not be representative of the national population, but that rate of increase is broadly in line with the approximate doubling of the population seen between the early 1970s and the 1990s (Heather & Robertson 1996).

Photo F. Nest with two eggs of Variable Oystercatcher on the beach of Ulva Island, New Zealand, 30 January 2007 (photo: Bruno Ens).

HABITAT AND FOOD

The species is almost entirely coastal, although there are rare examples of pairs breeding on lake shores or riverbeds up to 30 km inland (Marchant & Higgins 1993, Heather & Robertson 1996). Most pairs breed on sandy beaches and sand spits, and are particularly concentrated around the mouths of streams, rivers and estuaries. In this type of habitat, densities at some North Island sites can be high. For example at Opoutere, Coromandel Peninsula, about 12–14 pairs nest on a 450 m sand spit, and at Omaha, North Auckland, 15–16 pairs nest on about 600 m of sand spit. Away from estuaries and river mouths pairs are more thinly spread along beaches, and densities are considerably lower. Nesting also occurs on shell banks, shingle beaches, rocky shores, and occasionally on bare earth, grass (including golf courses) or coastal pasture. Most nesting occurs in open habitat, with little or no vegetation and good all-round visibility, but on Stewart Island nests have been found among undergrowth in tall forest close to the shoreline (J.E. Dowding unpubl. data); a similar site has been found in Waimea Inlet (W. Cook pers. comm.). In the northern North Island, breeding territories commonly overlap with those of northern New Zealand dotterels *Charadrius obscurus aquilonius*. Flocks almost always occur at or near large tidal estuaries.

Food consists of a wide range of invertebrates, including molluscs (particularly bivalves), crustaceans (isopods, amphipods, and crabs) and worms. Occasionally, small fish are taken (Heather & Robertson 1996). One bird has been seen with a tunicate (D.S. Melville pers. comm.) and jellyfish are sometimes eaten (Melville 2013). Feeding occurs in a range of habitat types, including tidal estuaries, around stream and pond margins, on reefs and rocky shorelines over low water, along the tide-line and among tide wrack on beaches. Feeding sometimes also occurs on pasture, grassed areas (such as parks, golf courses and playing fields) and bare ground (such as ploughed fields) near the coast, particularly after rain, when earthworms are readily available. Details of prey species recorded and feeding techniques are given by Marchant & Higgins (1993).

Observations of colour-banded birds in North Auckland and Dunedin show that most birds feed locally, but occasionally off-duty breeding adults will make round trips of up to *c*. 20 km to feed at tidal estuaries over the low-tide period (J.E. Dowding unpubl. data, P. Schweigman pers. comm.).

DISTRIBUTION

Variable Oystercatchers are found around the North, South, and Stewart Islands and on many of their offshore islands (Checklist Committee 2010). They have not been recorded on any of the outlying island groups. About two-thirds of the population occur in the North Island (Heather & Robertson 1996), with the Northland–Auckland east coast and Coromandel Peninsula–Bay of Plenty regions being particular strongholds (Dowding & Moore 2006).

Distribution maps in Baker (1973a) show that the species was widely spread around the main islands at that time, but that there were areas of low or very low density on the North Island west coast from Kaipara Harbour to Manawatu, on the North Island east coast from East Cape to Wellington, on the South Island east coast from Marlborough to South Canterbury, and in northern areas of the South Island west coast. A comparison of maps in Baker (1973a) with those in the two bird atlases (Bull *et al*. 1985, Robertson *et al*. 2007) suggests there have been no major changes in distribution, although densities have increased in some regions that previously had sparse populations, e.g. the Canterbury coast. The Variable Oystercatcher is listed by Robertson *et al*. (2007) as a species that has increased (based on an increase in the number of squares occupied) since the earlier atlas was compiled.

POPULATION SIZE

There appear to be no early population estimates, and given the taxonomic confusion that prevailed, they would almost certainly be of doubtful value.

In the early 1970s, the total population was estimated to be about 2,000 birds (Baker 1973a). There was been a rapid increase subsequently, apparently throughout much of the range, and Heather and Robertson (1996) estimated that the population had doubled by the early-mid 1990s. Assuming the increase had continued at the same rate, Dowding & Moore (2006) estimated that the population had reached about 4,500 individuals. These authors also noted that because breeding is delayed, the population would be expected to include a significant proportion of non-breeding birds, and suggested it might contain about 2,000 breeding pairs. An estimate of 7,000 birds (Bell 2010) was based on density (birds/km of coastline) in the Marlborough Sounds and Wellington Harbour, and it is not clear whether densities in these regions (which together comprise about 10% of the national coastline) are representative; the latest Checklist indicates that both regions are strongholds for the species (Checklist Committee 2010). Until further data are available, a range of 4,500–5,000 individuals (Dowding 2013) appears to be an appropriate precautionary value.

The overall increase over the four decades since the 1970s has been reflected in local increases in a number of regions. Numbers increased in Whangarei Harbour until 2003, with some of the increase probably due to conservation management (targeted at other species, notably New Zealand Dotterel and New Zealand Fairy Tern *Sternula nereis davisae*) at nearby sites (Beauchamp & Parrish 2007); subsequently, numbers there have apparently declined (Ornithological Society of New Zealand annual shorebird counts unpubl. data). Small populations in the Manukau Harbour and Firth of Thames both increased between 1960 and 1998 (Veitch & Habraken 1999), and notably after 1990 (Battley & Brownell 2007). Numbers recorded in Wellington Harbour increased between the 1970s and 1980s, although part of the increase may have been due to better survey coverage (Robertson 1992). Numbers for Farewell Spit, Golden Bay and Tasman Bay increased from an average of 310 in the period 1983–2001 to 730 in the period 2002–2012 (Schuckard & Melville 2013). The species was considered rare on the South Island's Canterbury coast for most of the 20th century; since the late 1980s, however, numbers have increased rapidly at two wintering sites in the region (Avon-Heathcote estuary and Lyttelton Harbour) (Crossland 2001). Numbers at Washdyke Lagoon, Timaru, have increased since the mid-1960s; the increase began in the mid-1980s and has been pronounced since the mid-1990s (P.M. Sagar pers. comm.).

The sizes of some winter flocks have clearly increased in recent decades as the total population has increased. Baker (1973a) noted that flocks never exceeded 150 birds, but counts in the early 2000s showed that flocks of 200–400 were not uncommon at favoured estuaries (Dowding & Moore 2006).

While there have been ongoing increases in most regions, numbers in some northern North Island strongholds (e.g. the North Auckland east coast and Coromandel Peninsula) appear to have stabilized in the 2010s, possibly suggesting that carrying capacity was being approached in these areas.

DEMOGRAPHIC AND MECHANISTIC CAUSES OF POPULATION CHANGE

Like the South Island Oystercatcher, the Variable Oystercatcher was apparently declining in the early 20th century as a result of being shot for food (Heather & Robertson 1996). The species is long-lived, with delayed maturation and low reproductive output (Dowding & Murphy 2001), and maintaining high adult survival is therefore important if the population is not to decline. Legal protection from shooting in 1922 appears to have increased adult survival, and this is likely to have been the main driver behind the increase in population size in recent decades.

Increases in productivity at a growing number of managed sites in the past 20 years will also have assisted population growth; at these sites, which are mainly on the North Island east coast, management of other species (mainly New Zealand Dotterel and New Zealand Fairy Tern) includes control (or exclusion) of introduced mammalian predators, and reduction of disturbance caused by human activities. These measures benefit Variable Oystercatchers at these sites, and may result in high levels of productivity locally. Human activities in the coastal zone (such as clearance of vegetation from sand spits) may have increased the amount of breeding habitat available in a few areas (Dowding & Murphy 2001), but this has probably been a minor benefit.

CONSERVATION STATUS

The Variable Oystercatcher is ranked Least Concern by IUCN. While the population is not large, numbers are increasing, the population is not severely fragmented, and it does not suffer from extreme fluctuations. The species also has a relatively large range, with the EOO given as 73,500 km^2 by BirdLife International (2013). It is not clear how this figure was derived – the species is found around much of the coastline of the country, which has an area of about 269,000 km^2, so the EOO should be close to that figure. However, as has been noted for other strictly coastal species (e.g. Ens & Underhill 2014), the EOO is not a useful measure of range. In such cases, the AOO is undoubtedly more appropriate, and usually very much smaller than the EOO. New Zealand's coastline length is about 15,000 km; assuming that about 80% is occupied by VOCs (Robertson *et al*. 2007), and that the coastal strip occupied averages 0.5 km in width, the AOO for the Variable Oystercatcher is estimated at about 6,000 km^2. In the absence of decline, fragmentation, or fluctuations, this area is too large to trigger Vulnerable or Near Threatened status (IUCN 2001).

However, the population size of the Variable Oystercatcher remains relatively small, and this species is probably the second-rarest oystercatcher globally at species level. Under the New Zealand threat-ranking scheme, the Variable Oystercatcher is considered At Risk (Recovering A) (Robertson *et al*. 2013), a ranking roughly equivalent to the Near Threatened status of the IUCN. This ranking acknowledges that while the species is clearly recovering from a decline, it is still relatively uncommon; for inclusion in At Risk (Recovering A), a taxon must have a population of 1,000−5,000 mature individuals (Townsend *et al*. 2008).

THREATS

Threats to the species have been discussed by Marchant & Higgins (1993) and Dowding & Murphy (2001), but there have been no robust studies of the relative importance of the various threats.

Predation is thought to be the main threat at the present time. A range of introduced mammals and native birds prey on all life stages. The main introduced mammalian predators are probably hedgehogs *Erinaceus europaeus*, which eat eggs, dogs *Canis familiaris*, which chase and kill chicks, and cats *Felis catus* and mustelids *Mustela* spp. which eat eggs, chicks, and adults. The main avian predators are the native Southern Black-backed Gull *Larus dominicanus* and Swamp Harrier *Circus approximans*, which take eggs and chicks; both species have increased as a result of human occupation (Dowding & Murphy 2001). Groups of Red-billed Gulls *Larus novaehollandiae* have also been seen killing small chicks.

Nests of *H. unicolor* are commonly located near the high-water line, and are often lost to spring tides and storm-surge conditions. Nests and chicks may also be crushed by people, horses, stock and vehicles on beaches. Recreational use of beaches by people causes disturbance that can, if prolonged, result in eggs dying from thermal stress, or in chicks being separated from parents and thereby becoming more susceptible to predation, particularly by gulls.

Disease is not thought to be a significant threat at the population level, but avian pox lesions have been recorded on chicks at a number of widely-separated sites in the North Island (Mackereth 1992, S. Davy pers. comm., M. Ward, pers. comm., J.E. Dowding pers. obs.). Most of the affected individuals failed to fledge, but it was not clear whether the pox infection alone was responsible.

In a small number of cases, birds become entangled in discarded nylon fishing line and may experience amputation of toes or feet. During the *CV Rena* oil-spill in October 2011, one oiled Variable Oystercatcher was picked up dead, and many more were seen with oiled feet and feathers (J.E. Dowding pers. obs.).

In some areas, there is occasional natural loss of breeding habitat due to erosion of sand spits and beaches. There is also habitat loss and degradation caused by human activities in the coastal zone, in particular construction of housing estates and marinas. A large proportion of the Variable Oystercatcher population occurs on the east coast of the northern North Island, and this is also where a high proportion of the human population is located. Increasing construction and recreational activities in the coastal zone are inevitable, and are likely to lead to continuing loss and degradation of habitat and reduced breeding success.

Mechanical harvesting of shellfish has the potential to affect a range of shorebirds including both mainland species of oystercatcher (Schmechel 2001). At present, this activity does not appear to be widespread in New Zealand, but it has had a major impact on some European populations of *H. ostralegus* (e.g. Atkinson *et al*. 2003, Verhulst *et al*. 2004).

The predicted impacts of climate change on the New Zealand coastline include sea-level rise, with an increase in vulnerability of coastal areas to storm-surge conditions, spring tides, and erosion (Lundquist *et al*. 2011). There may also be an increase in salinization of estuarine systems (Kingsford & Watson 2011), which could lead to a reduction in availability of some shorebird prey species. With higher temperatures, increased growth of vegetation on beaches and sand spits is possible, and would reduce nesting and roosting habitat further, as well as providing increased cover for ground-based predators. These and related changes will potentially have a negative impact on many coastal-breeding species, including the Variable Oystercatcher; breeding, roosting and feeding habitat is likely to be lost or degraded, and productivity reduced through increased loss of nests and chicks to flooding and predation.

RECOMMENDATIONS FOR CONSERVATION RESEARCH

There appear to be no urgent research needs for conservation purposes, but a number of longer-term issues are apparent.

1. It would clearly be desirable to resolve definitively the relationships between all the Australasian oystercatchers, using larger samples than those of Banks & Paterson (2007). The conservation implications of any major differences from the currently accepted taxonomy could then be assessed.

2. Given that the Variable Oystercatcher is strictly coastal, and that human impacts in the coastal zone are increasing rapidly in New Zealand, long-term monitoring of density, survival and productivity (of this and other shorebird species) in relation to human activity is desirable at selected sites. The results from this monitoring should be used to inform planning processes for proposed coastal activities and development.

3. Assessing the potential impacts of climate change on all coastal-breeding species, including the Variable Oystercatcher, is clearly essential in the medium term. In this regard, an accurate, up-to-date population estimate would be useful, as it would provide baseline data against which to measure future changes in density, as well as informing the next review of the conservation status of the species..

RECOMMENDATIONS FOR MANAGEMENT

The species currently appears to be stable or increasing in most parts of its range without dedicated management. In addition, it must be noted that New Zealand has a disproportionately high number of threatened bird species and relatively few resources for their conservation management. The Variable Oystercatcher is therefore not a high priority for conservation action, and the reality is that the Department of Conservation and other government agencies will almost certainly not undertake management of the taxon in the foreseeable future.

However, experience has shown that the Variable Oystercatcher can be managed effectively by community groups. While no recovery or conservation plans have been written specifically for the taxon, the management protocol for New Zealand Dotterels (Dowding & Davis 2007) is also effective at increasing Variable Oystercatcher productivity. Multi-species management of coastal shorebirds is already undertaken by community groups in parts of New Zealand (e.g. Dowding 2006). Government agencies (notably the Department of Conservation) should continue to encourage such activities by provision of materials (predator-control tools, fencing, and signage), training programmes, and advice.

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APPENDIX 1. OVERVIEW OF RECENT STUDIES AND RESEARCH

There has been little work carried out on the species since the research undertaken in the late 1960s and early 1970s by Baker (1969, 1972, 1973a, 1973b, 1974). Small–scale colour-banding or flagging studies are currently being undertaken by:

J.E. Dowding (North Auckland)
W. Cook, D. Cooper, D.S. Melville (Nelson)
L. Rowe (Kaikoura)
P. Schweigman (Dunedin)

APPENDIX 2. LEGAL STATEMENT

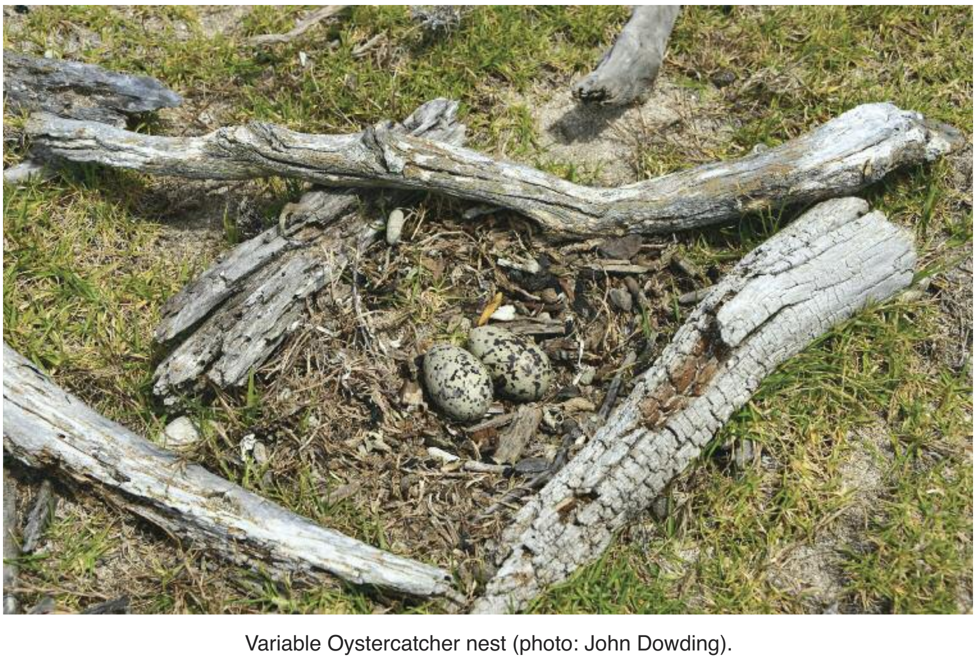
The species is absolutely protected under the Wildlife Act (1953). Under the Conservation Act (1987), the Department of Conservation has a statutory responsibility to protect and preserve New Zealand's natural resources, including species. Most of the breeding range of the species is not legally protected, but about 5–10% of the population breeds at sites that have some form of protection or status, either as reserves under the Reserves Act (1977), as designated Ramsar sites, or as Regional Parks administered by local government.

APPENDIX 3. KEY CONSERVATION SITES

Sites of international importance are defined as those that regularly hold 1% of the estimated total population (45 birds) or 1% of the estimated effective population (20 breeding pairs).

Table 9 of Sagar *et al*. (1999) listed 8 sites where >50 birds were recorded on average in winter during national wader counts, 1984–1994. Table 8 of Southey (2009) listed 17 sites where >50 birds were recorded on average in winter during these counts between 1995 and 2003. While the number of sites with >50 birds has undoubtedly increased, note that three of the sites included by Southey (2009) have only a single count (and may not have averaged >50 birds).

Table 2 of Dowding & Moore (2006) listed the top 10 wintering sites, all of which averaged >50 birds. In Appendix 2 of Dowding & Moore (2006), Table A2.1 listed 23 important breeding season sites, all of them important at the 1% level for breeding pairs, or total numbers, or both. Table A2.2 listed 39 important wintering sites; few counts are available from some of these sites, but most are known or thought to be important at the 1% level. As noted by Dowding & Moore (2006), there are almost certainly additional winter flock sites, significant at the 1% level, that have not been identified; these are likely to include sites in Kaipara Harbour and parts of the Fiordland coast.



Variable Oystercatcher nest (photo: John Dowding).