

Synthesis of oystercatcher conservation assessments: general lessons and recommendations

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This chapter synthesizes the information in the conservation assessments of the various oystercatcher species and subspecies. The Canary Island Oystercatcher *Haematopus meadewaldoi* went extinct in about 1940, leaving 11 surviving oystercatcher species. Between two and five subspecies are recognized for three species of oystercatcher, making a total of 18 surviving taxa (excluding *buturlini* as a separate subspecies of the Eurasian Oystercatcher).

The volume and quality of information available on the feeding ecology, life history, population size and trends, conservation status and threats, are highly variable between the various (sub)species. Whereas the nominate subspecies *ostralegus* of the Eurasian Oystercatcher *Haematopus ostralegus* is the best studied shorebird in the world, hardly any information is available on some other (sub)species.

All oystercatcher species are long-lived and dependent on coastal habitats during the non-breeding season. Many species and populations are coastal throughout the year, but some populations of some species move inland to breed. Oystercatchers breed on the open ground, making nests and chicks vulnerable to flooding, predation and destruction by human activities. 'Black' oystercatcher species are generally found on rocky shores, while 'pied' species are more often found on beaches, sandy shores, muddy coasts and estuaries.

The current IUCN Red List of Threatened Species (IUCN 2013) only addresses the conservation status of oystercatcher species, not subspecies or subpopulations. Many subspecies have disjunct geographical distributions, so that if the subspecies went extinct, the empty area would not be re-occupied quickly by another subspecies. Furthermore, some subspecies have small population sizes. Indeed, the Chatham Oystercatcher *Haematopus chathamensis* has been classified as 'Endangered' since 1994 because of its small population size. We suggest that the subspecies *galapagensis* of the American Oystercatcher *Haematopus palliatus* should be classified as 'Endangered' and the subspecies *frazari* of the American Oystercatcher as 'Vulnerable' because of their small population sizes. The subspecies *osculans* of the Eurasian Oystercatcher should be classified as 'Near Threatened'. IUCN may wish to consider revising the classification of the American Black Oystercatcher to 'Near Threatened' from 'Least Concern', but clear declines or fluctuations of population and distribution have not been demonstrated.

Coastal development and human activities in the coastal zone are the most important threat to oystercatcher species around the world under present conditions. Increasing human use of the coastal zone in combination with sea-level rise may well be the greatest threat in the future.

INTRODUCTION

This issue of *International Wader Studies* is dedicated to the conservation status of the oystercatcher species (and subspecies) around the world. The work on this issue was initiated during a workshop on the conservation status of oystercatchers around the world at the conference of the International Wader Study Group in La Rochelle, in September 2007. Abstracts of the talks were published in volume 114 (December 2007) of the Wader Study Group Bulletin and it was decided to publish complete conservation assessments for all species and subspecies in an issue of *International Wader Studies*. Whereas some assessments were finished within a year, it took much longer to finish other assessments and complete the issue. Thus, there is

considerable variation between assessments in the extent to which they are fully up to date.

The oystercatchers (Haematopodidae) form a distinct family within the order Charadriiformes, suborder Charadrii. They occur along most of the world's shorelines, in North and South America, Europe, Asia and Australasia; notable gaps are along the African shoreline between the equator and Angola in the west, and between the equator and Mozambique in the east, along most of the shoreline of southeastern Asia, and the Arctic coastline of northern Eurasia. Oystercatchers also occur inland in Eurasia, southern South America and New Zealand. The species in this family occur predominantly in the southern hemisphere: two of the nine species breed only in the northern hemisphere, one in both, and six only in the southern hemisphere.

We organized the workshop because we were under the impression that in many different areas, oystercatcher populations were in decline due to conflicts with human activities, either because they compete for the same prey, like shellfish, or because they use the same habitat, like sandy beaches. For one species, conservation comes too late. The Canary Islands Oystercatcher *Haematopus meadewaldoi* was officially declared extinct by the IUCN in 1994, after having been listed as “Threatened” in 1988 (IUCN 2011). The decline of the species is thought to have resulted from overharvesting of intertidal invertebrates and disturbance by people (Hockey 1987). Predation by rats and cats may also have played a role (Collar & Stuart 1985). What is the likelihood that other oystercatcher species face a similar fate?

The workshop had three major objectives:

1. To review the population status and demographic trends for all (sub)species.
2. To review the threats faced by each (sub)species.
3. To provide recommendations for management and research.

Such recommendations will only contribute to the successful conservation of oystercatcher (sub)species if they are made public and easily accessible. This we hope to achieve via publication in this issue of *International Wader Studies*.

Conservation is also aided if it is possible to draw general lessons on the conservation of oystercatchers from the individual conservation assessments. In this overview we investigate if there are any such general lessons to be learnt.

There is a wide disparity between oystercatcher species in the extent to which they have been studied. While the nominate subspecies of the Eurasian Oystercatcher *Haematopus ostralegus ostralegus* is the best studied wader in the world (I. MacLean pers. comm.), some of the other species have hardly been studied at all, and in fact there is much less information available about the other subspecies of the Eurasian Oystercatcher. Thus, we will also search for characteristics and findings in well-studied species that may be relatively safely extrapolated to the less well-studied species and in this way help the conservation efforts targeted to these species.

TAXONOMY

There is scientific debate about the taxonomic status of some of the oystercatcher species and subspecies (Hockey 1996). In this review we follow the choices of the experts that wrote the individual accounts and recognize nine monotypic species (African Black, American Black, Australian Pied, Blackish, Canary Island, Chatham Island, Magellanic, South Island Pied and Variable Oystercatcher) and three polytypic species (American, Eurasian and Sooty Oystercatcher; see Table 1 for subspecies). At the species level, this taxonomy conforms to the taxonomy adopted by the IUCN in their Red List of Threatened Species (IUCN 2013). With regard to the subspecies of the Eurasian Oystercatcher there is a difference of opinion between two contributions on the subspecies *longipes*. Sarychev & Mischenko (2014) assume that the southern breeding range of the subspecies *longipes* is

Table 1. Egg dimensions, incubation period and fledging period for different (sub)species of oystercatcher. Most data are from species accounts in this volume. Exceptions are American Black Oystercatcher (David Tessler, unpublished data) and American Oystercatcher (Canabarro & Fedrizzi 2010, Cortés Barrios 2004). A few measurements were taken from Hockey (1996), except a female body mass of 436 g that he reported for ssp. *longipes* of the Eurasian Oystercatcher, as this value seems way too low.

Species English name	Latin name	Egg length (mm)	Egg width (mm)	Egg mass (g)	Incubation period (days)	Fledging period (days)	Calculated egg volume (cm ³)	Female body mass (g)
African Black Oystercatcher	<i>H. moquini</i>	61.6	42.0	58.0	32.0	40.0	53.2	701
American Black Oystercatcher	<i>H. bachmani</i>	56.0	38.9	44.9	27.0	39.0	41.4	619
American Oystercatcher ssp. <i>palliatu</i> s	<i>H. p. palliatu</i> s	56.3	39.7	49.3			43.4	638
American Oystercatcher ssp. <i>dumfordi</i>	<i>H. p. dumfordi</i>							
American Oystercatcher ssp. <i>pitanay</i>	<i>H. p. pitanay</i>	55.8	38.1		28.0	35-40	39.6	
American Oystercatcher ssp. <i>galapagensis</i>	<i>H. p. galapagensis</i>							
American Oystercatcher ssp. <i>frazari</i>	<i>H. p. frazari</i>							
Australian Pied Oystercatcher	<i>H. longirostris</i>	59.0	41.0	53.7	29.0	52.0	48.5	703
Blackish Oystercatcher	<i>H. ater</i>	63.0	42.5	54.7			55.5	643
Chatham Island Oystercatcher	<i>H. chathamensis</i>	56.9	40.5	46.0	29.0	48.0	45.6	640
Eurasian Oystercatcher ssp. <i>longipes</i>	<i>H. o. longipes</i>	54.7	39.1			30.0	40.9	
Eurasian Oystercatcher ssp. <i>osculans</i>	<i>H. o. osculans</i>	56.7	39.3	47.5	24.0		42.8	518
Eurasian Oystercatcher ssp. <i>ostralegus</i>	<i>H. o. ostralegus</i>	55.5	39.6	45.4	28.0	35.0	42.6	531
Magellanic Oystercatcher	<i>H. leucopodus</i>	54.8	39.6	50.8	25.0		42.0	632
Sooty Oystercatcher ssp. <i>fuliginosus</i>	<i>H. f. fuliginosus</i>	64.2	43.4	63.2			59.4	827
Sooty Oystercatcher ssp. <i>ophthalmicus</i>	<i>H. f. ophthalmicus</i>							653
South Island Pied Oystercatcher	<i>H. finschi</i>	56.0	38.6	44.2	28.0	35.0	40.8	545
Variable Oystercatcher	<i>H. unicolor</i>	59.6	40.5		28.4	46.0	47.8	751

actually occupied by a different subspecies *buturlini*. In contrast, van Roomen *et al.* (2014) follow Delany & Scott (2006) and do not distinguish between *buturlini* and *longipes* and assume it is a single subspecies. In this synthesis chapter, we include *buturlini* as part of *longipes*.

Remarkably, whereas for many species the IUCN Red List provides information on subspecies or even subpopulations, in the case of oystercatchers information is provided only at the level of the species. Yet, as is clear from the various assessments, conservation efforts should be directed to subspecies at the very least.

GENERAL BIOLOGY

A considerable number of characters are shared by all oystercatcher species. As a result, it is not difficult to recognize an oystercatcher in the field as an oystercatcher, irrespective of species. These characters that are common to all oystercatcher species (Hockey 1996) are described below.

The key diagnostic feature of an oystercatcher is its bill. All oystercatchers have a long sturdy bill which is orange to red in adults, but partly or wholly brown in immatures and juveniles. Plumage varies between all black to pied (black and white) between species; in one species there are black and pied morphs. The iris is bright red (Palearctic) or bright yellow (Nearctic) in adult birds, but brownish in immatures and juveniles. Adults have an orange (sometimes yellow) eye-ring. The feet and legs are pink in adults, but greyer in immatures and juveniles.

The most common prey of Oystercatchers are shellfish and worms. The length of their bill aids in extracting worms from the substrate. A unique feature of Oystercatchers is that they do not swallow shellfish prey whole, as other birds feeding on shellfish do, but instead use their bill to open the shellfish via stabbing or hammering and subsequently extract the flesh. Outside the breeding season, Oystercatchers often aggregate in intertidal areas where shellfish are abundant.

Oystercatchers are relatively large, conspicuous and noisy birds. They inhabit open, generally coastal habitats, but especially during the breeding season, the birds can also be found inland. During the breeding season, they are highly territorial and social monogamy is the rule. Both partners defend the territory and share parental duties (incubation, nest and brood defence and chick feeding) more or less equally. Chick

feeding makes the semi-precocial oystercatchers special among waders, because the majority of the species are precocial and do not feed their chicks. The extreme territoriality during the breeding season may be linked to this particular feature of the biology of these birds; the best territories are those where the birds can nest safely as well as find adequate food for their chicks. Oystercatchers transport single prey items to the chicks, which is not efficient. Ideally, the parent birds can take the chicks with them on their foraging trips. Good territories are probably scarce.

Oystercatchers are generally single-brooded, but nest losses are often high, despite vigorous defence against predators. The habit of breeding on the ground in the open makes the nest vulnerable both to predators and to flooding. Following nest loss, one or more repeat clutches may be laid. Whereas most members of the Charadriiformes typically lay four eggs, the average clutch size reported for the various species of oystercatcher varies between 1.7 and 3.4. Egg loss can be very high during egg laying (Verboven *et al.* 2001), possibly due to mate guarding (Ens 1991), leading to a reduced clutch size. Thus, a clutch size of less than four eggs can also be due to the loss of one or more eggs during laying. However, this seems an unlikely explanation for the reduced clutch size in species in which clutch sizes above two are never reported. Depending on the circumstances oystercatchers will initiate one or more repeat clutches after clutch loss, but the raising of a second brood in a single breeding season occurs only exceptionally, if at all.

There is sexual dimorphism with females being on average larger than males and with females having longer, but often more slender, bills compared to males. These differences in bill morphology can be linked to diet differences between the sexes.

Oystercatchers are long-lived and spend several years as nonbreeders before recruiting into the breeding population. They take on average three years to become fully adult, and it is only then that they start competing for a breeding territory. The number of years between entering this competition and successful recruitment is variable.

LIFE HISTORY AND DEMOGRAPHY

As in other birds, oystercatchers start their life in an egg. For Eurasian Oystercatcher eggs, volume (V in cm^3) can be calculated from egg length (L in cm) and egg width (W in

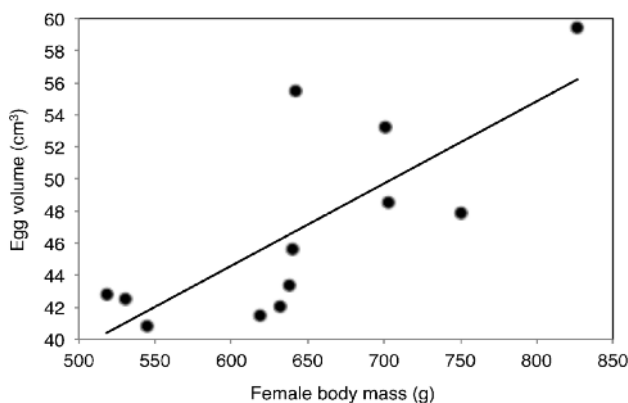


Figure 1. The relationship between egg volume estimated from egg dimensions (V , in cm^3) and female body mass (M , in g) for different oystercatcher species: $V = 0.0512M + 13.84$, $r=0.76$, $N=12$. Data from Table 1.

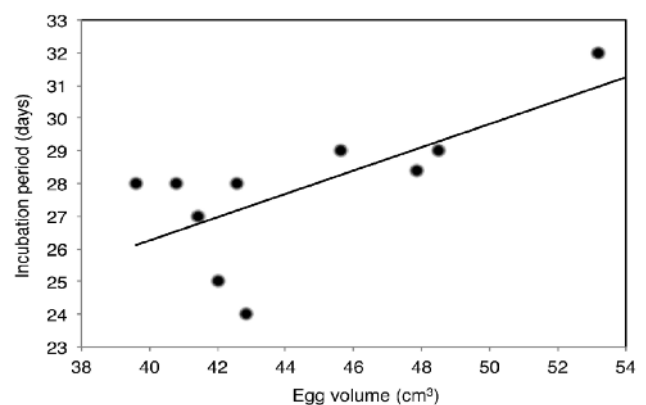


Figure 2. The relationship between incubation period (P , in days) and egg volume (V , in cm^3) estimated from egg dimensions for different oystercatcher species: $P = 0.357V + 11.99$, $r=0.69$, $N=10$. Data from Table 1.

cm) with the formula $V=0.489L \times W^2$ (R. Strijkstra pers. comm.). We assume that egg shape does not vary between species, so that this relationship can also be used for other oystercatcher species. Egg volume and egg mass (which is less often reported, see Table 1) are closely correlated ($r=0.90$, $p<0.001$, $N=10$). In a major review of avian egg and body weights, it was found that birds belonging to the Charadriiformes had large egg weight relative to body weight (Rahn *et al.* 1975). For this group egg weight (E, in g) was related to body weight (B, in g) as follows $E=0.61B^{0.73}$. Egg weights calculated in this way are on average 30–50% higher than the weights reported in Table 1, suggesting that oystercatchers lay relatively small eggs compared to other waders of the same mass.

Species where the females are large lay bigger eggs (Figure 1). The incubation period for species with large eggs tends to be longer (Figure 2), thus extending the period over which the nest is at risk from predation or flooding.

Data on demographic rates are summarized in Table 2. Oystercatchers are long-lived and in most species adult survival exceeds 90%. Long-lived species generally have low fertility rates and deferred maturity (Saether *et al.* 1996, Saether *et al.* 2005, Saether & Bakke 2000) and this is also

the case for those oystercatcher species for which this information is available. So far, there are no records of an oystercatcher breeding at one year of age and few records of oystercatchers breeding in their second year. Comparing species, the average age of first breeding varies between 3.6 and 6.9 years and the record is held by an Eurasian Oystercatcher which took 16 years to acquire a territory. Nonetheless, it is quite possible that average age of first breeding is underestimated in some studies, because censoring of data (Bressers *et al.* 1991) was not, or could not, be taken into account. Especially in studies with short duration, the birds with a large age of first breeding will not have settled before the study ended. Conversely, if birds of known age regularly first breed outside the study area without being noticed, before settling in the study area, this may lead to an overestimation of the age of first breeding. However, the high site fidelity of adult oystercatchers makes this unlikely.

Data on survival of juveniles (birds in their first year of life) and immatures (birds in their second year of life) are only available for three species; in those species annual survival of juveniles is much lower than annual survival of immatures, which in turn is lower than the annual survival of adults. Probably, it takes young birds several years before

Table 2. Data on demographic rates for different species of Oystercatchers. Data are from the species accounts in this volume, except for data on American Oystercatcher ssp. *palliates* (Ted Simons, pers. comm.) and ssp. *pitanay* (Cortés Barrios 2004) and Sooty Oystercatcher ssp. *ophthalmicus* (Birgita Hansen, pers. comm.). Juvenile survival is measured over the first year of life. When age of first breeding refers to the modal age, this is indicated via italics. Generation time is estimated using the formula $\alpha + [s/(1-s)]$, where α is the age at maturity (here taken as the average age at first breeding) and s is the expected adult survival rate (Lande *et al.* 2003).

Species / subspecies	Juvenile survival (%)	Immature survival (%)	Survival non-breeders (%)	Adult survival (%)	Range age at first breeding	Average age at first breeding (years)	Estimated generation time (years)	Average clutch size	Hatching success (%)	Fledging production (fledglings/pair)
African Black Oystercatcher	60	80		96	3-10	6.0	30	1.8	32	0.37
American Black Oystercatcher				87		5.0	12	2.4	33	0.43
American Oystercatcher ssp. <i>palliates</i>				89	3-5	3.6	12	2.3	31	0.32
American Oystercatcher ssp. <i>durnfordi</i>										
American Oystercatcher ssp. <i>pitanay</i>								2.4	49	
American Oystercatcher ssp. <i>galapagensis</i>										
American Oystercatcher ssp. <i>frazari</i>										
Australian Pied Oystercatcher				97		6.9	39	2.9	42	0.34
Blackish Oystercatcher								2.0		
Chatham Island Oystercatcher	80		92	96%	2-6	4.0	28	2.2	23	0.40
Eurasian Oystercatcher ssp. <i>longipes</i>								3.4		
Eurasian Oystercatcher ssp. <i>osculans</i>								3.0	24	
Eurasian Oystercatcher ssp. <i>ostralegus</i>	50	80	90	90%	3-16	6.5	15.5	2.8	51	0.33
Magellanic Oystercatcher								1.7		
Sooty Oystercatcher ssp. <i>fuliginosus</i>								2.0		0.90
Sooty Oystercatcher ssp. <i>ophthalmicus</i>								1.8	51	
South Island Pied Oystercatcher				89%	4-6	5.0	13	2.3	47	0.48
Variable Oystercatcher				95%	2-8	5.5	25	2.4		0.49

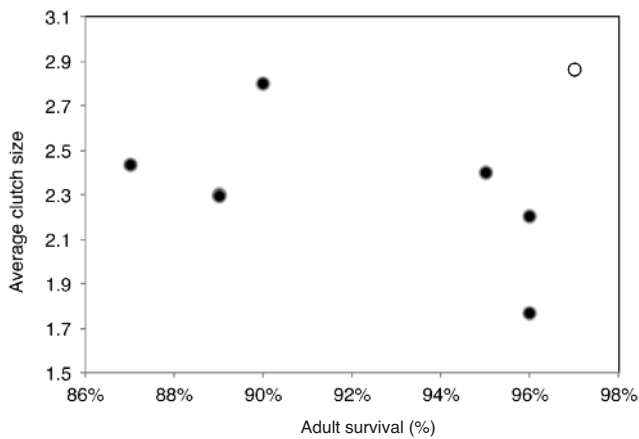


Figure 3. The relationship between clutch size and adults survival comparing oystercatcher species; $r=-0.14$, $p=0.82$, $N=8$. The open dot refers to the Australian Pied Oystercatcher. Data from Table 2.

they are sufficiently proficient in foraging and competing for food, which are necessary skills for survival. Only then can they start competing for breeding territories and mates. The young birds of migratory populations stay on their non-breeding grounds during the first few summers. The young birds of resident populations move to areas suitable for feeding that are not occupied by territorial birds. For resident species breeding along the coast, such “nonbreeder” areas may be far removed from the breeding area (Hockey *et al.* 2003).

For a considerable number of oystercatcher species we lack information on demographic rates. However, it seems likely that these will fall in the range reported for the better studied species. In the absence of any other information, this seems the best guess in case one is asked to develop a conservation plan for a poorly studied oystercatcher species. Can we improve on this guess? The parameter that can be measured most easily and is consequently widely recorded is the average clutch size. We would expect shorter-lived species to be more productive, i.e. we expect that clutch size decreases with adult survival, in which case we could use clutch size to arrive at a crude first estimate of adult survival. The available data do not indicate a very strong relationship (Figure 3), but this could be due to some estimates of adult survival being based on small sample sizes and therefore being unreliable. The estimate of 97% survival for the Australian Pied Oystercatcher is based on the observation that 12 out of 16 birds were still alive after 10 years (Taylor *et al.* 2014). Without this data point, the relationship improves, but remains statistically non-significant ($R^2=0.30$, $p=0.17$, $n=7$). Several studies have been published on adult survival in the subspecies *ostralegus* of the Eurasian Oystercatcher and these studies show that adult survival varies depending on the severity of the winter and/or feeding conditions (Atkinson *et al.* 2003, Camphuysen *et al.* 1996, Durell *et al.* 2001, Duriez *et al.* 2009, Goss-Custard *et al.* 1996b, Safriel *et al.* 1984, van de Pol *et al.* 2010b). In fact, the variability is not the only problem. The cited studies show that the distribution of annual survival is strongly left skewed, indicating that rare (e.g. cold) years with extreme low survival during winter have a disproportionate influence on the mean annual survival, meaning that one needs many years to reliably estimate mean annual survival.

Population dynamics depend on the generation time of species (Saether *et al.* 2005) and therefore IUCN assessment

criteria for conservation status compare any temporal decline in numbers to the generation time of that species (IUCN Standards and Petitions Subcommittee 2010). In the absence of detailed data on the average age of mothers in a population, generation time can be estimated using the formula $\alpha + [s/(1-s)]$, where α is the age at maturity (here taken as the average age at first breeding) and s is the expected adult survival rate (Lande *et al.* 2003). We can estimate generation time for eight species (Table 2). It varies between 12 years for the American Black Oystercatcher and the American Oystercatcher up to 39 years for the Australian Pied Oystercatcher. The most important contribution to this high generation time is due to the estimate for adult survival of 97% for this species, which is based on a small sample size as noted before.

Generally, we do not know which of predation, starvation, disease, weather, poisoning, hunting or traffic kills is the most important cause of death for full-grown oystercatchers. Full-grown oystercatchers can be killed by birds of prey such as Peregrine Falcon *Falco peregrinus*, native mammalian predators such as the Red Fox *Vulpes vulpes* and introduced mammalian predators such as feral cats *Felis catus*. Nonetheless, the general impression is that full-grown oystercatchers rarely fall victim to predators. The same more or less applies to the other causes of death. Sometimes, we do know the major cause of death. In rare severe winters, many Eurasian Oystercatchers die of starvation and many get hunted while searching for non-frozen mudflats (Goss-Custard *et al.* 1996b). Similarly, high mortality was reported for Eurasian Oystercatchers in a few years when their food stocks were overfished (Atkinson *et al.* 2003), implying the birds died of starvation. These incidents seem the exception rather than the rule.

Perhaps we should not be surprised that we know so little about the actual cause of death of full-grown oystercatchers, because (1) mortality causes interact, and (2) adult birds are very good at staying alive, making mortality a rare event. This is not the case for eggs and chicks. The probability that a nest will hatch varies between 23% and 51%, but we doubt whether this variation represents clear interspecific differences. In the Eurasian Oystercatcher estimates of hatching success were found to vary between 5% and 95% when all studies between 1930 and 1992 were reviewed (Goss-Custard *et al.* 1996a). The chicks are also vulnerable. On the basis of the data on clutch size, hatching success and fledgling production in Table 2, it can be roughly estimated that the probability that a hatchling will turn into a fledgling ranges between 23% and 79%, with most values between 28% and 54%, but again it is doubtful whether this variation truly represents interspecific differences. In the previously mentioned intraspecific review, estimates of fledging success were as variable as estimates of hatching success, ranging from 0% to 95% in the Eurasian Oystercatcher (Goss-Custard *et al.* 1996a). We tentatively conclude that losses of nests and chicks are generally high and probably of the same order of magnitude for all species. There may well be consistent differences between species, but assessment of these interspecific differences requires good estimates of the variability within a species. Such estimates are currently lacking for most species.

The reason that losses of eggs and chicks are high is almost certainly related to the fact that the birds nest on the ground in open habitat. The eggs and chicks are camouflaged, but the nest itself is nothing more than a shallow depression on the ground, which is soon abandoned by the

chicks after hatching. Both male and female aggressively attack and chase potential predators and warn the chicks of imminent danger, so they can seek a hiding place. Nonetheless, predation is considered a major cause of nest loss in nearly all studied populations (Table 3). Similarly, it is also a major cause of death for chicks. In populations breeding close to the shoreline, many nests are also lost to flooding. One reason that the birds nest in such dangerous places is that the closer they breed to the shore, the closer they are to the food with which they can feed the chicks, and the higher their breeding success (van de Pol *et al.* 2010a). Another reason may be that the risk of predation is lower close to the shoreline. The importance of trampling by livestock and people, and crushing by vehicles, varies greatly between species, depending on the presence of livestock, people and vehicles. Not a single conservation assessment considers chick starvation a major cause of loss, yet, in the Eurasian Oystercatcher, the primary difference between high quality territories and poor quality territories is related to the ease with which the parents can bring food to the chicks and later take the chicks to the food (Ens *et al.* 1992). Many studies in different oystercatcher species attest to competition among siblings for the food provisioned by the parent, leading to growth retardations and decreased survival in the subdominant sibling (Groves 1984, Heg & van der Velde

2001, Safriel 1981, Tjorve & Underhill 2009). Malnourished chicks may be more prone to predation (Safriel 1981). It is possible that the importance of food shortage is underappreciated, because starvation is hard to detect when predation rates are high and most chicks which died of starvation are not found.

Average clutch size varies between 1.7 and 3.0, which is below the usual clutch size of 4 eggs of most wader species. Almost certainly this is linked to the oystercatchers' habit of feeding their chicks, which limits the production of fledglings. Oystercatcher pairs that raise a single fledgling do well and pairs raising more than a single fledgling do very well. If high predation rates on eggs and chicks were the only problem for the birds, they should lay 4 eggs, the maximum clutch size that can be properly incubated (Heg & Van Treuren 1998). However, typically the parents cannot bring enough food to raise that many chicks. Despite the reduction in clutch size, sibling rivalry has been documented in several oystercatcher species (Groves 1984, Heg & van der Velde 2001, Safriel 1981, Tjorve & Underhill 2009). Probably, Eurasian Oystercatchers lay more eggs than they can raise chicks as insurance against unpredictable losses due to high predation rates on both nests and chicks (Heg & van der Velde 2001).

Table 3. The relative importance of different mortality causes of eggs and chicks for different oystercatcher species. Cause of loss on the basis of qualitative assessments made by researchers in the contributions to this volume: XXX = major, XX = minor, X = occasional, 0 = negligible, ? = unknown/uncertain.

Species / subspecies	Nest flooding	Nest trampling by livestock, people, vehicles	Nest predation	Nest disturbed/destroyed by agricultural activities	Chick starvation	Chick trampling by livestock, people, vehicles	Chick disease	Chick predation	Chick killed by agricultural activities
African Black Oystercatcher	XXX	X	XXX	0	X	X	?	XXX	0
American Black Oystercatcher	XXX	X	XXX	0	?	X	?	XXX	0
American Oystercatcher ssp. <i>palliatu</i> s	XXX	XX	XXX	0	X	X	?	XXX	0
American Oystercatcher ssp. <i>durnfordi</i>	?	?	?	?	?	?	?	?	?
American Oystercatcher ssp. <i>pitanay</i>	?	?	?	?	?	?	?	?	?
American Oystercatcher ssp. <i>galapagensis</i>	?	?	?	?	?	?	?	?	?
American Oystercatcher ssp. <i>frazari</i>	?	?	?	?	?	?	?	?	?
Australian Pied Oystercatcher	XXX	0	XXX	0	X	X?	0?	XXX	0
Blackish Oystercatcher	XXX?	X?	XXX?	0	?	X?	?	XX?	0
Chatham Island Oystercatcher	XXX	XX	XXX	0	0	XX	0	XX	0
Eurasian Oystercatcher ssp. <i>longipes</i>	XX	XX	XXX	0?	?	XX	?	XXX	0?
Eurasian Oystercatcher ssp. <i>osculans</i>	?	?	?	0?	?	?	?	?	0?
Eurasian Oystercatcher ssp. <i>ostralegus</i>	XXX	XX	XXX	XXX	XX	XX	X	XX	XXX
Magellanic Oystercatcher	?	?	?	0	?	?	?	?	0
Sooty Oystercatcher	XX?	XX?	XX	0?	?	XX?	?	?	0?
South Island Pied Oystercatcher	XX	XXX	XXX	X?	?	?	?	?	X?
Variable Oystercatcher	XXX	XX	XXX	0?	?	XX?	?	XXX	0?

Table 4. Summary of habitats occupied by different oystercatcher (sub)species during the non-breeding season and the breeding season. For the breeding season a distinction is made between the habitat of the breeders and the habitat of the non-breeders. The importance of a habitat is classified as follows on the basis of qualitative assessments made by researchers in the contributions to this volume: XXX = major habitat, XX = minor habitat, X = habitat used occasionally, 0 = habitat never used, ? = classification not certain. Also indicated the maximum densities reported. Maximum nesting densities are expressed as pairs per km² or as pairs per km shoreline.

Species / subspecies	Breeding season							Non-breeding season						Non-breeders during breeding season						Maximum nesting densities	Unit nesting density
	Rocky shores	Sandy shores and beaches	Muddy coast and estuaries	Inland freshwater wetlands	Inland river margins and lakes	Inland fields	Urban areas	Rocky shores	Sandy shores and beaches	Muddy coast and estuaries	Inland river margins	Inland fields	Urban areas	Rocky shores	Sandy shores and beaches	Muddy coast and estuaries	Inland river margins	Inland fields	Urban areas		
African Black Oystercatcher	XXX	XXX	XX	0	0	0	0	XXX	XXX	XX	0	0	0	XXX	XXX	XXX	0	0	0	?	pairs/km
African Black Oystercatcher	XXX	XX	XX	0	0	0	0	XXX	XX	XX	0	0	0	XXX	XX	XX	0	0	0	10	pairs/km
American Oystercatcher ssp. <i>palliatius</i>	X	XXX	XX	0	0	0	X	0	XX	XXX	0	0	0	X	XXX	XX	0	0	0	40	pairs/km
American Oystercatcher ssp. <i>dumfordi</i>	XX	XXX	XX	0	0	0	0	0	0	0	0	0	0	XX	XXX	0	0	0	0	?	
American Oystercatcher ssp. <i>pitanay</i>	0	XXX	0	0	0	0	X	0	0	0	0	0	0	0	XXX	0	0	0	X	?	
American Oystercatcher ssp. <i>galapagensis</i>	XXX	XX	0	0	0	0	0	0	0	0	0	0	0	XXX	XX	0	0	0	0	?	
American Oystercatcher ssp. <i>frazzari</i>	XX	XXX	0	0	0	0	X	0	0	0	0	0	0	XX	XXX	0	0	0	X	?	
Australian Pied Oystercatcher	0	XXX	XXX	0	0	0	0	0	0	XXX	0	X	0	0	XXX	XXX	0	X	0	?	
Blackish Oystercatcher	XXX	X	0?	0	0	0	0	XXX	X	X	0	0?	0	XXX?	X?	X?	0	0?	0	?	
Chatham Island Oystercatcher	XXX	XXX	0	0	0	X	0	XXX	XXX	0	0	X	0	XXX	XXX	0	0	XX	0	10	pairs/km
Eurasian Oystercatcher ssp. <i>longipes</i>	0	0	0	0	XXX	XX	0	?	XXX	XXX	?	0	0	0	0	XXX?	XX?	XX?	0	21	pairs/km ²
Eurasian Oystercatcher ssp. <i>osculans</i>	XXX	XXX	XXX	XX?	XX?	XX?	0	XXX	XXX	XXX	0	0	0	XXX	XXX	XXX	?	?	0	?	
Eurasian Oystercatcher ssp. <i>ostralegus</i>	XXX	XX	XXX	0	XX	XXX	XX	X	XXX	XXX	X	XX	0	XX	XX	XXX	?	XX	0	200	pairs/km ²
Magellanic Oystercatcher	XXX	XXX	XXX	XXX	XX	XX	0	XXX	XXX	XXX	0	0	0	XXX	XXX	XXX	0	0	0	?	
Sooty Oystercatcher	XXX	XXX	0?	0	0	0	0	XXX	XXX	XXX	0	0	0	XXX	XXX	XXX?	0	0	0	300	pairs/km ²
South Island Pied Oystercatcher	X	XXX	XXX	XX	XXX	XXX	0	X	XXX	XXX	X	XX	X	X	XXX	XXX	XXX	XXX	X	?	
Variable Oystercatcher	X	XXX	XXX	0	X	X	0	X	XXX	XXX	0?	X	0	X	XXX	XXX	0?	0	0	25	pairs/km

Table 5. Relative importance of different prey items taken by different oystercatcher species during the breeding season and the non-breeding season. Classification of importance in the diet on the basis of qualitative assessments made by researchers in the contributions to this volume: XXX = staple food, XX = regular food item, X = occasional food item, 0 = not taken, ? = not clear/uncertain.

Species / subspecies	Breeding season												Non-breeding season																	
	Marine bivalves	Marine snails	Limpets	Chitons	Cnidarians	Ascidians	Echinoderms	Marine worms	Marine crustaceans	Marine fish	Freshwater bivalves	Earthworms	Tipidil larvae	Terrestrial invertebrates	Marine bivalves	Marine snails	Limpets	Chitons	Cnidarians	Ascidians	Echinoderms	Marine worms	Marine crustaceans	Marine fish	Freshwater bivalves	Earthworms	Tipidil larvae	Terrestrial invertebrates		
African Black Oystercatcher	XXX	XXX	XXX	XX?	0?	0?	X?	0?	0	0	0	0	0	0	XXX	XXX	XXX	XX?	0?	X?	0?	X?	0?	X?	0?	0	0	0	0	0
African Black Oystercatcher	XXX	XX	XX	XX	0?	0?	0?	0?	0	0	0	0	0	0	XXX	XXX	XX	XX	0?	0?	0?	0?	0?	0?	0	0	0	0	0	0
American Oystercatcher ssp. <i>palliatu</i> s	XXX	0?	0?	0?	0?	0?	XX	XX	0?	0?	0?	0?	0?	0?	XXX	0?	0?	0?	0?	0?	0?	0?	XX	XX	0?	0?	0?	0?	0?	0?
American Oystercatcher ssp. <i>durnfordi</i>	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
American Oystercatcher ssp. <i>pitanay</i>	XXX	0?	0?	0?	0?	0?	XXX	XXX	0?	0?	0?	0?	0?	0?	XXX	0?	0?	0?	0?	0?	0?	0?	XXX	XXX	0?	0?	0?	0?	0?	0?
American Oystercatcher ssp. <i>galapagensis</i>	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
American Oystercatcher ssp. <i>franzari</i>	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Australian Pied Oystercatcher	XXX	XX	0	0	0?	0?	XX	XX	0	0	0	0	0	0	XXX	XX	0	0	0?	0?	0?	XX	XX	0	0	0	0	0	0	0
Blackish Oystercatcher	XXX	?	XXX	?	0?	0?	?	?	0	0	0	0	0	0	XXX	?	XXX	?	0?	0?	0?	0?	0?	?	0	0	0	0	0	0
Chatham Island Oystercatcher	XXX	X	X	X	0	X	XXX	XXX	X	0	0	X	0	0	XXX	?	XXX	?	?	?	?	?	XXX	XXX	?	?	?	?	?	?
Eurasian Oystercatcher ssp. <i>longipes</i>	XX	0	0	0	0	0	X	X	0	0	0	?	?	?	XXX?	?	?	?	?	?	?	?	XXX?	XXX?	?	?	?	?	?	?
Eurasian Oystercatcher ssp. <i>osculans</i>	XXX	XXX	?	?	?	?	XX	XXX	XX	XX	?	?	?	?	XXX	XXX	?	?	?	?	?	XX	XXX	XX	?	?	?	?	?	?
Eurasian Oystercatcher ssp. <i>ostralegus</i>	XXX	X	XX	0?	0	0	XXX	XX	0	0	0	XXX	XXX	XXX	XXX	X	X	0	0	0	0	X	0	0	0	0	0	0	0	0
Magellanic Oystercatcher	XXX	XXX	XXX	0	0	0	XXX	0?	0	0	0?	X?	?	?	XXX	XXX	XXX	X	0	0	0	XXX	?	?	?	?	?	?	?	?
Sooty Oystercatcher	XXX	XXX	XXX	XXX	0	XX	XX	XX	X?	0	0	0	0	0	XXX	XXX	XXX	XXX	0	XX	XX	XX	XX	XX	X	0	0	0	0	0
South Island Pied Oystercatcher	XXX	XXX	X	XX	X	0	XXX	XX	X	0	0	XXX	0	XXX	XXX	XXX	X	XX	X	0	0	0	XXX	XX	XX	0	XXX	0	XXX	XXX
Variable Oystercatcher	XXX	?	XX	XX	?	?	XXX	XXX	?	?	?	XX	?	X	XXX	?	XX	XX	?	?	?	?	XXX	XXX	?	?	?	?	?	?

HABITAT AND FOOD

During the non-breeding season, all oystercatcher species rely on coastal habitats as primary habitat: rocky shores, sandy shores and beaches, and muddy coasts and estuaries (Table 4). A few (pied) species sometimes use agricultural inland fields for supplementary feeding at this time of year. During the breeding season these inland fields can also be an important breeding habitat. This is true for two “pied” oystercatcher species: the subspecies *ostralegus* of the Eurasian Oystercatcher (van de Pol *et al.* 2014) and the South Island Pied Oystercatcher *Haematopus finschi* (Sagar & Veitch 2014), which both showed a considerable increase in number when agricultural practices increased the area of suitable fields. For the subspecies *longipes* of the Eurasian Oystercatcher (Sarychev & Mischenko 2014) and mainland populations of the Magellanic Oystercatcher *Haematopus leucopodus* (Escudero *et al.* 2014), natural inland areas, like freshwater wetlands and margins of rivers and lakes, are an important breeding habitat. For the majority of (sub)species, coastal habitats are the primary habitat for breeding. Whereas many “black” oystercatcher species are found on rocky shores, “pied” species are more often found on beaches, sandy shores, muddy coasts and estuaries.

Although oystercatchers can eat many different prey items, marine bivalves are a staple food for all oystercatcher species during the non-breeding season (Table 5). The importance of other prey species varies between species. For specific species, the following prey can be staple food: marine worms, limpets, chitons (Sooty Oystercatcher), marine crustaceans, earthworms (S Island Pied Oystercatcher) and other terrestrial invertebrates. During the breeding season, bivalves are also a staple food for all oystercatcher species. Interestingly, whereas most species feed on marine bivalves,

the inland breeding subspecies *longipes* of the Eurasian Oystercatcher feeds on freshwater bivalves. Other staple foods during breeding include marine snails, limpets, chitons (Sooty Oystercatcher), marine worms, marine crustaceans, earthworms, tipulid larvae (subspecies *ostralegus* of the Eurasian Oystercatcher) and other terrestrial invertebrates.

DISTRIBUTION AND MIGRATION

For the species studied in detail, natal philopatry, breeding site fidelity and mate fidelity are typically high (Table 6). The exceptions are the South Island Pied Oystercatcher and the American Black Oystercatcher, where it is considered possible (Sagar & Veitch 2014) resp. likely (Tessler *et al.* 2014) that natal philopatry is low. We therefore expect that most of the poorly studied species will also be characterized by high natal philopatry, high breeding site fidelity and high mate fidelity.

Many species of oystercatcher are sedentary, but other species are migratory, or consist of populations that migrate and populations that are sedentary. In general, populations breeding at high latitudes are migratory. For instance, American Black Oystercatchers in the northern part of their range are mostly migratory, whereas they are largely sedentary in the southern part of their range (Tessler *et al.* 2014). Also, inland breeding populations move to the coast in all species.

There is no evidence that in migratory populations, the parents travel as a family with their young to the wintering grounds, as happens in geese. The available evidence indicates that male, female and young travel independently and do not maintain social bonds during migration and wintering (Hulscher *et al.* 1996).

Table 6. Information on fidelity to natal area, breeding site and mate, as well as migratory behaviour and fidelity to the wintering site for different oystercatcher (sub)species. Based on species accounts in this volume.

Species / subspecies	Natal philopatry	Breeding site fidelity	Mate fidelity	Migration of adults	Migration of juveniles	Winter site fidelity
African Black Oystercatcher				sedentary	migratory	
American Black Oystercatcher	low	92%	95%	partial	partial	
American Oystercatcher ssp. <i>palliatu</i> s	high	high	high	partial	partial	moderate
American Oystercatcher ssp. <i>durnfordi</i>				sedentary		
American Oystercatcher ssp. <i>pitanay</i>				sedentary		
American Oystercatcher ssp. <i>galapagensis</i>				sedentary		
American Oystercatcher ssp. <i>frazari</i>				sedentary		
Australian Pied Oystercatcher	high	high	high	sedentary	dispersal	high
Blackish Oystercatcher		high?	high?	partial		
Chatham Island Oystercatcher	high	high	high	sedentary	partial	
Eurasian Oystercatcher ssp. <i>longipes</i>				migratory	migratory	
Eurasian Oystercatcher ssp. <i>osculans</i>				migratory	migratory	
Eurasian Oystercatcher ssp. <i>ostralegus</i>	high	high	high	partial	migratory	high
Magellanic Oystercatcher				partial	migratory	high?
Sooty Oystercatcher ssp. <i>fuliginosus</i>		high	high	sedentary	dispersal	
Sooty Oystercatcher ssp. <i>ophthalmicus</i>				sedentary		
South Island Pied Oystercatcher	low?	high	high	migratory	migratory	high
Variable Oystercatcher	moderate	high	high	sedentary	partial	

For migratory populations fidelity of individuals to their wintering site is high, except for the American Oystercatcher, where it is considered moderate (Clay *et al.* 2014). In the absence of information, it seems logical to assume that the poorly studied species will also be characterized by high fidelity to the wintering site.

Young birds of migratory populations must find a good place to spend the winter. How they do this is unknown, but for Eurasian Oystercatchers it has been documented that the greater tendency of young birds to move around, instead of returning to a traditional wintering site, puts them in a good position to discover areas that have suddenly improved in quality (Sutherland 1982).

Of course, young birds of sedentary populations must also find a good place to spend the winter. They cannot stay in the territory of their parents, necessitating post-fledging dispersal. Variable Oystercatchers usually leave the natal territory in autumn and join flocks in nearby estuaries, but some juveniles stay with parents on their natal territory for much of their first winter (Dowding 2014). In the case of the Sooty Oystercatcher, distances of up to 120 km have been recorded (Hansen *et al.* 2014). In the African Black Oystercatcher, the “nonbreeder” areas are hundreds of kilometers away from the breeding grounds, requiring a long journey by the young birds (Underhill *et al.* 2014). For that species there is no doubt that we should classify this journey as migration. Irrespective of our precise classification, it is clear that the areas where the young birds spend the first winter (and the summers that they abstain from territorial strife, i.e. where they learn how to survive), are very important to the future population. Thus, they deserve good protection. Yet, these areas are often unknown, or their importance may not always be sufficiently realized.

POPULATION SIZE AND TRENDS

Table 7 presents data on population size and trends of the various subspecies. By far the rarest species is the Chatham Island Oystercatcher with a current population size of only a few hundred animals. The subspecies *galapagensis* of the American Oystercatcher is similarly rare. The most abundant species is the Eurasian Oystercatcher with a population size numbering hundreds of thousands of birds, almost a million, nearly all belonging to the subspecies *ostralegus*. The next most abundant species is the South Island Pied Oystercatcher with an estimated population size exceeding 100,000 birds. These two most abundant species witnessed a considerable increase in numbers during the previous century, when changes in agricultural practices increased the area and quality of inland fields suitable for breeding. The earliest quantitative estimates for these two species, dating from the 1970s and the 1980s, may well have been too low, but there is little doubt that their populations increased until recently, and that the increase was considerable. The oystercatcher subspecies that are strictly coastal during the breeding season have population sizes that do not exceed 20,000 and generally vary between 3,000 and 15,000. It appears that the length of the coastline determines the extent of suitable habitat and thus the size of the population in these subspecies.

The majority of populations are thought to be more or less stable, but more often than not, no good data are available to back up this impression. A few populations are increasing. This includes the African Black Oystercatcher *Haematopus moquini*, where improved protection, a ban on the driving of off-road vehicles on the shoreline, and an increase in food supply brought about by the spread of the invasive alien mussel species *Mytilus galloprovincialis* more

Table 7. Estimates of population size of the various oystercatcher subspecies. Indicated is most recent estimate and the earliest account, if available. Also indicated is the most recent population trend. Source: (sub)species chapters in this volume.

Species / subspecies	First population estimate	Period first population estimate	Most recent population size	Period most recent population estimate	Most recent population trend
African Black Oystercatcher	4,591	1979-1980	6,670	1997-2003	increasing
American Black Oystercatcher	7,600	1994	10,000	2012	stable?
American Oystercatcher ssp. <i>palliatas</i>			20,266	1980-2009	possibly increasing
American Oystercatcher ssp. <i>durnfordi</i>			12,500	2001-2007	
American Oystercatcher ssp. <i>pitanay</i>			12,500	2001-2007	
American Oystercatcher ssp. <i>galapagensis</i>			300	1973-2007	
American Oystercatcher ssp. <i>frazari</i>			1,000	2001-2009	
Australian Pied Oystercatcher	11,000	1981-1985	12,000-14,000	1981-1995	stable?
Blackish Oystercatcher			12,000-24,000	1983-1992	stable?
Chatham Island Oystercatcher	50	1970	309	2010	stable
Eurasian Oystercatcher ssp. <i>longipes</i>			27,000	1990-2012	stable?
Eurasian Oystercatcher ssp. <i>osculans</i>			11,000	2013	decreasing?
Eurasian Oystercatcher ssp. <i>ostralegus</i>	214,000-291,000	1980	817,390	1990-2006	decreasing
Magellanic Oystercatcher			46,000-139,000	2006	stable?
Sooty Oystercatcher ssp. <i>fuliginosus</i>			4,000	1993	stable?
Sooty Oystercatcher ssp. <i>ophthalmicus</i>	1,000	1993	7,500	2006	stable?
South Island Pied Oystercatcher	49,000	1970-1971	112,675	1983-1994	stable?
Variable Oystercatcher	2,000	1973	4,500	2006	increasing

than offset the loss of habitat due to rapid urban development (Underhill *et al.* 2014). Numbers of Variable Oystercatchers *Haematopus unicolor* are recovering from previous declines, due to legal protection from shooting and local predator control (Dowding 2014). It is believed, but not certain, that the populations of the subspecies *palliatu*s of the American Oystercatcher (Clay *et al.* 2014) and the subspecies *longipes* of the Eurasian Oystercatcher (Sarychev & Mischenko 2014) are increasing.

It is suggested that the eastern subspecies *osculans* of the Eurasian Oystercatcher is currently declining due to the rapid economic development in Asia leading to large-scale degradation of many preferred wintering areas as a result of

reclamation (Melville *et al.* 2014). The western subspecies *ostralegus* of the Eurasian Oystercatcher is the only population that is declining with certainty (van de Pol *et al.* 2014). The reasons for this decline are manifold, including deterioration of the quality of wintering habitat and changes in agricultural practices. Also, the strength of the decline varies in different parts of its range. On Iceland, the species is even increasing (Jóhannsson & Guðjónsdóttir 2009).

CONSERVATION STATUS

Numbers and trends are an important component of the

Table 8. Information for each subspecies on population size, trend and 1% criterion from *Waterbird Population Estimates* (fifth edition, Wetlands International 2014). Also indicated the most recent classification according to the IUCN Red List of Threatened Species (IUCN 2013).

Species / subspecies	Waterbird Population Estimates 19 January 2014				Assessment	IUCN Red List	Assessment
	Area	Population size	Trend	1% crit.	Suggested 1% crit.	Listing	Suggested listing
African Black Oystercatcher	SE Africa	5,000- 6,000	increasing	55	67	Near Threatened	
Black Oystercatcher	Pacific N America	10,000	stable	100	100	Least Concern	Vulnerable
American Oystercatcher						Least Concern	
American Oystercatcher ssp. <i>palliatu</i> s	Coasts E & S USA, Caribbean	10,700- 11,300	stable	110	203		
American Oystercatcher ssp. <i>durnfordi</i>	E South America				125		
American Oystercatcher ssp. <i>pitanay</i>	W South America	25,000- 100,000		1,000	125		
American Oystercatcher ssp. <i>galapagensis</i>	Galapagos Islands	500		5	3		Endangered
American Oystercatcher ssp. <i>frazari</i>	Gulf of California & W Mexico	350		4	10		Vulnerable
Australian Pied Oystercatcher	Australia, S New Guinea	11,000	increasing	110	130	Least Concern	
Blackish Oystercatcher						Least Concern	
Blackish Oystercatcher	S. American Coast	10,000- 10,000		1,000			
Blackish Oystercatcher	Falkland/ Malvinas Is	12,000- 24,000		170			
Chatham Island Oystercatcher	Chatham Islands	313-351	increasing	3	3	Endangered	
Eurasian Oystercatcher						Least Concern	
Eurasian Oystercatcher ssp. <i>longipes</i>	Black Sea, Asia Minor, Arabian Peninsula	100,000- 200,000	decreasing?	1,400	270		
Eurasian Oystercatcher ssp. <i>osculans</i>	Kamchatka, Korea, NE & E China	5,000- 10,000		70	110		Near Threatened
Eurasian Oystercatcher ssp. <i>ostralegus</i>	N, C & W Europe	820,000	decreasing	8,200	8,200		
Magellanic Oystercatcher						Least Concern	
Magellanic Oystercatcher	S. American Coast	25,000- 100,000		1,000			
Magellanic Oystercatcher	Falkland/ Malvinas Is	21,000- 39,000		290			
Sooty Oystercatcher						Least Concern	
Sooty Oystercatcher ssp. <i>fuliginosus</i>	S Australia	4,000	increasing	40	40		
Sooty Oystercatcher ssp. <i>ophthalmicus</i>	N Australia	7,500	stable	75	75		
South Island Pied Oystercatcher	New Zealand	79,000- 130,000	increasing	1,000	1,127	Least Concern	
Variable Oystercatcher	New Zealand	4,500	increasing	45	45	Least Concern	

conservation status of a species. The information on numbers and trends assembled in this special issue of International Wader Studies differs from the most recent estimates assembled by Wetlands International in their *Waterbird Population Estimates* (WPE) (Wetlands International 2014). Contrary to the fourth edition of *Waterbird Population Estimates* (Delany & Scott 2006), the new estimates are no longer published as a booklet, but constantly updated online <http://wpe.wetlands.org> (Wetlands International 2014).

Most population estimates included in the various editions of *Waterbird Population Estimates* have been derived from censuses made towards the end of the non-breeding season or from estimations of breeding pairs. To allow for the element of immature birds in each population, estimates given by original sources in the form of number of breeding pairs have been multiplied by three to give the total population size, as suggested by Meininger *et al.* (1995). Estimates given in the form of breeding adults or mature individuals (i.e. twice the number of breeding pairs) have been multiplied by a factor of 1.5. This is similar to the conservation assessments in this volume.

The estimates of Wetlands International are often used to derive the 1% criterion (a wetland is considered internationally important, if it regularly supports more than 1% of the individuals of a species or a subspecies of waterbird), and probably also the listing on the IUCN Red List (Table 8). In the current “edition” of WPE (Wetlands International 2014) population sizes are underestimated (in brackets the extent of underestimation as percentage of the old population estimate) for African Black Oystercatcher (21%), American Oystercatcher ssp. *palliatu*s (84%), American Oystercatcher ssp. *frazari* (150%), Australian Pied Oystercatcher (18%) and Eurasian Oystercatcher ssp. *osculans* (57%). Quantitative estimates are lacking in WPE for the subspecies *durnfordi* and *pitanay* of the American Oystercatcher, as well as the populations of Blackish Oystercatcher and Magellanic Oystercatcher breeding on the mainland coast of South America. WPE overestimates (in brackets the extent of overestimation as percentage of the improved population estimate) the size of the American Oystercatcher ssp. *galapagensis* (40%) and especially the subspecies *longipes* of the Eurasian Oystercatcher (80%). According to the Ramsar Convention on Wetlands, a wetland is considered of international importance

Table 9. For each oystercatcher subspecies the number of sites considered of international importance to the species for breeding and during the non-breeding season is estimated. Also indicated is the number of sites that receive protection. For the non-breeding season, the criterion is the 1% level of total population size. For the breeding season, an alternative criterion based on the number of breeding pairs is sometimes applied. Source: species accounts. For the Variable Oystercatcher an estimated 5-10% of the population breeds on sites that have some form of protection (Dowding 2014). On the Falklands, 22 sites are listed as Important Bird Area and the Blackish Oystercatcher occurs in at least 21 of these sites, but none reaches the 1% criterion (Woods 2014). The same applies to the Magellanic Oystercatcher on the Falklands (Rob Woods, pers. comm.).

Species / subspecies	Breeding season			Non-breeding season		
	Criterion	No. of sites listed	No. of sites protected	1% level	No. of sites listed	No. of sites protected
African Black Oystercatcher						
American Black Oystercatcher	>1%	19	?	100	?	?
American Oystercatcher ssp. <i>palliatu</i> s	20 pairs	17	?	200	20	?
American Oystercatcher ssp. <i>durnfordi</i>	20 pairs	10	?	100	10	?
American Oystercatcher ssp. <i>pitanay</i>	20 pairs	10	?	100	10	?
American Oystercatcher ssp. <i>galapagensis</i>	20 pairs	?	?	3	?	?
American Oystercatcher ssp. <i>frazari</i>	20 pairs	4	?	30	4	?
Australian Pied Oystercatcher	>1%	24	few	130	24	few
Blackish Oystercatcher	nature reserve	?	few			
Chatham Island Oystercatcher	>1%	4	2	3	4	2
Eurasian Oystercatcher ssp. <i>longipes</i>	>80-120 pairs	3	?	?	3	?
Eurasian Oystercatcher ssp. <i>osculans</i>	>1%	2	2	70	18	6
Eurasian Oystercatcher ssp. <i>ostralegus</i>				10,200	16	?
Magellanic Oystercatcher	nature reserve	?	few	250	9	4
Sooty Oystercatcher	>1%	12?	at least 4	10	12	at least 4
South Island Pied Oystercatcher				1,120	12	at least 2
Variable Oystercatcher	>1% or 20 pairs	23	2?	45	39	few?

for a species or subspecies of waterbird when it regularly supports 1% of the individuals in the population of that species or subspecies. When population size is underestimated, wetlands classify “too easily” as internationally important, but when population size is overestimated, internationally important wetlands may fail to classify.

The IUCN criteria may be applied to any taxonomic unit at or below species level (IUCN Standards and Petitions Subcommittee 2010), but at present the IUCN Red List of Threatened Species (www.iucn.redlist.org) features only assessments of oystercatcher species (Table 8).

All except three oystercatcher species have been classified as Least Concern. The Canary Islands Oystercatcher *Haematopus meadewaldoi* was declared Extinct in 1994 (IUCN 2011). The Chatham Island Oystercatcher is classified as Endangered, due to the number of mature individuals being less than 250. What these two species have in common is that they are/were restricted to an isolated group of relatively small islands. Thanks to intensive conservation efforts the Chatham Island Oystercatcher was saved from immediate extinction; in 1970 the population size measured only 50 individuals (Moore 2014). The African Black Oystercatcher was first listed as Near Threatened in 1988

owing to its small population, estimated at 5000–6000 individuals. It has increased substantially since then, and Kemper *et al.* (2007) recommended that it be reclassified as Least Concern.

Are all classifications of Least Concern correct? We suspect not. One problem is the global Extent of Occurrence (EOO), which is defined as “the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred, or projected sites of present occurrence of a taxon, excluding cases of vagrancy (IUCN 2001). EOO is almost certainly overestimated for strictly coastal species. For the American Oystercatcher the IUCN Red List estimates EOO at 860,000 km². A value of 32,500 km² is much more likely, given a length of the coastline of 65,000 km and assuming that the area that the birds use has a width of 0.5 km. For the American Black Oystercatcher the global population of reproducing adults is less than 10,000 birds and the available habitat is estimated at about 1000 km². IUCN may wish to consider revising the classification of the American Black Oystercatcher to “Near Threatened” from “Least Concern,” but clear declines or fluctuations of population and distribution have not been demonstrated (Tessler *et al.* 2014).

Table 10. Anthropogenic activities that have benefited different oystercatcher species, at least for a while. A distinction is made between the breeding season and the non-breeding season. For each species and each ‘activity’ the magnitude of the impact is indicated on the basis of qualitative assessments made by researchers: XXX = major impact, XX = minor impact, X = some impact, 0 = no impact, ? = not certain/unclear.

Species / subspecies	Breeding season					Non-breeding season				
	Human creation of suitable agricultural habitat	Agricultural changes beneficial to oystercatchers	Urban development benefiting oystercatchers	Increasing eutrophication	Introduction of new prey species	Human creation of suitable agricultural habitat	Agricultural changes beneficial to oystercatchers	Urban development benefiting oystercatchers	Increasing eutrophication	Introduction of new prey species
African Black Oystercatcher	0	0	0	?	XXX	0	0	0	?	XXX
American Black Oystercatcher	0	0	0	0	0	0	0	0	0	0
American Oystercatcher ssp. <i>palliatu</i> s	0	0	0	?	?	0	0	0	?	?
American Oystercatcher ssp. <i>dumfordi</i>	?	?	?	?	?	?	?	?	?	?
American Oystercatcher ssp. <i>pitanay</i>	?	?	?	?	?	?	?	?	?	?
American Oystercatcher ssp. <i>galapagensis</i>	?	?	?	?	?	?	?	?	?	?
American Oystercatcher ssp. <i>frazari</i>	?	?	?	?	?	?	?	?	?	?
Australian Pied Oystercatcher	?	?	?	?	?	?	?	?	?	?
Blackish Oystercatcher	0	0	0	0	0	0	0	0	0	0
Chatham Island Oystercatcher	0	0	0	0	0	0	0	0	0	0?
Eurasian Oystercatcher ssp. <i>longipes</i>	XX?	XX?	0	0?	0?	0?	0?	0	0?	0
Eurasian Oystercatcher ssp. <i>osculans</i>	0	0	0	?	0	0	0	0	?	0?
Eurasian Oystercatcher ssp. <i>ostralegus</i>	XXX	XX	X	XXX?	0	XX?	XX?	0	XXX?	0
Magellanic Oystercatcher	0	0	0	0	0	0	0	0	0	0
Sooty Oystercatcher	0	0	0	?	0?	0	0	0	?	0?
South Island Pied Oystercatcher	XXX	XX	X	0?	X	XX	X	X	0?	X
Variable Oystercatcher	0	0	0	?	0?	0	0	0	?	0?

breeding range between 1900 and 1990, often moving up the rivers and colonizing neighbouring areas from there (Goss-Custard *et al.* 1996a). Similarly, the South Island Oystercatcher used to breed only on gravel riverbeds, but since about 1950 has spread onto arable land following changes in land use, leading to a tenfold increase in population size in just a few decades. New Zealand has at least 171 species of native earthworms, but the South Island Oystercatcher may have benefited from the introduction of 17 species of Lumbricidae into New Zealand by European settlers in the 19th century. The introduction of the non-native mussel species *Mytilus galloprovincialis* in coastal waters of South Africa has greatly increased the food supply for the African Black Oystercatcher and allowed the species to expand in numbers. Locally, Eurasian Oystercatchers may have benefited from aquaculture, more specifically, from mussels transported from subtidal areas (where they are inaccessible to oystercatchers) to intertidal areas. An increase in eutrophication may have increased food stocks in the intertidal in some cases, but a causal link between eutrophication and oystercatcher population size is quite difficult to show (Philippart *et al.* 2007). Nowadays, some oystercatchers also breed in urban areas, where they usually nest on flat roofs, well protected against ground predators. The birds can feed on lawns and sport fields. The habit of feeding the chicks has pre-adapted them for these urban habitats, but densities are nonetheless low and most urban areas are actually unsuitable for oystercatchers, because of too much stone and concrete and too few green areas. Highest densities (for urban habitats) are reached in industrial areas around cities and these are among the few areas in the Netherlands where Eurasian Oystercatchers are not declining (Ens *et al.* 2011).

Although humans may have a positive influence on oystercatchers, negative impacts are much more common (Table 11). During the breeding season, all (sub)species are threatened by disturbance from human activities. Another major threat is habitat loss due to coastal development. At present, only the Chatham Island Oystercatcher does not seem to suffer from this threat and the threat is considered minor for the Sooty Oystercatcher. For many species, introduced predators pose a threat during the breeding season. For inland breeding (sub)species agricultural intensification and loss of nests and chicks due to trampling by livestock are a problem. For coastal breeding species increased flooding due to climate change is the most common threat, followed by shellfish fishery, oil and gas exploration and oil spills and pollution. Some threats are quite specific. For instance, Chatham Island Oystercatchers suffer from the introduction of Marram grass *Ammophila arenaria* to stabilize dunes, forcing the birds to breed lower down the shore and in this way increasing the risk of the nest being flooded.

During the non-breeding season, habitat loss due to coastal development and disturbance from human activities (like off-road vehicles) are threats to nearly all oystercatcher (sub)species, except the Chatham Island Oystercatcher. Other important threats affecting several species are shellfish fishery (including aquaculture and bait digging), increased flooding due to climate change, pollution, oil and gas exploitation and oil spills, introduced predators and hunting.

Coastal development and human activities in the coastal zone are threatening the largest number of oystercatcher species, both during the breeding and the non-breeding season. Human populations reach higher densities near the coast than inland (Small & Nicholls 2003). If current human demographic trends remain, it seems likely that human

pressure on the coasts will increase dramatically within the next decades, although there will be considerable variation between countries (Martinez *et al.* 2007). But what about climate change? Climate change may have negative impacts, like increased risk of nest flooding (van de Pol *et al.* 2010a), as well as positive impacts, like a decrease in the frequency of years with very cold winters leading to low survival of oystercatchers (van de Pol *et al.* 2010b). Making predictions is difficult. Scenario calculations for coastal flooding and wetland loss under different climate and socio-economic scenarios indicate that the losses of coastal wetlands due to sea level rise may be relatively small compared to the potential for direct and indirect human destruction (Nicholls 2004). However, these calculations ignore the combined impact of sea level rise and increasing human use on the quality of coastal habitats for Oystercatchers. This combined impact may pose the greatest threat.

RECOMMENDATIONS ON RESEARCH

Many oystercatcher (sub)species are poorly known, e.g. Blackish Oystercatcher (Woods 2014), so it is concluded that more research is needed on taxonomy, total population size, breeding distribution, wintering distribution, movement between sites, population trend, survival, reproduction, demographic processes and major threats (Table 12). Even for the best studied shorebird in the world, the nominate subspecies of the Eurasian Oystercatcher, more research is needed on movement between sites and demographic processes. Taxonomic studies are considered a high priority for the various subspecies of the American Oystercatcher and the subspecies *osculans* of the Eurasian Oystercatcher.

RECOMMENDATIONS WITH REGARD TO MANAGEMENT

Recommendations with regard to management are quite diverse. For the South Island Pied Oystercatcher (with a current population well over 100,000) the authors perceive no need for a changed protection status. For the Variable Oystercatcher the authors do not identify priority actions either, because the species is increasing. From a global perspective the species is admittedly rare with a current population estimated at only 4,500 individuals. However, from the same global perspective New Zealand has a disproportionate number of threatened species and relatively few resources for their conservation management. For the other species a whole suite of recommendations is made.

For the Chatham Island Oystercatcher a recovery plan was drafted in 2001 (Aikman *et al.* 2001). More recently, a conservation action plan was finished for the American Black Oystercatcher in 2007 (Tessler *et al.* 2007) and for the American Oystercatcher in 2009 (Clay *et al.* 2010). The latter two conservation plans have in common that they stress the need to monitor the effectiveness of the conservation measures. For the American Black Oystercatcher, it is suggested that this should include an online conservation database and a geospatial risk analysis.

For the majority of species, better protection of breeding habitat is recommended. This protection may be brought about by legal means, but another common recommendation is to improve education and outreach, so as to make the local community aware of the vulnerability of breeding oystercatchers and to engage them in protection. For several

species, including the Variable Oystercatcher it is suggested that multi-species management of coastal birds by community groups could be very effective in increasing productivity of both oystercatchers and other species breeding in the same habitat.

The next most common group of suggestions is to reduce human disturbance at key sites and to control introduced predators. For some species, measures are proposed to combat introduced plants.

Where wintering, breeding or roosting habitat was lost, it is proposed to mitigate this.

For species that suffer from shellfish fishery, or from the harvesting of washed-up kelp (Taylor *et al.* 2014) and other marine resource, improved management is proposed through increased regulation of private and commercial harvesting.

Resources for conservation are limited, so it is important to prioritize conservation efforts. For this, improved understanding of habitat requirements through spatial analyses and mapping is recommended, including “geospatial” risk analyses and identification of important areas.

For several species, authors feel that the translation of research findings into policy and legislation should be improved.

Since coastal development is probably the most important threat to the majority of oystercatcher (sub)species, actions associated with improving local planning laws and overlays for the purpose of regulating development in sensitive shorebird areas should have the highest priority.

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REFERENCES

Aikman, H., Davis, A., Miskelly, C., O'Connor, S., & Taylor, G. 2001. Chatham Island Oystercatcher recovery plan 2001-2011. In: *Chatham Islands threatened birds – recovery and management plans* Department of Conservation, Wellington.

Atkinson, P.W., Clark, N.A., Bell, M.C., Dare, P.J., Clark, J.A., & Ireland, P.L. 2003. Changes in commercially fished shellfish stocks and shorebird populations in the Wash, England. *Biological Conservation* 114: 127–141.

Bressers, M., Meelis, E., Haccou, P., & Kruk, M. 1991. When Did It Really Start Or Stop – the Impact of Censored Observations on the Analysis of Duration. *Behavioural Processes* 23: 1–20.

Camphuysen, C.J., Ens, B.J., Heg, D., Hulscher, J.B., van der Meer, J., & Smit, C.J. 1996. Oystercatcher *Haematopus ostralegus* winter mortality in The Netherlands: the effect of severe weather and food supply. *Ardea* 84A: 469–492.

Canabarro, P.L. & Fedrizzi, C.E. 2010. Aspectos da reprodução do pirupiru *Haematopus palliatus* (Charadriiformes: Haematopodidae) na Praia do Hermenegildo, Rio Grande do Sul, Brasil. *Revista Brasileira de Ornitologia* 18: 249–255.

Clay, R.P., Lesterhuis, A.J., Schulte, S., Brown, S., Reynolds, D., & Simons, T.R. 2014. A global assessment of the conservation status of the American Oystercatcher *Haematopus palliatus*. In: *The Conservation Status of Oystercatchers around the World*, B.J. Ens & L.G. Underhill (eds). pp. 62–82. International Wader Study Group.

Clay, R.P., Lesterhuis, A.J., Schulte, S., Brown, S., Reynolds, D., & Simons, T.R. 2010. Conservation Plan for the American Oystercatcher (*Haematopus palliatus*) throughout the Western Hemisphere. Version 1.1. 1–57. Manomet Center for Conservation Sciences, Manomet, Massachusetts.

Collar, N.J. & Stuart, S.N. 1985. *Threatened birds of Africa and related islands: the ICBP/IUCN Red Data Book*. International Council for Bird Preservation, and International Union for Conservation of Nature and Natural Resources, Cambridge, UK.

Cortés Barrios, C.E. 2004. Aspectos reproductivos y crecimiento de *Haematopus palliatus* (Murphy 1925) (Charadriiformes: Haematopodidae) en el sector de Punta Teatinos, IV Región de Coquimbo, Chile.

Delany, S. & Scott, D. 2006. *Waterbird Population Estimates – Fourth Edition*. Wetlands International, Wageningen, The Netherlands.

Dowding, J.E. 2014. Conservation assessment of the Variable Oystercatcher *Haematopus unicolor*. In: *The Conservation Status of Oystercatchers around the World*, B.J. Ens & L.G. Underhill (eds). pp. 182–190. International Wader Study Group.

Durell, S.E.A.I.V.d., Goss-Custard, J.D., Stillman, R.A., & West, A.D. 2001. The effect of weather and density-dependence on Oystercatcher *Haematopus ostralegus* winter mortality. *Ibis* 143: 498–499.

Duriez, O., Saether, B.E., Ens, B.J., Choquet, R., Pradel, R., Lambeck, R.H.D., & Klaassen, M. 2009. Estimating survival and movements using both live and dead recoveries: a case study of oystercatchers confronted with habitat change. *Journal of Applied Ecology* 46: 144–153.

Ens, B.J. 1991. Guarding your mate and losing the egg: an Oystercatcher's dilemma. *Wader Study Group Bulletin* 61 (Supplement): 69–70.

Ens, B.J., Aarts, B., Hallmann, C., Oosterbeek, K., Sierdsema, H., Slaterus, R., Troost, G., van Turnhout, C., Wiersma, P., van Winden, E., & Nienhuis, J. 2011. Scholeksters in de knel: onderzoek naar de oorzaken van de dramatische achteruitgang van de Scholekster in Nederland. SOVON-onderzoeksrapport 2011/13: 1–120. SOVON Vogelonderzoek Nederland, Nijmegen.

Ens, B.J., Kersten, M., Brenninkmeijer, A., & Hulscher, J.B. 1992. Territory quality, parental effort and reproductive success of Oystercatcher (*Haematopus ostralegus*). *Journal of Animal Ecology* 61: 703–715.

Escudero, G., Ferrari, S., Albrieu, C., Matus, R., Imberti, S., Stoyanoff, P., Webb, A., Castro, M., Abril, M., Benegas, L., Morrison, R.I.G., Ross, R.K., Edelaar, P., Sitters, H.P., Niles, L.J., & Dey, A.D. 2014. Conservation assessment and ecology of the Magellanic Oystercatcher *Haematopus leucopodus*. In: *The Conservation Status of Oystercatchers around the World*, B.J. Ens & L.G. Underhill (eds). pp. 173–181. International Wader Study Group.

Goss-Custard, J.D., Durell, S.E.A.I.V.d., Clarke, R.T., Beintema, A.J., Caldow, R.W.G., Meininger, P.L., & Smit, C.J. 1996a. Population dynamics: predicting the consequences of habitat changes at the continental scale. In: *The Oystercatcher: From Individuals to Populations* J.D. Goss-Custard (eds). pp. 352–383. Oxford University Press, Oxford.

Goss-Custard, J.D., Durell, S.E.A.I.V.d., Goater, C.P., Hulscher, J.B., Lambeck, R.H.D., Meininger, P.L., & Urfi, J. 1996b. How Oystercatchers survive the winter. In: *The Oystercatcher: From Individuals to Populations* J.D. Goss-Custard (ed.). pp. 155–185. Oxford University Press, Oxford.

Groves, S. 1984. Chick Growth, Sibling Rivalry, and Chick Production in American Black Oystercatchers. *Auk* 101: 525–531.

Hansen, B.D., Minton, C.D.T., Harrison, A.E., & Jessop, R. 2014. Conservation assessment of the Sooty Oystercatcher *Haematopus fuliginosus*. In: *The Conservation Status of Oystercatchers around the World* B.J. Ens & L.G. Underhill (eds). pp. 161–172. International Wader Study Group.

Heg, D. & van der Velde, M. 2001. Effects of territory quality, food availability and sibling competition on the fledging success of oystercatchers (*Haematopus ostralegus*). *Behavioral Ecology and Sociobiology* 49: 157–169.

Heg, D. & Van Treuren, R. 1998. Female-female cooperation in polygynous oystercatchers. *Nature* 391: 687–691.

- Hockey, P.A.R.** 1987. The influence of Coastal Utilisation by Man on the Presumed Extinction of the Canarian Black Oystercatchers *Haematopus meadewaldoi* Bannerman. *Biological Conservation* 39: 49–62.
- Hockey, P.A.R.** 1996. *Haematopus ostralegus* in perspective: comparison with other Oystercatchers. In: *The Oystercatcher: From Individuals to Populations* J.D. Goss-Custard (ed.). pp. 251–285. Oxford University Press, Oxford.
- Hockey, P.A.R., Leseberg, A., & Loewenthal, D.** 2003. Dispersal and migration of juvenile African Black Oystercatchers *Haematopus moquini*. *Ibis* 145: E114–E123.
- Hulscher, J.B., Exo, K.M., & Clark, N.A.** 1996. Why do Oystercatchers migrate? In: *The Oystercatcher: From Individuals to Populations* J.D. Goss-Custard (ed.). pp. 155–185. Oxford University Press, Oxford.
- IUCN** 2001. IUCN Red List Categories and Criteria: Version 3.1. Report Species Survival Commission: 1–35. IUCN, Gland, Switzerland and Cambridge.
- IUCN** 2011. IUCN Red List of Threatened Species. Version 2011.1. <http://www.iucnredlist.org>. Downloaded on 15 August 2011.
- IUCN** 2013. IUCN Red List of Threatened Species. Version 2013.1. <http://www.iucnredlist.org>. Downloaded on 25 August 2013.
- IUCN Standards and Petitions Subcommittee** 2010. Guidelines for Using the IUCN Red List Categories and Criteria. Version 8.1. 1–85. Prepared by the Standards and Petitions Subcommittee in March 2010, Downloadable from <http://intranet.iucn.org/webfiles/doc/SSC/RedList/RedListGuidelines.pdf>.
- Jóhannsson, J. & Guðjónsdóttir, B.** 2009. Tjaldur á Ströndum. *Bliki* 30: 65–69.
- Kemper, J., Underhill, L.G., Crawford, R.J.M., & Kirkman, S.P.** 2007. Revision of the conservation status of seabirds and seals breeding in the Benguela Ecosystem. In: *Final Report of the BCLME (Benguela Current Large Marine Ecosystem) Project on Top Predators as Biological Indicators of Ecosystem Change in the BCLME*, S.P. Kirkman (ed.). pp. 325–342. Avian Demography Unit, UCT, Cape Town.
- Lande, R., Engen, S., & Saether, B.E.** 2003. *Stochastic Population Dynamics in Ecology and Conservation*. Oxford University Press, Oxford.
- Martinez, M.L., Intralawan, A., Vazquez, G., Perez-Maqueo, O., Sutton, P., & Landgrave, R.** 2007. The coasts of our world: Ecological, economic and social importance. *Ecological Economics* 63: 254–272.
- Meininger, P.L., Schekkerman, H., & van Roomen, M.W.J.** 1995. Populatieschattingen en 1 procent-normen van in Nederland voorkomende watervogelsoorten: voorstellen voor standaardisatie. *Limosa* 68: 41–48.
- Melville, D.S., Gerasimov, Y.N., Moores, N., Yu, Y.T., & Bai, Q.Q.** 2014. Conservation assessment of the Far Eastern Oystercatcher *Haematopus [ostralegus] osculans*. In: *The Conservation Status of Oystercatchers around the World*, B.J. Ens & L.G. Underhill (eds). pp. 129–154. International Wader Study Group.
- Moore, P.** 2014. Conservation assessment of the Chatham Island Oystercatcher *Haematopus chathamensis*. In: *The Conservation Status of Oystercatchers around the World*, B.J. Ens & L.G. Underhill (eds). pp. 23–32. International Wader Study Group.
- Nicholls, R.J.** 2004. Coastal flooding and wetland loss in the 21st century: changes under the SRES climate and socio-economic scenarios. *Global Environmental Change-Human and Policy Dimensions* 14: 69–86.
- Philippart, C.J.M., Beukema, J.J., Cadée, G.C., Dekker, R., Goedhart, P.W., van Iperen, J.M., Leopold, M.F., & Herman, P.M.J.** 2007. Impacts of nutrient reduction on coastal communities. *Ecosystems* 10: 96–119.
- Rahn, H., Paganelli, C.V., & Ar, A.** 1975. Relation of Avian Egg Weight to Body-Weight. *Auk* 92: 750–765.
- Saether, B.E. & Bakke, O.** 2000. Avian life history variation and contribution of demographic traits to the population growth rate. *Ecology* 81: 642–653.
- Saether, B.E., Lande, R., Engen, S., Weimerskirch, H., Lillegard, M., Altwegg, R., Becker, P.H., Bregnballe, T., Brommer, J.E., McCleery, R.H., Merila, J., Nyholm, E., Rendell, W., Robertson, R.R., Tryjanowski, P., & Visser, M.E.** 2005. Generation time and temporal scaling of bird population dynamics. *Nature* 436: 99–102.
- Saether, B.E., Ringsby, T.H., & Roskaft, E.** 1996. Life history variation, population processes and priorities in species conservation: Towards a reunion of research paradigms. *Oikos* 77: 217–226.
- Safriel, U.N.** 1981. Social hierarchy among siblings in broods of the oystercatcher *Haematopus ostralegus*. *Behavioral Ecology and Sociobiology* 9: 59–63.
- Safriel, U.N., Harris, M.P., Brooke, M.L., & Britton, C.K.** 1984. Survival of breeding oystercatchers *Haematopus ostralegus*. *Journal of Animal Ecology* 53: 867–877.
- Sagar, P. & Veitch, D.** 2014. Conservation assessment of the South Island Oystercatcher *Haematopus finschi*. In: *The Conservation Status of Oystercatchers around the World*, B.J. Ens & L.G. Underhill (eds). pp. 155–160. International Wader Study Group.
- Sarychev, V. & Mischenko, A.** 2014. Conservation assessment of *Haematopus ostralegus longipes*. In: *The Conservation Status of Oystercatchers around the World*, B.J. Ens & L.G. Underhill (eds). pp. 33–40. International Wader Study Group.
- Small, C. & Nicholls, R.J.** 2003. A global analysis of human settlement in coastal zones. *Journal of Coastal Research* 19: 584–599.
- Sutherland, W.J.** 1982. Food supply and dispersal in the determination of wintering population levels of oystercatchers, *Haematopus ostralegus*. *Estuarine, Coastal and Shelf Science* 14: 223–229.
- 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*. In: *The Conservation Status of Oystercatchers around the World*, B.J. Ens & L.G. Underhill (eds). pp. 116–128. International Wader Study Group.
- Tessler, D.F., Johnson, J.A., Andres, B.A., Thomas, S., & Lanctot, R.B.** 2007. Black Oystercatcher (*Haematopus bachmani*) Conservation Action Plan. Report International Black Oystercatcher Working Group, U.S. Fish and Wildlife Service: 1–115. Manomet Centre for Conservation Sciences, Manomet, Massachusetts.
- Tessler, D.F., Johnson, J.A., Andres, B.A., Thomas, S., & Lanctot, R.B.** 2014. A global assessment of the conservation status of the Black Oystercatcher *Haematopus bachmani*. In: *The Conservation Status of Oystercatchers around the World*, B.J. Ens & L.G. Underhill (eds). pp. 83–96. International Wader Study Group.
- Tjorve, K.M.C. & Underhill, L.G.** 2009. Growth and its relationship to fledging success of African black oystercatcher *Haematopus moquini* chicks. *Zoology* 112: 27–37.
- Underhill, L.G.** 2014. A global assessment of the conservation status of African Black Oystercatcher *Haematopus moquini*. In: *The Conservation Status of Oystercatchers around the World*, B.J. Ens & L.G. Underhill (eds). pp. 97–108. International Wader Study Group.
- van de Pol, M., Atkinson, P.W., Blew, J., Crowe, O., Delany, S., Duriez, O., Ens, B.J., Hälterlein, B., Hötter, H., Laursen, K., Oosterbeek, K.H., Petersen, Æ., Thorup, O., Tjorve, K., Triplet, P., & Yésou, P.** 2014. A global assessment of the conservation status of the nominate subspecies of Eurasian Oystercatcher *Haematopus ostralegus ostralegus*. In: *The Conservation Status of Oystercatchers around the World*, B.J. Ens & L.G. Underhill (eds). pp. 47–61. International Wader Study Group.
- van de Pol, M., Ens, B.J., Heg, D., Brouwer, L., Krol, J., Maier, M., Exo, K.M., Oosterbeek, K., Lok, T., Eising, C.M., & Koffijberg, K.** 2010a. Do changes in the frequency, magnitude and timing of extreme climatic events threaten the population viability of coastal birds? *Journal of Applied Ecology* 47: 720–730.
- van de Pol, M., Vindenes, Y., Sæther, B.-E., Engen, S., Ens, B.J., Oosterbeek, K., & Tinbergen, J.M.** 2010b. Effects of climate change and variability on population dynamics in a long-lived shorebird. *Ecology* 91: 1192–1204.
- van Roomen, M., Langendoen, T., Amini, H., de Fouw, J., Mundkur, T., Thorpe, A., & Ens, B.J.** 2014. Population estimate of *Haematopus ostralegus longipes* based on nonbreeding numbers in January. In: *The Conservation Status of Oystercatchers around the World*, B.J. Ens & L.G. Underhill (eds). pp. 41–46. International Wader Study Group.
- Verboven, N., Ens, B.J., & Dechesne, S.** 2001. Effect of investigator disturbance on nest attendance and egg predation in Eurasian oystercatchers. *Auk* 118: 503–508.
- Wetlands International** 2014. Waterbird Population Estimates. retrieved from wpe.wetlands.org on 23 February 2014.
- Woods, R.W.** 2014. Conservation assessment of the Blackish Oystercatcher *Haematopus ater*. In: *The Conservation Status of Oystercatchers around the World*, B.J. Ens & L.G. Underhill (eds). pp. 109–115. International Wader Study Group.

