S37-5   Understanding global trends in seabirds — are there winners and losers?

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Abstract   We review the lessons provided by long-term studies of seabirds. The literature holds few examples of long-term studies and exposes major gaps in the knowledge required for making sound conservation decisions. Sufficient long-term data for assessing population trends is available for few species. The northern fulmar (*Fulmarus glacialis*) and the gannets (*Morus* spp.) have increased or remained stable, but several albatrosses have declined, the cause for which has often been attributed to impacts from human fisheries, although direct links are seldom demonstrated. Declines in grey-headed albatrosses (*Thalassarche chrysostoma*) and rockhopper penguins (*Eudyptes chrysocome*) at Campbell Island have been correlated with environmental change, a factor that is often overlooked. Such changes do occur; and to understand their effects on seabird populations fully, seabirds need monitoring at sea as well as on breeding grounds..

Key words   Seabirds, Long-term studies, Populations, Longevity

1   Introduction

For seabirds, changes in the marine environment or breeding grounds may result in either "winners" or "losers". We define a "winner" as a species that is able to maintain or increase its population size and prevail within its environment in spite of human induced and/or natural change. Conversely, a "loser" is one consistently unable to cope in the face of change.

Determining "winners" or "losers" requires detailed information on global population size and trends for each species. Good data on population trends can only come from long-term study, ideally over 40–50 years. The coloniality of many seabirds makes them accessible subjects for such study (Wooller et al., 1992), yet little is known about the size and demographic trends in most of their populations. Moreover, there is a paucity of long-term studies, a phenomenon not restricted to seabirds. Although there was a move away from long-term monitoring for several decades (Krebs, 1991), seabird ecologists are now rediscovering their importance (Woehler et al., 2001). Trends in populations are needed for finding out whether observed threats to individuals have impact on populations.

Of 328 seabird taxa, 28.7% have been identified as critical, endangered or vulnerable by IUCN, with a further 10% categorized as at lower risk/near threatened or data deficient (BirdLife International, 2000). The list may well provide a guide to the species thought to be declining rapidly, the presumed "losers", but current information is too coarse to identify gradual declines in other species.

2   How well are seabird populations known?

To assess data on size and trends in seabird populations, we used recent handbook summaries of relevant information on 328 species of Sphenisciformes, Procellariiformes, Pelecaniformes and seabirds from the Charadriiformes (Marchant and Higgins, 1990; del Hoyo et al., 1992; BirdLife International, 2000). From these sources, we grouped the methods by which global population size was determined for each species, whether by direct counts, partial counts or guesstimates from brief visits, or unknown.

In Sphenisciformes (penguins), population estimates are available for 82% of the 17 species; those for the remainder are guessed. In Procellariiformes (petrels and albatrosses), direct estimates are available for 60% of the 108/128 species, 29% are guessed, and 11% lack information. In Pelecaniformes (gannets, frigatebirds, cormorants and allies), direct estimates are available for 38% of the up to 58 species, 36% are guessed, and a surprising 26% lack information. In the marine Charadriiformes of up to 125 species (gulls, terns, alcids, skuas, and plovers and allies), direct estimates are available for only 31%, 48% are guessed and 21% lack adequate information.

Data on population trends are considerably fewer. Although long-term studies are a prerequisite, almost all information on trends comes from short-term studies or

anecdotal reports. It seems that the lack of knowledge about population trends in seabirds has been greatly underestimated.

Of the 328 seabird species, 127 are listed under categories of threat by IUCN (Birdlife International, 2000); and of these, no global population trends are available for 28% in Procellariiformes, 21% in Pelecaniformes and 18% in Charadriiformes. In the 201 species not listed as threatened, global population trends are unknown for 18% of Sphenisciformes, 54% of Procellariiformes, 64% of Pelecaniformes and 63% of Charadriiformes. How can risk be assessed reliably from such a dearth of information?

This analysis reveals that current knowledge of seabird population sizes and trends is poor. However, some long-term studies do exist, and we now examine them for the factors and threats that cause some species to "win" and others to "lose".

3 Long-term seabird case-studies

3.1 Declining species

Taxa in decline may demonstrate some of the threats being faced. The Campbell albatross (*Thalassarche impavida*), grey-headed albatross (*T. chrysostoma*) and rockhopper penguin (*Eudyptes chrysocome*) all breed on Campbell Island, southeast of New Zealand. Populations there have all declined over the at least the last 50 years, due to different factors.

The Campbell albatross population appears to have been stable until 1966 (Waugh et al., 1999). Then the numbers breeding declined rapidly during the 1970s and early 1980s. This decline was correlated with the impact of fisheries bycatch. Since at least 1984, numbers have increased, coincident with a reduction in longline fishing (Waugh et al., 1999). A correlation between fishing effort and the decline of Campbell Albatrosses is evident, and demographic models show good agreement with observed numbers in nest counts.

In contrast, grey-headed albatrosses appear to have been affected predominantly by factors other than longlining. They declined steadily at about 3.7% a year at Campbell Island between the early 1940s and mid-1980s (Waugh et al., 1999). Between 1992–1996, the rate of decline was similar. Because the drop before and after the advent of longline fishing is much the same (Murray et al., 1993; Klaer and Polacheck, 1995), it cannot be explained by that factor alone. Waugh et al. (1999) attribute the cause instead to low and variable breeding success, together with low juvenal survival, driven by environmental factors. Longline fishing may only be a recent contributor, because some grey-headed albatrosses have been taken in the New Zealand and Australian bycatch (Gales et al., 1998).

Rockhopper penguins have also declined steadily at Campbell Island, by 94% over *c*. 45 years (Cunningham and Moors, 1994). They are not caught on longlines. The decline has probably resulted from changes in the marine environment about Campbell Island, associated with a substantial increase in sea temperature. Cunningham and Moors (1994) suggest that warmer waters were most likely to affect rockhopper penguins through altered availability of their food. Average sea temperatures throughout the southern ocean have risen by 0.5°C since the 1950s (Allan et al., 1996).

3.2 Stable species

Few seabirds are known to have stable populations, probably due to the short-term nature of most population data. Viewed long-term, rises and falls in some populations may actually reflect a stable but fluctuating pattern. Cape gannets (*Morus capensis*) around southern Africa appear to have fluctuated in numbers over the past 40 to 50 years (R. J. M. Crawford, pers comm.). They declined markedly in Namibia, following the collapse of the sardine (*Sardinops*) fisheries in the 1970s, but there followed an increase in the South African colonies during the 1980s, perhaps caused by first-time breeders moving to colonies with a better food supply (Crawford, 1999). This may well be a species with a stable population able to respond to environmental change, and therefore be one of the "winners". Yet it is currently listed as Vulnerable, with a rapidly declining population.

3.3 Increasing species

Over the past 200 years, the northern fulmar (Fulmarus glacialis) has undergone one of the most spectacular population increases of any seabird, both in distribution and numbers (Warham, 1990). Although well studied, there is still argument about the cause of the increase. Greater food supply from fisheries waste appears likely to have had an effect, but adaptation to changes in the marine environment may have contributed also. Hence, we cannot predict the impact of declining fisheries and environmental change, and so must class it as a "winner" for the time being.

In contrast to the Cape gannet, both the northern gannet (*Morus bassana*) and Australasian gannet (*M. serrator*) have increased markedly. Populations of the northern gannet grew steadily at *c*. 3% a year for most of the last century. Nelson (2002) attributes this to cessation of exploitation by humans. The Australasian gannet has also increased in New Zealand, and, since the late 1980s, in Australia, after exploitation of its breeding colony on Cat Island, Tasmania, was stopped (cf. Warham and Serventy, 1978). Early exploitation by Maori in New Zealand may have led to an earlier decline, so the recent increase there may also be due to a release from hunting pressure.

Changes in both northern and Australasian gannet populations show a relatively smooth rate of increase. Census points are at least a decade apart. However, this does not represent the real fluctuations in their populations accurately.

4 Conflicts in seabird studies

Short- and long-term studies offer conflicting perspectives on trends in seabird populations. Short-term studies

indicate that many species are in decline. Yet there is often no historical baseline for determining what such trends mean in the long-term, or what is causing them.

Considering the smooth line phenomena in some population data, we reviewed the long-term Australasian gannet data at Cape Kidnappers in New Zealand. There, the Plateau colony shows an annual increase of just over 4%. This study, which began in 1945, is an excellent example of a long-term data set, involving annual counts of breeding pairs at one colony. There is much inter-annual variation, both in the numbers of breeding pairs and productivity, yet a trend line drawn between data points spaced a decade apart does not show this. Much of the inter-annual variation detected appears to be related to environmental factors.

Without the benefit of such a long-term data set, the results could be very different. It is possible to choose periods of three to four years from within the Cape Kidnappers data set, normal for a University-type study, that give decreasing, stable, and steeply increasing population trends. Population models based on such short-term data would be unlikely to reflect the real long-term population trend. Data collected long-term are required to model seabird populations accurately and so determine correctly the effects of various threats.

5 What are the threats and what are we studying?

Longlining is often said to be the single greatest threat to seabirds and responsible for widespread declines in seabird populations across the world. Yet, to put the impact of longlining into perspective, only some 10% of seabird species are caught regularly in longline bycatch, and some of them appear to be declining for other reasons. Unfortunately, precise demographic reasons for the declines are known for only a few (Weimerskirch et al., 1997; Waugh et al., 1999), due to the lack of long-term studies (Wooller et al., 1992). Some studies have linked population declines circumstantially with fisheries (Weimerskirch and Jouventin 1987, 1998; Croxall et al., 1990, 1998), even though little or no data on population size or parameters existed before the fisheries started. Campbell and Buller's (*Thalassarche bulleri*) albatrosses are still represented in fisheries bycatch, but their populations appear to be increasing (Sagar et al., 1999).

Research into recruitment factors, knowledge of foraging zones (especially for juveniles, immatures, and non-breeding adults), and data relating to fisheries outside national fishery zones are needed to resolve questions of "winners" and "losers" (Wooller et al., 1992; Waugh et al., 1999). Relatively little attention has yet been paid to bycatch in other fisheries. The effects of other anthropogenic threats such as pollution, introduced predators at breeding grounds, disturbance and human exploitation have also received little attention.

Environmental factors may well be the most important of impacts, yet recent reviews of seabird threats have either ignored them or addressed them superficially (e.g., Baker et al., 2002). From the case studies presented here, it is clear that environmental factors affect seabird populations. Long-term environmental changes, such as the increase in Southern Ocean sea surface temperatures, are almost unstudied. The impact of events such as the El Niño Southern Oscillation on seabird populations are evident even in the short-term (Schreiber and Schreiber, 1984; Lyver et al., 1999); but there is little understanding of its importance long-term.

Short-term environmental perturbations, such as storms, have also affected seabird populations and breeding habitat, as in the case of the northern royal albatross, *Diomedea epomophora sanfordi* (Robertson, 1998). The faster breeding, shorter-lived brown noddy *Anous stolidus*, however, has been found to compensate for high mortality after storms (Morris and Chardine, 1995), possibly by drawing upon birds from within a "strategic reserve" (Warham, 1996). Thus there may well be an inherent resilience to cope with short-term events, but there is little understanding of what this means in the long-term.

6 Where do we go from here?

To understand the threats facing seabirds, more information is needed on birds at sea. Most of the threats impacting on them happen there, yet until recently almost all have been studied on land. The technological advances in transmitters and data-loggers will facilitate measuring seabird activities at sea. Such research, however, should not be conducted at the expense of long-term land-based studies. Only long-term monitoring can provide the information on population trends that will allow us to understand the demographic consequences of the threats to seabirds.

So, are there "winners" or "losers"? Based on long-term studies, there are clearly some current "winners", such as northern fulmars and northern and Australasian Gannets. Yet we still do not fully comprehend why these species have done so well, nor can we make predictions about their continuing success. What about current "losers"? At this stage, there is not enough long-term information on trends to declare as "losers" most species currently on the IUCN threatened list. Many of them may be fluctuating in the short-term within normal population cycles. There certainly are some seabirds which, with assistance, appear to be returning from the brink of extinction; but these are few: Chatham Island taiko (*Pterodroma magentae*), Bermuda petrel (*P. cahow*) and short-tailed albatross (*Phoebastria albatrus*).

Seabird ecologists, managers and modelers will not win the conservation battle until they can provide the information required to understand the ecology and demography of the seabirds they study. At the very least, this requires a precise knowledge of seabird populations and trends, and an understanding of the wider links between seabird threats and human population change.

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