Chapter 38. Seabirds

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1. Introduction

Seabirds are the most threatened bird group and their status has deteriorated faster over recent decades. Globally 28 per cent are threatened (5 per cent are in the highest category of Critically Endangered) and a further 10 per cent are Near Threatened. Of particular concern are those species whose small range or population is combined with decline (64 species). Pelagic species are disproportionately represented in comparison with coastal species; those listed under the Agreement on the Conservation of Albatross and Petrels[2] have fared worst of all.

Declines have been caused by ten primary pressures. At sea these include: incidental bycatch (in longline, gillnet and trawl fisheries); pollution (oil spills, marine debris)); overfishing; energy production and mining. On land, invasive alien species, problematic native species (e.g. those that have become super-abundant), human disturbance, infrastructural, commercial and residential development, hunting and trapping have driven declines. Climate change and severe weather affect seabirds on land and at sea.

Given their imperilled conservation status, many seabirds have been highlighted for special conservation status and action under a range of international, regional and national agreements and mechanisms. Data on distribution, abundance, behaviour and pressures can be used to inform the design of effective management regimes for seabirds. Management decisions can be guided by: (1) where the key areas are, (2) when these areas are used, (3) what variables explain seabird presence in a given area, (4) the threat status of species in a given area, (5) what pressures may be adversely affecting the species, associated habitats and processes, (6) what management actions are needed to address these threats, and (7) how any management intervention can best be monitored to assess its effectiveness.

Seabirds provide many ecosystems services and their role as potential indicators of marine conditions is widely acknowledged. Many studies use aspects of seabird biology and ecology, especially productivity and population trends, to infer relationships with and/or effects on and/or correlate with aspects of the marine environment, particularly food availability.

[1] The writing team thanks Esteban Frere for his substantial contribution to this chapter.
[2] United Nations, *Treaty Series*, vol. 2258, No. 40228.

2. **Population trends or conservation status**

2.1 Aggregated at global scale

Croxall et al. (2012) reviewed 346 seabird species and found that overall, seabirds are more threatened than other comparable groups of birds and their status has deteriorated faster over recent decades. In terms of the categories used in the International Union for the Conservation of Nature (IUCN) Red List, globally 97 species (28 per cent) are threatened, with17 species (5 per cent) in the highest category of Critically Endangered) and a further 10 per cent Near Threatened. Only four species, all storm petrels, are regarded as Data Deficient; three species are considered Extinct, and two other species are Possibly Extinct. Of the 132 threatened and Near Threatened seabird species 70 (53 per cent) qualify by virtue of their very small population and/or range. 66 species (50 per cent) qualify by virtue of having undergone rapid population decline. Of particular concern are those with both small range and/or population as well as having undergone decline (64 species; 48 per cent); this includes six species of penguins, 17 of gadfly petrels and eight of cormorants. Pelagic species are disproportionately represented in all categories in comparison with coastal species (Figure 1). 57 species (17 per cent) are increasing; for many, such as the 17 gull species, this is doubtless due to their abilities to exploit close links with human activities.

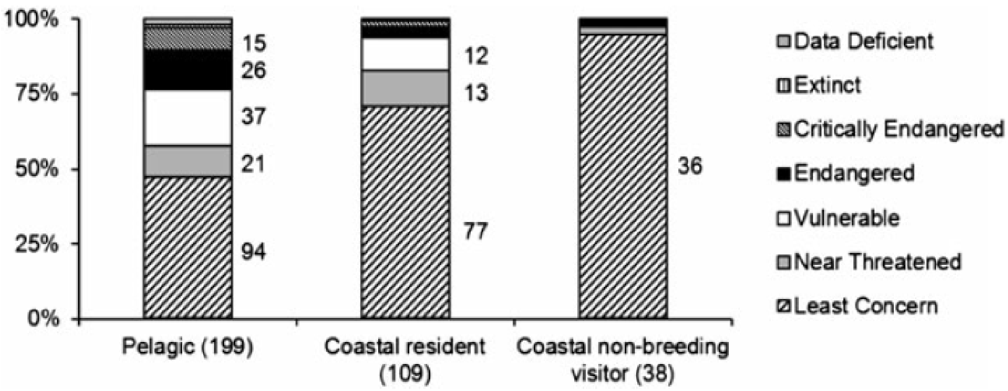

Figure 1. Proportion of species in each IUCN Red List category for pelagic species, coastal residents and coastal non-breeding visitors. Figures give number of species (for totals >5). Source: Croxall et al., 2012.

A broader, but less sensitive, measure of overall trends is provided by the Red List Index (Butchart et al., 2004; 2007), which measures trends in extinction risk (based on the movement of species through IUCN Red List categories owing to genuine improvement or deterioration in status) and is virtually the only trend indicator currently available for seabirds on a worldwide and/or regional basis. It shows (Figure 2) that, over the last 20 years, seabirds have had a substantially poorer conservation status than non-seabirds and that they have deteriorated faster over this period. Pelagic species are more threatened and have deteriorated faster than coastal species, and this difference is particularly pronounced for the albatrosses and large petrels that are covered by the 2004 Agreement on the Conservation of Albatross and Petrels ([ACAP] BirdLife International, 2012).

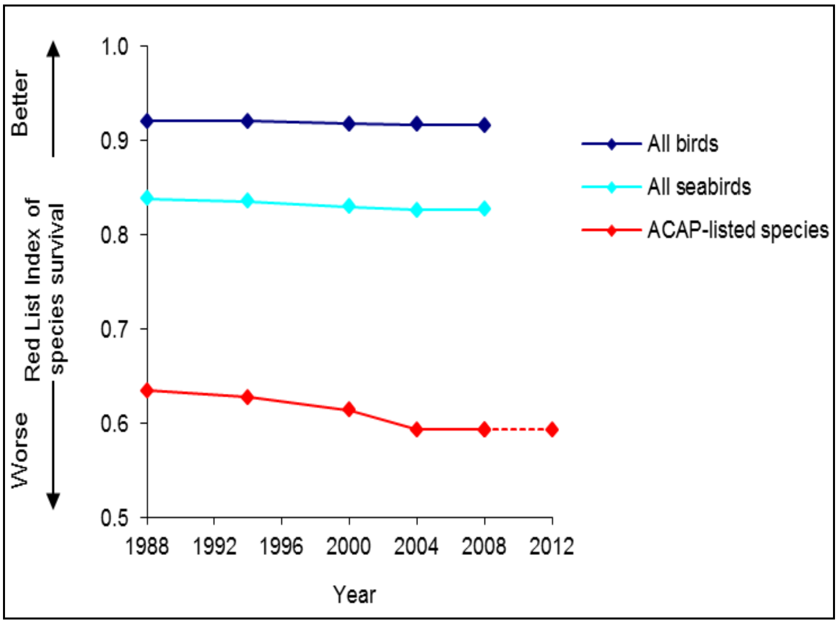

Figure 2. Red List Index of species survival for all bird species (n=9,853 non-Data Deficient species extant in 1988), all seabirds (n=339) and ACAP (Agreement on Conservation of Albatross and Petrels)-listed species (n=29). Values for the latter are projected to 2012 based on data from the 2012 IUCN Red List to be published later this year. RLI values relate to the proportion of species expected to remain extant in the near future without additional conservation action. An RLI value of 1.0 equates to all species being categorized as of Least Concern, and hence that none are expected to become extinct in the near future. An RLI value of zero indicates that all species have become Extinct. See Butchart et al 2004 for further explanation. Source: BirdLife International 2012.

For major taxonomic and/or geographic subdivisions

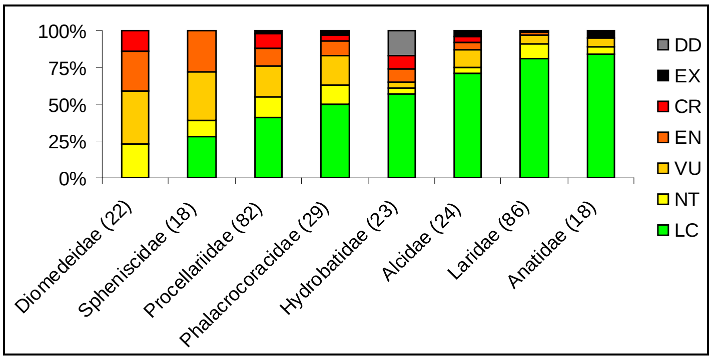

Figure 3. Percentage of species in each IUCN Red List category for the major seabird families. Figures give number of species. Source: Croxall et al., 2012.

Reviewing the pattern taxonomically (Figure 3) reveals that, of the main families (which together account for 87 per cent of species), the most threatened are the albatrosses/petrels (Diomedeidae/Procellariiformes and penguins (Sphenisciformes).Together these (represent nearly one half (43 per cent) of all seabirds and contain many pelagic species. Conservation of Diomedeidae benefits considerably from ACAP. Within Procellariiformes the genera *Pterodroma* and *Pseudobulweria* are the next most threatened and a special internet forum has recently been established to promote priority conservation action for them: Gadfly Petrel Conservation Group; www.gadflypetrel.ning.com.

2.2 Special conservation status issues

Given their imperilled conservation status, many seabirds have been highlighted for special conservation status and action under a range of international, regional and national agreements and mechanisms. However, because seabirds are highly mobile and migrate, they are exposed to vagaries of differing levels of protection across international (and non-governmental) regions. Those agreements and mechanisms currently most actively undertaking work include ACAP (30 species), EU Birds Directive (all seabirds in the EU), the Convention for the Protection of the Marine Environment of the North-East Atlantic[3] (OSPAR Convention) (9 species), the Agreement on the Conservation of African-Eurasian Migratory Waterbirds[4] (82 species), East Asian-Australasian Flyway Partnership (39 species), the Convention for the Protection of the Mediterranean Sea Against Pollution[5] (Barcelona Convention) (14 species), Convention on the Conservation of Migratory Species of Wild Animals[6] (CMS; 20 seabird species are listed on Annex I; 50 on Annex II), the Convention on the conservation of European wildlife and natural habitats[7] (Bern Convention) (over 30 species), Helsinki Commission (HELCOM; 11 species), the Convention on the Protection of the Black Sea Against Pollution[8] (Bucharest Convention) (2 species), Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR; 7 species), Convention for Arctic Flora and Fauna (3 species), Migratory Bird Treaty Act (139 species)**,** North American Agreement on Environmental Cooperation (1 species), Trilateral Committee for Wildlife and Ecosystem Conservation and Management (1 species), and the Convention on International Trade in Endangered Species of Wild Fauna and Flora[9] (CITES) (6 species). Other agreements that have this remit but are not yet active include the Nairobi Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region[10] (Nairobi Convention) (47 species), the Regional Convention for the Conservation of

[3] United Nations, *Treaty Series*, vol. 2354, No. 42279.
[4] Ibid., vol. 2365, No. 42632.
[5] Ibid., vol. 1102, No. 16908.
[6] Ibid., vol. 1651, No. 28395.
[7] Ibid., vol. 1284, No. 21159.
[8] Ibid., vol. 1764, No. 30674.
[9] Ibid., vol. 993, No. 14537.
[10] http://www.unep.org/NairobiConvention/The_Convention/index.asp

the Red Sea and Gulf of Aden Environment[11] (Jeddah Convention) (lists not yet provided by contracting parties), the Convention for Cooperation in the Protection, Management and Development of the Marine and Coastal Environment of the Atlantic Coast of the West, Central and Southern Africa Region[12] (Abidjan Convention) (considering adding a species list), and the Convention for the Protection and Development of the Marine Environment in the Wider Caribbean Region (WCR)[13] (Cartagena Convention) (5 species). In addition to the above agreements, Regional Fisheries Management Organisations (RFMOs) have also begun to adopt strategies that address incidental seabird bycatch. Level of regulation varies across RFMOs but includes combinations of the use of one or more bycatch mitigation measures in certain areas, data collection through observer programmes and use of monitoring, surveillance and compliance measures.

3. Key pressures linked to trends

The majority of seabirds are highly migratory species that require a variety of marine and terrestrial habitats during different seasons and life stages (Lascelles et al, 2014). Many seabirds are long-lived and slow reproducing. These characteristics make them particularly vulnerable to a wide range of pressures, where even quite small increases in mortality can lead to significant population declines. In addition, many seabirds have highly specialised diets, being reliant on just a few prey species, the abundance and distribution of which can alter dramatically in response to abrupt environmental changes.

Croxall et al. (2012) found that globally, of the top 10 pressures on threatened seabirds (Figure 4), invasive species typically acting at the breeding site potentially affect 73 species (75 per cent) of all threatened seabird species and nearly twice as many as any other single threat, although in some cases the threat is of a potential future impact. The remaining pressures are fairly evenly divided between: (a) those acting mainly at the breeding site, namely problematic native species (e.g. those that have become superabundant - 31 species, 32 per cent), human disturbance (26 species, 27 per cent), infrastructural, commercial, and residential development (14 species, 14 per cent) and (b) those acting mainly at sea in relation to foraging, moulting or migration areas/aggregations, namely, bycatch in longline, gillnet and trawl fisheries (40 species, 41 per cent), pollution (30 species, 31 per cent), overfishing and/or inappropriate spatial management of fisheries (10 species, 10 per cent). Hunting and trapping (23 species, 24 per cent) and energy production and mining (10 species, 10 per cent) affect both domains, the former more at breeding sites, the latter more in relation to foraging areas, flight paths and flyways. Climate change and severe weather (39 species, 40 per cent), as currently assessed, largely reflect adverse weather and flooding at breeding sites. However, the impact of sea

[11] http://www.persga.org/Documents/Doc_62_20090211112825.pdf
[12]http://abidjanconvention.org/index.php?option=com_content&view=article&id=100&Itemid=200&lang=en
[13] United Nations, *Treaty Series*, vol. 1506, No. 25974.

level rise is clearly an important driver of change that is increasingly affecting seabirds in many ways, albeit mainly in the medium to long term (i.e., at time frames mostly outside those of relevance to IUCN Red List criteria). The relative importance of threats is largely similar when only those of high impact are considered, although bycatch becomes almost as significant as the effects of invasive alien species (Croxall et al., 2012).

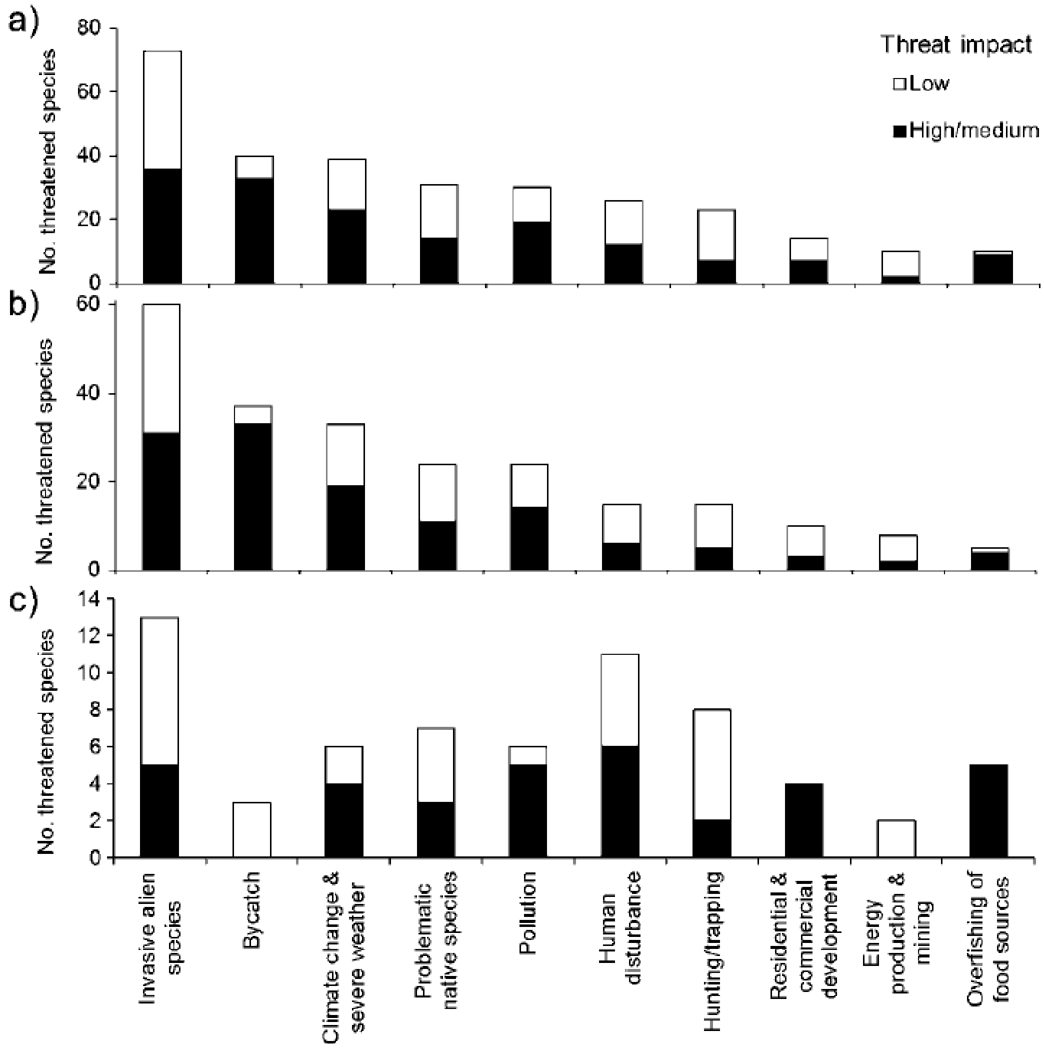

Figure 4: threats to threatened (a) seabirds (n=346 species); (b) pelagic seabirds (n=197 species); (c) coastal seabirds (n=146 species). Source: Croxall et al., 2012.

Commercial fisheries are the most serious at-sea pressure facing the world's seabirds, affecting both adult and juvenile birds. Despite data gaps, each year incidental bycatch in longline fisheries is estimated to kill 160,000-320,000 seabirds from 70 species, although there is evidence of substantially reduced bycatch in some key fisheries where the pressure has been managed (Anderson et al., 2011). Several papers have reviewed seabird bycatch rates in both demersal (bottom) and pelagic (upper water column) longline fisheries in various regions (e.g., Brothers, 1991; Dunn and Steel, 2001; BirdLife International, 2007; Steven et al., 2007; Bugoni et al., 2008; Rivera et al., 2008; Waugh et al., 2008; Kirby et al., 2009, Waugh et al., 2012), and two assessments have been made on a global scale (Nel and Taylor, 2003; Anderson et al., 2011). The fleets identified as having the highest levels of seabird bycatch include the Spanish hake fleet in the Gran Sol area, the Japanese pelagic tuna fleet in the North Pacific, the Namibian hake fleet and the Nordic demersal fleets (Anderson et al., 2011). The impacts of illegal, unreported, and unregulated fishing (IUU) on seabirds have been estimated in the thousands of individuals each year south of 30° S but are inherently difficult to assess here and elsewhere (Anderson et al., 2011).

Since 1992 a global moratorium has been imposed on the use of all large-scale pelagic drift-net fishing on the high seas, including enclosed and semi-enclosed seas (General Assembly resolution 46/215). Gillnet fisheries (both set and drift nets) are, however, still permitted to operate within a State’s Exclusive Economic Zone (EEZ). Although many data gaps remain, hampering assessment, a review of existing data shows that gillnets are responsible for the incidental capture of large numbers of birds, sharks and marine mammals (e.g., Northridge, 1991; Hall, 1998; Tasker et al., 2000; Johnson et al., 2005; Rogan and Mackey, 2007; Žydelis et al., 2013). Amongst birds, the pursuit-diving species, such as divers (loons), grebes, seaducks, auks and cormorants, are the most vulnerable to entanglement (Piatt and Nettleship, 1987; Žydelis et al., 2009). The most recent global review estimated incidental bycatch in gillnet fisheries at 400,000 seabirds from 150 coastal and diving species each year (Žydelis et al., 2013). The highest bycatch has been reported in the Northwest Pacific, Iceland and the Baltic Sea (Žydelis et al., 2013).

Although seabird bycatch in long-line fishing has been known since the 1980s, the threat posed by trawl fisheries has also become apparent in recent years (Bartle, 1991; Weimerskirch et al., 2000; Sullivan et al., 2006). No global review of the impact of trawl fishing on seabirds has been undertaken, but a number of regional and national levels studies highlight the significance of the problem (Gonzalez-Zevallos et al., 2007; Petersen et al., 2008; Yorio et al., 2010) with tens of thousands of 40 larger species of seabird thought to be killed each year. Trawling can also alter benthic habitats which may have indirect impacts on seabirds via the effect this has on forage fish species (see, for example, Chapter 36A).

Fisheries may compete with seabirds for their prey items, and overfishing of both forage species and predatory species that help aggregate food sources for seabirds have been cited as a reason for the decline in several species (e.g., Becker and Beissinger, 2006; Camphuysen, 2005). Cury et al. (2011) assessed prey abundance and breeding success for 14 bird species within the Atlantic, Pacific, and Southern Oceans and found that when less than one third of the maximum prey biomass was available to seabirds, their productivity was adversely affected.

Climate change and severe weather driven by habitat shifts and alterations, storms and flooding, and temperature extremes are already affecting some seabird species. Species' sensitivity and adaptive capacity depend on a suite of taxon-specific biological and ecological traits; as well as the degree to which they are exposed to changes in climate (Foden et al. 2013). Known negative impacts may include loss of habitat, decreased marine productivity causing shifts in location of prey, and shifts in range and migration routes due to changes in winds, ocean currents and sea surface temperature (e.g. Forcada and Trathan, 2009; Hazen et al., 2012; Sydeman et al., 2012).

Pollution in various forms is a widespread problem adversely affecting many seabirds. Oil spills, from both offshore facilities and shipping tankers, can cause mortalities that lead to population-level impacts, particularly when they occur within the most sensitive sites. Single spills have been recorded as killing up to a quarter of a million birds (García et al., 2003) and causing the loss of 7 per cent of regional populations of certain species (Piatt and Ford, 1996). Since its advent, plastic in the form of solid waste materials has become ubiquitous in all oceans of the world and entanglement and ingestion of this material by seabirds is now a widespread problem, affecting at least 100 species (Laist, 1997, Provencher et al. 2014).

Attraction to artificial sources of light has been recorded in at least 21 species of Procellariiformes, as well as in several other seabird groups, and has a detrimental effect on some globally threatened populations (Reed et al., 1985), notably shearwater (e.g. Day et al. 2003) and Pterodroma (e.g. Ainley et al. 1997; Le Corre et al. 2002;) species around their breeding colonies. Light-induced seabird collisions at sea, either with fishing vessels (such as those emitting light to catch squid) or with marine oil platforms, are difficult to quantify, occurring episodically particularly in low-visibility conditions and probably exacerbated by seabirds' attraction to bright lights and flares (Ronconi et al 2014). However, up to tens of thousands of seabirds have been observed in a single collision event (Montevecchi, 2006).

Impacts from shipping may include water and air pollution, disturbance, and collision. The level of impact may increase in the future as ship traffic increases, particularly in sensitive areas such as the Arctic, where key seabird habitats and potential shipping routes may overlap, and further exacerbate impacts from predicted climate change (Humphries and Huettman 2014).

4. Major ecosystem services provided by the species group and impacts of pressures on provision of these services

4.1 Services to ecosystems

The role of seabirds as potential indicators of marine conditions is widely acknowledged (e.g., Boyd et al., 2006; Piatt et al., 2007; Parsons et al., 2008). Many studies use aspects of seabird biology and ecology, especially productivity and population trends, to infer relationships with and/or effects on and/or correlate with aspects of the marine environment, particularly food availability.

Seabirds play a key role in nutrient cycling via the shaping of the plant community in their terrestrial and coastal breeding habitat. Seabirds transport allochthonous nutrients (i.e., fixed nitrogen, phosphorus, and trace elements), mainly via their guano, to seabird colonies (i.e., cross-ecosystem subsidies). They also shape plant communities in their breeding habitat by creating physical disturbance, dispersing seeds, and bioturbating the soil with their burrowing (Ellis, 2005; Bancroft et al., 2005). These functions provided by seabirds increase productivity and diversity in terrestrial and coastal ecosystems surrounding seabird colonies (Powell et al., 1991; Bosman et al., 1986; Brimble et al., 2009).

4.2 Direct services to humans including economic and livelihood services

Seabirds contribute several provisioning (e.g., protein, guano) services, play an important cultural role in many countries (e.g., for the Maori of New Zealand and the Tsimshian of Alaska), and feature in Greek, Hawaiian and Christian mythology. Seabird breeding colonies are increasingly used as a means to generate tourism income.

Seabird guano has excellent properties as a natural fertilizer enriching both terrestrial (Havik et al. 2014) and marine (Gagnon et al. 2013) environments. It consists of nitrogen-rich ammonium oxalate and urate, phosphates, as well as some earth salts and impurities. It typically contains 8 to 16 per cent nitrogen (the majority of which is uric acid), 8 to 12 per cent equivalent phosphoric acid, and 2 to 3 per cent equivalent potash. Archaeological evidence suggests that Andean peoples have collected seabird guano for well over 1,500 years (Collar et al., 2007). A harvest boom in the nineteenth century, called the “white gold rush”, saw tens of thousands of workers extracting guano from the Peruvian seabird breeding islands and loading thousands of tons onto each ship. Other harvested guano islands were located in the Caribbean, atolls in the Central Pacific, and off the coast of Namibia, South Africa, Oman, Patagonia, and Baja California (Skaggs, 1994). This unsustainable harvest resulted in massive deposits of guano, in some cases more than 50 m deep, being severely depleted. Many areas of the industry collapsed, although some Peruvian islands are still managed for guano on a rotational system (Méndez, 1987).

Harvesting of seabird adults, chicks, eggs, and feathers have been important activities for some coastal communities for many centuries, but have also driven seabird declines. Bones were used to make fishing hooks and musical instruments and to engrave tattoos; feathers featured prominently in the millinery trade and are still used in some countries for local arts and handicrafts, e.g., to make cloaks and hair adornments (Spennemann, 1998). The meat and eggs still form key sources of protein. Harvest methods have changed over time to include more efficient tools, making the seabirds more exposed to excessive harvesting. Declines in a number of species have been attributed to over-exploitation. Harvesting quotas exist in some areas, such as in the Seychelles (limited to 20 per cent of Sooty Tern eggs each year), New Zealand (limited to 13 per cent of Sooty Shearwater chicks each year (Newman et al., 2009), and the United Kingdom (limited to 2,000 Northern Gannet each year).

However, unregulated harvesting is a substantial problem in the entire Arctic region (2 million adults and countless eggs of several species of Alcidae are taken each year (Merkel, 2008))**,** the Tuamotus and the Marquesas (egg collection), Peru (Waved Albatross and Humboldt Penguin), Madagascar (egg collection), Jamaica (egg collection (Haynes, 1987)) and Indonesia.

For centuries fishers have used seabirds as a visual guide to locate fishing areas. They remain important for artisanal operations (such as in Hawaii, Comoros, Madagascar and Tanzania), which search for flocks of seabirds in order to find fish. Without seabirds, these livelihoods (e.g., catching small skipjack and juvenile yellow-fin tuna) could disappear or be substantially adversely affected.

Viewing seabirds is an increasingly popular pastime for many tourists; many spectacular breeding colonies are accessible to visitors and revenues generated contribute substantially to local economies (Steven et al., 2013). For example, in Australia, the Phillip Island Little Penguin colony receives half a million visitors a year, spending 35 million Australian dollars (Marsden Jacob Associates, 2008). A single African Penguin colony in South Africa generates United States dollars 2 million/yr in tourist revenue (Lewis et al., 2012). In New Zealand, nature-based tourism relying primarily on the Yellow-eyed Penguin returned 100 million dollars annually to the Dunedin economy, hence a single breeding pair could be worth 60,000 dollars/yr (Tisdell, 2008). The Royal Society for the Protection of Birds (RSPB) estimated that four of its seabird reserves in the UK (one each in England, Northern Ireland, Scotland and Wales) together generated around 1.5million dollars/yr for the local economies (RSPB 2010). Tourism in the Galapagos is thought to generate over 62 million dollars each year; seabirds are a prime reason for visiting. Pelagic trips to view seabirds at sea have also become popular, particularly in Europe, North America and the Southern Ocean. The value of these trips has not been quantified to any degree, but is likely to be significant; for example, 80,000 dollars was spent on a single pelagic trip off South Africa (Turpie and Ryan, 1999).

5. Conservation responses and factors for sustainability

Data on seabird distribution, abundance, behaviour and pressures can be used to inform the design of effective management regimes (Lascelles et al 2012). Management decisions can be guided by: (1) where the key areas are, (2) when these areas are used, (3) what variables explain seabird presence in a given area, (4) the threat status of species in a given area, (5) what pressures may be adversely affecting the species, associated habitats and processes, (6) what management actions are needed to address these threats, and (7) how any management intervention can best be monitored to assess its effectiveness.

Depending on the species, the priority actions needed may involve: (a) formal and effective protection of the most important sites. For site protection to be effective, it should ensure that areas are large enough to capture critical behaviour (such as key breeding sites, the marine areas around them used for maintenance and more distant feeding and aggregation sites), consider temporal and spatial variations, and have adequate regulation to minimise effects of any pressures. Where national, regional and global networks of Marine Protected Areas (MPAs) are being developed, inclusion of key sites in those networks would contribute substantially to the necessary site protection; (b) removal or control of invasive, and especially predatory, alien species from areas used for seabird breeding, feeding and/or aggregation, as part of habitat and species recovery initiatives; and (c) reduction of bycatch to levels that do not pose a threat of species decline. For many uncommon species or species of low productivity, this likely can only be achieved when bycatch is reduced to near zero. Other, more generic actions, such as education and awareness-raising and accompanying stakeholder involvement, are also high priorities, as are some more species-specific activities, such as harvest management, species reintroductions and species recovery. Although it is relatively straightforward to derive these generic recommendations for conservation action, it can be costly and difficult to implement them effectively and at a sufficient scale to make a difference to the conservation status of seabird species. However, progress has been achieved in recent years in terms of the three highest priority actions, but despite these successes, problems will continue without further action.

Where simple seabird mitigation measures have been implemented, there is evidence of substantially reduced bycatch in some key fisheries where the pressure has been managed (e.g. Anderson et al., 2011), including a greater than 95 per cent reduction in some areas (Maree et al., 2014). The main tuna RFMOs now have voluntary or binding regulations in place that require the use of a combination of mitigation techniques in different geographies, though their effectiveness may be hampered by a lack of monitoring and/or enforcement.

Key sites for seabirds have begun to be protected in several countries, primarily covering selected breeding sites on land, though marine designation for seabirds has also advanced, with new MPAs in Europe, the Antarctic and the Americas in recent years. Where eradications and/or controls of invasive alien species have been undertaken, recoveries of seabird populations have been rapid and dramatic (e.g Pitman et al., 2005), and a great number of larger islands are now being tackled. Translocations of some species to new locations have also proved an effective conservation strategy for several species (e.g. Carlile et al., 2003; Madeiros 2004).

Actions that are implementing an ecosystem approach to capture fisheries management are discussed in Part IV of this assessment; many of those measures, including better management of selectivity of fishing gear and including ecosystem feeding requirements in setting fishery harvest limits, will contribute to improving the conservation status of seabirds if implemented effectively.

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