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Marine spatial planning for the conservation of albatrosses and large petrels breeding at South Georgia

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ABSTRACT

Tracking of seabirds at sea is valuable for marine spatial planning. Many seabirds are of conservation concern, including albatrosses and large petrels (Procellariiformes) which face a major threat from mortality in fisheries. We examine how important areas used by seven of these species breeding at South Georgia change throughout the year, based on tracking data collected between 1991 and 2012, and discuss the implications for spatial management in the region within the current jurisdictional framework.

Foraging areas overlapped with a patchwork of national and international management organizations, and areas outside clear jurisdiction. National waters were generally unimportant, besides that of South Georgia. The other exception was Falkland Islands coastal waters, which were important for wandering albatrosses *Diomedea exulans* during incubation, and were opened for new oil and gas drilling in 2015. The marine protected area established at the South Orkney Islands protects very little habitat used by the tracked seabirds; however, a northern extension of this would benefit a number of species at different breeding stages.

The area around South Georgia was important year-round, including in periods when fishing is allowed. A contiguous region to the north of this was also important and here, mechanisms should be improved to ensure compliance with bird bycatch mitigation recommendations. The study highlighted the use of tracking for identifying key areas for pelagic albatrosses and petrels, and the advantages of incorporating these data into a multilateral approach to marine spatial planning to ensure the future conservation of these highly-threatened marine predators.

1. Introduction

The loss of terrestrial biodiversity and habitat can be ameliorated, to some extent, by establishing national parks (Rodrigues et al., 2004; Le Saout et al., 2013). The creation of such national parks has a long history, with the first designated at Yellowstone, USA in 1872, yet similar protection measures were only implemented in the marine realm much more recently. Targets initially set at the World Summit on Sustainable Development in 2002, aiming to reduce biodiversity loss by establishing a network of MPAs by 2012, were not met and were revised in 2010 to a more achievable goal of protecting 10% of ecological systems in the marine and coastal environment by 2020, known as Aichi Target 11. The aim is to establish a network of MPAs that are "ecologically representative and well-connected" and "integrated into the wider land- and seascape" by 2015. Though these redefined targets are more qualitative, meeting them remains a major challenge; to date, MPAs have been designated in just 2.8% of the global ocean (International Union for the Conservation of Nature and United Nations Enivironment Programme-World Conservation Monitoring Centre, 2013).

The existing MPAs are mainly located within 200 M of the coast, under national jurisdictions or EEZs. The notion of national EEZs was developed by the United Nations and implemented under the 1982 UNCLOS in order to help resolve territorial disputes over ocean resource ownership and exploitation. Management of areas within EEZs is simplified, in theory, because they are controlled by a single organization; a national government. UNCLOS categorized areas beyond these zones as "the common heritage of mankind", which amounts to more than two thirds of the surface of the global ocean (and 70% of its volume) and is classified as "high-seas" (Rogers et al., 2014). The high seas comprise 45% of the earth's surface and yet only 0.79% of their area is designated as MPAs (High Seas Alliance, 2014). Although out of sight of most of the human population, and seemingly far removed from coastal fisheries within EEZs that are more heavily legislated, increasing recognition of the intrinsic value provided by the high seas has led to calls for the establishment of high seas MPAs (Game et al., 2009). In terms of commercial fishing, Rogers et al. (2014) showed that 99% of commercial fish species span both coastal and high seas habitats. Recent modeling of the link between commercial fisheries within EEZs and

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Table 1
Number of tracks included in study in each year, species and breeding stage. As these species breed in the austral summer (with egg laying in Sept. to Dec.) the year indicated is the year in which the chicks fledge.

Species, IUCN Red List Status and Population Trend	Stage	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Wandering Albatross Vulnerable / Decreasing	Incubation															17								
	Brood		14	14						22		14			30	22								
	Post-brood		30							22	22	30		54		31		14			31			
Black-browed Albatross Threatened / Decreasing	Incubation							14					22											
	Brood													19								67		
	Post-brood				54									23										
Grey-headed Albatross Endangered / Decreasing	Incubation													23										
	Brood					8																30		30
	Post-brood				57	19		16				11										33		33
Light-mantled Sooty Albatross Near-threatened / Decreasing	Incubation																							
	Brood																							
	Post-brood														42									
White-chinned Petrel Vulnerable / Decreasing	Incubation														14									
	Brood																							
	Post-brood									22														
Northern Giant Petrel Least concern / Increasing	Incubation																							
	Brood																30							
	Post-brood																							
Southern Giant Petrel Least concern / Increasing	Incubation																24							
	Brood																13							
	Post-brood																13							

those in the high seas illustrated that complete closure of the high seas to all fishing would lead not only to a dramatic recovery of global fish stocks, but also to increased profitability of fisheries within EEZs (White and Costello, 2014).

Despite the importance of the offshore marine environment, UNCLOS is not set up as a global instrument for the designation of MPAs in the high seas, neither does it stipulate the requirement for Environmental Impact Assessments of activities in the high seas, and nor is there any other appropriate legal framework in existence that does so (Scott, 2012). New regulatory frameworks have been called for, as has the use of surveillance technology for their enforcement (Delfour-Samama and Leboeuf, 2014). Currently, the majority of high seas fishery management is carried out by an incomplete patchwork of regional fisheries management organizations. In some cases, these are directed at a single species, or a small group of related species, and national membership is voluntary with resolutions optional, even for signatories (Small, 2005). Implementation of their regulations is variable, depending on licensing controls and resources available for policing and enforcement; indeed, current levels of observer coverage are considered far below that sufficient to estimate seabird bycatch accurately (Churchill, 2011; Phillips, 2013). More than two thirds of fisheries managed by RFMOs lack regional observer coverage, and fish stocks in waters with no national jurisdiction have been shown to be systematically over exploited (McWhinnie, 2009; Gilman et al., 2014).

The geopolitical landscape in the region used by albatrosses and petrels breeding at South Georgia is diplomatically complex and to a large extent reflects the challenges facing high seas protection in general, having no clear global structure or framework for management of threatening processes other than fishing and pollution (Kimball, 2005). The first MPA to be established in the high seas was implemented under CCAMLR in 2009; the South Orkney Islands Southern Shelf MPA. In October 2014, the fourth round of talks at CCAMLR aimed at moving forward with the designation of further MPAs in the Southern Ocean collapsed when consensus could not be reached. High seas management has been identified as one of the most important issues for the conservation of global biodiversity (Sutherland et al., 2009). New structures for high seas governance under the United Nations Convention on the Law of the Sea (UNCLOS) have been debated since the United Nations Conference on Sustainable Development recognized the need for high seas biodiversity conservation in 2012 (Ban et al., 2014). However, implementation of new instruments for cohesive management of the global ocean is not imminent and it is not clear how current geopolitical concerns can be surmounted in the immediate future.

The distributions of seabirds are recognized as important indicators of marine ecosystem processes (for example, the black-browed albatross *Thalassarche melanophris* is used as an ecosystem monitoring indicator species by the CCAMLR and can therefore inform the process of MPA design (De Monte et al., 2012; Wong et al., 2014). When used in this way, seabird distribution acts as a proxy for ecosystem productivity; the MPAs that have been designated on this basis within EEZs provide some benefits to the indicator species if they encompass near-shore foraging or rafting zones (Tanner et al., 2008). However, many seabirds forage predominantly in the high seas where protection measures are varied and fragmented. Not only do the lack of cohesive governance, geopolitical issues and competition with fisheries for natural resources make high seas protection difficult, but also seabirds are more threatened, and their conservation status poorer, than any other comparable bird group, with commercial fishing and pollution constituting the main threats while at sea (Croxall et al., 2012). Fishing vessels have been shown to be important foraging cues for seabirds and, each year, an estimated 200,000 and 400,000 seabirds, respectively, are killed in longline, and gillnet fisheries, and mortality is of a similar order in trawl fisheries (Anderson et al., 2011; Løkkeborg, 2011; Žydelis et al., 2013).

Here, we compile available tracking data collected during the breeding season from seven species of medium-sized to large Procellariiformes (albatrosses and petrels) at South Georgia (wandering albatrosses *Diomedea exulans*, black-browed albatrosses, gray-headed albatrosses *Thalassarche chrysostoma*, light-mantled albatrosses *Phoebetria palpebrata*, white-chinned petrels *Procellaria aequinoctialis*, northern giant petrels *Macronectes halli* and southern giant petrels *Macronectes giganteus*). We examine the regulatory frameworks in force across the distribution of these seven species, review the conservation measures that have been put in place by the different management organizations, the extent of observer coverage and the degree of compliance, to assess the degree of protection afforded in different parts of the range to each species, and how this changes throughout the year.

2. Methods

Wandering, black-browed, gray-headed and light-mantled albatrosses and white-chinned, northern giant and southern giant petrels breeding at South Georgia (54°00′S, 38°03′W) were tracked during incubation, brood-guard (early chick-rearing) and post-brood (mid to late chick rearing) in one or more seasons from 1991 to 2012.