

Marine protected areas, spatial scales, and governance: implications for the conservation of breeding seabirds

Pablo Yorio

Centro Nacional Patagónico (CONICET) and Wildlife Conservation Society, Bv. Brown 2915, (9120) Puerto Madryn, Chubut, Argentina

Keywords

Breeding seabirds; conservation tools; fisheries; foraging seabirds; governance; marine protected areas; Patagonia; spatial scales.

Correspondence

Pablo Yorio, Centro Nacional Patagónico (CONICET), Boulevard Brown 2915, (9120) Puerto Madryn, Chubut, Argentina.
Tel: 54-2965-451375; fax: 54-2965-451543.
E-mail: yorio@cenpat.edu.ar

Received: 3 February 2009; accepted 21 April 2009.

doi: 10.1111/j.1755-263X.2009.00062.x

Abstract

As in many regions worldwide, seabird colonies in Argentina are important conservation targets of marine protected areas (MPAs). Seabirds are wide ranging, often crossing jurisdictional boundaries during foraging. Using a recently designated MPA as a case study, this article discusses the challenges of protecting breeding seabirds given their spatial requirements and use of different jurisdictions. Seabirds breeding at the MPA have distinct foraging strategies. Rock Shags and Olrog's Gulls forage inshore within the MPA. Imperial Cormorants, Magellanic Penguins, and Southern Giant Petrels, in contrast, often feed beyond the MPA's jurisdiction, traveling into provincial, federal, or international waters where they can be affected by fisheries and oil development. This indicates the need of management actions beyond MPA boundaries. The large scale and connectivity of marine ecosystems and the variety of economic pressures require the participation of stakeholders and several government agencies in conservation issues, and thus integrated coastal management and marine spatial planning appear as options to complement the use of MPAs. Although MPAs are a valuable tool to conserve breeding seabirds, increased efforts are needed to design new governance structures and complementary strategies for spatial protection so as to deal with the biological, social, and political complexities of marine systems.

Introduction

Seabirds are important components of marine ecosystems which are characterized by a long life span, delayed maturity, low fecundity, and high adult survival (Furness & Monaghan 1987). Given their life-history traits, seabirds are highly vulnerable to some human impacts (Croxall & Rothery 1991; Boersma *et al.* 2002a). Seabirds are also wide ranging, several of them moving from hundreds to thousands of kilometers during foraging trips or winter migrations (Schreiber & Burger 2002). Current main threats to breeding seabirds worldwide include commercial fisheries, pollution, human disturbance, alien species, and global climate change.

Marine protected areas (MPAs) have been proposed and used as a tool for seabird conservation worldwide (Duffy 1994; Hyrenbach *et al.* 2000; Yorio 2000; Johnston 2001; Wienecke & Robertson 2002; Aíramé *et al.* 2003;

Garthe & Skov 2006; Lombard *et al.* 2007). Seabirds are colonial and thus concentrate, often in large numbers and in mixed-species assemblages, to nest at specific locations along the continental shore and islands during the breeding season. Of the 31 marine protected areas in Argentina, 21 include colonies of one or more seabird species (Yorio *et al.* 1998; P. Yorio, unpublished data). Moreover, the main objective in designating some of these areas has been the protection of their colonies, particularly for ecotourism. As in many other regions, these MPAs are focused on the protection of such breeding colonies but seldom include adjacent marine areas of appropriate size to fulfill conservation goals. Many of the existing MPAs may provide relatively good protection for seabirds while they are on land during the nesting season, by controlling human visitation or preventing habitat modification. However, MPAs are in general ineffective for the protection of highly mobile species or species

showing site fidelity but with high dispersal abilities such as seabirds (Boersma & Parrish 1999; Hyrenbach *et al.* 2000; Yorio 2000; Boersma *et al.* 2002b). Interestingly, few marine reserves have been designed to explicitly address movement of top predators such as seabirds (Gerber *et al.* 2003; Hooker & Gerber 2004; but see Louzao *et al.* 2006). In addition, because of their large-scale movements seabirds often cross-jurisdictional boundaries and, thus, their protection needs an integrated approach at different spatial scales. Using the recent designation of a new MPA in Golfo San Jorge, Patagonia, as a case study, this article discusses the challenges of protecting breeding seabirds given their different spatial scale requirements, the complexities derived from their use of different jurisdictions and vulnerability to wide range and large-scale human activities, and the opportunities and limitations of using protected areas as a tool for their conservation.

Breeding seabirds of Golfo San Jorge

The northern sector of Golfo San Jorge, between Cabo Dos Bahías ($44^{\circ} 55' S$, $65^{\circ} 31' W$) and Isla Quintano ($45^{\circ} 13' S$, $66^{\circ} 03' W$) in central Patagonia (Figure 1), includes over 3,500 km² of highly productive waters, approximately 250 km of coastline cut by numerous bays and inlets, and more than 50 islands and islets. This sector is one of the most important coastal areas in terms of marine biodiversity (Fundación Patagonia Natural 1996) and one of the priority areas for breeding seabirds in Argentina. Thirteen of the 16 Patagonian breeding seabirds nest on the islands of this coastal sector, including a significant proportion of the Patagonian population of some species. For example, the sector holds 25% of the Near Threatened Magellanic Penguin (*Spheniscus magellanicus*), 80% of the Near Threatened Southern Giant Petrel (*Macronectes giganteus*), and 28% of the Imperial Cormorant (*Phalacrocorax atriceps*). It is also one of the two breeding grounds of the Vulnerable Olog's Gull (*Larus atlanticus*). Magellanic Penguins and Imperial Cormorants are important targets for ecotourism and guano production, respectively (Yorio *et al.* 1999). Recognition of the environmental value of this area has resulted in its recent designation as a marine protected area by the federal and provincial governments, through an agreement between the National Parks Administration and the Government of the Province of Chubut (Law 26446/2008). Although a great success for conservation, the resulting protected area is significantly smaller than originally planned. Only an area of 750 km², one quarter of the size defined in the original proposal and extending from the high tide mark one nautical mile offshore, was finally included in the Marine Park.

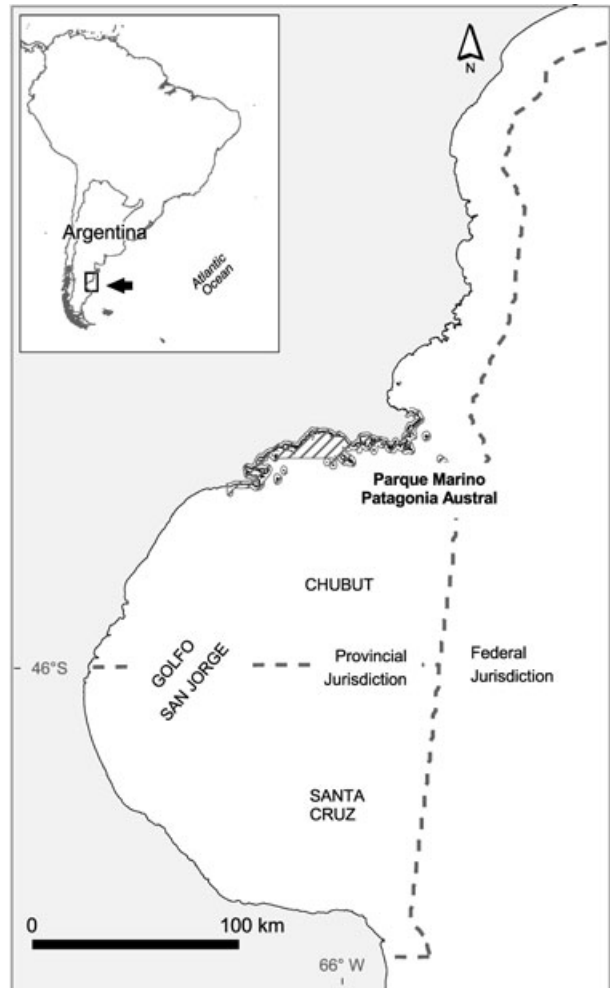


Figure 1 Geographical location of Golfo San Jorge and jurisdiction limits for the study area. The management of waters and seabird populations within the gulf are shared by the provinces of Chubut (north of $46^{\circ} S$) and Santa Cruz (south of $46^{\circ} S$). Waters east of the shown provincial limit are under the management of the Federal Government. The hatched area corresponds to the Patagonia Austral Marine Park.

Despite the designation of the Marine Park and the governments' willingness to conserve this important sector, the area still faces major threats. Increased interest in offshore oil development, ecotourism, and artisanal fisheries are sources of concern. Oil pollution is a major threat for the marine environment in this area, Golfo San Jorge being one of the richest oil basins in Patagonia, and may affect several seabird species including valuable tourist resources such as the Magellanic Penguin (Gandini *et al.* 1994; García-Borboroglu *et al.* 2006). However, the gulf's status as a primary fishing ground for the area's growing commercial fisheries represents the current most critical threat to the area's seabird populations. About 80 freezer trawl vessels targeting Argentine Red

Shrimp (*Pleoticus muelleri*) and 20 ice trawlers targeting Argentine Hake (*Merluccius hubbsi*) operate in waters of northern Golfo San Jorge mostly from September to May between 5 and 50 km offshore, although they can occasionally fish in waters outside the gulf to distances over 100 km offshore.

Research on the foraging ecology of several seabirds breeding at Golfo San Jorge has shown that different species have distinct foraging strategies with differing feeding ranges, and that the size of marine areas upon which they depend can be variable. Some species forage onshore or close to shore. For example, the threatened Olrog's Gull consumes mostly crabs along the intertidal zone relatively close to their colonies (Yorio *et al.* 2004) (Figure 2), while the Rock Shag (*Phalacrocorax magellanicus*) feeds within a few kilometers of its breeding sites in relatively shallow waters (Sapoznikow & Quintana 2003) (Figure 2). Other species, such as the Imperial Cormorant and the Magellanic Penguin forage further offshore, while still depending mostly on coastal waters. At Golfo San Jorge, these species have been recorded foraging up to approximately 70 and 120 km away from their colonies, respectively (F. Quintana & P. Yorio, unpublished data) (Figure 3). Southern Giant Petrels, in contrast, forage across large portions of the ocean up to 600 km from their colony (Quintana & Dell'Arciprete 2002) (Figure 4). The observed diversity in foraging ranges suggests the importance of considering different spatial scales when evaluating the needs of this seabird assemblage as well as the efficacy of the protected area.

Spatial scales and effectiveness of the protected area

Despite the fact that one of the goals for the designation of the new Marine Park was the protection of breeding seabird populations, the defined boundaries do not appear to be adequate for the effective protection of some species. The feeding grounds of the Olrog's Gull and Rock Shag are located close to shore, within the waters protected by the new Marine Park. Thus, the park provides spatial protection to both the nesting and feeding grounds of these species and a better setting for the management of existing small-scale activities such as ecotourism, artisanal fisheries, guano extraction, and macroalgae harvesting that may affect these seabirds. In contrast, Imperial Cormorants, Magellanic Penguins, and Southern Giant Petrels forage mostly beyond the limits of the park, and the main challenges facing their conservation include commercial fisheries and oil development taking place in the adjacent waters. Foraging Imperial Cormorants and Magellanic Penguins commonly overlap

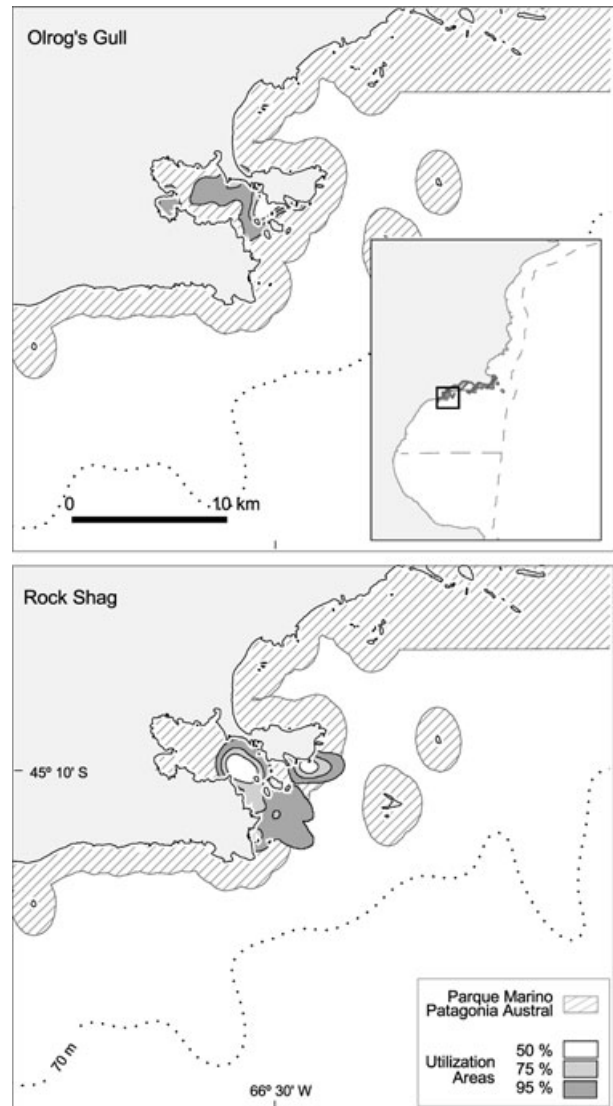


Figure 2 Relative locations of foraging areas of the Olrog's Gull (adapted from Yorio *et al.* 2004) and the Rock Shag (adapted from Sapoznikow and Quintana 2003), breeding at Caleta Malaspina, Golfo San Jorge, Chubut. Gray areas represent data density obtained using Kernel analysis (95%, 75%, and 50% contours). The hatched area indicates the Patagonia Austral Marine Park.

with trawl fishing operations within the gulf, often resulting in incidental mortality (Yorio *et al.*, unpublished data; González-Zevallos & Yorio 2006). For example, total mortality associated with trawl fisheries during the 2004 fishing season in northern Golfo San Jorge was estimated to be over 1600 Magellanic Penguins and 420 Imperial Cormorants (G. González-Zevallos & P. Yorio, unpublished data). Southern Giant Petrels breeding within the marine park show a marked spatio-temporal association with fisheries, particularly those operating on waters

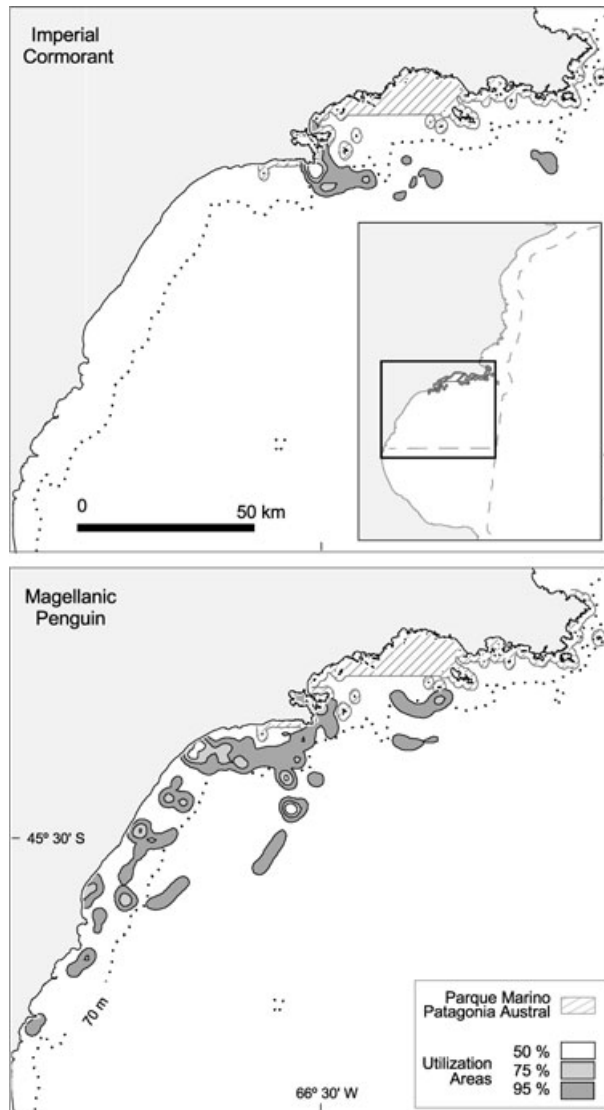


Figure 3 Relative locations of foraging areas of Imperial Cormorants and Magellanic Penguins breeding at Caleta Malaspina, Golfo San Jorge, Chubut, during 2007. Gray areas represent data density obtained using Kernel analysis (95%, 75%, and 50% contours). The hatched area indicates the Patagonia Austral Marine Park (Data source: F. Quintana and P. Yorio, unpublished data).

of federal jurisdiction (Copello *et al.* 2008). Similarly, oil pollution may affect seabird populations, as occurred in December 2007 when a spill in an area south of the Marine Park, and within the foraging range of breeding Magellanic Penguins, resulted in the mortality of over 1,000 individuals (P. García Borboroglu, personal communication). The importance of conservation and management actions directed at these economic activities outside the protected area boundaries should not be underestimated, as, given their life-history traits, seabirds are sensitive to

even slight changes in adult mortality (Furness & Monaghan 1987). The information on seabird foraging ecology indicates the need to re-evaluate the spatial design of the park and/or the definition of management actions beyond the boundaries of the protected area so as to complement the current protection afforded by the Marine Park.

The diversity in seabird foraging habits makes it clear that careful consideration of spatial scales is essential for the design of successful conservation actions. Effectiveness of marine protected areas depends on their ability to protect different life stages and distributional ranges (nesting, feeding, and migrating grounds), as vulnerability of a population may be habitat and stage specific (Hooker & Gerber 2004). If large enough, MPAs may help protect seabirds with large foraging ranges, at least during part of their annual cycle (e.g., Wieneke & Robertson 2002). However, in most cases breeding populations of seabirds with large foraging ranges cannot be adequately protected by MPAs alone, although the identification and implementation of MPA networks and corridors could increase the effectiveness of conservation efforts by linking spatial protection for different life stages (Roberts *et al.* 2003). Several initiatives have been working on the identification and selection of relevant marine areas for feeding, wintering, or migrating seabirds (e.g., Johnston *et al.* 2002; BirdLife International 2004; SPEA-SEO/BirdLife 2006; Skov *et al.* 2007; Rabuffetti *et al.* 2008). The special importance of areas for particular life-history stages of marine species has been identified as one of the key scientific criteria for selecting ecologically significant marine areas in need of protection in open-ocean waters and deep-sea habitats by the Conference of the Parties to the Convention on Biological Diversity, and which should guide the design of representative networks of marine protected areas (COP 9, Decision IX/20 2008). In addition, seabirds within protected areas may be negatively affected by outside factors, given the connectivity of marine systems and the linkages with terrestrial areas (Carr *et al.* 2003; Stoms *et al.* 2005). Thus, as for other wide-ranging top predators, broad-scale conservation activities may be often needed to protect seabird breeding populations (Sanderson *et al.* 2002; Boersma *et al.* 2002b; Boyd *et al.* 2008).

Scale and governance: complementary tools to marine protected areas

As indicated in the case of Golfo San Jorge, the large scale and connectivity of marine ecosystems and the variety of economic pressures on the marine environment necessarily require the participation of several agencies from

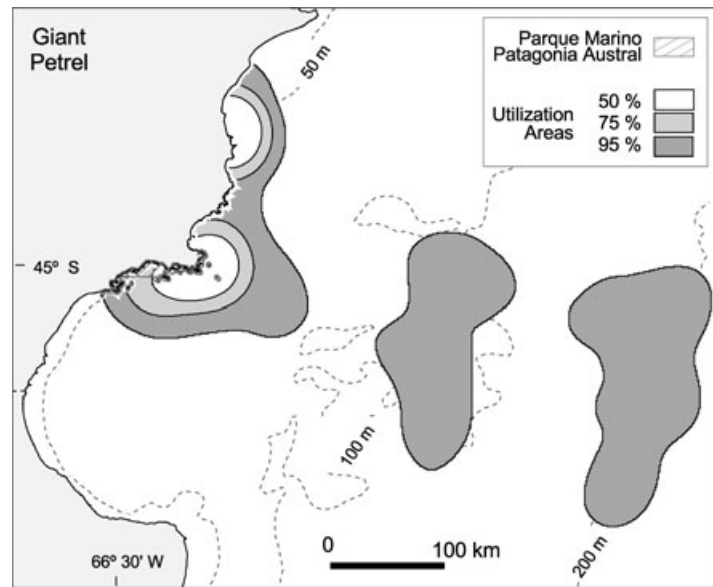


Figure 4 Foraging locations of Southern Giant Petrels breeding at Golfo San Jorge, Chubut. Gray areas represent data density obtained using Kernel analysis (95%, 75%, and 50% contours). The hatched area indicates the Patagonia Austral Marine Park (Data source: F. Quintana, unpublished data).

the same and different government levels in issues related to both protection and management. Seabirds such as the Imperial Cormorant, Magellanic Penguin, and Southern Giant Petrel often extend their feeding ranges way beyond the jurisdiction of the park—in this case partly the responsibility of the National Parks Administration—traveling into waters under provincial jurisdiction and, in the case of the latter two, often further offshore into federal waters (Figure 1). Southern Giant Petrels may even fly into international waters to the east of the shelf break (F. Quintana, unpublished data). In Argentina, biotic resources within gulfs and bays and from the coast up to a 12-mile offshore limit are under the domain and jurisdiction of provincial governments while those in the rest of the exclusive economic zone fall under federal control. This also has major implications, for example, with respect to widely distributed and mobile fish and invertebrate resources upon which wide-ranging seabird populations depend.

Coordination between agencies and administration levels in Argentina, is often inefficient and in many cases lacking altogether. This is mostly a result of the overlapping spheres of authority between administrative bodies and the lack of public organizations responsible for coordinating the various agencies and institutions (Esteves *et al.* 2000; Barragán-Muñoz *et al.* 2003). Conflicts of interest between administrative bodies and different governments may curtail important conservation initiatives. During the designation of the Marine Park in Golfo San Jorge, governance conflicts between provincial and federal levels in relation to the administration of natural resources were partially solved by the development of

an inter-jurisdictional agreement, which helped generate consensus. This treaty is an innovative legal instrument that will allow the co-management of a protected area that combines sections under the jurisdiction of different government levels. The management of natural resources within each of these sections will be under the responsibility of the corresponding administration level, but actions to fulfill the marine park's goals will be guided by a Management Committee constituted by members of both federal and provincial governments. If successfully implemented, this agreement may be used as an example to be applied in similar situations along the coasts of Argentina, as this or a similar type of cooperation between government levels will be required in most protected areas on the Patagonian coast under provincial jurisdiction which include breeding seabird populations dependent on offshore marine resources. However, in the case of Golfo San Jorge, different interests of administrative bodies at provincial and national levels, resulted in a marine protected area that is too small and does not include a large enough portion of the ocean to fulfill part of its conservation target. Limited communication and lack of mechanisms for effective coordination between agencies may also jeopardize seabird conservation and reduce management effectiveness. One of the challenges for the long-term preservation of marine resources in Argentina, including seabirds, is achieving effective joint efforts by different agencies, both within and between government levels (Esteves *et al.* 2000; Sabsay 2008).

In addition, given the dynamic nature of the marine environment and the current growth in human activities outside the limits of protected areas, the participation of

stakeholders is a key factor if the goal is to minimize negative impacts on seabird populations, particularly those derived from human activities operating at large scales. For example, the implementation of mitigation measures to reduce incidental mortality in fishing gear (Gandini *et al.* 2003; Sullivan *et al.* 2006; González-Zevallos *et al.* 2007) is dependent on the participation of fishing companies and fishers. Similarly, a reduction in oil dumping into the ocean will greatly depend on the compliance with current legislation by oil companies. These actions may be successfully implemented through sectoral planning and the regulation of specific economic activities. But in this respect, as well as in cases needing the interplay of several agencies, integrated coastal management and marine spatial planning appear as valuable options to complement the use of protected areas. Both tools allow for the coordination of different management or conservation actions across economic sectors and government levels, and include the consultation and agreement with stakeholders and communities, facilitating the implementation of guidelines (Post & Lundin 1996; Ehler & Douvère 2007). However, as has been suggested for similar scenarios, the complexity of problems resulting from the diversity of spatial scales, environmental problems, and actors at different levels will also require the exploration of new hybrid modes of governance structures (Lemos & Agrawal 2006).

Finally, it should be noted that consideration of the ecological scale and its relationship with governance structures and MPA effectiveness is not restricted to seabird conservation issues during the breeding season. Many seabirds from breeding sites in Patagonia migrate or disperse over large distances outside their breeding season, crossing international boundaries. For example, Magellanic Penguins and Olog's Gulls migrate north, many of them reaching to Uruguay and southern Brazil (Yorio *et al.* 1999; Schiavini *et al.* 2005), while Southern Giant Petrels disperse over wide oceanic areas reaching even New Zealand waters (F. Quintana, unpublished data). Conservation efforts directed at breeding populations will need complementary actions once birds leave their breeding areas for wintering grounds. Magellanic Penguins, for example, are regularly killed as a result of oil pollution during their migration in waters of northern Argentina, Uruguay, and Brazil (García-Borboroglu *et al.* 2006). International conventions, treaties, and agreements, such as the Convention for the Conservation of Migratory Species and the Agreement on the Conservation of Albatrosses and Petrels—both ratified by the Argentine government—can greatly contribute to integrate efforts to protect seabird populations. Other governance instruments related to the Large Marine Ecosystem approach are currently being developed and tested in other

regions (Sherman *et al.* 2008), and may be used in the design of management strategies at the level of the Patagonian Shelf LME.

The example from Golfo San Jorge highlights the complexities of governance issues and the importance of considering ecological scales in the design of proper conservation and management actions for seabirds and other marine organisms. These considerations can be generalized to the entire Argentine coast as, for example, penguins and cormorants regularly make foraging trips that take them far beyond the boundaries of protected areas at most of their main breeding locations in Patagonia (Stokes & Boersma 2000; Wilson *et al.* 2005; Boersma *et al.* 2007; F. Quintana *et al.*, unpublished data). Thus effectiveness of many MPAs that include seabird colonies as conservation targets will have to be carefully assessed in reference to their conservation goals. Given the foraging ranges of many seabirds, commuting between areas under different jurisdictions during foraging trips is very likely a common trait of populations of many species in many countries, resulting in similar governance problems. Although protected areas can be a valuable tool for the protection of breeding seabirds, increased efforts are needed to design alternative and complementary strategies for spatial protection so as to deal with the biological, social, and political complexities of marine systems. In particular, there is an urgent need for mechanisms of effective participation by different actors in ocean management planning, which will often require the development and implementation of new governance arrangements.

Acknowledgments

Support for the writing of this article was provided by the Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Argentina, and Wildlife Conservation Society. Special thanks to Kent Redford for his insights and helpful comments on the manuscript. Many thanks to Flavio Quintana for access to unpublished information and to Patricia Dell'Arciprete for help in developing the maps.

References

- Airamé, S., Dugan J.E., Lafferty K.D., Leslie H., McArdle D.A., Warner R.R. (2003) Applying ecological criteria to marine reserve design: a case study from the California Channel Islands. *Ecol Appl* **13** (Suppl), 170–184.
- Barragán-Muñoz, J.M., Dadon J.R., Matteucci S.D., Morello J.H., Baxendale C., Rodríguez A. (2003) Preliminary basis for an Integrated Management Program for the coastal zone of Argentina. *Coast Manage* **31**, 55–77.

- BirdLife International. (2004) Tracking ocean wanderers: the global distribution of albatrosses and petrels. Results from the Global Procellariiform Tracking Workshop, 1–5 September, 2003, Gordon's Bay, South Africa. Cambridge, UK: BirdLife International.
- Boersma, P.D., Parrish J.K. (1999) Limiting abuse: marine protected areas, a limited solution. *Ecol Econ* **31**, 287–304.
- Boersma, P.D., Clark J.A., Hillgarth N. (2002a) Seabird conservation. Pages 559–579 in E.A. Schreiber, J. Burger, editors. *Biology of marine birds*. CRC Press, Washington, D.C.
- Boersma, P.D., Stokes D.L., Strange I.J. (2002b) Applying ecology to conservation: tracking breeding penguins at New Island South reserve, Falkland Islands. *Aquat. Conservation* **12**, 63–74.
- Boersma, P.D., Rebstock G.A., Stokes D.L., Majluf P. (2007) Oceans apart: conservation models for two temperate penguin species shaped by the marine environment. *Mar Ecol Progr Ser* **335**, 217–225.
- Boyd, C., Brooks T.M., Butchart S.H.M. *et al.* (2008) Spatial scale and the conservation of threatened species. *Conserv Lett* **1**, 37–43.
- Carr, M., Neigel J., Estes J., Andelman S., Warner R., Largier J. (2003) Comparing marine and terrestrial ecosystems: implications for the design of coastal marine reserves. *Ecol Appl* **13** (Suppl), 90–107.
- Copello, S., Quintana F., Pérez F. (2008) Diet of the southern giant petrel in Patagonia: fishery-related items and natural prey. *Endang Species Res* **6**, 15–23.
- Croxall, J.P., Rothery P. (1991) Population regulation of seabirds: implications of their demography for conservation. Pages 272–296 in C.M. Perrins, J.-D. Lebreton, G.J.M. Hirons, editors. *Bird population studies: their relevance to conservation and management*. Oxford University Press, Oxford.
- Duffy, D.C. (1994) Toward a world strategy for seabird sanctuaries. *Colon Waterbirds* **17**, 200–206.
- Ehler, C., Douvère F. (2007) Visions for a Sea Change. Report of the First International Workshop on Marine Spatial Planning. Intergovernmental Oceanographic Commission and Man and the Biosphere Programme. IOC Manual and Guides No. 48, No. 4. Paris, UNESCO.
- Esteves, J.L., Ciocco N., Colombo J.C. *et al.* (2000) The Argentine Sea: the southeast South American shelf marine ecosystem. Pages 749–771 in C. Sheppard, editor. *Seas at the Millennium*. Elsevier Science, Amsterdam.
- Fundación Patagonia Natural. (1996) *Plan de Manejo Integrado de la Zona Costera Patagónica: diagnóstico y recomendaciones para su elaboración*. Fundación Patagonia Natural and Wildlife Conservation Society, Puerto Madryn, Argentina.
- Furness, R.W., Monaghan P. (1987) *Seabird ecology*. Blackie, Glasgow.
- Gandini, P., Boersma P.D., Frere E., Gandini M., Holik T., Lichtschein V. (1994) Magellanic Penguins (*Spheniscus magellanicus*) affected by chronic petroleum pollution along coast of Chubut, Argentina. *Auk* **111**, 20–27.
- Gandini, P.A., Rabuffetti F., Crujeiras J., Nieto G., Cesar G. (2003) Status and trends in the Argentinean longline fisheries, evaluation of mitigation measures and its efficiency. FAO Fisheries Report, no. 751.
- García-Borboroglu, P., Boersma P.D., Ruoppolo V. *et al.* (2006) Chronic oil pollution harms Magellanic Penguins in the Southwest Atlantic. *Mar Pollut Bull* **52**, 193–198.
- Garthe, S., Skov H. (2006) Selection of suitable sites for marine protected areas for seabirds: a case study with Special Protection Areas (SPAs) in the German Baltic Sea. Pages 739–742 in G.C. Boere, C.A. Galbraith, D.A. Stroud, editors. *Waterbirds around the world*. The Stationery Office, Edinburgh.
- Gerber, L.R., Botsford, L.W., Hastings, A. *et al.* (2003) Population models for reserve design: a retrospective and prospective synthesis. *Ecol Appl* **13** (Suppl), 547–564.
- González-Zevallos, D., Yorio P. (2006) Seabird use of waste and incidental captures at the Argentine hake trawl fishery in Golfo San Jorge, Argentina. *Mar Ecol Progr Ser* **316**, 175–183.
- González-Zevallos, D., Yorio P., Caille G. (2007) Seabird mortality at trawler warp cables and a proposed mitigation measure: a case of study in Golfo San Jorge, Patagonia, Argentina. *Biol Conserv* **136**, 108–116.
- Hooker, S.K., Gerber L.R. (2004) Marine reserves as a tool for ecosystem-based management: the potential importance of megafauna. *BioScience* **54**, 27–39.
- Hyrenbach, K.D., Forney K.A., Dayton P.K. (2000) Marine protected areas and ocean basin management. *Aquat Conserv* **10**, 437–458.
- Johnston, C. (2001) Conservation status and needs of high seas birds: consideration from the UK perspective. Pages 75–82 in H. Thiel, J.A. Koslow, editors. *Managing risks to biodiversity and the environment on the high sea, including tools such as Marine Protected Areas - scientific requirements and legal aspects*. German Federal Agency for Nature Conservation, Bonn.
- Johnston, C.M., Turnbull C.G., Tasker M.L. (2002) Natura 2000 in UK Offshore Waters. JNCC Report, no. 325.
- Lemos, M.C., Agrawal A. (2006) Environmental governance. *Annu Rev Environ Resour* **31**, 297–325.
- Lombard, A.T., Reyers B., Schonegevel L.Y. *et al.* (2007) Conserving pattern and process in the Southern Ocean: designing a Marine Protected Area for the Prince Edward Islands. *Antarct Sci* **19**, 39–54.
- Louzao, M., Hyrenbach D., Arcos J.M., Abelló P., Gil de Sola L., Oro D. (2006) Oceanographic habitat of an endangered Mediterranean Procellariiform: implications for marine protected areas. *Ecol Appl* **16**, 1683–1695.
- Post, J.C., Lundin C.G. (1996) Guidelines for integrated coastal zone management. *Environmentally sustainable development studies and monograph Series N° 9*. The World Bank, Washington, D.C.

- Quintana, F., Dell’Arciprete P. (2002) Foraging grounds of Southern Giant Petrels (*Macronectes giganteus*) in the Patagonian shelf. *Polar Biol* **25**, 159–161.
- Rabuffetti, F., Coconier E., Aldabe J. (2008) Áreas marinas importantes para la conservación de las aves (IBAs - AICAs) en el Mar Patagónico y zonas de influencia. In *Estado de conservación del mar patagónico y áreas de influencia*. [online]. Puerto Madryn, Edición del Foro. Available from: <http://www.marpatagonico.org>. Accessed 8 April 2009.
- Roberts, C.M., Branch G., Bustamante R.H. *et al.* (2003) Application of ecological criteria in selecting marine reserves and developing reserve networks. *Ecol Appl* **13** (Suppl), 215–228.
- Sabsay, D.A. *et al.* (2008) “Marco legal” en Estado de Conservación del Mar Patagónico y Áreas de Influencia. [online]. Puerto Madryn, Edición del Foro. Available from: <http://www.marpatagonico.org>. Accessed 8 April 2009.
- Sanderson, E.W., Redford K.H., Vedder A., Coppolillo P.B., Ward S.E. (2002) A conceptual model for conservation planning based on landscape species requirements. *Landscape Urban Plan* **58**, 41–56.
- Sapozhnikow, A., Quintana F. (2003) Foraging behavior and feeding locations of Imperial Cormorants and Rock Shags breeding in sympatry in Patagonia, Argentina. *Waterbirds* **26**, 184–191.
- Schiavini, A., Yorio P., Gandini P., Raya Rey A., Boersma D. (2005) Los pingüinos de las costas argentinas: estado poblacional y conservación. *Hornero* **20**, 5–23.
- Schreiber, E.A., Burger J. (2002) Seabirds in the marine environment. Pages 1–15 in E.A. Schreiber, J. Burger, editors. *Biology of marine birds*. CRC Press, Washington, D.C.
- Sherman, K., Hempel G., editors. (2008). *The UNEP Large Marine Ecosystem Report: a perspective on changing conditions in LMEs of the world’s Regional Seas*. UNEP Regional Seas Report and Studies No. 182. United Nations Environment Programme, Nairobi, Kenya.
- Skov, H., Durinck J., Leopold M.F., Tasker M.L. (2007) A quantitative method for evaluating the importance of marine areas for conservation of birds. *Biol Conserv* **136**, 362–371.
- SPEA-SEO/BirdLife. (2006) *Marine IBAs: implementing natura 2000 in the marine environment*. SPEA, Lisboa.
- Stokes, D.L., Boersma P.D. (2000) Where breeding Magellanic penguins *Spheniscus magellanicus* forage: satellite telemetry results and their implications for penguin conservation. *Mar Orn* **27**, 59–65.
- Stoms, D.M., Davis F.W., Andelman S.J. *et al.* (2005) Integrated coastal reserve planning: making the land–sea connection. *Front Ecol Environ* **3**, 429–436.
- Sullivan, B.J., Brickle P., Reid T.A., Bone D., Middleton D.A.J. (2006) Mitigation of seabird mortality on factory trawlers: trials of three devices to reduce warp cable strikes. *Polar Biol* **29**, 745–753.
- Wienecke, B., Robertson G. (2002) Foraging areas of King Penguins from Macquarie Island in relation to a Marine Protected Area. *Environ Manage* **29**, 662–672.
- Wilson, R., Sclaro J.A., Grémillet D. *et al.* (2005) How do Magellanic penguins cope with variability in their access to prey? *Ecol Monogr* **75**, 379–401.
- Yorio, P. (2000) Breeding seabirds of Argentina: conservation tools for a more integrated and regional approach. *Emu* **100**, 367–375.
- Yorio, P., Frere E., Gandini P., Conway W. (1999) Status and conservation of seabirds breeding in Argentina. *Bird Conserv Int* **9**, 299–314.
- Yorio, P., Quintana F., Gatto A., Lisniser N., Suárez N. (2004) Foraging patterns of the Olrog’s Gull during breeding at Golfo San Jorge, Argentina. *Waterbirds* **27**, 193–199.
- Yorio, P., Tagliorette A., Harris G., Giaccardi M. (1998) Áreas protegidas costeras de la Patagonia: síntesis de información, diagnóstico sobre su estado actual de protección y recomendaciones preliminares. *Informes Técnicos del Plan de Manejo Integrado de la Zona Costera Patagónica - Fundación Patagonia Natural (Puerto Madryn)* **39**, 1–75.

Editor: Dr. Amanda Lombard