

Chapter 2

**SEABIRDS AND ISLAND COMMUNITIES:
BIODIVERSITY AWARENESS AS
A TOOL FOR THE CONSERVATION OF
INSULAR SPECIES**

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ABSTRACT

Seabirds can serve as fundamentally important components of biodiversity of insular ecosystems, playing an important role as vectors of marine-derived nutrients, increasing primary production which in turn is transferred through the food web, and influencing the numbers and types of primary and secondary consumers. The status and trends of seabirds can be an excellent indicator of the impacts of human activities on their populations and communities. These impacts include loss of breeding sites through trampling and grazing by introduced domesticated animals; mortality by introduced mammalian predators such as rats, dogs and cats; egg and chick harvest; and interactions with local and regional fisheries. These impacts have occurred on most human-inhabited islands, ranging from the tropics to the sub-polar regions. Until the 1990s, the general state of knowledge about seabirds of oceanic islands in Chile was poor, since virtually no

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basic ecological information such as population size, breeding biology or the extent of conservation problems had been compiled for many species.

Human communities of oceanic and coastal insular systems in Chile currently possess only a small percentage of people who retain local traditional ecological knowledge, as a result of the recent influx of immigrants during the second half of the 20th century and the progressive decline of the ancestral native population. The relationship of recently arrived human communities with the biodiversity of the insular systems has been restricted to the use and exploitation of resources to satisfy basic needs for the human population (e.g. heating, food). Many of these activities have a negative impact on the biodiversity of the island, including seabirds. As a resource, seabirds were usually ignored by island communities because they did not provide any immediate benefit. In the 1990s, initiatives of national and foreign researchers began in different islands of Chile to elucidate basic aspects of the ecology and conservation status of several seabird species. The information generated was shared with the island communities associated with these seabird species in order to increase awareness and build support for conservation actions. This community engagement was undertaken based on the understanding that island communities, especially isolated ones, have particular characteristics that distinguish them from the inhabitants of the continent. These include a strong sense of belonging to the place, a heightened sense of community among residents, a detachment from the nearby continental areas, and a sense of not belonging to the central government that manages the island.

Here we document community engagement experiences and results on five significant Chilean seabird islands distributed in a wide latitudinal range: (1) Robinson Crusoe, Santa Clara and Alejandro Selkirk islands (the Juan Fernández Archipelago) (34° S), inhabited by six species of procellariids (Pink-footed Shearwater *Puffinus creatopus*, Kermadec Petrel *Pterodroma neglecta*, De Filippi's Petrel *Pterodroma defilippiana*, White-bellied Storm-Petrel *Fregetta grallaria*, Juan Fernández Petrel *Pterodroma externa* and Stejneger's Petrel *Pterodroma longirostris*); (2) Mocha Island (38° S) where the Pink-footed Shearwater *Puffinus creatopus* breeds; (3) Puñihuil Island, Chiloé (42° S) with a mixed-colony of Humboldt (*Spheniscus humboldtii*) and Magellanic (*Spheniscus magellanicus*) penguins; (4) Guafo Island, Quellón town (44°S) with the largest colony of Sooty Shearwater *Puffinus griseus* in the world; and (5) Navarino Island (55°S), Cape Horn Biosphere Reserve, that is inhabited by rich ensembles of seabirds and shorebirds, including cormorants, plovers, sandpipers, steamer-ducks and geese. On all of these islands, islanders have participated in initiatives that support the conservation of resident seabird species, including the cessation of chick and egg harvests, development of special interest tourism around birds, removal of introduced animals and responsible pet ownership, and as a general rule, inclusion of birds as co-inhabitants of the community.

INTRODUCTION

Seabirds can play a role as important drivers of biodiversity of insular ecosystems, serving as vectors of marine-derived nutrients (Stapp & Polis 2003; Hawke & Newman 2004, Smith et al. 2011), increasing primary production which in turn is transferred through the food web, and influencing the numbers and types of primary and secondary consumers (Sanchez-Piñero & Polis 2000, Stapp & Polis 2003). Although seabirds vary in the extent to which they rely on terrestrial systems throughout their annual cycle, most seabirds depend extensively or exclusively on islands to provide breeding habitat.

As such, the status of seabirds living on islands can provide an effective indicator of the intensity of use and degree of degradation of island ecosystems; human activities in many

insular systems, ranging from the tropics to the sub-polar regions, have negatively impacted seabird populations and communities (Schlatter 1987, Croxall et al. 2012, Libois et al. 2012, Nogales et al. 2013).

Until the 1990s the state of knowledge about seabirds of many oceanic islands in Chile was poor, since basic ecological information such as population size, breeding biology and the conservation status of many species had not been studied (Schlatter 1987, Schlatter & Simeone 1999, Simeone et al. 2003).

Since that time, our understanding of the status of, and issues confronting, seabirds in Chile has improved considerably. Significant threats to seabirds include loss of breeding habitat through trampling and grazing by managed domestic animals; predation by introduced mammals such as rats, dogs and cats; harvest of eggs and chicks by humans; and interactions with local fisheries (Schlatter 1984, Schlatter & Simeone 1999, Simeone et al., 2003).

Historically, island communities, either indigenous people or later immigrants, have maintained one of two positions related to seabirds: (1) disinterest/lack of knowledge or (2) use as a primary or secondary resource. Using seabirds as a resource has often been to meet subsistence needs, and, as such, also forms part of important sociocultural activities that help define the participants' cultural identity and provide links to their history, ancestors, land, art and environmental philosophy ([Kirikiri & Nugent 1995](#)). Some of these customary uses of wildlife are controversial because they are unsustainable at present (Redford 1992), such as the harvesting of chicks and eggs of some seabird species (Moller et al., 2004). Increasing social, economic, and ecological pressures such as technological change, human population growth, habitat destruction, species introductions, pollution and climate change may exacerbate the impacts of these traditional practices on seabirds (Moller et al. 2004). Thus, local human communities can play a major role in determining the persistence of seabird communities on islands.

To understand the relationship between local human communities and the insular ecosystems in which they live and on which they depend, it is necessary to determine whether or not general characteristics of island communities exist that may be used to inform conservation actions and planning. One of the few complete studies to date is that of [Zissi et al., \(2010\)](#), which used the perceptions of local people to describe 84 island communities in the region of the North Aegean Sea. The elements of this research can be useful to provide general characterizations of island inhabitants. [Biddle \(2014\)](#) described similar results for indigenous island people in Australia, both works identifying the following six attributes:

1. Island people identified themselves as a unity with few 'overt' distinctive groupings without types of social networks.
2. Islanders show low levels of intimate interpersonal relationships, due to culturally differentiated notions of friendship, limited personal resources (energy and time) due to daily tasks, and safeguarding of privacy, since friendships are perceived to foster gossip. In this sense, people are more interested in their "own good" in these communities. But since island communities frequently are composed of extended kin relations, extended family members often overlap with friends. As such, the levels of mutual aid, solidarity and help in cases of emergency as well as expectations of collective action in order to address a common issue or to organize a festival or a fair are relatively high. There is a contrast between interpersonal and collective

sociability organized around the moral and religious values of helping behavior and practical aid.

3. Even though inhabitants trust and help each other, they do not seem to share a common system of values in terms of mentality and lifestyle. Trusting and bonding relationships are not necessarily characterized by shared values, which are viewed as personal and private identifications. Nevertheless, island communities have strong, deep-rooted ties born through kinship networks within small and spatially dense settlements. Social ties facilitate trust and local cohesion, but they may include obligations that discourage rural inhabitants from active participation.
4. Islanders show feelings of satisfaction with their life and, importantly, attachment to the place. This arises from the great value island people place on the physical environment in multiple terms; experiences of socialization, source of economic activity and natural capital and aesthetics, and related to identifying two components of place attachment: rootedness or physical attachment and bonding or social attachment ([Riger & Lavrakas 1981](#))
5. Trust in central administration and politicians is lacking. Islanders feel that they have limited links outside the immediate locality and poor participation in more wide-ranging networks, either economic or social.
6. Islanders have a sense of acceptance of a deprived social position and perceived low civic power. The deprived position derives from multiple possible causes, including poor material infrastructure, moderate albeit acceptable quality of principal services (electricity, sewage and water), infrequent transport links, lack of upgrading of rural roads and closing of educational institutions. The lack of linking social capital combined with limited resources is arguably responsible for the almost non-existent levels of civic trust.

Island communities of oceanic and coastal insular systems in Chile share to a great extent the attributes identified by [Zissi et al., \(2010\)](#) and [Biddle \(2014\)](#) in Greek and Australian island communities, respectively. However, Chilean island communities are characterized by having a low percentage of people who maintain their traditional ecological knowledge. This loss of local ecological knowledge is a result of the high rates of immigration arrived in recent times into these communities and the progressive decline of the ancestral native population. The relationship of recently arrived human communities with the biodiversity of the insular systems has been restricted to use and exploitation of resources to satisfy basic needs for the human population (e.g. heating/fuel, food). Many of these activities have a negative impact on the biodiversity of the island, including seabirds. As a resource, seabirds were ignored by island communities because they did not provide any immediate benefit. In the 1990s, initiatives of national and foreign researchers began in different islands of Chile to elucidate basic aspects of the ecology and conservation status of several seabird species. The information generated was shared with the island community associated with these seabird species in order to increase awareness and build support for conservation actions. This community engagement was undertaken based on the understanding that island communities, especially isolated ones, have particular characteristics that distinguish them from the inhabitants of the continent. These include a strong sense of belonging to the place, a heightened sense of community among residents and a detachment from the nearby

continental areas, as well as a sense of not belonging to the central government that manages the island.

The main goal of this study is to document, based on our previous research and the research of other colleagues on these islands, the experience of island communities with conservation of seabirds on five islands of Chile distributed in a wide latitudinal range. All of these islands hold significant populations and/or communities of seabirds: (1) Robinson Crusoe, Santa Clara and Alejandro Selkirk islands, collectively the Juan Fernández Archipelago (34° S), where six species of procellariids breed (Pink-footed Shearwater *Puffinus creatopus*, Kermadec Petrel *Pterodroma neglecta*, De Filippi's Petrel *Pterodroma defilippiana*, White-bellied Storm-Petrel, *Fregetta grallaria*, Juan Fernández Petrel *Pterodroma externa* and Stejneger's Petrel *Pterodroma longirostris*); (2) Mocha Island (38° S) where the Pink-footed Shearwater breeds; (3) Puñihuil Island, Chiloé (42° S), with a mixed-colony of Humboldt (*Spheniscus humboldtii*) and Magellanic (*Spheniscus magellanicus*) penguins; (4) Guafo Island, Quellón town (44°S) with the largest colony of Sooty Shearwater *Puffinus griseus* in the world; and (5) Navarino Island (55°S), Cape Horn Biosphere Reserve, that is inhabited by rich ensembles of seabirds and shorebirds, including gulls, cormorants, plovers, sandpipers, steamer-ducks and geese. On all of these islands, islanders have taken initiatives actions that support the conservation of resident seabird species. Conservation actions include to cessation of harvesting of chicks and eggs, development of special interest tourism around birds, removal of introduced animals and responsible pet ownership, and as a general rule, consideration of birds as co-inhabitants of the community. Our second goal is to use these case studies and experiences to identify strategies that will improve the practice of using community engagement to strengthen the effectiveness of seabird conservation on islands with human communities.

FIVE CASE STUDIES OF BUILDING ISLAND COMMUNITY AWARENESS OF SEABIRDS IN CHILE

Juan Fernández Archipelago

Context

The Juan Fernández Archipelago, located 670 km off the coast of central Chile, is a 9,002 ha Chilean National Park created in 1935 (Araya 2004). Since 1997, it is also a UNESCO International Biosphere Reserve (Hoffmann & Marticorena 1987, Bourne et al. 1992). The archipelago was nominated for World Heritage status in 1995, and is one of the sites considered as most valuable world natural heritage (Perry 1984) due to the high endemism of the flora (67%) (Guicking & Fiedler 2000). The 1984 General Assembly meeting for the International Union for the Conservation of Nature and Natural Resources (IUCN) identified the archipelago as one of the world's 12 most threatened national parks (Allen 1984). Since its discovery in 1574, the archipelago has suffered major modifications of all major terrestrial habitat types. Although deforestation and habitat alteration are significant factors, the greatest impact has been caused by introduced species, both plant and animal. Introduced mammals include goats, cattle, horses, cows, rabbits and feral cats (Bourne 1983, Cuevas & Van Leersum 2001). The eradication of these species, essential for the long-term conservation of

the threatened seabird community as well as critically endangered endemic landbirds, although extremely challenging is technically and logistically feasible, with assessment plans already having been completed (Saunders et al. 2011)

For the island community some of these introduced species have represented money supply or food, such as rabbits, cows and goats (Guicking & Fiedler, 2000). They have used some of the introduced species as pets, such as coatis and cats, without considering them as a threat to their environment (Guicking & Fiedler 2000). Following their discovery in 1574, for 300 years the islands were used primarily by privateers and pirates as a source of wood, water and fresh food, and as a place of exile. Although there were earlier attempts to establish settlements, it was not until 1877 that a permanent village was founded on Robinson Crusoe Island. The other large island, Alejandro Selkirk served as a penal colony in the early 1900s and has since supported only a small summer population of 50 people engaged in fishing. The smallest of the three islands, Santa Clara, has never been inhabited. The local economy has depended primarily on the harvest of a species of spiny lobster (*Jasus frontalis*) and, to a lesser extent, tourism. Men are mainly engaged in fishing, although employment opportunities are slowly diversifying. Until recently, women had a minor role in the economy of the archipelago, but this scenario has changed, as women have taken a more active role in the creation of new businesses, especially those related to tourism, which is the second major economic activity in the archipelago. A third economic activity is small-scale agriculture, which has developed in recent times due to the decline in lobster captures in recent decades (Cuevas & Van Leersum 2001). Until the late 1990s, many islanders showed a relative lack of interest in nature and conservation issues on the island (Guicking & Fiedler 2000), reinforced by the fact that the main source of income for the community, the lobster fishery, was not terrestrial but marine (Cuevas & Van Leersum 2001).

Conservation Problems for Seabirds

Information on the abundance, ecology and conservation status of the six breeding seabird species of the archipelago was scarce until the early 2000s (Bourne 1983, Schlatter 1987, Brooke 1987, Bourne et al. 1992, Guicking & Fiedler 2000 and Reyes-Arriagada et al. 2012). In 2001, the conservation non-profit organization Oikonos Ecosystem Knowledge began systematic studies of the ecology and conservation status of, and threats to, the threatened breeding seabird community of the islands (e.g., Hodum and Wainstein 2002, 2003, 2004). In addition to their negative impact on the Juan Fernández firecrown *Sephanoides fernandensis*, an iconic, endemic and currently critically endangered species, introduced species have historically affected three species of shearwater; the Pink-footed Shearwater *Puffinus creatopus*, Juan Fernández Petrel *Pterodroma externa* and Stejneger's Petrel *Pterodroma longirostris*. The first species is affected by trampling that collapses burrows and by competition with rabbits for burrow use; indeed, rabbits remove the eggs of shearwaters from the burrows. The other two species are mainly affected by trampling of goats. There is an unknown impact of predation by feral cats on other species such as the Kermadec Petrel *Pterodroma neglecta*, De Filippi's Petrel *Pterodroma defilippiana* and the White-bellied Storm-Petrel, *Fregatta grallaria*.

Sensitizing/Awareness

In 1997, the Chilean federal agency responsible for managing federal protected areas, the Corporación Nacional Forestal (CONAF) began a multi-faceted conservation project focused on the recovery of this highly complex ecosystem and using a socio-ecological approach. Because the local communities, San Juan Bautista on Robinson Crusoe and Colonia de la Rada on Alejandro Selkirk are surrounded by the park, and have historically used the entire archipelago to meet their resource needs, they cannot be excluded from any conservation project developed on the island. As such, the inclusion of and engagement with the local community in conservation planning and actions were recognized as being fundamentally important. Initially, one of the main conflicts was the community's negative perception of programs focused on control and eradication of rabbits, goats and fruit tree species, because they constituted local food source. To decrease the pressure of obtaining food produced on the island, the program promoted the importation of food from mainland Chile (Cuevas & Van Leersum 2001). In 2001, the NGO Oikonos in collaboration with the park administration and local community initiated a community-based conservation program for the seabird community of the archipelago, initially through awareness-building artistic and educational activities. Community-based activities have been ongoing and continuous since that time and have expanded in scope to include community talks and workshops, technical training, capacity building, volunteer opportunities, and an environmental education program for children. Specific examples of recent activities include creative writing workshops, drawing contests, informational brochures and posters, field trips to seabird colonies, and student involvement in monitoring a local shearwater colony. An important aspect of their approach is to train local residents, thereby creating and strengthening local capacities. There is now a team of trained local residents hired by Oikonos to work as field technicians and coordinators on a variety of conservation and restoration programs, including for the threatened seabird community (Hodum et al. 2013, Colodro et al. 2014). All of these activities have resulted in a generally positive change of attitude towards the seabirds of the archipelago, promoting the conservation of these species through active participation of the community. In addition, these programs have further reinforced the community's sense of place through the increased awareness of the unique natural heritage that their archipelago possesses.

Mocha Island

Context

Mocha Island (38° 22 'S, 73° 56' W) is one of the main offshore islands of the Chilean continental shelf. It has an area of 52 km² and has a great diversity of flora and fauna, mainly associated with forests dominated by olivillo (*Aextoxicon punctatum*), and by myrtaceous species in the upper elevations of the island (Lequesne et al. 1999). These forests are responsible for water retention from clouds and precipitation that people of the community use, and are protected as a National Reserve (Pefaur & Yáñez 1980). The island is a unique place for some species of breeding seabirds, highlighting the endemic Pink-footed shearwater *Puffinus creatopus* which breeds in the forests of the central part of the island. The coastal area is also an important site for other species of seabirds, such as the Imperial cormorant

Phalacrocorax atriceps, Rock cormorant *Phalacrocorax magellanicus*, Peruvian booby *Sula variegata*, peruvian pelican *Pelecanus thagus*, Magellanic penguin *Spheniscus magellanicus* and Humboldt penguin *S. humboldtii* breeding on the coast and nearby islets (Schlatter & Reyes-Arriagada unpublished doc).

Concerning the island community, it has been established that the native indigenous population was expelled from the island by Spanish colonists in 1687, and the island remained uninhabited for almost 200 years. Repopulation occurred around 1850 by farmers of central Chile, whose descendants constitute the current population of the island (Lequesne et al., 1999). The community has always depended on the forest biodiversity of the island for use in daily activities, causing degradation of natural habitats. As a result of extraction activities total deforestation was produced in the lower and flat part of the island. Today, introduced and crop species dominate and there are only small, dispersed and fragmented relicts of forest. At the edge of the forest, due to tree logging and subsequent erosion a shrubby ecotone dominates, separating the old-growth forests from disturbed grassland (Saavedra et al., 2003). The lifestyle of the island inhabitants is strongly influenced by the isolation from the continent. The few opportunities to travel to the mainland to buy supplies, especially perishable foods, along with the null importation of these products, their limited production on the island and the inability to store food because of the restricted use of electricity, makes saturated fats and carbohydrates the basic diet (Pasten et al., 2014).

Conservation Problems for Seabirds

In the forest of National Reserve Isla Mocha, *Puffinus creatopus* breeds in colonies that are about 150 m above sea level (Guicking 1999, Guicking et al., 2001). A census conducted in 2008-2009 estimated a population of 19,440 breeding pairs, but because of difficulties in comparing these results with the few previously conducted surveys, it is not possible to establish population trends (Guicking 1999, Muñoz, unpublished data in Azócar et al., 2013). However, it has been suggested that the population has declined, due primarily to the harvest of fledgling chicks by the community for consumption. Traditionally, between March and May each year residents of the island took large numbers of chicks, which were distributed among the families of the community. This activity began in the early twentieth century, and to date it has not been possible to establish the extent of this practice. However in the late 1990s it was estimated that the collection reached 3,000-5,000 chicks per year (Guicking 1999). Often, longer burrows were destroyed in order to get the chicks from inside (Azócar et al. 2013).

In addition to harvesting, there is now predation pressure by rats, feral cats and probably dogs accompanying egg collectors, all of unknown magnitude (Guicking et al., 1999, Azócar et al., 2013).

Sensitizing/Awareness

Since 2010, the National Forest Service CONAF, the Chilean government agency that administers the Isla Mocha National Reserve, has enforced the prohibition of harvesting chicks and eggs. The qualitative information provided by the rangers and local residents

suggests that the harvest level has dropped dramatically since CONAF began the restriction, possibly totaling at present only a few hundred chicks per season (Herrera, personal communication to Azócar et al., 2013). In order to minimize the costs on the community by this restriction, this conservation strategy has been strongly supported by a community education program whose objective is raising awareness about the patrimonial importance of Pink-footed shearwater on the island. In particular, the NGO Oikonos in cooperation with CONAF, the Environment Regional Department and the American Bird Conservancy, have focused their efforts on the community, working with children and adults of the entire island. They have conducted environmental education initiatives, including lectures, workshops, soccer tournaments, and making affective passive animals (soft toys). Together with these actions there have been efforts to control predators such as domestic dogs and cats; the pet population has been censused and responsible ownership has been promoted, there have been campaigns for sterilization to control the canine and feline population and the capture of cats in the nesting colony using traps because of attacks on the shearwaters.

Puñihuil Islets

Context

The Puñihuil Islets lie exposed in the Pacific Ocean off the Isla Grande de Chiloé (41°55' S, 74°02' W).

Chico Islet and Grande Islet have areas of 1.54 and 2.65 ha, respectively, and are located 340 m and 700 m offshore, respectively (Reyes-Arriagada et al. 2013). Vegetation is composed mostly of understory bamboo (*Chusquea* sp.), bromeliads (*Fascicularia bicolor*, *Greigia sphacelata*), and herbaceous vegetation (*Holcus lanatus*, *Anthoxantum odoratum*, Simeone & Schlatter 1998). On these islets the largest mixed colony of two penguin species breed, Humboldt and Magellanic penguins (*Spheniscus humboldtii* and *S. magellanicus*, Duffy 1987, Wilson et al. 1995, Simeone & Schlatter 1998), with 86 and 477 breeding burrows in 2008 (Reyes-Arriagada et al. 2013). The biological relevance of this Humboldt/Magellanic penguin colony was recognized due to its potential for species hybridization, allowing studies of resource partitioning, behavioral interactions, diet comparisons, foraging ecology and habitat use (Wilson et al., 1995, Simeone & Schlatter 1998, Raya Rey et al., 2013).

At the time of its discovery in 1985 no threats were evident for this unique colony, and the site was not officially protected (Duffy 1987). Today there is an intense tourist activity from guided boat tours around the islets, mainly during the austral spring and summer (Skewgar et al., 2009). Access ashore to the islets is still forbidden under the Natural Monument regulations. Chico Islet had a population of goats until their removal in 1999 (Simeone & Schlatter 1998).

Conservation Problems for Seabirds

For more than a decade after its discovery there was serious damage to the nesting burrows from trampling by goats introduced in 1988 and by unregulated tourism (Simeone &

Schlatter 1998). Trampling and overgrazing by goats alters the structure and composition of plant communities, causing habitat degradation and accelerating soil erosion, which results in the collapse of breeding burrows of seabirds. Additionally, according to the local residents of the cove near islets, mostly fishermen, these islands are the most accessible known places in Chile where the two penguin species breed, making this a popular tourist attraction in Chiloé. This has resulted in an unknown number of people visiting the colonies while no regulations or management plans were in place until 2009 (Reyes-Arriagada et al., 2013). Populations of both penguin species have been decreasing due to entanglement in artisanal fishing nets and illegal capture for consumption and bait (Simeone et al., 1999, Majluf et al., 2002, Pütz et al., 2011).

Sensitizing/Awareness

In 1999 the colonies became officially protected by the Chilean Forest Service (CONAF). The islets became a Natural Monument, subject to some regulations as MPAs (Guarderas et al. 2008). Access to the penguin colony was forbidden as a main restriction, and all the resident goats were removed (Simeone & Schlatter 1998). However, tourist activities continued to occur around the islets through boat trips. Protection was reinforced by the Otway Foundation, a nongovernmental organization, which provided constant surveillance and environmental education to locals of the Puñihuil cove. Following these conservation measures penguins increased in numbers as a result of habitat improvement, attributable to the exclusion of tourists and removal of goats from the islets (Reyes-Arriagada et al., 2013). Furthermore, with the help of technical reports given to authorities, in 2009 a local county ordinance regulated tourism activity around the islets in Puñihuil, contributing to improve this activity within a framework of responsibility for tour operators. This technical information was socialized to the community of the Puñihuil cove through workshops warning them about the implications of the increase in tourist fleet operations and promoting preventive behavior and good practices around the islets. Currently the tourist activities at Puñihuil appear to be in line with recommendations of good practices for the penguin colonies, i.e., those developed in a context of responsibility toward the environment (Reyes-Arriagada et al., 2013). Examples of negative impacts on seabird colonies attributable to poorly managed tourism are abundant (see Carney & Sydeman 1999 for a review), but there are also examples of sustainable coexistence between tourism and seabird conservation, such as in penguin colonies (e.g., Boersma & Stokes 1995, Holmes 2007, Landau & Spletstoesser 2007, Powell et al. 2008). The effects of regulations such as the ordinance that improved the management of tourism in Puñihuil will be reflected in the penguin populations in the mid and long term (Reyes-Arriagada et al., 2013).

Guafo Island

Context

Guafo Island (43 ° 61 'S, 74 ° 75' W) is located at the northern end of the Chilean fjords near the southwest corner of Chiloé Island and the mouth of the Gulf of Corcovado. The

island is of particular interest because of its relative isolation from the mainland and marked seasonal regime. It has an extensive coastline, varied aquatic systems and an inner area that allows a high availability of breeding sites for shearwaters (Reyes-Arriagada et al., 2009), with high productivity of the surrounding sea (Ramirez & Pizarro 2005). With an area of 30,000 ha and a coastline of 72 km, Guafo Island is a significant breeding habitat of birds, as it shows a considerable coastline and forest ecosystem for nesting of species of 13 of the 22 orders present in Chile. The Sooty shearwater *Puffinus griseus* is the main breeding species on the island with nearly 4 million breeding pairs, the largest colony in the world (Reyes-Arriagada et al., 2007). An important colony of Magellanic penguin *S. magellanicus* is also present with at least 1,700 breeding pairs, and there are several colonies of cormorant species along the coast (Reyes-Arriagada et al. 2009)

Historically, industrial and artisanal demersal and benthic fishing has benefited from the seas adjacent to Guafo Island because of upwellings rich in productivity (Ramirez & Pizarro 2005), but with not quantified impact for bycatch on seabird species, especially during the breeding season (Reyes-Arriagada et al., 2009). Until the 1960s a whaling plant operated on the island, which processed species of marine mammals that inhabit the waters surrounding the island, with an impact never quantified on populations of these large cetaceans. Currently artisanal fishermen stay temporarily on the island during summer, with a fleet of 120-150 vessels, which deliver their products in the town of Quellón in Chiloé Island, 120 km from Guafo Island. Fishermen do not make use of the land resources of the island, except for firewood extraction on a small scale.

The community associated with Quellón, in addition to extractive activities in the sea and small-scale agricultural activity, has a traditional tourism activity associated with the patrimonial culture and idiosyncrasy of Chiloé, in which ecological biodiversity and touristic elements were incorporated to a small extent in the tourist offer. In 2003 a revolution occurred in the region in terms of biodiversity assets, as a result of the discovery of aggregations of blue whales *Balaenoptera musculus* with feeding and breeding activities in the area (Hucke-Gaete et al., 2003). This fact, plus the recognition of other elements of the biodiversity, has meant that the Chiloé-Corcovado area, where communities of Guafo Island and Quellón town are located, is recognized today as important for conservation by national and international organizations such as IUCN, WWF, and TNC (Hucke-Gaete et al., 2006). Since then an increase of tourist activities focused on marine biodiversity of the area has occurred, with particular emphasis on the sighting of blue whales.

Conservation Problems for Seabirds

The press has reported the sale of Guafo Island for coal mining, which is clearly a risk to the breeding population of Sooty Shearwater (Reyes-Arriagada et al., 2007).

The Sooty Shearwater has been classified as “Near Threatened” (IUCN 2014) due to the decrease in the abundance of the species in the California Current System (Veit et al., 1996) and the decline in populations and colonies in New Zealand (Hamilton et al., 1997).

These conservation problems may potentially affect the colonies of the austral Chilean archipelagos as a result of the introduction of predators and the interaction with fisheries (Reyes-Arriagada et al., 2007).

Interaction with other species of seabirds in the area has not been reported to date, although interaction occurs between the demersal fishery of the Patagonian toothfish *Dissostichus eleginoides* and the Black-browed albatross *Thalassarche melanophris* (Moreno et al., 2006) at the southern end of Guafo Island where the latter species benefits from fishery discards.

Sensitizing/Awareness

Following the discovery of blue whales in the Chiloé-Corcovado area, complemented with the outstanding productivity and biodiversity of the area, its unique importance for many fish species, and marine mammals, as well as the growing number of threats to marine life in the area, national and international researchers promoted the establishment of a Marine and Coastal Multipurpose Protected Area in the Chiloé-Corcovado area. For this purpose, they used the blue whale as flagship and umbrella species (Hucke-Gaete et al., 2006). The proposal includes establishing monitoring plans leading to a comprehensive management plan, environmental education in local communities and environmental awareness at the national level, as well as the regulation and promotion of ecotourism related activities of interest to many local actors. Those tour operators who have started whale watching activities have noticed that not only this species provides opportunities for the development of ecotourism, but also other components of biodiversity including seabird species found in the area, provide opportunities for attractive field observations at sea in cases when whale sightings are not successful. This broader tourism offer on marine biodiversity sighting, including attractive seabirds, also reduces the pressure from tourists on the tourism operator to ensure whale sightings, the latter constituting only the "icing on the cake" in an ecotourism product that promotes marine biodiversity of the area as a whole. The information obtained on seabirds in the area of Guafo Island and surrounding seas has helped to supplement the database on biodiversity of species of interest for tourism, promoting their inclusion in conservation plans and increasing the demand by the community to keep ecosystems free of activities that may affect this source of local development.

Navarino Island

Context

Navarino Island is located within the Cape Horn UNESCO International Biosphere Reserve, which contains the southernmost forest ecosystems of the planet, and represents one of the most pristine wilderness areas in the world. It has a great diversity of ecosystems, and represents the southern distribution extreme of many animal and plant taxa from the species to the class level (Rozzi et al., 2007). The region is affected by the masses of Antarctic and subsurface waters related to the West Wind Drift from the South Pacific. Birds are the most diverse and abundant group of vertebrates, since there is a lack of large terrestrial mammals and herpetofauna (Rozzi et al. 2007, Rozzi & Jiménez 2013). Along the coast, there are significant colonies of Dolphin gull *Larus scoresbii*, Dominican gull *L. dominicanus*, Neotropical and rock cormorant, *P. brasiliensis* and *P. magellanicus*, along with several

marine species of geese and ducks, nesting dispersal in the upper limit of the high tide line (Pizarro et al., 2012). For human populations, the island represents the southernmost territory of the world with pre-Columbian settlement, currently with the presence of the ancestral of Yhagan people. In addition to members of indigenous groups, the community is composed of various actors, such as Chilean Navy base staff and their families (majority), fishermen, tour operators and people working in services (Rozzi et al., 2007), totaling about 2500 people. This diversity of people has different skills, interests and social, cultural and economic needs (Berghoefer et al., 2008) which need to coexist harmoniously.



Figure 1. Map of study areas in Chile, Southern South America.

Conservation Problems for Seabirds

In the case of Navarino Island, one of the principal threats to coastal and marine birds is the spread of deliberately or accidentally introduced species such as the American mink *Neovison vison*, which exerts pressure primarily through egg predation, and the North American beaver *Castor canadensis* and muskrat *Ondatra zibethicus* (Anderson et al., 2006), which modify the composition and structure of watersheds and habitat. The American mink has recently established a feral population on Navarino Island where it is drastically affecting the reproductive success of ground nesting coastal seabirds, including solitary species (*Chloephaga picta*, *Tachyeres pteneres*) and colonial species (*Larus dominicanus*, *Larus scoresbii*, *Sterna hirundinacea*) (Schuettler et al. 2009). In the community there is still little awareness about the mink's impacts. However, a growing concern is expressed by local residents about the mink had caused the perceived decline of birds during the last number of years and feared negative consequences for tourism (Schuettler et al., 2011). Another threat to seabird populations and biodiversity in general is represented by exponential growth of the tourism industry by cruise ships in areas previously restricted by the Chilean Navy has led to an increasing number of landings on uninhabited islands and to unregulated tourism in channels and protected areas (Rozzi et al., 2007, 2010b). These places lack basic infrastructure, tour-guide information and park rangers; this type of unregulated tourism poses a threat to this remote wilderness region and to the breeding seabirds of the island (García 2004).

Sensitizing/Awareness

The implementation of the Cape Horn Biosphere Reserve in 2005 has ensured the continuity of traditional activities and proposes their inclusion in a sustainable tourism development that benefits local people, particularly the Yhagan community, enriching the experiences of visitors (Rozzi et al., 2007, 2010b). From the point of view of the Government, the Cape Horn Biosphere Reserve aims to change a policy based on short-term extractive cycles to a long-term development point of view sustained in the ecological and cultural singularities of the territory. The Reserve promotes the value of ecological services for the wellbeing of communities and reveals the relevance of territory conservation to science, artisanal fisheries and sustainable tourism (Rozzi et al. 2007). The last, mainly through nature tourism, is the main attraction for visitors to the region (Chacón 2002, García 2004), because this area represents one of the last "wild" destinations for the global citizen who tends become more urbanized, industrialized and homogenized (Rozzi et al., 2010a). The research team of the Omora Ethnobotanical Park created the Sub-Antarctic Omora Bird Observatory in the year 2000 (Anderson et al., 2002), which has provided a useful starting point to gather basic information on the avifauna present in Navarino Island. As part of the activities of the Observatory, a plan of socialization and community education was implemented on the importance of the ornithological biodiversity heritage of the region. Emphasis is given to the K-12 levels for environmental education, because they show the most readiness to explore these issues. However, the adult population is also included, particularly the guides and tour operators who live in the town of Puerto Williams on Navarino Island. In order to increase the appreciation of birds by the local community, activities have included the identification of the

most charismatic bird species for the community, importantly the Magellanic Woodpecker *Campephilus magellanicus*, incorporating environmental education strategies, development of educational material and outreach activities (Arango et al., 2007). Since 2000, these activities are carried on permanently in the school, with the help of researchers and practitioners from Omora Park (administrated by the University of Magallanes, Omora Foundation and Institute of Ecology and Biodiversity in Chile and the University of North Texas, in the United States), incorporating the topics of bird biodiversity in terrestrial and marine environments. Workshops and training for the adult community are also conducted through theoretical and field activities, emphasizing "face to face" encounters between human and birds to conduct activities such as the development of special interest tourism with low impact to the ecosystem through awareness, management and conservation of birds (Rozzi et al., 2010a). Thus four benefits are obtained by working with the community: i) these dynamics allow the residents of the community to discover the rich cultural diversity of Cape Horn; ii) field experiences help to interrelate this cultural diversity with birds and other species that inhabit the landscapes of Cape Horn, iii) the relationship between the two diversities allows workshop participants to make a synthesis to enable an understanding of sub-Antarctic biocultural diversity; and iv) finally, this understanding allows incorporation of the singularities of the sub-Antarctic biocultural diversity in regional education programs, policies and environmental decision-making relevant to the wellbeing of many inhabitants and biocultural diversity conservation (Rozzi et al., 2010a,b), including the diversity of seabirds in the island.

DISCUSSION

There is a growing recognition that relying solely on conventional, disciplinary and specialized scientific approaches is insufficient in the face of the complexity of conservation problems. Complex adaptive systems involving human uses and impacts often cannot be separated from topics of value, equity and social justice, and they require a participatory approach in which scientists need to work with local people to promote autonomy in conservation actions of the community when scientific research or particular projects end (Ludwig 2001, Moller et al., 2004). Characteristics of the island communities may be viewed as positive, neutral or negative, according to strengthening strategies for conservation planning. We may consider the concept of social capital that consists of social ties, levels of trust and level of civic engagement as a negative point of view for conservation planning. Community networks, group membership and social participation, despite the relatively high levels of generalized trust, are of low relevance in life of island people. Social participation is a mechanism through which community identity is activated only under certain circumstances, such as in need or emergency and in collective social events. This type of social participation is unrelated to civic engagement (Zissi et al., 2010). But we may consider that participation in social events can be useful in conservation plans if these include activities such as soccer tournaments, song festivals, thematic parties, etc., focusing on the awareness for a particular species. In contrast, other aspects perceived by island communities can be used in a positive way to develop conservation management. Zissi et al., (2010), describe the rural island communities with pre-modern socio-economic features facing severe

demographic imbalance. This work also illustrates island rural communities of high devotion with deep roots and psychological sense of place. Their residents depend very much on systems of symbols and meanings which are collectively shaped. Both primary and secondary ties play a significant role in people's realities despite the competitiveness and tensions that frequently characterize small and spatially dense settlements.

By contrast, perceived civic is low due to their accounts of limited choices, poor resources, few links with external agents and their perception that they have no say in decision making. This implies that there is a good chance to promote a symbol of pertinence, with patrimonial character, enabling the community to generate, through recognizable and unique character elements, a local identity that can be used as a product to enhance economic benefits.

Remote locations are one of the destinations that today have become important for a tourist sector looking for this kind of less traditional tourism experiences. This activity usually is developed through practices of tourism of special interest in rural nature, and involving the connection with the environment, both in human and non-human dimension implying no overcrowding. For the community, tourism of special interest provides the opportunity to implement these thematic activities with a high degree of originality and exclusivity with respect to similar initiatives in other communities, by the own character of biodiversity present.

From the five cases described above, we identified seven features that are common, in terms of care and positive use that local community must do about the diversity of seabirds present on each island:

1. Presence of researchers that help to gather information on the biology, ecology and conservation status of species of seabirds.
2. Development of educational workshops for the school community of the island in at least one of the levels of education.
3. Development of educational and training workshops for local guides and tour operators living on the islands.
4. Use of bird species as charismatic, iconic and/or flagship species as part of community outreach and engagement.
5. Dissemination of education and conservation activities through the media, both locally and regionally.
6. Integration of NGOs and government agencies to help implement conservation activities.
7. Development of low impact tourism activities linked to seabird species and biodiversity of the area.

TEN STRATEGIES TO IMPLEMENT CONSERVATION PLANS AT THE LOCAL LEVEL IN INSULAR ECOSYSTEMS

As a way to complement the statements described above and to systematize a socio-ecological conservation planning we used the principles proposed by Rozzi et al., (2006). Due to the integrative nature of these principles, they can be useful as a basis for implementing

conservation plans for local Chilean island systems with similar characteristics. Rozzi et al., (2006) identified ten principles that have been effective for integrating long-term socio-ecological research in the implementation of sustainable environmental policies, in which participants from universities, local communities and the Chilean Government were involved. Also, the NGO Pacific Invasives Initiative has developed five social principles for partnerships with communities (Towns et al., 2011), that are in line with principles stated by Rozzi et al., (2006). Based on their implementation, these are described from lesser to greater complexity:

1. *In situ* experience of the community, researchers, policy makers, and others involved in "direct encounters" with humans and non-humans in their habitats of origin.
2. Participatory approach, not only providing information, but sharing work processes in education and conservation; understanding the problem through education and/or research.
3. Identification and implementation of charismatic species that act as symbols of local or regional biocultural richness.
4. Continuous dissemination of results, conflicts and actions through media.
5. Transdisciplinary integration of the sciences, the arts, philosophy and environmental decision-making.
6. Interagency cooperation, public and private.
7. Collaborative networking with research, education and/or conservation at local, regional, national and international levels to identify causes and define solutions to existing environmental problems, ensuring that communities participate in their implementation.
8. Economic sustainability, through activities that link biodiversity and local economic practices (e.g. programs of special interest tourism).
9. Administrative sustainability, through the provision of infrastructure, conservation areas and programs of long-term research.
10. Conceptual sustainability through the development of transdisciplinary research, education and conservation, coupled with local, national and international political, economic and environmental dynamics.

Finally, we must not forget that the conservation of seabird species on inhabited islands depends heavily on the engagement and commitment of the local community. Therefore, community-based seabird conservation projects should explicitly consider the continuity of project-related activities by the community, independent of whether ongoing funding sources exist. The lack of a long-term commitment to supporting such projects can cause communities to question the importance of the work and, in turn, can lead to disengagement and loss of local support. In the process of instilling cultural heritage and biodiversity values in the consciousness of the community, this focus should never be lost, because the island community will be instrumental in determining the long-term success of any conservation plan of the fauna and flora of the region.

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