Chapter 14

PRIVATE CONSERVATION, THE EXAMPLE THAT THE WILDLIFE CONSERVATION SOCIETY BUILDS FROM TIERRA DEL FUEGO

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1. INTRODUCTION

Protected areas are recognized and valued instruments to manage biodiversity conservation worldwide. Their creation is an activity that is mostly performed by the public sector (CBD 2008). However, there is an increasing need for and interest in the private sector to participate in protected area creation and management (Environmental Law Institute 2003), and Chile is no exception to this trend (Sepúlveda et al. 1998, 1998, 2003). In fact, the private sector's importance for conservation has been recognized in the current Chilean political frameworks (CONAMA 2003, 2005, 2006a, OCDE 2005).

The private sector's involvement in establishing protected areas in Chile is a phenomenon dating back to the 1990s (CODEFF 1999). There are nearly 300 private protected areas, currently comprising 1.3 million hectares, or, 9% of the public system (Pliscoff 2009). Figueroa et al. (2010) estimated that private protected areas of Chile provide ecosystem services to the country's population worth, at least, USD 421.1 millon per year.[2] National policies are needed to effectively integrate these private conservation activities with national public efforts.

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[2] This value corresponds to USD 286,4 million provided by the Network of Private Protected Areas (RAPP) of the National Committee for the Defense of Flora and Fauna (CODEFF), and USD 134,7 million provided by the protected areas of private forest enterprises (values in USD of 2009) (Figueroa et al. 2010).

The Wildlife Conservation Society (WCS, www.wcs.org) is a New York-based global conservation NGO that, since 1895 has been implementing actions intended to protect wildlife and wild landscapes by applying science to solving critical problems and disseminating education programs (Sanderson 2002). WCS carries out these tasks along two complementary axes: through a Global Conservation Program comprising about 300 on-site conservation programs in almost 60 countries and on four continents, and, by managing the world's largest urban wildlife park system, including the Bronx Zoo, Central Park Zoo and Aquarium, among others, all in New York City.

Human presence on Earth and its consequent impact on biodiversity are varied with some sites where the human footprint is strong as in New York City or Santiago (sensu Sanderson et al. 2002). Such sites are contrasted with others where this footprint is less pronounced and, therefore, the pressure on habitats and wildlife is comparatively lower. These sites are the last of the wild areas and provide unique opportunities to implement conservation actions (Redford and Richter 2001), since they contain vast and well conserved biodiversity.

WCS carries out its conservation activities on these two extremes of human presence, from ex-situ education and conservation programs in New York City through the work it performs in its global program, which focuses on promoting the conservation of the last of the wild on Earth. There are 75 of these WCS Landscaspes with low human footprint around the world. Some of these areas include tropical forests in Equatorial Africa, temperate forests in the United States, as well as Patagonia (Sanderson et al. 2002). The assumption is that it is in these areas with limited human presence where biodiversity, in all its complexity (see Noss 1990), can be conserved including structures and processes (Redford and Richter 2001).

WCS has been present in Patagonia since the 1960s, specifically on the Atlantic coast and the Argentine Steppe, where it has fostered knowledge and conservation of wild fauna and their habitats (Conway 2005). WCS's vision and experience in Patagonia supported the Society's development of a new conservation program in Tierra del Fuego: Karukinka (www.karukinkanatural.cl) in 2004, which is the largest protected area existing on Isla Grande, in the Tierra del Fuego archipelago.

In this chapter we document the WCS experience in establishing Karukinka, a private protected area in Chile in order to provide information on the role of private initiatives to conserve biodiversity in Chile. By doing so, we: a) share key aspects of this initiative; b) highlight the critical challenges we are facing to strengthen our conservation work; and c) add to the dissemination of the private conservation work carried out to date so that it may be incorporated into a systemic analysis of the design and operation of Chile's protected areas.

2. BIRTH AND ORIGIN OF KARUKINKA

The creation of Karukinka started when Goldman Sachs (GS), a US investment bank, acquired a vast piece of land on the Main Island of Tierra del Fuego that was part of a defaulted debt portfolio purchased in 2002. The former owner of this estate had been Trillium, a US forestry company that in mid 1990s worked to develop a large scale forestry project on the island, which was strongly opposed by the local and global environmental community (Gligo 2006). This project conducted different activities in the area, investing significant resources in preparation for beginning to cut trees.

Goldman Sachs understood the local and global value of the biodiversity found on the lands it had acquired from Trillium and, made the unusual decision not to sell it but to turn it into a conservation property. This decision required their transferring ownership of this land to a US-based conservation NGO. The resulting donation became one of the most significant donations of private land for conservation to date in the World and the largest in Chile (Saavedra 2006). For WCS it was an opportunity to leverage its 40 years of experience in Argentine Patagonia (Conway 2005), and more than 20 years of independent conservation work throughout Chile (e.g. conservation of flamencos in high plateau salt flats (Caziani et al. 2006, Valqui et al. 2000), in order to establish an anchor from where to strengthen its conservation work in the Southern Cone.

As part of the deal, an alliance between GS and WCS was created to allow joint work on the conservation of these lands. GS would provide seed financial support allowing WCS to start a conservation operation in Tierra del Fuego Chile, and an additional financial contribution to seed a trust fund that would allow a sustainable operation of the property. WCS would design and carry out programs to achieve the long-term conservation of the area's biodiversity. After a series of consultations with entities and individuals in the public, private, academic and NGO sectors in Chile, Karukinka was born.

This action was associated with the decision by Goldman Sachs to establish an Environmental Policy (Goldman Sachs Environmental Policy Framework[3]) defining a new standard for the businesses. Additionally, Goldman Sachs also created the Center for Environmental Markets[4], which works with different partners, including corporations, NGO's and the academic world, to analyze and promote market-based environmental solutions (Tercek 2008). This decision allowed incorporation of environmental variables into GS's business

[3] Available at http://www2.goldmansachs.com/services/advising/environmental-markets/documents-links/policy-framework.pdf

[4] See at http://www2.goldmansachs.com/services/advising/environmental-markets/center-for-em/introduction.html

practices, and led to development of million-dollar investments related to clean energies and carbon markets (Tercek 2008). The support given by the then President and CEO, Henry Paulson, and that of Larry Linden, then Senior Advisor, were crucial in the decision to establish Karukinka.

Karukinka born was officially announced in September 10th in 2004, by Dr. Steven Sanderson, WCS President and CEO, when he underscored the important role the private sector could, and should play in the efforts to save wildlife and conserve wild lands. At that time, Dr. Sanderson also highlighted the pioneer effort GS, WCS and the people of Chile would develop to conserve these precious wild lands, and its contribution for global conservation. WCS committed to create a reserve and protect the key ecological features of this land for the people of Chile in perpetuity. The general goal for Karukinka would be the conservation of its key ecosystems: forests and peat bogs, including the restoration of ecosystem processes that sustain forests and peat bogs; and maintenance of viable and functional populations of endangered Tierra del Fuego populations.

3. ESTABLISHMENT: KEYS TO INTEGRATION. STRATEGIC, LOCAL, GLOBAL ALLIANCES

Karukinka occupies the south-western portion of Main Island of Tierra del Fuego, in Chile (Figure 1). Its current surface area comprises 297,655 hectares, making it the largest protected area on the Island. The ecological value of Tierra del Fuego has been documented (Pisano 1977, 1981, 1983, Moore 1983, Tuhkanen et al. 1990), and most comprehensively by the Independent Scientific Commission funded by Trillium (Arroyo et al. 1996).

Figure 1. Public and private protected areas in Tierra del Fuego. Karukinka is shown in orange (Map V. Fallabella).

WCS was committed both to establish a project that would have both local and global value, and to work with the Chilean national community on the development of conservation actions that would benefit both Chile and the global community (Saavedra 2006). To achieve these twin goals, WCS set up an Advisory Council, made up mostly of Chilean representatives from the scientific and business worlds[5]. The WCS President would be a member of this Council and would interact with its Executive Board, also headed by a Chilean national. The Advisory Council plays an advisory role and analyzes the project's progress and challenges, discussing alternate strategies to achieve the stated goals.

In addition to their annual meeting, Karukinka Advisors add their expertise to the discussion of specific topics, and take part in the granting of the annual fellowships. The advisors help on specific topics, as in the case of Juan Carlos Castilla, a marine ecologist who, in 2007, developed a base line on the marine biodiversity in the Admiralty Sound along Karukinka coastline[6]. This work was used for subsequent development of the Karukinka Marine Program. Another is the case of Laura Novoa, a lawyer specialized in mining topics, who has evaluated alternatives supporting the conservation of Karukinka's globally important peat bogs.

The Advisory Council first convened in September, 2005, and has met annually since then (Photograph 1). Its first suggestion was to name this project "Karukinka", the name used by the Selk'nam, the extinct Tierra del Fuego native people, to describe their land (Chapman 1986, Bridges 1983).

[5] Members of the Advisory Board at http://www.karukinkanatural.cl/consejo-asesor.htm

[6] Godoy N, J Sotomayor and JC Castilla (2007) Expedition to Almirantazgo Fjord, Tierra del Fuego, Chile. WCS Internal Report.

Photograph 1. Fourth Meeting of the Karukinka Advisory Council (Karukinka, Tierra del Fuego, April 2007). From left to right (standing): Steven Sanderson, Patricia Calabrese, Antoni Muñoz, Cecilia Martínez, Eliodoro Matte, Avecita Chicchón, Pedro Ibáñez, Bárbara Saavedra, Rafael Asenjo, Laura Novoa, Mark Tercek, Juan Quelín, Javier Simonetti, Kathleen Barclay, Antonio Lara, Guillermo Donoso, and Roberto Medina; (squatting) Alfredo Prieto, Kent Redford, Claudio Venegas, Juan Sotomayor and Claudio Moraga.

4. VALUES AND THREATS: CHALLENGES THAT ARE OPPORTUNITIES FOR CONSERVATION

Only five percent of the temperate forests of the world are in the southern hemisphere, with most of them in the southern part of the Southern Cone (Chile and Argentina, Armesto et al. 1998). Karukinka contains a significant portion of these forests, which are noted for their quality. Recent estimates on the plant communities indicate that Karukinka includes 132,582 hectares of sub-Antarctic forests, the largest forest area on the Island (Tapia 2010). Given its location as the southern-most of the continental forests, the forests of Karukinka are of global significance.

The forests of Karukinka are deciduous, dominated by lenga (*Nothofagus pumilio*), which extend over the south-western portion of the Main Island of Tierra del Fuego. Karukinka also contains mixed evergreen forests, mainly lenga and Magellan coigue (*N. betuloides*) and maitén (*Maytenus magellanica*), on the Karukinka coast (Photograph 2).

Photograph 2. Karukinka Forests, Tierra del Fuego (Chile).
Photos by G. Wenborne, A. Ginon and C. Silva.

Human use of Karukinka's forests has been less than that of other areas within the Chilean Region of Magallanes (Schmidt and Urzúa 1982, Bava 1999). Human impact has focused on the mixed coastal forests along the Admiralty Sound with timber cutting and the use of fire to clear land for cattle raising (Martinic 2009). These activities reached their peak in the second half of the past century, when timber was extracted to supply the cities in Southern Patagonia, including Río Gallegos and Ushuaia (Argentina), and Punta Arenas (Chile). The most recent

exploitation of these forests was a small (450 ha) commercial cut carried out by Trillium, early in 2000, in the Vicuña sector.

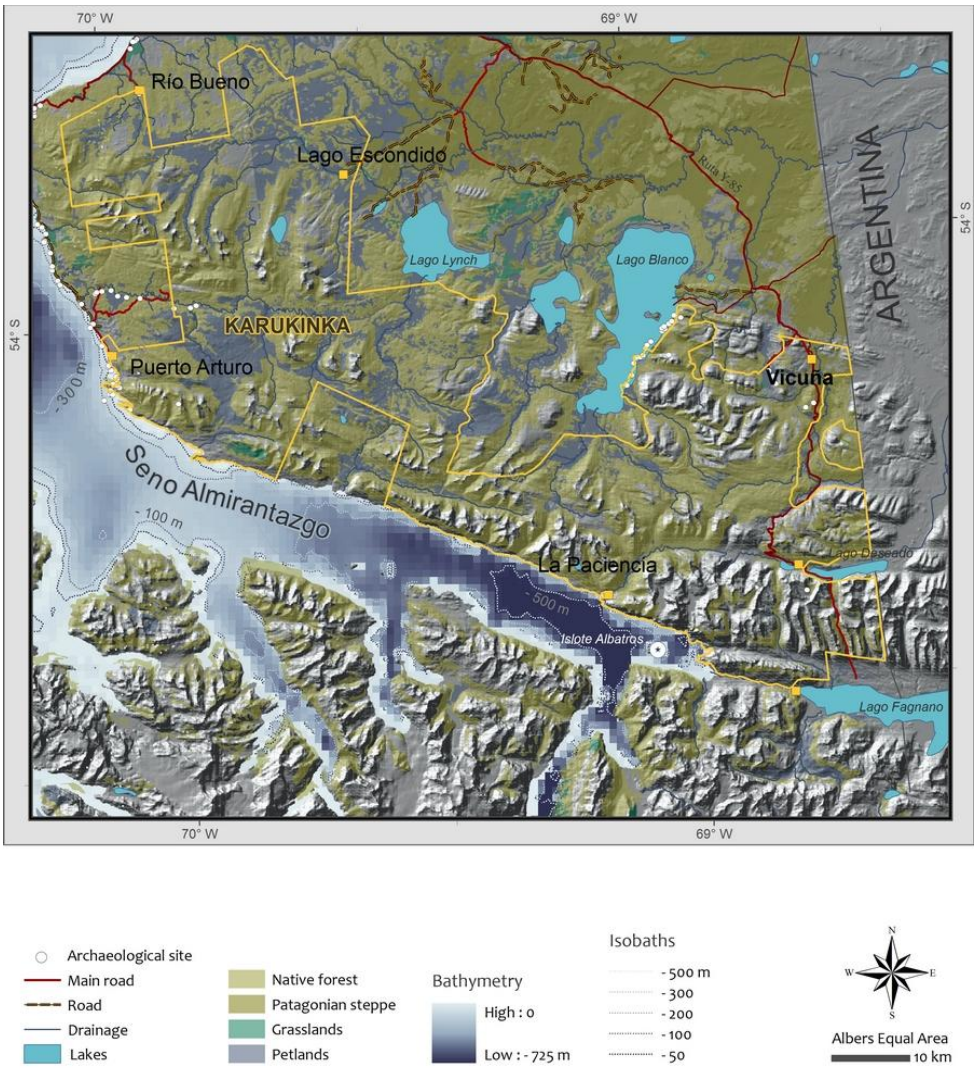

Figure 2. Detail of Karukinka (yellow line), Wildlife Conservation Society's protected area, in Tierra del Fuego, Chile.

In addition to the forests, Karukinka contains significant peat bog ecosystems. Global peat bog distribution is highly heterogeneous, with only 5% being found in the southern hemisphere, mostly in South America, a continent that contains 4% of the global total (Joosten and Clarke 2002). Peat bogs in Karukinka comprise 104,381 hectares (Tapia 2010), making this the most important area for peat bogs in the Tierra del Fuego Province of Chile (Ruiz and Doberti 2005).

Though poorly known in Chile, peatbogs play a key role in climate control, flood mitigation, and underground water supply, as well as supporting aquatic and terrestrial biodiversity (Iturraspe 2010).[7] Global estimates indicate that the carbon contained in peat bogs are twice that of forests , and if released into the atmosphere would increase by 75% the carbon currently contained in the atmosphere (Joosten and Clarke 2002). Karukinka forests and peat bogs are jointly the greatest protected land carbon sinks and reservoirs in this area, which give Karukinka a unique and irreplaceable value, not yet fully understood.

Karukinka holds 33% of the vascular flora, 38% of the birds, and 59% of the land vertebrates of Tierra del Fuego archipelago (Arroyo et al. 1996). Of particular conservation importance are the culpeo fox (Pseudalopex culpaeus lycoides), Chile's largest canine canine sub-species; the tuco-tuco, a fossorial rodent (Ctenomys magellanicus), the huillín, a river otter (Lontra provocax), the Magellanic woodpecker (Campephilus magallanicus (CONAMA 2005). Karukinka contains two fish species (Galaxias maculatus and G. platei), both native and endangered (Arismendi and Penaluna 2009)). Karukinka plays an important role in the conservation of guanaco (Lama guanicoe), the largest native herbivore with a long history of human use. This species, which used to populate all of Patagonia, was the basis of the Selk'nam culture (Chapman 1986). Guanaco have been decimated throughout the country and are currently protected. In Tierra del Fuego, its populations have rebounded as a result of a successful government program started in the 1970s (Raedeke 1978), repopulating a large portion of the Island. Population estimates suggest that up to 75% of Island of Tierra del Fuego's guanaco population is in Karukinka (Moraga et al. 2011), making this the largest protected population in Chile.

In addition to the terrestrial biodiversity Karukinka has a coastline, of almost 50 km along the Admiralty Sound, a particular and rich Patagonian fjord (Acevedo et al. 2011), in addition to being a destination of interest for the development of the local tourist and artisanal fishing industries. The Admiralty Sound is a vital link between Karukinka and D'Agostini National Park, second largest in Chile, which is located just across the Sound (Figure 1 and 2). This area

[7] Figueroa et al. (2010) estimated in more than USD 330 million per year, the value of ecosystem services provided by peatbog ecosystems located within the country's National System of Protected Areas (SNAP).

is part of a binational watershed, which includes the Azopardo River and Fagnano Lake in Argentina, and thus is connected to protected areas in Argentina (Corazón de la Isla Reserve and Tierra del Fuego National Park), offering a unique opportunity to integrate marine-terrestrial conservation at an adequate ecological scale, thus maximizing conservation return.

Karukinka's importance for Chilean conservation has been recognized. It contains one of Chile's 68 national priority sites for national conservation along the southern portion of the property between Lago Blanco and Lago Fagnano. Proposed as a priority in 2002 by CONAMA[8], this area is now conserved in perpetuity as a result of the creation of Karukinka. This illustrates the vital role private conservation can play in Chile.

5. STRATEGIC PLANNING: KARUKINKA BIODIVERSITY MANAGEMENT

Identifying objects for conservation, their specific threats, as well as critical interventions to reduce these threats, requires systematic conservation (Hockings et al. 2006, Salafsky et al. 2002, Leverington and Hockings 2004). The Karukinka Program, as with all the other WCS conservation programs, applies an explicit, participative methodology that defines and makes explicit the central axes of its conservation management (Salafsky et al. 2002).

This process begins with designing conceptual models which identifies, and prioritizes critical actions. In Karukinka, WCS has identified, seven specific conservation targets, including: a) structure and processes that maintain old growth *Nothofagus* forests; b) Karukinka's water courses and peat bogs; c) key habitats for marine and coastal biodiversity in the Admiralty Sound, and adjacent fjords, including Whiteside Channel; d) the reproductive black-browed albatross (*Thalassarche melanophrys*) colony in the Admiralty Sound ; e) guanaco (*Lama guanicoe*) populations in Karukinka and adjacent lands; f) functional assemblages of small cetaceans in the Admiralty Sound and neighboring areas; g) populations of culpeo fox (*Lycalopex culpaeus*) in Karukinka and neighboring areas.

For each one of these conservation targets, WCS has summarized the threats, both direct and indirect, and the interventions that are regarded as necessary to abate them. As an example, Figure 3 details conceptual model for Karukinkas's water courses, critical for maintaining the structure and operation of the forests, peat bogs and native aquatic species. For this target, four direct threats have been identified: i) presence of introduced beavers (*Castor canadensis*); ii)

[8] Chile's Environmental National Comission

presence of other invasive aquatic species, such as mink (*Mustela vison*), muskrat (*Ondatra zibethicus*), salmonids (e.g. *Salmo trutta*); iii) climate change; and iv) drainage caused by change in land use for infrastructure. Four general actions to reduce these threats have been identified, including: permanent eradication of beavers; research on the effect of invasive species on the ecology and biodiversity of water courses; research on and monitoring the climate change process; and research, restoration and promotion of good practices in the construction of road infrastructure (Figure 3).

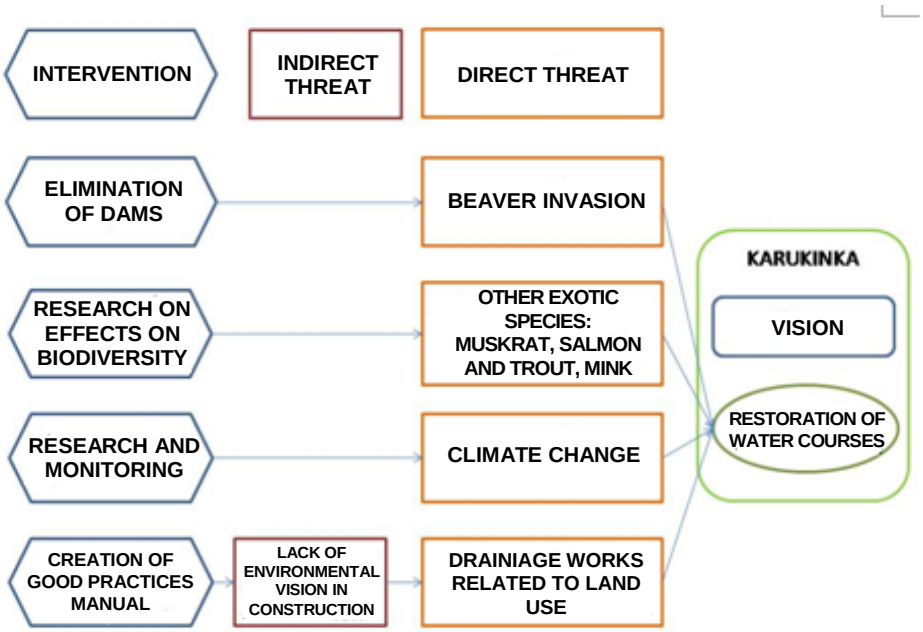

Figure 3. Conceptual model showing direct threats (pink), indirect threats (orange), and necessary interventions (yellow) to achieve the conservation of the water courses located in Karukinka, Tierra del Fuego.

The conceptual model helps to define the specific conservation goals for each object, as well as a monitoring framework, the method to be used to achieve the goal, and a numerical indicator of the process. This framework is made for each element contained in each conceptual model, in order to monitor not only the recovery of the object for conservation, but also its threats and the interventions related to each one of them. The example below shows the monitoring framework as defined for the conceptual model for the water courses (Figure 4).

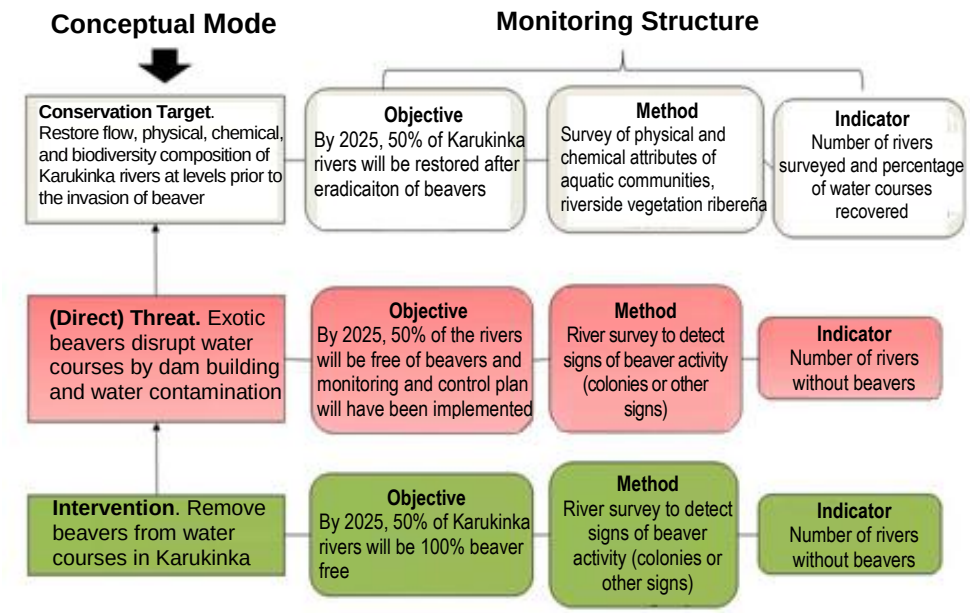

Figure 4. Monitoring framework of the causality chains of the conceptual model for the restoration of water courses in Karukinka, Tierra del Fuego.

Implementation of specific conservation actions will depend on the priority assigned to the conservation targets, their threats and actions. This is a recursive process that must be reviewed on a periodical basis. In this process, effectiveness of the conservation management must also be verified, which must be corrected whenever the compliance indicators are not adequate. In Karukinka, four objects and actions has been given urgent priority, including: a) water courses, through direct control of beaver populations; b) peat bog conservation, by promoting and establishing long-term research on the ecosystemic systems and effects of climate change; c) conservation of marine biodiversity in the Admiralty Sound, by establishing a multiple use marine protected area, and d) implementation of Karukinka as an effective protected area, through the development of its public use plan.

Below is a general discussion of the complexity in identifying and conducting appropriate strategies for four conservation targets and the key interventions more relevant to achiving them: a) water courses by beaver removal, b) peat bogs conservation through research, c) marine conservation in the Admiralty Sound, and d) implementation of the Karukinka pulbic use.

6. RESTORATION OF TIERRA DEL FUEGO FORESTS, WATER COURSES AND PEAT BOGS THROUGH BEAVER ERADICATION.

One of the global threats to biodiversity, the invasion of exotic species, has a significant presence in Tierra del Fuego: the beaver.[9] This species was introduced to the southern part of the island in 1946, with the release of 25 pairs in order to establish a "natural" population to supply a future fur industry (Lizarralde 1993, Lizarralde et al. 2004). The number of beavers has risen to over 60,000, spreading over the entire Main Island , and a large part of the neighboring islands (e.g. Navarino, Hoste, Dawson), to finally cross the Strait of Magellan and be found on the Brunswick Peninsula, on the continental part of America (Skewes et al. 2006).

Beavers modify their environment by building dams and creating ponds where they establish dens, as well as extending the safer aquatic environment, closer to the trees, especially lenga. This flooding behavior kills trees either by direct feeding behavior of the beaver or due to flooding which can kill trees up to 100 meters along each watercourse (Photograph 3). Trees generally do not regenerate due to changes in the sedimentation patterns of water courses, which, even after abandonment by beavers remains a meadow consisting of many introduced herbaceous species (Anderson et al. 2005, Martínez-Pastur et al. 2006, Anderson et al. 2006). At least half of the riverine forests in Tierra del Fuego have been lost as a result of beaver action (Skewes et al. 1999, Baldini et al. 2008). Under Chilean law, these forests are protected given their importance for the conservation of water resources.

[9] Chapter 6 of this book, written by Pauchard et al., is devoted to analyzing invasive species in Chile, and Chapter 7 by Azevedo and Dechoum analyzes the strategy designed by the Sao Paulo Satate, in Brazil, to deal with invasive alien species.

Photograph 3. Examples of the damage arising from beaver activity (*Castor canadensis*) in the forest and limnic environments in Karukinka, Tierra del Fuego. Photographs by WCS.

The presence of beavers affects other biodiversity components at all levels in the ecological hierarchy, including modification of the chemical quality of water (Lizarralde et al. 1996), reducing the native forest regeneration processes (Anderson et al. 2006), favoring the establishment of invasive plants in the forest (Anderson et al. 2006), creating a habitat for exotic fish (Moorman 2008), among others. Added to the above are adverse economic effects arising from the flooding of cattle raising areas, destruction of fences and damage to road infrastructure, causing annual

losses amounting to US$3 million, a relevant sum of money to Tierra del Fuego's small economy (Parks et al. 2008) (Figure 5).

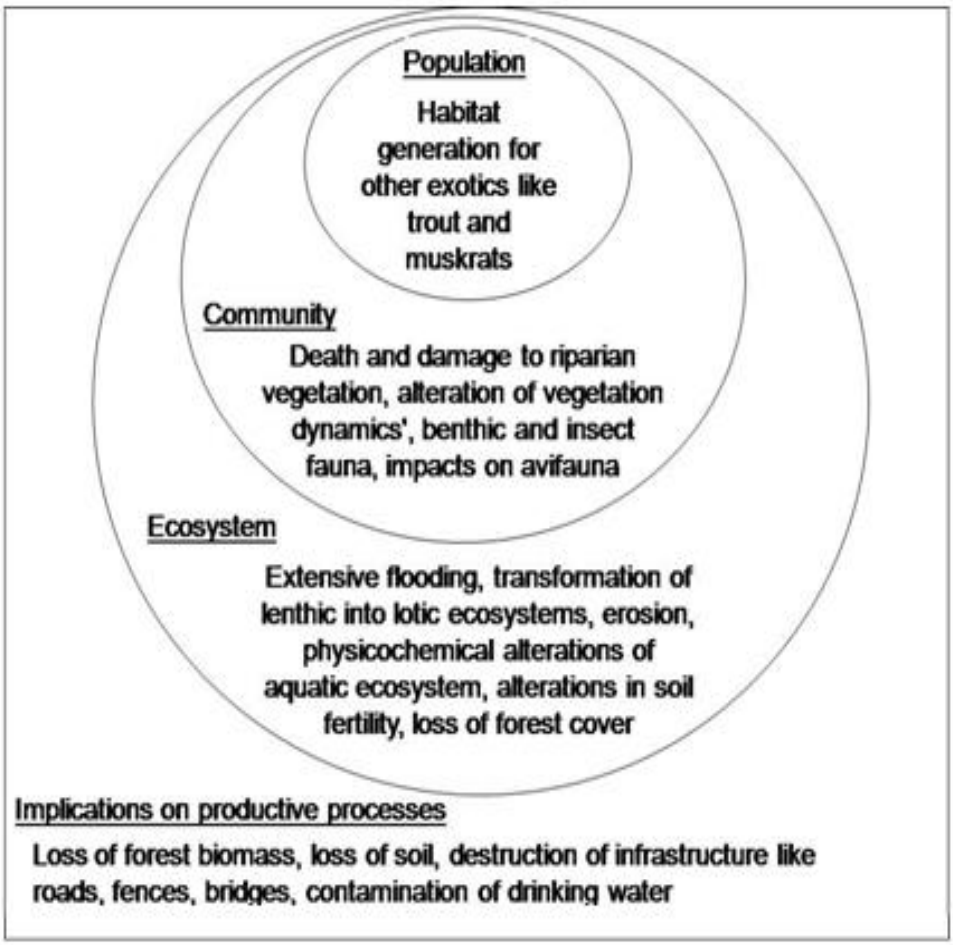

Figure 5. Summary of effects arising from the presence of the beaver introduced to Tierra del Fuego.

Controlling the beaver population in Tierra del Fuego started only 35 years after the arrival of the species on the Island, and was initially confined to hunting them for their pelts. As of 1999, Argentina and Chile started species management programs combined with indirect support for the development of fur markets. This program was based on the assumption that increased fur trapping would cause

their population sizes to drop and would generate a permanent local economic activity. These programs operated until about 2007-2008, and were ineffective in controlling beaver populations in the archipelago for three reasons: i) there is no hunting culture in Tierra del Fuego as in the Northern Hemisphere; ii) there is no road infrastructure or means of transportation in Tierra del Fuego allowing access to vast areas of the island and its surroundings, especially on the Chilean side; iii) there is not currently a fur market lucrative enough to encourage the local population to overcome the two aforementioned barriers and set out to hunt a significant number of beavers.

In 2006, WCS began working to promote a new vision to address the restoration of riverine forests due to beaver damage by eradicating beaver throughout their range in southern Patagonia. This decision was taken as a result of i) a critical analysis of the control efforts made to date, ii) relevant international information about new techniques to manage exotic species, and iii) the apparent threat to biodiversity and the economy of the southern part of the Southern Cone posed by the expanding beaver population (Menvielle et al. 2010) (Figure 5). A new road map was defined to reach this vision (Menvielle et al. 2008), which has led the Chilean and Argentine governments, supported by national and foreign scientists and NGO's (see Menvielle et al. 2010), to develop a Binational Strategy to eradicate the beaver. This process has moved forward on a variety of fronts, including:

i) 2007-2008: development of a study to evaluate the feasibility of eradication as a management tool, which was funded by the governments of Chile and Argentina and WCS, and executed by international experts (see Parkes et al. 2008[10]). The result of this analysis indicated that eradication not only was feasible but also had the best cost-benefit ratio as a beaver management tool to manage the restoration of the ecosystems in Southern Patagonia. This project is highly complex and costly, requiring detailed and goal-oriented planning, which, in turn, may provide room for the development of institutional, scientific, administrative and exotic species managing capacities, presently absent in the south of the Southern Cone.

ii) 2008- Signing of a Binational Agreement to work on the restoration of the native ecosystems of Southern Patagonia, supported by the governments of Chile and Argentina. This is a unique kind of agreement, to support cross-border conservation and management based on the definition and subsequent coordination of specific actions.

[10] Availanle at http://www.karukinkanatural.cl/publicaciones.htm

iii) Development of a Strategic Plan[11] which will guide the process of creation and operation of the Beaver Eradication Project, and coordinate the different national and international stakeholders. The Strategic Plan will specify required future actions, such as: 1) the development of pilot areas where management interventions will be tested (e.g., beaver expansion rates; trap effectiveness); 2) provision of technical support (e.g. GIS) upon which the eradication operation will be based ; 3) development of financial mechanisms for this operation (e.g. business plan), and 4) generate the technical (e.g. highly qualified trappers) and administrative (e.g. governance) capacities to implement the beaver project. WCS has been a key player in the development of this strategy, and hopes that Karukinka will serve as a basis to become one of the pilot areas for testing science and management. The newly created Chilean Ministry of the Environment has given this project national priority, and expects to contribute by raising funds for implementing the pilot sites during this year, initially through the GEF funds.

The Karukinka program has thus promoted the development of a new plan to manage an existing and previously-intractable problem. The key aspects of this process include: analyzing the problem at an adequate scale: the bi-national one; widening the collaboration and integration networks by adding international experts to existing local expertise; defining feasible goals and coordinating implementation; and strategically planning the steps to develop tools to drive this large-scale eradication program.[12] The next steps in this process are establishment of pilot programs, testing eradication in the field, creating adaptive monitoring protocols, as well as generating the capacities required in both countries to implement the eradication operation.

7. PATAGONIAN PEAT BOGS, LOCAL VALUE AND GLOBAL SERVICES

Patagonian peat bogs provide critical ecosystem services including the regulation of hydrological processes, maintenance of global carbon balances and supply of habitat for a wide range of species. Peat bogs in Chile and Argentina may be the

[11] Funes M, MF Menvielle, B Saavedra and A Schiavini (2010) Strategic plan of the project to eradicate the beaver in Patagonis and Tierra del Fuego. Document prepared on mandate arisen at the "First Binational Workshop (Chilean - Argentine) in the scope of the Agreement for the restoration of Southern Ecosystems affected by the American beaver (*Castor canadensis*)".

[12] Chapter 10 of this book, by Aguirre-Muñoz et al., describes and analyzes the complex and costrly programs implemented for aradicating 48 alien mammal species in 31 islands of Mexico. And Donlan et al., in Chapter 9, anlyze the large alien goat eradication programs implemented in the Galapagos Archipelago, Ecuador.

largest land carbon reservoirs existing at these latitudes (Blanco and de la Blaze 2004). One of the key factors in determining the carbon increase in the peat bogs or their potential as a greenhouse gas effect carbon source/reservoir is water depth, since, as the peat bogs become more exposed to the air, its rate of aerobic decomposition rises (Joosten and Couwenberg 2009).

Photograph 3. Examples of peat bogs in Karukinka, Tierra del Fuego (Chile).

One of the key biotic components of peat bog ecosystems are bryophytes (moss) of the *Sphagnum* type, which, due to the cell composition and structure of their tissues, absorb large quantities of water (Iturraspe and Roig 2000), being able to reach 20 times their own dry weight. This kind of moss is presently used by some local communities in northern Patagonia (e.g. Chiloé Island), who exploit the resource at a small scale (Valenzuela and Schlatter 2004). This activity has

attracted the attention of some local authorities in Chile, who have invested in its promotion (FIA 2009 a and b). Exploitation of *Sphagnum* might become sustainable if such critical variables as keeping the water table or keeping propagula sources for recolonizing the areas exploited during the extraction stage are managed properly. This is not the case of the extraction activities that are being carried out in Magallanes, which, in the absence of clear guidelines from the environmental authority, proceed without considering management variables necessary to conserve the ecosystem. Mining of peat bogs, which requires peat bog drainage, causes the loss of valuable wetland properties and the ecosystem services they provide. The development of a strategy that combines conservation and management, combining the exploitation of the *Sphagnum* biotic component with maintaining the integrity of the peat bog ecosystem, and the provision of the related ecosystemic services, represents a great challenge to Chile (and Argentina), while it is a extraordinary opportunity to develop new models for integrating conservation with sustainable use.

WCS, jointly with the Ministry of the Environment, Foundation Send Darwin, and Wetlands International has proposed a long-term research program for sustainable conservation and management of peat bogs in Patagonia, consisting of a variety of components:

i) Ecosystem services: studies on carbon storage and flows in peat bogs, and research on the importance of peat bogs in regulating hydrological cycles and water quality;

ii) Biodiversity: focusing on research on species in the *Sphagnum* habitat, and the invasive plant and animal species that are currently threatening these ecosystems; and

iii) Peat bog management and sustainability, establishing the conditions under which the extraction of *Sphagnum* may take place is a sustained way, as well as financial mechanisms that may lead to the carbon emission credits or ecotourism markets.

8. WCS'S VISION FOR THE COASTAL CONSERVATION OF PATAGONIA, THE ADMIRALTY SOUND.

Chile's coastline is one of the longest in the world and sustains artisanal and industrial economic activities. Despite the vital importance of this coastline, Chile has only protected less than 0.05% of its marine ecosystems and does not have a comprehensive coastal marine biodiversity conservation policy (Castilla and Fernández 2005). Recent conservation efforts like the development of the Marine

GEF project[13], or the declaration of Sala y Gómez Island as a marine zone, are small first steps compared to the large scale at which the exploitation of the ocean is promoted and facilitated (e.g. national promotion of salmon farming) (Castilla and Fernández 2005).

This neglect of the marine realm is replicated and intensified in the Magallanes Region, which, spanning nine degrees of latitude and has the longest coastline in Chile. The human population in this region is sparse, but its impact on the coastal biodiversity is significant due to the wide-scale development of the artisanal fishing activity, the most important factor affecting conservation along Chilean coast (Castilla and Fernández 2005), combined with the advent of the tourism and salmon farming industries. These activities have all been identified as threats to the region's coastal biodiversity (Vila et al. 2010), and affect invertebrate species of high economic value (e.g. kingcrab (*Lithodes antarcticus*), scallop (*Clamys patagónica*), jackknife clam (*Ensis macha*), seaweed (*Macrocystis* or *Durvillea*), vertebrate species (e.g. whales (e.g. *Balaenoptera borealis*) smaller cetaceans (e.g. *Lagenorhynchus australis*), penguins (e.g. *Spehniscus magellanicus*), sea elephants (*Mirounga leonina*) and even oceanographic processes (e.g., upwellings)). The coastal area of Magallanes has the largest number of species with small distribution ranges in Chile (Fernández et al. 2000), including a large number of endemics, emphasizing the importance of a robust system of marine protected areas.

In 2009, Karukinka started a Marine Conservation Program to help create a model for conservation management of the marine biodiversity existing in the Admiralty Sound and adjacent waters. Larger-bodied marine species of the Southern Cone use the oceans on both the Atlantic and Pacific sides of Patagonia (Campagna et al. 2006, Falabella et al. 2009). The overlapping species distribution, habitat use and threats make vital a binational integration for promoting conservation in the Patagonian Sea. The purpose of WCS's initiative is to integrate the experience and expertise on conservation that WCS has developed over decades on the Atlantic coast of Patagonia, and reinforce Karukinka as a new private player that may drive marine conservation from Tierra del Fuego.

WCS has begun to complement its work on terrestrial activities with a targeted set of marine conservation activities. It has conducted three scientific research cruises to Admiralty Sound (2007, 2009, 2010), to prepare a baseline on the knowledge and use of the marine resources found in the Fjord[14] and to conduct

[13] GEF Project "Conservation of biodiversity of world importance along the Chilean coast"
Executed by Comisión Nacional del Medio Ambiente (CONAMA), between 2005 and 2009. http://www.conama.cl/gefmarino/1307/channel.html

[14] Godoy N, J Bahamondes and JC Castilla (2007) Expedition to Almirantazgo Fjord, Tierradel Fuego, Chile. WCS Internal Report, Chile.

research on selected marine species. In collaboration with different national and foreign entities (e.g. INACH, CEQUA, University of California Santa Cruz, Agricultural and Livestock Srevice (SAG), Universidad de Chile, Universidad de Magallanes), WCS has started genetic, reproductive and behavioral studies, on the only colony of black-browed albatross in the world which inhabits inland waterways, and the only reproductive colony of sea elephants in Chile (Photograph 4), both present on the Karukinka coast. The first results of these expeditions have already been published (Acevedo et al. 2011).

Photograph 4. Black-browed albatrosses (*Thalassarche melanophrys)* and Elephant seals (*Mirounga leonine*) studied in the admiralty Sound, at the Karukinka coast, in Tierra del Fuego.

Focusing conservation work on the Admiralty Sound (Figure 2) allows active integration of marine and terrestrial management both in Karukinka and in adjacent areas, such as Alberto De Agostini National Park. This integration is especially necessary in coastal ecosystems, and is reflected in the effect that

beaver activity has on the quantity and quality of the waters that drain from the basins to the coast.

Creation of Karukinka's marine program allowed WCS to actively participate in the Coast Zoning Process that took pace in the Magallanes Region in 2009[15]. Intended to provide the Regional Government with scientific and up-to-date input for this process, WCS, together with WWF, led an exercise to identify the Marine High Conservation Value Areas (HCVA) in the Magallanes Region. This process started with the organization of a general Workshop (September 2009) for all national experts on the Magallanes coastline that applied systematic planning methodologies, to identify and prioritize conservation targets, threats and actions to alleviate these threats. A total of 74 Objects for Conservation were identified, and the geographic distribution of 46 of them could be defined (e.g. areas used by Peale's dolphin, fjord bottoms with glacier influence, presence of hydrocoral or submarine canyons, penguin colonies). Twenty-three threats to marine biodiversity were identified, including habitat destruction, over exploitation of biological resources, poor salmon farming-related practices, contamination, litter and unregulated tourism (Vila et al. 2009). Using a planning algorithm widely used in conservation (Marxan), potential protected area distribution scenarios were analyzed and selected, maximizing, at the same time, the representation of conservation objects and minimizing the implementation costs.

The analysis identified a 28-HCVA portfolio for the Magallanes Region covering 26% of the Region's coast, and protecting 46 marine conservation objects, including submarine mounts, fish feeding areas, sandy beaches, areas containing native seaweed forests, reproductive colonies, areas used by cetaceans, among others (Vila et al. 2010).

This portfolio was submitted to the Regional Government of Magallanes, as input to the zoning process underway and provided an important scientific perspective to this process. We hope this work will help generate effective planning allowing a balance between fishing, tourism, salmon farming activities, and conservation of biodiversity.

Engagement with the Government in the planning exercise had one significant conservation outcome which was its decision to ban salmon farming in Tierra del Fuego Province on grounds that coast is better suited to tourism, an industry that is not compatible with salmon industry farming (Besnier, Governor of Tierra del Fuego; pers. com.). This contrasts with decisions made by other provinces with proven tourist vocation, such as Última Esperanza (which receives half of the foreign visitors that come to national protected areas), which has

[15] Coastline 2009. http://www.bordecostero.cl/index.php/zonificacion/conceptos.html

devoted significant parts of its coast to salmon farming. This decision is incompatible with the larger conservation vision for Chile's coasts and may be reversed as a result of a regional zoning process.

Just as in the case of the beaver or conservation of peat bogs, managing conservation of the Patagonian Sea depends on the integration with adjoining Argentina. Binational work on marine conservation is critical for ensuring sustainability of economic activities like artisanal fishing and tourism. These activities depend directly on the existence and accessibility to coastal biological resources, including invertebrates and vertebrates, respectively. In order to provide a database accessible to decision makers and researchers, WCS is preparing the Atlas of Marines Scapes of the Southern Cone. This is a cross-border effort that will identify high value sites for biodiversity conservation south of the Southern Cone through a systematic planning process whose final objective is a public web space containing the mapping of relevant species, ecosystems and ecological processes to represent the marine biodiversity. This information can then be used in the design and implementation of a bi-national network of marine conservation areas in the Southern Cone.

9. CROSS CUTTING TOOLS: PUBLIC USE AND EDUCATION FOR CONSERVATION

When Karukinka was created, WCS made a commitment to allow it to be visited by Chileans and others. Prioritizing and managing this visitation will be done through a Public Use Plan which will structure visits for purposes of education, research, management and tourism. WCS has worked on the design and initial implementation of the Public Use Plan[16] for Karukinka, which is based on optimizing the use of space by considering natural variables (e.g. presence of viewpoints, lakes or rivers, attractive animal populations), as well as services (e.g., access roads, proximity to services), while safeguarding the fragile biodiversity and landscapes. This Plan proposes the construction of a trail network extending through much of Karukinka and to meet visitor needs, connect the Park with trails existing in the zone, provides facilities for visitors while creating the infrastructure necessary to carry out research and educational activities. The basic framework of the Public Use Plan is the Karukinka Circuit (Figure 5), which will consist of a network of almost 500 km of trials and roads connecting the area's most important spots (Vicuña, Lago Escondido, Puerto Arturo, La Paciencia, Lago Despreciado), allowing visitation to spots of beauty (e.g. observation points on Cordón Valdivieso,

[16] Pavicic S (2006) Tourist potential and Karukinka's management model. Internal Document, WCS-Chile.

Bahía Jakson, Río Cóndor), and permitting access to different activities such as trekking, fishing, and kayaking.

WCS has started the implementation of this Plan, opening trails to visitors (Figure 5), acquiring outdoor recreational equipment, developing materials to promote biodiversity and other local highlights (all materials that are available on our web page[17]). With the support of the Corfo Innova Program[18], this year WCS expects to integrate into this network Sendero La Paciencia, a path of about 30 km long that will link the internal public road that covers Tierra del Fuego (Vicuña-Yendegaia Road), with the Admiralty Sound at La Paciencia Bay. Recently, as a result of the funds granted by the Council for Culture and Arts, jointly with Pehuén Editores, we have started the publication of the "Explora Magallanes" Series, a set of bilingual guidebooks designed to increase appreciation of Magallanes heritage and the conservation work WCS carries out in the Region.

[17] http://www.karukinkanatural.cl/turismo.htm

[18] Project Innova Corfo "Integrating forests, peat bogs and coast in Karukinka Park: the opportunity of La Paciencia Trail to promote tourism of special interests in Tierra del Fuego" Awarded to Wildlife Conservation Society and EuroChile as Sponsoring Entity, to be executed in 2011.

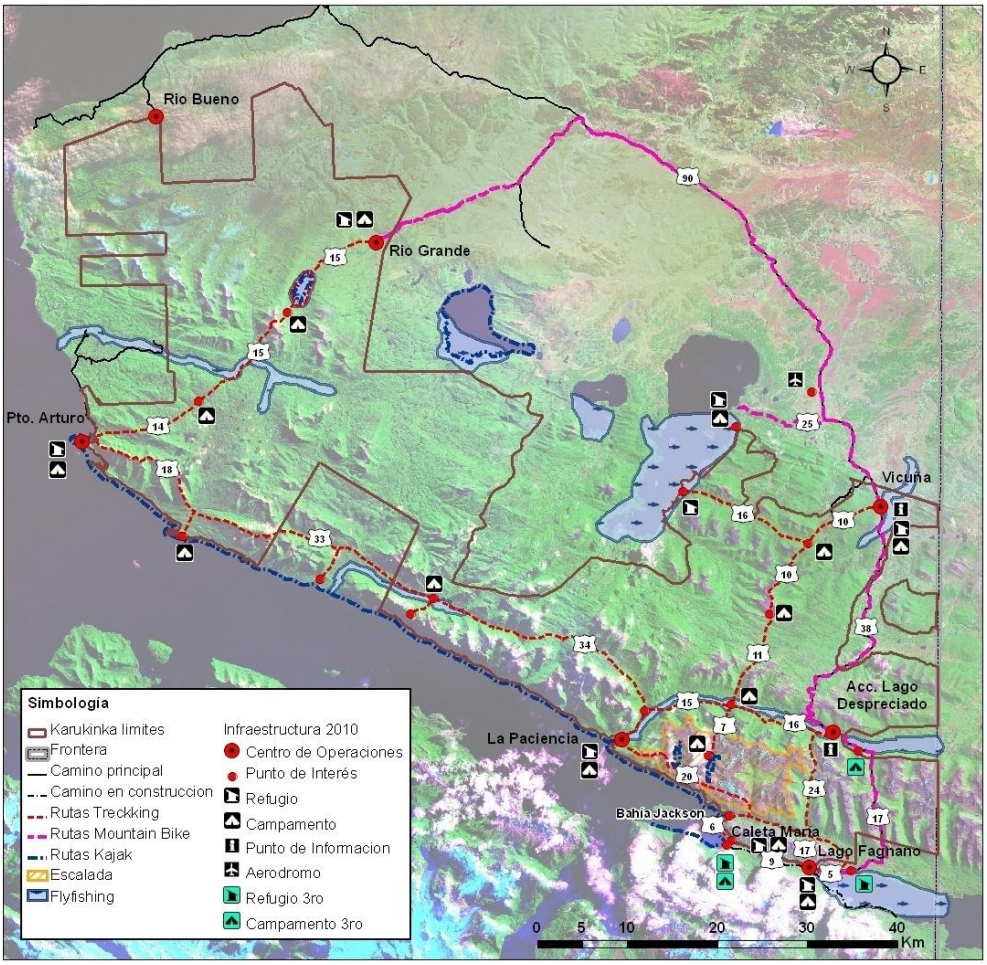

Figure 5. Chart showing Karukinka Circuit, and related infrastructure.
Tierra del Fuego, Chile.

The Vicuña-Yendegaia road, that covers Karukinka in a North-South direction along its far eastern section, is of particular interest. This is the only road existing in the area, the southernmost on Isla Grande, which has been under construction since 1995, and which should reach the Beagle Channel in the near future. Research conducted in Karukinka has quantified the environmental problems caused by the road, and proposed specific interventions to prevent further problems and restore areas already affected (Repetto 2009). Through its CooperativeAgreement signed with the Ministry of Public Works-Road Department (2009) WCS expects to undertake these interventions.

Through its commitment to ensure that Karukinka is valued not only by visitors from afar but also citizens of the region, WCS is committed to working with local populations, particularly school children. Since 2006, WCS has worked in the establishment of education programs in Tierra del Fuego Province, including primary and secondary schools in the nearby towns of Porvenir and Cameron. Co-financed by public granted funds such as those from CONICYT-Explora and FPA-CONANA, each year WCS has developed specific conservation education projects for local schools. The projects are conducted in Karukinka and the resulting products are made available to the Island's school communities and to the general public on the Internet, our web site, or on sites of the Ministry of Education19. In each project specific conservation problems are addressed, and capacity and value are generated promoting knowledge of local biodiversity through field experiences. To date we have conducted 10 education projects with more than 200 school children and provided many with their first direct contact with the Tierra del Fuego forests. We have also interacted with over 2,000 children through conferences, lectures, workshops and helped develop educational materials with local identity[20] which have helped to developing regional pride.

This work has been complemented with a college-level internship program which each year has brought about 10 students to Karukinka to work on selected management topics. This educational work, part of the Public Use Plan has allowed WCS to transform Karukinka into an engine for local and national environmental education in the area, actively and effectively helping to fill a little developed niche in Tierra del Fuego.

A critical challenge to protected area management in Chile and the rest of the world is how to generate and integrate applied research into management action. WCS has developed a strategy to make Karukinka an attractive place for applied research, providing basic support to attract students and researchers. A tool that serves this purpose and provides the Program with a special identity is the creation of the Karukinka Fellowship[21], which funds research for conservation in Tierra del Fuego. To date, five grants have been given and the work successfully completed. The contribution to knowledge of the area is supported through different publications, including articles (e.g., Silva and Saavedra 2008b, Vila et al. 2006, Baldini et al. 2008, Promis et al. 2008), theses (Silva 2010, Menegoz 2010, Sepúlveda 2010, Tapia 2010), and books (Etchegaray 2008, 2009, 2011a and b, Silva and Saavedra 2008).

[19] Etchegaray P (2008) Explora la Naturaleza de Magallanes. Available at www.edraleza_de_pmagallanes.dfucarchile.cl/UserFiles/P0001/File/CR_Articulos/explora_la_natu

[20] Textbooks available at http://www.karukinkanatural.cl/publicaciones3.htm

[21] Conditions available at http://www.karukinkanatural.cl/i-y-p.htm

WCS has made an effort to create direct and close relationships with universities and study centers of the region and beyond, by integrating local scientists into research activities that are carried out. WCS has signed Cooperation Agreements with different research entities (e.g., Universidad de Magallanes, Universidad Católica de Chile, Universidad Austral, Landcare Research (New Zealand), University of California-Santa Barbara (USA)). We believe that this not only will facilitate the exchange of researchers, but also give continuity to cooperative relationships over time.

10. FINAL CONSIDERATIONS

Chile is a country rich in biodiversity, from the Andean deserts in the north to the ice fields in the south. Conservation of this wealth will require cooperation by a variety of actors. IUCN's recent expanding of the categories of protected areas to include types of governance – including private governance – reflects the global belief in the need for this diversity. As a private park Karukinka is actively contributing to biodiversity conservation management in Chile through applying science-based methodologies (Meffe and Carroll 2006), focusing on adaptive management. The work done by WCS, from research through education through management is designed both to ensure the in-situ conservation of the biological wealth of Karukinka as well as to effect positive conservation in areas near and far from Karukinka itself.

The integration of conservation and management is one of the key elements that WCS applies in Karukinka. Management in Karukinka almost always requires a bi-national approach, both complicating and enriching the tasks as illustrated by the work on beaver control. This is even more true when it comes to marine conservation where the spatial scale is greatly expanded, ranging from Peninsula Valdes in the east to Chiloe Island to the west. Stronger and faster advances to implement conservation goals both at national and bi-national levels should be facilitated by key support offered by public sector, like integration of policies or resources allocation.

Conservation of Karukinka is an end in itself, given the high value of its biodiversity, but it is also a tool for advancing conservation in the region. The management for conservation that WCS is carrying out in Karukinka provides the possibility of establishing a large laboratory where effective and efficient conservation practices may be put to the test. Since conservation effectiveness is, in the end, a pragmatic matter (Robinson 2011), we believe that our work in Karukinka on conservation implementation will help improve conservation in Tierra del Fuego, Chile, the region, and the world. As such the work in a private protected area could be key in helping improve the Chilean protected area system.

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