

Chile Litoral

DIÁLOGO CIENTÍFICO SOBRE LOS ECOSISTEMAS COSTEROS

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PRIMERA PARTE

*Perspectivas para observar
el borde costero*

Comprehensive Chilean Coastal Assessment: Challenges, Policy and Science

RONALD G. HELLMAN AND OSMAN MORALES

ABSTRACT

This paper, a “Comprehensive Chilean Coastal Assessment: Challenges, Policy and Science”, is an initial survey of key themes and issues identified by our research partly based on a digest that summarizes selected materials of a number of web site sources. The document includes significant textual summaries and an internet bibliography with a list of web addresses that have been consulted. The survey provides a comprehensive, though not exhaustive, overview of the main socioeconomic, political and ecological issues in Chile’s coastal zones. We intend to analyze these issues in greater detail at the International Conference by FLACSO-Chile/IACERE on November 19-20, 2002.

The FLACSO/IACERE International Conference will (1) examine Chile’s coastal zones by bringing together academics (natural and social scientists), with policymakers and private sector stakeholders. (2) We have applied IACERE’s comparative method to the Chilean case by concentrating on the country’s regional economies and ecosystems (e.g., Valparaíso central zone, Reloncavi estuary in Southern Chile), in an equivalent way our team research is conducted in the New York region as well as in Mexico. (3) The international conference will also be an opportunity to review IACERE’s ongoing research and set new directions in the scientific understanding of estuaries in the Americas, and particularly the challenges for Chile’s coastal zones in the 21st century. (4) The policy research initiative of IACERE is to place our body of comparative work –the results of its research undertakings in five estuaries in the Americas– to further comprehensive management coastal planning in Chile. The conference will examine in detail these four areas.

This survey is divided into two parts. Part One provides an overview of Chile’s regional and national challenges in the coastal ecosystems. We

selected key and representative geographical areas in the North-South gamut of Chile's geography that provide scientific and governance challenging issues in ecosystem and development. Part Two is a comprehensive overview of the main themes in (a) science and governance, (b) regional economies, and (c) national policy and coastal management.

Science and governance issues that are especially relevant for our research purposes include water quality, multiple uses of the estuary, land management—especially zoning laws, and economic activities such as ecotourism. The most important regional economic challenges that we have identified for Chile at this juncture include the building of the Chacao Bridge to Chiloé; the increasing importance of ports in the context of globalization (e.g., the Port of Valparaíso as a potential center of marine service industries—freight insurance, shipping and inventory management software); and freshwater and energy management in coastal regions and watersheds (of particular interest is the case of Concepción). Last, national policy and coastal management combine a set of issues that are critical for the development of Chile's coastal areas: the role of science in coastal management plans, the development of marine protected areas and comprehensive coastal strategies (including zoning), the impact of ecosystem change and development on social and cultural institutions, and national security.



Fuente: <http://www.eia.doe.gov/emeu/cabs/chile.html>

I. OVERVIEW – REGIONAL PERSPECTIVE AND NATIONAL CHALLENGES

FLACSO - Biblioteca

The Southeast Pacific is one of the most productive marine ecosystems, characterized by the high variability in its oceanographic conditions. Chile is the one of the most important fishing countries worldwide.

The Chilean marine production has grown from 900,000 tons in 1975 to 7.6 millions tons in 1994. Between 1986 and 1994, the export of fisheries products grew by a 100%. In 1995, fisheries represented Chile's third largest export income, after mining and forestry. Fisheries and aquaculture represent 12% of total annual Chilean export value (<http://www.greenpeace.org/~comms/fish/chile01.html>).

Chile possesses a wide variety of ecosystems, ranging from deserts in the north to temperate rainforests in the south. Its forests are some of the most impressive of the world, ranging from Chilean palm forests and *Sclerophyllous* forests (composed of tree species adapted to drier climates), in north-central Chile, to prehistoric araucaria forests, temperate rainforests, and alerce forests—the “redwoods of the Andes”—to the South. Almost every type of temperate forest native to the Southern Hemisphere can be found in Chile. These forests are of great ecological and conservation value. They store vast quantities of carbon that contribute to global climate regulation, control flooding, purify water, cycle nutrients and soil, and are home to numerous plant and animal species, many of which can only be found there. At the local level, native forests are important not only for biodiversity but also as a source of timber, non-timber forest products, and fuel wood for many rural communities.

Unfortunately, it is not guaranteed that these forests will be conserved in the long term. To maintain their natural levels of biodiversity, large tracts of ‘frontier forests’ (tracts of mature forests or dense timberline forests of at least 5,000 hectares, which are intact or only slightly altered) must be conserved. In its latest study, *Chile's Frontier Forests: Conserving a Global Treasure*, GFW Chile found that of the roughly 30% of forests classified as frontier forests, only a small area (27%) is protected. Most of these frontier forests are in areas with steep slopes or located at high altitude. About 7% of protected areas are private, and the government manages the rest within parks, reserves, and as national monuments (<http://www.globalforestwatch.org/english/chile/index.htm>).

In 1990, a UN advisory panel reported that coastal pollution worldwide had grown worse during the decade of the 1980s. Experts

pointed to an overload of nutrients –mainly nitrogen and phosphorus from untreated or partly treated sewage, agricultural runoff, and erosion– as the most serious coastal pollution problem. Human activities may be responsible for as much as 35 million metric tons of nitrogen and up to 3.75 million metric tons of phosphorus flowing into coastal waters every year. Even such huge amounts could be dissolved in the open ocean, but most of the pollution concentrates in shallow coastal waters, causing massive algal blooms that deplete oxygen levels, suffocating near-shore marine life (<http://www.american.edu/TED/ice/chiledam.htm>).

SOUTHERN REGION: CASE STUDY: RELONCAVI



The Bay of Reloncavi has abundant Atlantic salmon, a large part of which escaped from the aquaculture farms that populate its pristine waters.

Tom Kehler, the owner and CEO of SalmoAmerica says that Chile produces more farmed Atlantic and Coho salmon than either Norway, Scotland or the United States. Most of it is sold to the Japanese.

White-garbed and surgically masked workers slice and de-bone salmon filets, which are only three days out of the bay when they reach the markets. Because of the Humboldt Current that runs along the Chilean coast, and the volcanoes and melting Andean snows,

the Reloncavi waters around Puerto Montt are the purest in the world. Every day, small boats unload cargoes of sea bass, salmon, sea urchins, spider crabs, huge barnacles and mussels, oysters and clams (http://www.msnbc.com/modules/Newsweek/macphersons/092500_thisweek.htm).

Forests are important ecological components of Chile's southern region. Their appropriate management is important for the health of the ecosystem. Several geographic information system (GIS) initiatives have emerged recently in response to the pressing need to document the breadth and diversity of these forests.

GIS is a computer-based technology used for the storage, management, and analysis of geographic information. Advanced technologies such as global positioning systems (GPS) and satellite imagery have contributed important data for GIS use.

Networking with other nonprofits, AFI (Ancient Forest International) is helping Chile's forest conservation community use GIS efficiently to develop conservation strategies and acquisition priorities. As demonstrated in the U.S. case, the U.S. forest protection movement takes advantage of GIS technology; one professional map can be as influential as a year of demonstrations and press releases.

Activists equipped with professional maps are attempting to stop U.S. and multinational companies from overexploiting Chile's forests, using those maps in court or sharing them with the media. Many in government want to protect Chile's native forests, but need quality information and scientifically based direction to do so.

Indigenous communities need maps to depict their ancestral homelands and so that they can develop sound management strategies.

However, GIS is rare in Chile's resource management and planning, used by only a few individuals in government, extractive industries, and universities.

In 1998, in conjunction with the Gondwana Forest Sanctuary Campaign, AFI (Ancient Forest International) opened Chile's first NGO-based conservation GIS office (in Punta Arenas, within Chile's southernmost region). Many in the Chilean conservation community had been discussing the benefits of GIS, and the idea has spread rapidly (<http://www.ancientforests.org/chile.htm>).

Another important ecological issue in the Reloncavi estuary is the existence of the 'Red Tide' of algal blooms. It is reaching further and further north on the Island of Chiloé. Its toxic effects are threatening the main source of income for a large part of the island's population,

who earn its living from cultivating and fishing for seafood.

Laboratory tests performed on May 1st 2002 by the Aysen Health Department in the area of Caleta Tortel detected the presence of the toxin found in the reddish algae and absorbed by bivalve shellfish such as mussels, clams, and oysters.

A large proportion of Chile's salmon farms are found in the Chiloé area. But this 'Red Tide' has not affected the cultivated salmon. Even though the advance of toxic marine plankton has been a serious problem for shellfish fishermen and mussel farmers, it hasn't been a problem for salmon farmers.

However, the spread of the Red Tide has caused a real catastrophe for the island, especially in the southernmost town of Quellón. The government declared the zone a disaster area because of the deleterious economic and social impact on the fishing industry.

As a result, Chilean public health officials have banned fishing and sales of seafood because of the presence of red tide off the country's southern coast. This restriction extends the one imposed on March 26, 2002 in the nearby Puerto Montt area.

The toxin found in red tide is a severe threat to humans, and in its most serious form it can result in progressive muscular paralysis and even death due to respiratory failure.

The surge of red tide and the continuous threat to forests are two important ecological issues in the Reloncavi. The increasing use of GIS technology can greatly contribute to the implementation of informed management programs to protect the Reloncavi estuarine ecosystem (http://www.redtide.whoi.edu/hab/notedevents/foreign/Chile/Chile_3-12-02.html) (http://www.redtide.whoi.edu/hab/notedevents/foreign/Chile/Chile_5-8-02.html) (<http://www.ancientforests.org/chile.htm>).

CENTRAL REGION:



Fuente: <http://www.gochile.cl/Info/Map/MapCentro.asp>

Valparaíso

With the opening of the Chilean economy to the international market, and the new thoughts about territorial and regional development, orientated mainly to exploit comparative advantages, the old planned national system of cities was altered. The impact of this change in Valparaíso, Concepción and other port-industrial regions of the country was enormous: counter-urbanisation proceeded as well the exodus and closing of old industries. Notwithstanding, Valparaíso experienced economical and physical decline through most of the XX century since it was not able to overcome the negative impact of the opening of the Panama Channel and the various earthquakes that shook the city during the XX century. Valparaíso was also late to react to the new challenges of globalisation. The rise of non-traditional and low level aggregated value export, contributed to the rise of agroexport locations but also gave a certain vulnerability to Chilean economy, which is manifested in behaviour during the international crisis of the late

90s. De Mattos argues that the Asiatic crisis and its consequences in the MERCOSUR was more noticeable in this region than in the Metropolitan Region of Santiago, since Santiago is less associated with Asia in absolute terms. The capital region is more associated with Argentina and Brazil, countries that were not directly impacted on by the Asian crisis. In the chart below, it can be seen that the Asian crisis had a retarding effect on the Metropolitan Region.

Chart shows the lowering of the GDP during the last three international crises and the unemployment rate.

Region	1975		1982		1998		1999	
	GNP	Unemployment	GNP	Unemployment	GNP	Unemployment	GNP	Unemployment
Metropolitan	-16.5%	15.3% (1)	-23.7%	23.8% (2)	3.9%		1.5%	10%
Valparaíso	-14.2%	18.8% (2)	-20.7%	21.3%	0.2%		7.8%	13.1%
Concepción	-13.1%	15.5%	-13.5%	13.8%	-3.3%		-1.7%	9.8%

Fuente: Banco central 1983, de Mattos, INE 1976 (http://216.239.33.100/search?q=cache:h9fcYmJ_1p0C:www.bk.tudelft.nl/users/carmona/internet/d4module/2002/chile/images/valparaiso.doc+valparaiso+concepcion+corridor&hl=en&ie=UTF-8).

With its crowning hills, labyrinthine streets, and wide bay, Valparaíso is perhaps the most elegant city in Chile. It is the country's second largest city, the seat of its parliament, and Chile's most important coastal center. Before the completion of the Panama Canal evaporated its importance in 1914, Valparaíso was South America's most significant Pacific port and a major naval base for the British Empire.

There are two distinct sections to Valparaíso: the modern coastal city that skirts the bay, and the older, more residential neighborhoods that haphazardly cling to the cerros, or hills. Over the last 90 years, earthquakes have come and gone, one of them completely devastating the city in 1906. By the year 2010, the Chilean coastal zone from Valparaíso to Concepción is expected to become one long urban area. One of the consequences of increases in coastal population density is the worldwide increase in pollution.

The watershed of Greater Valparaíso has great ecological significance to the Port of Valparaíso (serving as an estuarine drainage) as well as economic especially with regards to trade and eco-tourism. One important ecological issue in Chile's central region is the contamination of its rivers from various sources, including the building of infrastructure, especially dams, agricultural practices, and industrial and sewage wastes.

Concepción

The 380 kilometers Bío-Bío River flows from the Cordillera of the Andes all the way to the Pacific Ocean and has multiple uses from the cordillera to the Gulf of Arauco. Over one million people use the resources of the Bío-Bío for drinking and irrigation water, recreation, and fisheries; it supports the maintenance of Celulosa plants, oil refineries, and industrial plants. ENDESA, the largest private company in Chile, is planning to construct six hydroelectric dams on the Bío-Bío. The first of these, Pangue, is already 70% completed. ENDESA now says it will move ahead with construction of the largest of the dams, called Ralco. Ralco would be a 155 meter-high dam with a 3,400-hectare reservoir, which would displace 700 Pehuenche Indians. The upper Bío-Bío where the Ralco dam is planned is home to the Pehuenche group of the Mapuche Indians, the last group of Mapuche who continue their traditional lifestyle. The dam would flood over 70 km of the river valley, inundating the richly diverse forest and its wildlife.

Environmental and Indigenous rights groups oppose the project not only because of the wide scale destruction it would cause, but also because projections of Chile's future energy requirements indicate that the energy it would produce will not be needed. Critics of Ralco say that construction would violate the new Chilean Environmental and Indigenous Peoples Laws and prior agreements between ENDESA and the World Bank. The Pehuenche of Chile and environmentalists are struggling against a dam project on the Bío-Bío River that will force the Pehuenche off their ancestral land and flood 9,000 acres of farmland and rare temperate rainforest in Southern Chile. On June 6, 1997 the \$600 million Ralco dam project was approved by the Chilean government's environmental office. ENDESA, the private public utility company claims that this dam, and 10 more dams its size between now and 2013 are needed to satisfy the energy demands of the Chilean economy.

Agricultural activities are causing the pollution of the Rio Cruces. Researchers at the Austral University have found in Phosphorous and Nitrogen excesses as well as pesticides in the water of Rio Cruces. These are components that originate in agricultural activities. In addition, there were traces of sewage wastes from communities along the river that are provoking the growth of algae and aquatic plants (<http://www.american.edu/TED/ice/chiledam.htm>) (*El Mercurio* Aug. 30, 2000).

Northern Region: Iquique/Antofagasta

Antofagasta is perhaps the most polluted coastal area in Chile. According to Carlos Guerra, Biologist from the University of North Texas and from the *Universidad de Antofagasta*, the coastal area of II Region is the most polluted in Chile. This area runs from the Loa River mouth to the *Pan de Azúcar* Park. Mining activities, and industrial and sewage wastes have contributed to ecosystem damage. The mouths of the Loa, Michilla, Taltal, Caleta Cifuncho and Punta Grande Rivers are heavily polluted because of these past (mining) and current (sewage) activities. (<http://www.aqua.cl/>) (July 19, 2001).

There are prospects for the construction of infrastructure: a 400-mile gas pipeline from Bolivia to a port in northern Chile, possibly Mejillones or Patillos. Bolivia's natural gas will be marketed to energy-hungry California (there are foreign investors prepared to spend up to \$6 billion to drill and export).

The plan calls for Pacific LNG—consisting of Repsol-YPF, a Spanish company; British Gas; and Pan American Energy, a BP subsidiary—to build a pipeline to the coast and a \$2 billion plant, to liquefy the natural gas, so that it could be pumped aboard specially outfitted tankers. A memorandum has been signed with Sempra Energy, a California-based company that would receive the gas for 20 years. Sempra would build a regasification plant in northern Mexico and sell it to both Mexico and California. Proponents foresee increased oil production, since Bolivian gas has some oil content, and a sprawling network of pipelines from Tarija (<http://www.iadb.org/exr/PRENSA/2001/cp20701E.htm>) (*The New York Times*, July 8, 2002).

In addition to infrastructure building, energy and mining and industrial wastes, a critical ecological issue in Northern Chile's coastal zone is the phenomenon of El Niño. El Niño Southern Oscillation (ENSO) induced global climate change, as well as conspicuously large changes in the abundance and availability of marine living resources in Chile.

Northern Chile is the site of the earliest development of industrial fisheries in the 1950s. The ENSO events of 1965, 1972-73, and 1982-83 have all been decisive events in the development of the Chilean pelagic fishing industry, sometimes creating favorable or unfavorable situations for the industrial sector. Due to the 1965 oceanic anomaly and to industrial inefficiency, many fishing companies in northern Chile did not survive the difficult year and failed. As a consequence of this crisis, the bankrupt businesses sold their fleets and equipment to larger

NORTHERN REGION:



Fuente: <http://www.gochile.cl/Info/Map/MapNGrande.asp>

companies. This initiated a tendency toward economic concentration in this industry into several “mega-companies”.

Although landings of anchovy decreased immediately after the 1982-83 ENSO event, the sudden increase in availability of the Spanish sardine (*Sardinops sagax*) saved the pelagic fishing industry in northern Chile. The sardine became the principal pelagic species for the remainder of the decade, again replaced by anchovy in the early 1990s.

Even though the industrial sector in northern Chile was already highly concentrated by the 1990s and only four major companies control the majority of pelagic landings and fishmeal production, the scenario suggests even further fusion and industrial consolidation after the 1997-98 ENSO.

The recent oceanographic event brought a combination of layoffs and general weakening of labor unions of both fishmeal plant workers

and vessel crew members. The industry made ample use of short-term labor contracts and contracts for individual trips. The lack of availability of the pelagic resources in northern Chile also sharpened the conflict between the industrial and artisanal fisheries concerning the industrial use of the Artisanal Fisheries Zone, especially in Region 2. Although the outcome of this long-term conflict remains uncertain, the recent diminution of resource availability appears to have polarized the two involved sectors.

The recent 1997-98 ENSO event, like previous events since the 1960s, already appears to mark a decisive point in the history of pelagic fisheries in northern Chile.

Fishing regulations are being now imposed along other environmental laws that attempt to control the deleterious effects of infrastructure building, industrial and sewage wastes inputs, and natural phenomena on Northern Chile's coastal zone (Impacts of the 1997-98 ENSO Event on Northern Chilean Fisheries, Daniel Suman, Sarah Meltzoff, and Nelson Ehrhardt, Rosenstiel School of Marine and Atmospheric Science University of Miami: <http://www.ogp.noaa.gov/mpe/csi/econhd/fy99/suman99.htm>).

NATIONAL POLICY AND NATIONAL SECURITY

National Security

Chile will increasingly depend on its foreign trade and maritime communications. Ports, shipyards, fishing, canning, chemical, metallurgic, and even energy industries, are part of the tourist activities, creating a great economic activity in Chile's maritime area.

As a maritime nation, Chile needs to pay special attention to the development of maritime interests and safety. The oceans will continue to be an important food and energy source, and will be intensely used in the transportation and communications area. This implies a challenge in the preservation of its integrity, security and availability. For this reason, all activities developed at sea will have social, political and economic impacts.

A series of global threats, ranging from pollution, illegal migration, local conflicts, drug and food trafficking, natural disasters, climate change, overexploitation to international terrorism, will put the global maritime security to the test, which will demand coordinated actions by multinational entities in order to reduce its effect.

A great challenge faced by the maritime sector during the XXI century will significantly affect countries that depend on international trade.

Information Technologies is an area where important changes are taking place.

Globalization intensifies satellite, maritime, and terrestrial networks that facilitate the flow of data and information in response to the requirements of governments, governmental and non-governmental agencies, and individuals, thus eliminating international barriers to globalization.

Database and information becomes more available facilitating the decision-making process. This also applies to the maritime sector, where permanent technological evolution enables decision makers to make prompt and efficient decisions to respond to cases of maritime distress, contributing thus to management of the marine ecosystem.

Globalization is a second factor that will shape not only international trade but also policymaking in the coastal zone.

Globalization is a phenomenon that permeates all nations and that requires a response from all of them as well as from regional and local levels; hence the increasing necessity of national political reforms that will help not only national but also local and regional governments to address or face the challenges of globalization.

A third factor affecting national policy is the *Global Economy*. Recent trends in the global economy led to the creation regional groups such as NAFTA, the European Union, and the Association of Southeast Asian Nations. These regional economies and associations will intensify global trade.

Projections made for year 2020 show that international maritime trade will double or triple its activity. International trade, particularly maritime trade, for the countries of the Asia-Pacific and Latin America will significantly increase, demanding greater degrees of efficiency and effectiveness as well as competitiveness.

A fourth factor that will affect Chile's national policy is changes in *Demography*. Population growth will increase the demand for transportation of commodities and goods, accelerating the depletion of marine resources.

Climate Change and Global Warming

Climate change and global warming are believed to be caused by human activities and to a lesser extent by natural cycles. They will also require policy attention by the Chilean government. The frequency, lifetime and severity of extreme climatic situations, such as the phenomena of "El Niño" and "La Niña", will impact the ice polar regions, accelerating the hydrological cycles, and will also affect the marine ecosystem.

While scientists do not agree on the causes of climate change and global warming they do agree that variability of extreme weather exists. Climate change will cause the sea level rise that might have impacts on the shoreline. Rising sea levels could mean the total disappearance of some island nations and large scale flooding of many coastal regions (<http://www.earthaction.org/en/archive/99-01-cich/background.html>).

According to NOAA and the UN Framework Convention on Climate Change studies, the current rise in air temperature of 2° to the year 2100 will produce an increase in the mean sea level to 7 cm. in 2020 and between 50 and 95 cm. in 2100. Increase in sea level inundates large areas of the coastline. This phenomenon can have serious effects in agriculture, aquaculture and other activities in the coastal areas.

When such areas are inundated, among 92 and 118 million persons will abandon this area moving into a new habitat. These changes in the maritime ecosystem will produce effects such as reduction of ice masses, change in the sea and ocean circulation model, and modifications in the availability of nutrients for the marine species, among others. Due to the above mentioned, the strength and hydrological cycle will be accelerated. This translates into more droughts in some areas and less droughts in others, and an increase in the severity of the air temperature conditions shown in the last decades.

Since 1979, several activities have been performed in order to recognize the climate change as a problem that affects humankind, which are discussed in the Kyoto Protocol. However, there are several facts that must be taken into consideration which cause some uncertainty about such predictions, specially due to the complex models used, and the unknown causes which produce such changes, therefore its simulation exceeds the current capacity of the computers. Nevertheless, when making a balance of all the facts, one concludes that global warming of the Earth is caused by human activities and not by a natural cycle.

To conclude, the maritime world will be, over the next decade, a busier place at an international level. The economic factors and changes mentioned above, along with population growth, mass migrations, and significant increases in transportation, will increasingly intensify maritime activity. The Chilean national policy, particularly the Director General of the Maritime Territory within the Chilean regional scenario, faces a great challenge, as it needs to address these developments. The Director General of the Maritime Territory is the main entity of the Chilean Navy in charge of the institutional relationship among civilian activities and maritime interests, having its scope of action at sea (http://www.directemar.cl/noticias/articulos/Trends_2.pdf).

Chile's national security is closely related to its maritime security. As a maritime country, where sea resources are critical for its development, Chile pays close attention to the sea as a complex system that has internal biological as well as social, economic and political processes. Viewed as a system, with political, biological and economic boundaries that are however closely interrelated, the sea –as an ecosystem– can be managed more efficiently. The proper management, use and exploitation, of maritime resources are vital for the country's development and a high priority of the Navy (<http://www.revista-marina.cl/revistas/1991/1/thauby.pdf>).

Almirante Jorge Martínez Busch in his paper “La estrategia naval y la Oceanopolítica a la luz de la Convención del Mar” argues that the Chilean Navy has assumed far greater responsibilities than before with the incorporation of vast areas of the sea under the jurisdiction of the Chilean state. It has to ensure that these natural/maritime resources are protected, conserved, administrated and exploited for the benefit of national development. To achieve these goals the Navy must implement a “Security Naval Strategy for Development”.

To successfully be able to take advantage of the new rights afforded to Chile by the New Convention on the Sea, the “Security Naval Strategy for Development” must be efficiently developed. The best way to develop this strategy is through education of the naval cadre, especially in areas of scientific and technological information and methods of implementation.

Another factor that has given Chile international recognition in maritime affairs is the fact that it inspired the doctrine of the 200 miles, an idea that led to what is known today as the Economic and Exclusive Zone. In this zone, the exploitation of natural resources (e.g., mineral resources from the bottom water grounds) can cause conflicts of

interests. Chile—being a fisheries and mineral producer—needs to search for new ways to reach agreements leading to the protection of these resources that are of great importance for national development (<http://www.revistamarina.cl/revistas/1994/6/mart%EDnez.pdf>).

The Chilean government has implemented policies designed to enhance adequate maritime resource management and monitoring. For example, it has developed, with international support (e.g., RADARSAT International Incorporated [R.S.I.] Canada), technology such as Geodesy, Photogrammetry, Cartographic, Geographical Informations Systems (GIS), digital reconnaissance geological mapping and sampling, and remote sensing capabilities (<http://www.igm.cl/Espanol/Articulos/Radar.htm>).

CULTURAL AND COMMUNITY TRANSFORMATION

It is estimated that one in every eight dollars earned from Chilean exports come from marine resources. However, these staggering and impressive figures have their downside and do not show the serious adverse effects this huge industry has on society and the environment. After nearly two decades of sustained growth, which averaged 31.9 percent between 1975-1980 and 19 percent between 1980-1985, 95 percent of the main fishing grounds are now over exploited or slowly recovering. This is a potentially critical situation for the Chilean economy.

Almost 90 percent of the 107 million tons of marine resources extracted from Chilean waters between 1975 and 1998 were exported to foreign markets. The resources are now starting to show signs of running out. Though environmentalist organizations have been condemning this self-destructive process for more than a decade only in 1999 did the Fisheries Under Secretary and the National Fisheries Association make a public statement recognizing the fact. Their solution was to introduce individual quotas on commercial fishing businesses (The Fisheries Department had intended to introduce a limit to the total mackerel catch, rather than quotas for individual companies).

The poor management of marine resources at the cost of a short-term profit has put at risk the livelihoods of artisan fishermen and an important food source for a large sector of the population. The seas and oceans are vital for the development of local industry in many isolated regions of Chile and Latin America and the Caribbean, for

providing primary resources, employment, energy, transport, information, communication and culture.

Chile cannot afford to jeopardize any area of social development, small and medium industry. The government should recognize that it has an obligation to protect the resources that provide health, nutrition and quality of life to the population. It's surprising that for the third biggest fish exporter on the planet, the average Chilean citizen consumes barely 7 kilograms of fish per year, which is half of the world average. This is even more surprising considering that 22 percent of the Chilean population (around 3.4 million people) is clinically undernourished, lacking calories and protein in their diet, which are two important components in fish (<http://www.chiper.cl/reports/index.asp?r=97>).

II. MAIN THEMES IN GOVERNANCE, SCIENCE AND REGIONAL ECONOMIES

During the conference we intend to analyze in-depth the concept of "ecosystem resiliency" by focusing on how it is affected by the multiple uses of the coastal areas and estuary. The estuary's land use is subjected to multiple uses that include tourism among other economic activities, as the national and regional economies seek to advance their development. These multiple practices have important nutrient impacts on the coastal zones.

For example, we will analyze the fisheries industry in the context of the multiple uses (a large percentage of the population makes a living on commercial and to a lesser but increasing extent on recreational fisheries). What are the impacts of these and other human activities on the ecosystem's resiliency? What are the impacts on the coastal areas and water quality? What are the levels of sedimentation and hardening of shorelines? The findings/conclusions of the conference regarding the Chilean coastal areas will complement in a comparative perspective our work on other estuaries in the Americas, especially the Laguna Madre in Mexico and the New York Tri-State Interconnected Ecosystem.

An important human dimension issue in this study to be explored is governance. As we learned during the December 2000 New York international symposium on "Ecosystem Resiliency and Its Limits," the main components of the human dimension on governance include: (a) de-centralization and the political context in which ecosystem

management policies take place, (b) legal system: the existence or the lack of a legal regime, environmental laws and regulations, e.g., quotas, seasonal closures in the area of fisheries, (c) accountability, (d) the role of environmental NGOs and community/citizen organizations in policymaking, (e) the role of science in ecosystem policy, and (f) the trade regime and new political alignments. We will further explore these questions during the international conference.

A. SCIENCE AND GOVERNANCE

In late July 2000 there was an important international meeting on Science and Development in Tokyo, Japan among the main scientific institutions in the world (in future meetings participants from the social sciences and the humanities will also be invited). Scientists looked into the future, i.e. 50 years ahead. The future will present difficult problems at the scientific, technological as well as social and political levels.

Some of the conclusions: There will be a major demographic transition. World population will stabilize at about 9 billion. The first half of the next 50 years we will see an increase of 50% and the second half of only 7 to 8%. However, an increase of about 3 billion people will pose serious challenges to the earth's biosphere. What is worrisome is that the population increase will be experienced mainly in the developing countries, having tremendous implications on immigration from developing to developed countries. Two issues were salient: water-related issues and transgenic foods.

One of the main problems in the future will be the availability of food and water for the new billions of people by 2050. For that year we must aspire to have eliminated malnutrition that is currently experienced by 828 million people in many regions of the developing world. The production of food must be doubled in the next 25 years, when the major increase of the population will take place. Scientists have been able to duplicate food production in the last 35 years thanks to the green revolution and advances in the agricultural sciences; however, the increase was obtained through the tremendous increase of the use of nitrogen and phosphate fertilizers, expansion of irrigation and land use for agriculture.

The major question is whether or not this rate of production can be sustained without damaging the ecological systems. The answer to this question among the scientists was definitely negative. Erosion of the soil, contamination produced by fertilizers, global warming,

deforestation and the loss of bio-diversity all will be intensified as a result of the intensification of food production.

The most serious issue is water, especially for irrigation purposes. There are now 34 countries with a population of about 500 million people, which have serious shortages of water; for the year 2050 it is calculated that 3.5 billion people will suffer from water shortages. The problem is worsened as a result of contamination of water by fertilizers and chemical components; this is a great challenge for many countries that depend on underground water.

There is a great reservoir of water in the Oceans and de-salinity might be the solution. By then water's price will be notoriously high and the transportation of water from far away places will be required. Conflicts among nations and continents for water control will be conditions of instability in the world by the end of this new millennium. Chile's current dispute with Bolivia over the waters of the Silala River whose water Chile needs for the work of CODELCO, and with Argentina over the *Campo de Hielo Sur*, one of the major reservoirs of fresh water in the world, are signs of what is to come.

The solution of these major food and water problems requires scientific and technological research, and social and political leadership at the world level. The scientists that met in Tokyo were optimistic to reach solutions through research and human creativity, but they were also worried that many important groups in society are unaware of the role science must play in the search of solutions.

On transgenic foods, a good example in the criticism of scientific progress can be seen in relation to transgenic foods. Biotechnology can be the solution to increase the production and quality of food; gene manipulation can aid food producers to avoid virus/bacteria and insect plagues, produce crops in arid/acid/salinity soils, and come up with more nutritious foods. As scientists in Tokyo pointed out, genetic engineering can be the solution to provide food for the increasing world population, avoiding the negative results on the ecology and biodiversity of the planet that result from traditional crop production requiring the heavy use of fertilizers, pesticides and deforestation. The scientists in Tokyo are willing to participate in dialogues with all opposed to transgenic foods, e.g., ecological groups, and will persuade them that these foods do not pose health threats to the population (hunger and malnutrition are real threats).

The scientists acknowledge the ecologists' worries regarding the treat to the environment posed by the horizontal transmission of genes

among plants. They believe that this could seriously alter ecological systems, and criticize biotechnology companies that have arrogantly disregarded these worries. However, they believe that this treat can be aborted with new advances in technology and carefully monitored experiments that will avoid horizontal transmission of genes.

In conclusion, it is obvious that science and technology can help to make goods consumption sustainable by the year 2050. For example, it will be possible to create ultrasonic washing machines that do not consume water. Light bulbs will be replaced by "diodos" that generate light and can last twenty years. Waste elimination must be a definite goal; the U.S. generates 500 tons of waste a year per person (only 5% is recycled). The main challenge in altering current ways of consumption will be the dramatic impact on the foundations of the world market economy. This strategy of development encourages high levels of consumption and quick disposal of old products for new ones. The market is not capable of envisioning the world 50 years from now as the scientists are doing. The great contribution of this international scientific meeting was to open the dialogue between the scientific community and the societal components of the world's nations to seek solutions for the problems that are coming. In the Chilean case, the Encuentro Chile-Ciencia 2000 marks the beginning of this trend (*El Mercurio* Aug. 6, 2000).

Our goal is to understand how ecosystem resilience is being affected by the multiple uses in Chile's regional economies and coastal areas. To be able to implement appropriate ecosystem and conservation management policies, policymakers need to grasp the effects of multiple uses (economic activities) on the ecosystem resilience of coastal zones. An informed analysis of these dynamics is the task of both natural and social scientists. To understand the issues of governance is critical for a better knowledge of how ecosystem resilience is affected by human activities that involve the multiple uses of estuaries by economic activities such as fisheries, ecotourism, infrastructure building, among others. The degree of centralization in a political system—a governance issue—determines the degree of authority and participation by local stakeholders in the decision-making process and either facilitates or impedes sound policy initiatives and their implementation. One important question to explore is whether or not *Ordenamiento Territorial*, a policy initiative to address the governance issues regarding ecosystem conservation, will contribute to the bridging of the divide between economic development (multiple uses) and ecosystem resiliency.

The IACERE/FLACSO conference will discuss in detail the needed input of scientific understanding of coastal zones into the policymaking process. Four research areas of the IACERE initiative will be especially important for this part of the conference. These are: (1) Water quality in the Reloncavi estuary ecosystem; (2) the study of multiple uses of the estuary, particularly in terms of fisheries (aquaculture, commercial and recreational fisheries); (3) land management practices (e.g., agriculture) and their effects on the coastal zones; and (4) the development of ecotourism in the regional economies under study.

1. Water Quality in Estuary: Reloncavi Case

On May 2002, the *Universidad Austral de Chile* in Valdivia and the *Sociedad Chilena de Ciencias del Mar* organized the XXII Congress on Marine Sciences. CONICYT (*Comisión Nacional de Investigación Científica y Tecnológica*), the local government of Valdivia, and various other organizations interested in marine science developments and issues sponsored the meeting.

The meeting highlighted the most salient ecological issues in the Reloncavi/Corcovado estuarine ecosystem. Water quality and salmon aquaculture were singled out as the two most important issues in the estuary. IACERE team member Doris Soto, one of the participants in the event, made a presentation on "Environmental Situation and Rules in Salmon Aquaculture Activities" in the Panel on "Salmon Aquaculture: A Challenge to Marine Sciences". Soto argues that the success of salmon aquaculture is in large part due to the good water quality, which she encourages needs to be maintained. One danger that she warned about is that aquaculture's organic residuals might cause eutrophication in the coastal area. To prevent this from happening she suggested that aquaculture companies abide by the national and international environmental restrictions (e.g., evaluation systems on environmental impacts, and others).

In addition, she discussed in detail the relevancy of ecosystem approaches in managing salmon populations and environmental services. Citing work in southern Chile, Soto noted the economic importance of salmon farming and its two key ecosystem needs: nutrient reutilization and proper water quality. She reviewed management efforts to enhance these services, coupling salmon farming and sport fishing with biodiversity use and management. She discussed efforts in freshwater and marine environments to increase bivalve and benthic populations

for improving water quality and providing opportunities for sport fishing and mussel harvesting. Soto reviewed the successes of artificial freshwater and marine reefs in increasing species richness and biomass, restoring and sustaining longer food webs, and enhancing nutrient recycling. She also noted the importance of surrounding forest ecosystems for providing such services as moderating availability of freshwater and maintaining water quality. In closing she supported the use of integrated coastal management involving multiple resources users. Responding to a question on the impacts of salmon on the total ecosystem, Soto stressed the need to examine the issue at a global scale, while evaluating national comparative advantages and aquaculture technologies.

IACERE also studies salmon aquaculture and water quality in the Reloncavi estuary as the main ecological issues. Other participants in the conference highlighted different aspects of these issues. For example, Rodrigo Infante, General Manager of the Salmon Industry Association emphasized the successful growth of the industry in Southern Chile, growing from US\$ 159 millions in exports in 1991, to about US\$ 1 billion in 2002, contributing 5.5% of total exports. The economic impact of the industry is very important, especially in the Southern region; the spillover effects of the industry are far reaching, including business, retail and other services. He predicted that by the year 2010 the industry will export the value of US\$ 2.8 billion and will generate 50,000 new jobs.

Vivian Wilhelm, from *Fundación Ciencia para la Vida, el Instituto Milenio de Biología Fundamental y Aplicada, y Bios Chile IGSA* discussed the bacteria *Piscirickettsia salmonis* as being the cause of one of the most serious illnesses in the salmon aquaculture industry. Pedro Smith from *Unidad de Patología de Animales Acuáticos del Departamento de Patología Animal, Facultad de Ciencias Veterinarias y Pecuarias de la U. de Chile* attributed the outbreak of the bacteria to biotic (infectious agents in other animals including marine mammals and birds and fish) and a-biotic (heavy metals and chemical conditions of water – concentrations of dissolved oxygen, temperature, levels of salinity, and ultraviolet radiation) ecosystem variables.

Another important issue was genetic engineering in the salmon industry – a topic that the ACSS and IACERE are as well studying. Igor Solar from *Instituto de Acuicultura, Facultad de Pesquerías y Oceanografía de la Uach* argued that rapid population growth has demanded increased consumption from agricultural as well as aquaculture products. In this context and to be able to supply the required amounts of food increasingly being demanded, intensive aquaculture of salmon and other

species is necessary. To obtain this high level of productivity the application of biotechnology will be required, especially as a means to protect the ecosystem as well as human health. (<http://www.iisd.ca/linkages/sd/nor/sdvol31no3e.html>) (<http://www.aqua.cl/>) (June 7, 2002).

Land-Ocean Interactions in the Coastal Zone (LOICZ)

The Scientific Committee on Oceanic Research (SCOR) and the Land-Ocean Interactions in the Coastal Zone (LOICZ) Project of the International Geosphere-Biosphere Program (IGBP) have recently established a working group of experts to examine questions relating specifically to groundwater discharge in the coastal zone. Direct groundwater flow into the ocean is known to occur as springs and seeps in near-shore areas in many parts of the world. Submarine springs, for example, are well-known off both coasts of Florida; Mexico's Yucatan Peninsula; in several areas around the Pacific rim including Chile, Hawaii, Guam, American Samoa, and Australia; in the Persian Gulf near Bahrain; in the Mediterranean Sea off Spain, France, Italy, Greece, Syria, Lebanon, Israel, and Libya; and many other locations around the world. Some of these springs are large enough that they deliver amounts of fresh water that have been exploited for human needs. Perhaps much more important volumetrically is the slow yet persistent seepage of groundwater that flows out along most shorelines of the world. Although less spectacular and more difficult to detect than large springs, this disseminated seepage may occur over broad areas and deliver an unknown, yet potentially significant, amount of fresh water and dissolved components to the world's oceans (http://www.jhu.edu/~scor/wg112_article.htm) (<http://www.nioz.nl/loicz/>).

2. Fisheries and Multiple Use of Coastal Ecosystem: 10th & 11th Regions

Chile is one of the leading nations in fishing in the world. The military government deregulated fishing in 1980 by decreeing that marine resources were *Res Nullius* (nobody's property). Exports from Chile's fishing industry have doubled in the 1990s (from 4,907 tons to 8,000 tons). Although it is true that a new Fishing Law regulated the fishing industry in 1991, the extensive pressure on marine resources has continued during the democratic governments, due to lack of implementation of the rules and the lack of funding to enforce them. The greatest environmental impacts in the fishing sector are the collapse of pelagic small, valved species, some

of which have been declared off-limits for fishing, as well as the pollution caused by the fishing industry. In addition, in the last few years the effects of fish farming on the marine and lacustrine ecosystems have had a serious impact on tourism (Sara Larráin).

Contamination of fish is an important health issue in the coastal zones. For example in 1997 the Magallanes Health Service and union officials denounced small fishermen in the regions 11 and 12 for not taking sufficient precautions in the face of a crimson tide that contaminated shellfish and bivalve mollusks. Small fishermen extracted shellfish from unauthorized areas. The crimson tide affects bivalve mollusks including clams, oysters and mussels. Since 1971, 20 people had died in Chile as a result of eating contaminated seafood products.

Then, more recently (March 2002) the Chilean government prohibited fishing in the eastern coastal area of Chiloé as red tide affected seafood products in this area. The secretary of Health had to intervene in favor of about 3,700 families in Region 10 that make their livelihoods on fishing by allocating public resources to alleviate their economic losses (<http://www.aqua.cl/>) (March 28, 2002).

The relationship between economic development and ecosystem protection is seen very pronounced in the area of aquaculture. Between 1981 and the early 1990s Chilean farm-raised salmon production increased dramatically. By 1992 there were 55 salmon companies employing over 8,500 workers. Labor conditions and, cheap supplies of fishmeal, and lax environmental regulations, among other comparative advantages, helped the Chilean salmon industry prosper enormously. By 2000 Fundación Terram studied the ecological impacts of salmon aquaculture and concluded that the impacts were negative and that private companies were not making efforts to solve them.

The intricate relationship between economic development (employment), the salmon industry, and ecosystem issues represented an important challenge for Chilean policymakers. By 2000 the industry was employing directly about 25,000 people and indirectly about 10,000 in Regions 10 and 11, areas that otherwise would be deprived by unemployment and poverty (*El Mercurio* Aug. 25, 2000).

Doris Soto's research in Region 10 demonstrates that private companies are solving the conflict between ecosystem preservation and economic development. They are making efforts to preserve the ecosystem at the same time that continue production. This collaborative work is being enhanced by the participation of scientists (like Doris Soto) who engage in meetings with salmon industry representatives to

–through exchange of information and experiences– seek to enhance their understanding of ecosystem change and aquaculture.

The divide between economic development and ecosystem preservation is closing, at least as demonstrated in the case of Southern Chile's coastal areas. The Chilean army and the salmon companies are now cooperating in cleaning activities. Early this year (2002) they cooperated to clean the beaches in the coastal area of Puerto Chacabuco (Region 10). Last year they engaged in similar activities in both Regions 10 and 11, cleaning Chacabuco Bay, Aysen River and Ensenada Baja. Artisanal fishermen, engaged in government-supported marine resource management in Region 10, are complementing this cooperative work. This management involves restoration of benthic resources (<http://www.aqua.cl/>) (May 13, 2002).

Overfishing has been a problem especially for local fishermen affected by the depletion of certain fish species such as abalone.

Twenty years ago abalone were abundant throughout the Pacific Coast of North America and the fishery of this tasty mollusk thrived. Since then human consumption and overfishing, along with recurring El Nino events and habitat destruction, have caused abalone populations to crash. The fishery in Canada and the US has been forced to close and that in Mexico has been severely curtailed; scientists say that at least three of the five species can be considered threatened, and one, the white abalone, hovers on the brink of extinction throughout most, if not all, of its range. As the resource disappears, the price of the meat and collector's value of the beautiful shells increase, thereby providing even greater incentives for illegal abalone fishing.

AIDA is currently exploring mechanisms by which the force of law can be applied to protect this resource and prevent the extinction of the white abalone. Listing by one or more countries under the Convention on International Trade in Endangered Species (CITES) or the Endangered Species Act in the United States, could do much to help abalone populations recover. Fishing cooperatives in Mexico have an advanced system for regulating the allowed catch to ensure sustainability, but also need mechanisms for enforcement and ways to limit the amount of poaching that occurs. AIDA is starting to collaborate with US and Mexican scientists and Mexican fishing cooperatives to develop a coordinated international legal strategy to address the problem. AIDA's US and Canadian participating organizations are already contributing their resources to this project, but AIDA must seek further funding to continue with this project (<http://www.aida2.org/english/projects/prjabal.php>).

In the case of Chile, Juan Carlos Castilla is working on the recruitment, management and transplant of juveniles, re-population and population units of *Concholepas concholepas* (locos) in Central Chile. In collaboration with his colleagues he experimented the usefulness of management areas for the restoration of *Concholepas concholepas* populations. The following is a summary of his study:

The importance of non-harvested areas, marine protected areas, and management and exploitation areas (= harvest-controlled) as seeding areas of *Concholepas concholepas* larvae was quantitatively evaluated at intertidal and subtidal sites at Las Cruces, central Chile. Egg capsules of *C. concholepas* were sampled along both intertidal and subtidal strip-transects monthly in harvested, harvest-controlled and non-harvested areas from September 1990 to December 1993. Additionally, egg capsules of *C. concholepas* were sampled at subtidal sites in the 3 categories of areas during 1993 and 1994. Spawning activity of *C. concholepas* was consistently concentrated between February and July in both the intertidal and the subtidal zones. The total area occupied by egg capsules of *C. concholepas* was larger in non-harvested than in harvested areas; moreover, larger capsules were found in non-harvested areas. These differences in total surface occupied by egg capsules and their sizes have an important impact on the estimated number of *C. concholepas* larvae that would be released from harvested and non-harvested areas. Castilla and his colleagues concluded that protected areas might play an important role in the natural replenishment of *C. concholepas* stocks (See Section C.II on Marine Protected Areas for related research by Juan Carlos Castilla) <http://www.int-res.com/abstracts/meps/v215/p201-211.html>

The multiple uses of the estuary in the area of fisheries are divided into three main activities (commercial fishing, aquaculture, and recreational fishing). Commercial fishing and aquaculture, as we have seen, are critical areas of the national and regional economies in Chile. However, recreational fisheries are equally important, especially for the tourist industry.

Chile is considered one of the best destinations in the world for recreational fishing, and one of the few countries of the Southern Hemisphere that offers quality fly-fishing for trout. More than 80 years after trout were first introduced and colonized the Chilean fresh waters, recreational fishing provides first class sport for anglers from all over the world, including accommodations and services.

Literally thousands of rivers flow westward from the Andes Mountains, crossing the central valley, to empty into the Pacific Ocean. Almost every

stream at the foothills of the Chilean Andes has a wild trout population (<http://www7.lanchile.cl/english/un/vacaciones/destacados/pesca/>).

3. Land Management Practices and the Coastal Zone

Land management is critical for the health of coastal zones. The linkage between these two is the subject of investigation at Austral University. Research scientists from this institution are investigating the benefits for salmon aquaculture, sports fishing, water quality and other coastal zone related activities that derive from effective management of native woods. The *Centro Milenio* from the Chilean *Ministerio de Planificación* (Mideplan) promotes this kind of research that requires a multi-disciplinary approach.

Doris Soto plays a role in this research initiative and she said that the study seeks to assess the way native woods can ameliorate the quality of water for the benefits of salmon aquaculture and sports fishing, among other coastal area activities. She strongly believes that protection and conservation of native woods are critical for the health of coastal zones.

Soto hypothesizes that if half of the woods in the regional area of the Reloncavi estuary were depleted, the consequences would be detrimental for the estuary. Since woods absorb, retain and release fresh water, an adequate amount of fresh water would no longer be available for the estuary and higher levels of salinity would result, damaging the ecosystem. Water quality would also suffer, as levels of nitrogen and organic carbon absorbed by native woods, helping clean the water, would diminish (<http://www.aqua.cl/>) (January 4, 2002).

Furthermore, land management in the area of mining is also critical for coastal areas. Pollution of the air, land and water is widespread in the mining sector. All the mining regional ecosystems in Chile, particularly those that produce copper, have been impacted.

One of the most important factors that has contributed to the stress on ecosystems and the negative impact on the population (health issues) in the mining sector have been the laws and decrees on mining and water promulgated by the military government to attract foreign investment. Both sets of decrees have remained in effect without any change during the transition to democracy. One of them, Decree Law 600, is especially noteworthy for the way it supports and stimulates large investments at the expense of the rights of local community.

The lack of strong environmental protection rules to check mining – that requires intensive use of water resources– has caused not only

damage of coastal areas but also creates social and economic disruption in local communities. For example, companies have obtained water rights from the government, forcing local populations to diminish their farming and herding activities, and finally abandon their homes. This has had special impact on indigenous groups. 90% of the mining activities are in the 1st, 2nd and 3rd regions that are desert zones (Sara Larraín).

One way to improve land use management (in the areas of forestry and mining among others) is through the *Ordenamiento Territorial* (OT). The decentralization process in Chile to improve management of land use is under way. We need to study how the OT will affect governance, particularly at the regional and local levels. OT seeks to make land use management more efficient to prevent deterioration of ecosystems as well as to attend local needs (social and economic). It will strengthen governance at the local level as well as increase local community and civil society participation.

For example, the Region of Bío-Bío, one of the most important regional economies in the country with near 10% of GDP in diverse areas as iron, fishing, energy, petrochemical industry, agriculture and tourism, concentrates paradoxically one of the most depressed areas, particularly in the coastal zones, where the local populations are plagued by poverty. An adequate OT in this region will create conditions for a more equal regional development.

Many factors and obstacles, however, will need to be overcome to implement an efficient OT process. Difficulties are diverse. Some of them have to do with conflicts generated over the use of natural resources in a regional economy and ecosystem. Others have to do with technical issues. For instance, there is a lack of expertise at the municipal and community level to implement, for example, environmental impact studies. In this and other areas that require expertise regional governmental agencies like COREMA will have more decision-making power, conspiring against broader community participation and decentralization. Training programs, with active participation of local universities, can amend some of these issues (http://www.ordenamientoterritorial.cl/que_es_ot.htm) (http://www.conama.cl/nuestra_institucion/areas_de_trabajos/u_rrnn/8.htm) (http://www.ordenamientoterritorial.cl/red_uni.htm) (<http://www.ordenamientoterritorial.cl/biobio.htm>)

4. *Ecotourism and the Regional/National Economies*

The National Forestry Corporation (CONAF) began in October 1996 a novel plan to involve the private sector in developing ecotourism in protected areas of the Chilean National Park system. The aim was to speed ecotourism development in 34 national parks, 43 national reserves and 13 natural monuments throughout the country.

The state forestry agency manages 14.5 million hectares, representing 19 percent of the country's surface, but must administer the property with a low budget that barely covers the maintenance costs. Consequently, the agency decided to seek the financial support of the private sector through ecotourism projects.

Ricardo Diaz, CONAF Operations Manager in 1996 dismissed concerns about the environmental effects the ecotourism projects might have, noting that the administration of all the parks would remain in the hands of CONAF. CONAF would provide an ecotourism policy indicating specifically the sorts of activities allowed.

Each concession area had a management plan to protect the natural resources affected by the project. In each area there was a zone designated for intensive use and the rest of the land for ecotourism activities. Diaz at the time stated that "These complexes, apart from having cabins or hotels, must also provide camping areas, because we want multiple services to be offered We do not want to transform the parks into vacation grounds only for the elite of the population".

National parks and other non-protected areas (such as areas with native woods) are important for ecotourism. For example, three per cent of the world's remaining primary forest is located in the temperate zones, and one-third of this is in Chile. Chile is the world's third largest exporter of wood chips, after Canada and the U.S., yet wood chipping accounts for less than one per cent of Chile's Gross Domestic Product. Tourism is worth seven times more than wood chipping to Chile's economy. Wood chipping on the massive scale proposed by Boise Cascade could greatly damage Chile's growing tourism economy by destroying one of Chile's prime attractions, native forests (*La Época*, 1996).

B. REGIONAL ECONOMIES CHALLENGES

The IACERE research initiative focuses on the role science plays in the decision making process, especially in the areas of regional economic development and policy management of natural resources. Our