CARP

FREPLATA

CTMFM

**“Environmental Protection of the Río de la Plata and its Maritime Front:
Pollution Prevention and Control, and Habitat Restoration”**

Transboundary Diagnostic Analysis Synthesis for Policymakers

December 2006

UNDP

**UNDP/GEF Project RLA/99/G31
International Waters Operational Programme 8**

GEF

Administrative Commission for the Río de la Plata (CARP)
Bi-national Technical Commission for the Maritime Front (CTMFM)

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Recommended citation for this publication:
FREPLATA, 2006. Transboundary Diagnostic Analysis: Synthesis for Policymakers. Technical Report FREPLATA. "Environmental Protection of the Río de la Plata and its Maritime Front. Pollution Prevention and Control, and Habitat Restoration". *UNDP/GEF/RLA/99/G31.*

Preface

The Project Environmental Protection of the Río de la Plata and its Maritime Front: Pollution Prevention and Control and Habitat Restoration (FREPLATA), to give it its full name, is a joint initiative of the Governments of the República Argentina (referred to as Argentina in this text) and the República Oriental del Uruguay (referred to as Uruguay in this text), which is being carried out within the framework of the Treaty of the Río de la Plata and its Maritime Front, signed by both countries in 1973. The Project execution agency is a Consortium set up by the Administrative Commission for the Río de la Plata (CARP) and the Bi-national Technical Commission for the Maritime Front (CTMFM), two Argentine-Uruguayan governmental organizations established in 1976, in accordance to the terms of the Treaty. The Global Environment Facility is one of the main financing agencies of FREPLATA. The United Nations Development Programme (UNDP) is the GEF implementation agency for the Project.

This Synthesis for Policymakers is a non-technical summary of the main points contained in the Transboundary Diagnostic Analysis (TDA). It is designed to inform policymakers and other interested groups and stakeholders, and to facilitate their participation in the second stage of FREPLATA: the design of a Strategic Action Programme (SAP), that shall include proposals for specific measures to address the problems identified in the TDA. Nevertheless, great care has been taken to ensure that the document supplies the reader a complete picture of the present situation of the environment of the Río de la Plata and its Maritime Front and of the main development trends for the next decades, so as to provide a sound basis for the adoption of policies.

One of the main precedents of the Project was the United Nations Conference on Environment and Development (Río de Janeiro, 1992); another precedent is the significant development of the environmental legislation and governmental institutions in Argentina and Uruguay. The Project, therefore, responds to an important demand in both countries and takes advantage of an existing legal and institutional framework

The TDA is the outcome of five years of dedicated work by a large number of specialists from Argentina and Uruguay and is based upon the expert judgment of the best available data. Perhaps one of the main contributions made by the Project until now is the strategy adopted since its early stages, of carrying out most of the research, studies and analysis activities by means of bi-national, inter-disciplinary working groups. This strong emphasis on participation has led to the creation of a wide and dynamic network among research institutions, hydrographic services and governmental agencies in both countries. This work has been coordinated and developed by the expert staff of the FREPLATA Executive Unit in Montevideo (and at its office in Buenos Aires). The outcome has been a work of over 200 detailed scientific and technical reports containing the information that underpins the TDA.

The TDA will always be a dynamic work and in permanent development. The coordinators would appreciate feedback and comments on this document. Full information on the Project and its outputs is available on the internet at www.freplata.org.

FREPLATA, December 2006.

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Abbreviations and Acronyms

ANP	National Port Administration
ASP	Amnesic shellfish poison
CARP	Administrative Commission for the Río de la Plata
CARU	Administrative Commission for the Río Uruguay
CFZ	Common Fishing Zone
CONICET	National Council of Scientific and Technical Investigations
CTMFM	Bi-national Technical Commission for the Maritime Front
DINAMA	National Directorate of Environment
DINARA	National Directorate of Aquatic Resources
DSP	Diarrheic shellfish poison
EcoQOs	Ecosystem Quality Objectives
ENSO	El Niño Southern Oscillation
EPU	Executive Project Unit
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
GEF	Global Environment Facility
GIS	Geographical Information System
GIWA	Global International Water Assessment
HABs	Harmful algal blooms
ILPLA	Limnology Institute "Raúl Ringuelet"
INIDEP	National Institute for Fisheries Research and Development
MACN	Natural History Argentinean Museum "Bernardino Rivadavia"
MARPOL	Convention for the Prevention of Marine Pollution from Ships
MERCOSUR	Southern Common Market
MVOTMA	Ministry of Housing, Land management and Environment
NAP	National Action Plan
NGOs	Non Governmental Organizations
PCBs	Polychlorinated Biphenyls
POPs	Persistent Organic Pollutants
PSP	Paralytic shellfish poison
PSU	Practical Salinity Units
RPMF	Río de la Plata and its Maritime Front
SAGPyA	Secretariat of Agriculture, Livestock, Fish and Food
SAP	Strategic Action Programme
SSP	Undersecretary for Fisheries and Aquaculture
SHN	Naval Hydrographic Service
TDA	Tranboundary Diagnostic Analysis
UBA	Buenos Aires University
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
UNLP	National University of La Plata

1. Context.

1.1.- The Río de la Plata and its Maritime Front.

The Project Area is the Río de la Plata and its Maritime Front as delimited in the Treaty of the Río de la Plata and its Maritime Front signed by Argentina and Uruguay in 1973. From the point of view of International Law, the Project Area, therefore, comprises a river sector subject the legal regime of internal waters, and a maritime sector: the Maritime Front. This overlaps part of the territorial waters and the economic exclusive zone of Argentina and Uruguay. The Area is included within the technical concept of "international waters" and "transboundary waters" as applied by the Global Environment Facility.

Situated on the South American coast on the upper Southwest Atlantic, the total surface area of the Río de la Plata and its Maritime Front involved is of approximately 252,000 km^2 (Figures 1.1; 1.2). This can be compared, for instance, with the surface of the Baltic Sea, which is of 377,000 km^2.

Economic and social development in Argentina and Uruguay is increasing the pressure on the aquatic environment in the Project Area. To this long term trend one should add the development in the rest of Plata Basin.

Although that vast, complex and dynamic aquatic region has specific and unique features, it also shares some characteristics with similar regions elsewhere. Therefore, the FREPLATA Project, in the same measure that it has learned from similar experiences, can also provide a valuable example for other comparable transboundary waters regimes elsewhere.

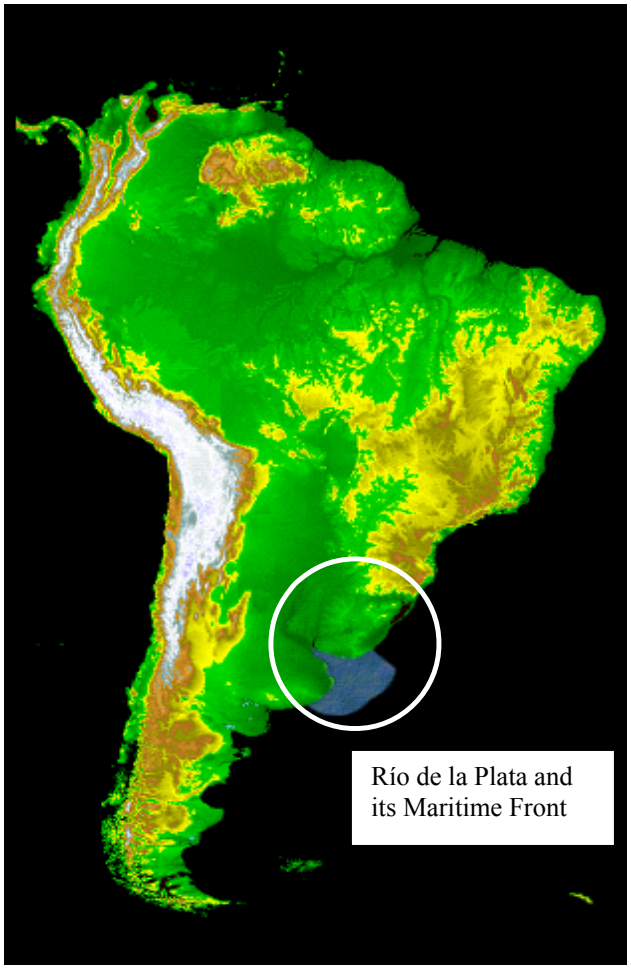


Figure 1.1. Localization of Río de la Plata and its Maritime Front in South America.

1.2.- The Project.

The aim of the Project is to contribute to the long term goal of mitigating the degradation of the transboundary environmental resources of the Río de la Plata and its Maritime Front and enhancing the sustainable use of these resources by the inhabitants of the region. To achieve this end, the Project Document defines three main immediate objectives: to develop a Transboundary Diagnostic Analysis (TDA), which will fill critical information gaps and provide key data and tools for the Strategic Action Programme (SAP); to prepare and adopt a SAP of policy, proposals of legal and institutional order and priority investments aimed at reducing, controlling and monitoring pollution, and the protection and conservation of biodiversity; and, finally, strengthening and sustaining the framework for the implementation of that Programme.

The Project is financed with resources provided by the Global Environment Facility (GEF), other international governmental agencies – for instance the French Fund for the World Environment and the Inter-American Development Bank - and Argentina and Uruguay. The United Nations Development Programme (UNDP) is the GEF implementation agency for the Project. It is only fair to stress the generous contribution in information, work and time made by the scientific research institutes of Argentina and Uruguay, their respective hydrographic services, governmental agencies as well as civil society organizations.

The Global Environment Facility was established in 1991 as a mechanism to provide "new and additional grant and concessional funding to meet the agreed incremental costs of measures to achieve agreed global environmental benefits". The Operational Strategy objective for the international waters focal area is *to contribute primarily as a catalyst in the implementation of a more comprehensive-based approach to managing international waters and their drainage basins as a means to achieve global environmental benefits*. The goal of GEF international waters projects is to *assist countries to use the full range of technical, economic, financial, regulatory and institutional measures needed to implement sustainable development strategies for international waters*. The GEF also seeks to act as a catalytic agent that lays the foundations for investment.

The Project execution unit is a Consortium established by the Administrative Commission for the Río de la Plata (CARP) and the Bi-national Technical Commission for the Maritime Front (CTMFM).

Figure 1.2. Jurisdictional limits established by the Treaty of the Río de la Plata and its Maritime Front (Source: FREPLATA, 2005).

1.3.- The ecosystem approach and adaptive management.

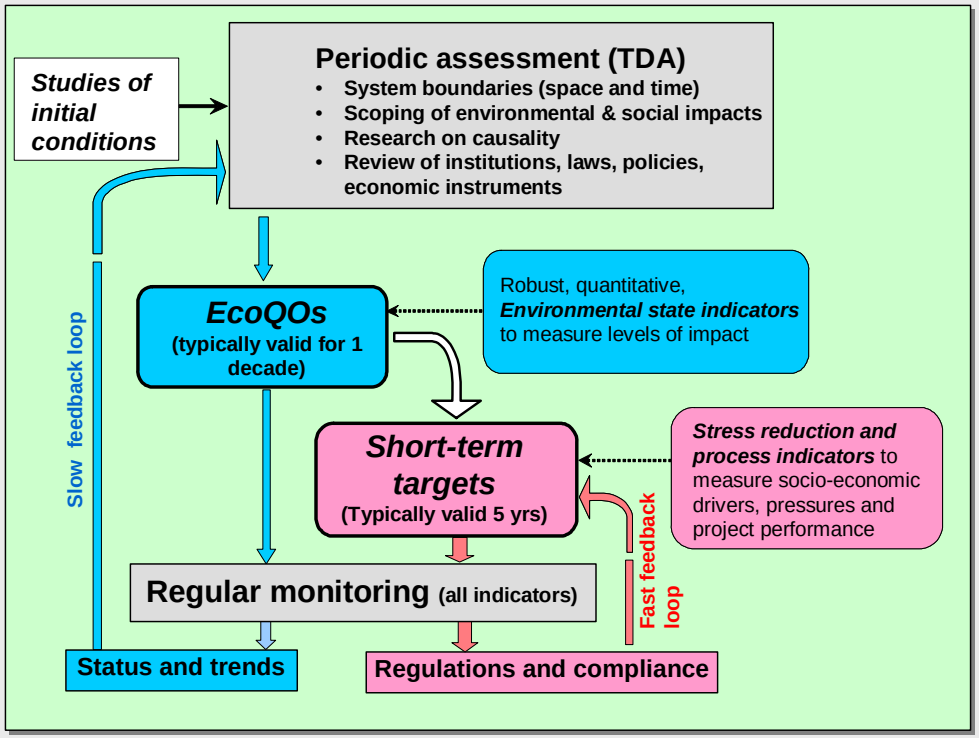
The methodology used for the TDA has taken into account the ecosystem approach (also known as ecosystem-based management) and the notion of adaptive management.

The basic framework for the Project is the Treaty, in particular its provisions on the protection of the aquatic environment. In fact the origins of the Project can be traced to the United Nations Conference on the Environment and Development, held at Río de Janeiro in 1992. The structure has been enriched since then by a significant number of multilateral, regional and bilateral agreements dealing with environmental issues signed by both countries, and relevant for the Project Area, by their increasingly comprehensive national legislation and by a structure of governmental organizations having as a objective the protection of the environment. In this respect, the Project is contained in a much wider normative and institutional "landscape", which has been charted as part of the TDA studies. A number of treaties signed by Argentina and Uruguay, as well as an important body of "soft law" instruments, as well as internal legislation of both countries have incorporated the concept of ecosystem (in some moment the Treaty of 1973 refers to bio-ecological systems). Early attempts at management of transboundary waters tended to be *reactive* – responding to each problem as it arose, *sectoral* – limited cooperation between different economic or administrative sectors, and *centralist* – decisions were taken by central authorities with limited consultation of local interested parties (stakeholders). Strategies to protect natural systems frequently paid little attention to the needs of human users of the environment. On the other hand, human activities often failed to recognize the inherent limitations of the natural environment to provide goods and services. Bridging this division called for a new approach to policy and eventually led to the development of the ecosystem approach in which considerable emphasis is placed on achieving sustainability. In the context of an aquatic environment, the ecosystem approach can be defined as *"the comprehensive integrated management of human activities, based on best scientific knowledge about the ecosystem and its dynamics, in order to identify and take action on influences that are critical to the health of the aquatic ecosystems, thereby achieving sustainable use of ecosystem goods and services and maintenance of ecosystem integrity"* (Laffoley *et al.*, 2004). This definition reflects the close relationship between people and the aquatic environment, acknowledging that fluvio-marine environmental problems are of anthropic origin. The human sustainability depends on appropriate information that implies a balance between the use and conservation of natural resources.

A key requirement for any ecosystem-based management system is the periodic assessment of the natural environment, human pressures on it and institutions capable of reducing or removing the pressures. Data and information will never be complete however and so an important part of the ecosystem approach is adaptive management combined with the precautionary approach. Adaptive management, sometimes described as 'learning through doing', recognizes the need to manage ecosystems in a stepwise manner. That approach to management makes the best possible use of available information but accepts that there is always uncertainty associated with the results and relies heavily on scenario-building to select the best option. A basic model for adaptive management is illustrated in Box 1.1.

The present document summarizes the scientific information informed in the TDA on (1) the boundaries of the system (not just the geographical boundaries, but the temporal ones), (2) of the environmental problems in the region, (3) their social consequences, (4) the underlying causes of the problems, and (5) the existing legislation, policies and economic instruments in both coastal countries that can help resolve the problems and prevent their reoccurrence. This will provide basic inputs for the application of adaptive management methodologies.

Box 1.1. A framework for adaptive management of the fluvio-marine environment



This figure illustrates the practical approach to adaptive management developed from experiences in a number of GEF International Waters Projects as well as in Europe through the North Sea Ministerial Process. The approach is designed to involve stakeholders in setting long-term Ecosystem Quality Objectives (EcoQOs). These are key attributes of the system if it were in good ecological health. The EcoQOs are set following completion of the TDA - a multidisciplinary assessment conducted through a 'joint fact finding' process where stakeholder representatives work alongside specialists. The EcoQOs are an easy to understand expression of the vision of what the water body would be like if it were sustainably managed. It requires improved understanding of the factors leading to degradation, and the management actions required to control them. The initial agreed actions taken to reduce human pressure on the environment can be expressed as short-term operational targets, closely linked to regulatory mechanisms. This allows a pragmatic stepwise approach towards achieving the EcoQOs; progress towards the EcoQO is monitored after each step and new operational targets are agreed for each subsequent one.

The important feature of the adaptive management framework is that it recognises that improvements in the status of the fluvio-marine environment often require decadal timeframes, but political planning processes rarely involve cycles of more than a few years. Operational targets can be designed to be reached relatively quickly and with crediting given to those involved. The EcoQOs can also be reviewed periodically, enabling them to be adjusted as scientific information improves or the environment changes. Each review provides an opportunity to maintain knowledge and political momentum. Adaptive management requires a firm commitment to the long-term monitoring of meaningful indicators and full disclosure of all information obtained. Carefully chosen indicators, supported by scientific research, may provide early warnings of major ecosystem changes. The TDA of FREPLATA is an important first step in an adaptive management strategy for this transitional water body.

2. A sense of place.

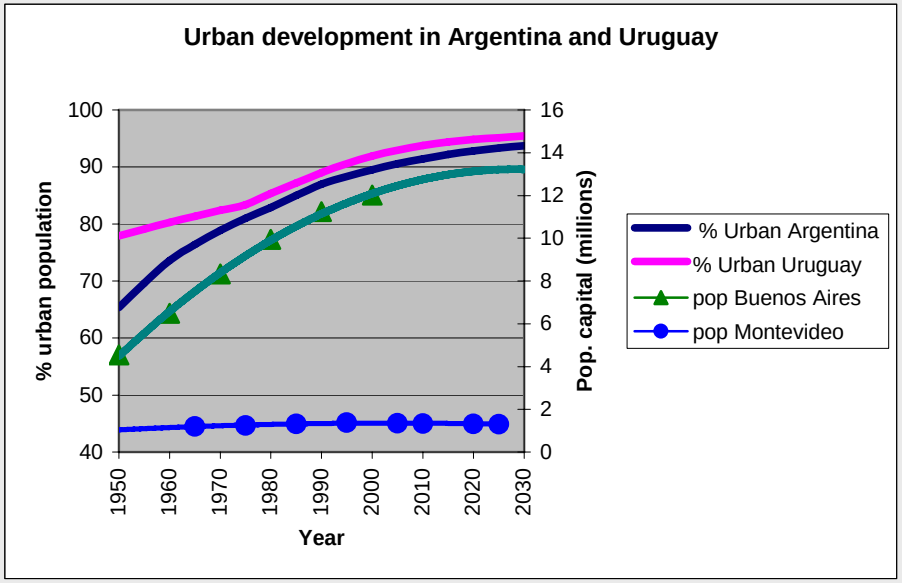
2.1.- General characteristic of the Project Area.

Biological productivity in the Project Area is very high, particularly in fisheries, and it contains globally significant biodiversity; river, coastal and high seas species develop all or part of their life cycle in the Project Area. A great overlap of species from warm, temperate and cold waters is found in the area. The exploitation of shared fishing resources is very significant for the economies of both countries.

The main urban centres of both countries are located on the coasts of the Río de la Plata and its Maritime Front (Figure 2.1), as well as leading economic activities. Industrial, agricultural and port activities, together with fisheries and tourism, are an important source of livelihood for a significant percentage of the population. In Argentina the coastal area concentrates 45% of all industrial activity and 35% of its population, while in Uruguay it contains approximately half of its total population and most of its economic, industrial and port activities. The waterbody is therefore a sink for substantial urban, agricultural and industrial pollution, and suffers from habitat degradation due to dredging, sedimentation and the alteration of hydrological processes caused by construction of numerous dams in the basin.

Box 2.1. An increasingly urban environment

The figure shows the changing demography in Argentina and Uruguay since 1950. The populations of both countries have become increasingly urban over the past 50 years and are projected to become over 93% urban by 2030 (FAOStat, 2006). Also shown on the figure are the populations of Montevideo, where almost half of the population of Uruguay resides, and Buenos Aires with 31% of the national population of Argentina residing. The rapid expansion of the population of Buenos Aires contributes to explain the considerable pressure from land-based activities on the southern margin of the RPMF.



Population statistics for Autonomous City of Buenos Aires and Montevideo refer to the metropolitan areas of the cities (Source: http://faostat.fao.org/ http://www.demographia.com/; http://www.ine.gub.uy).

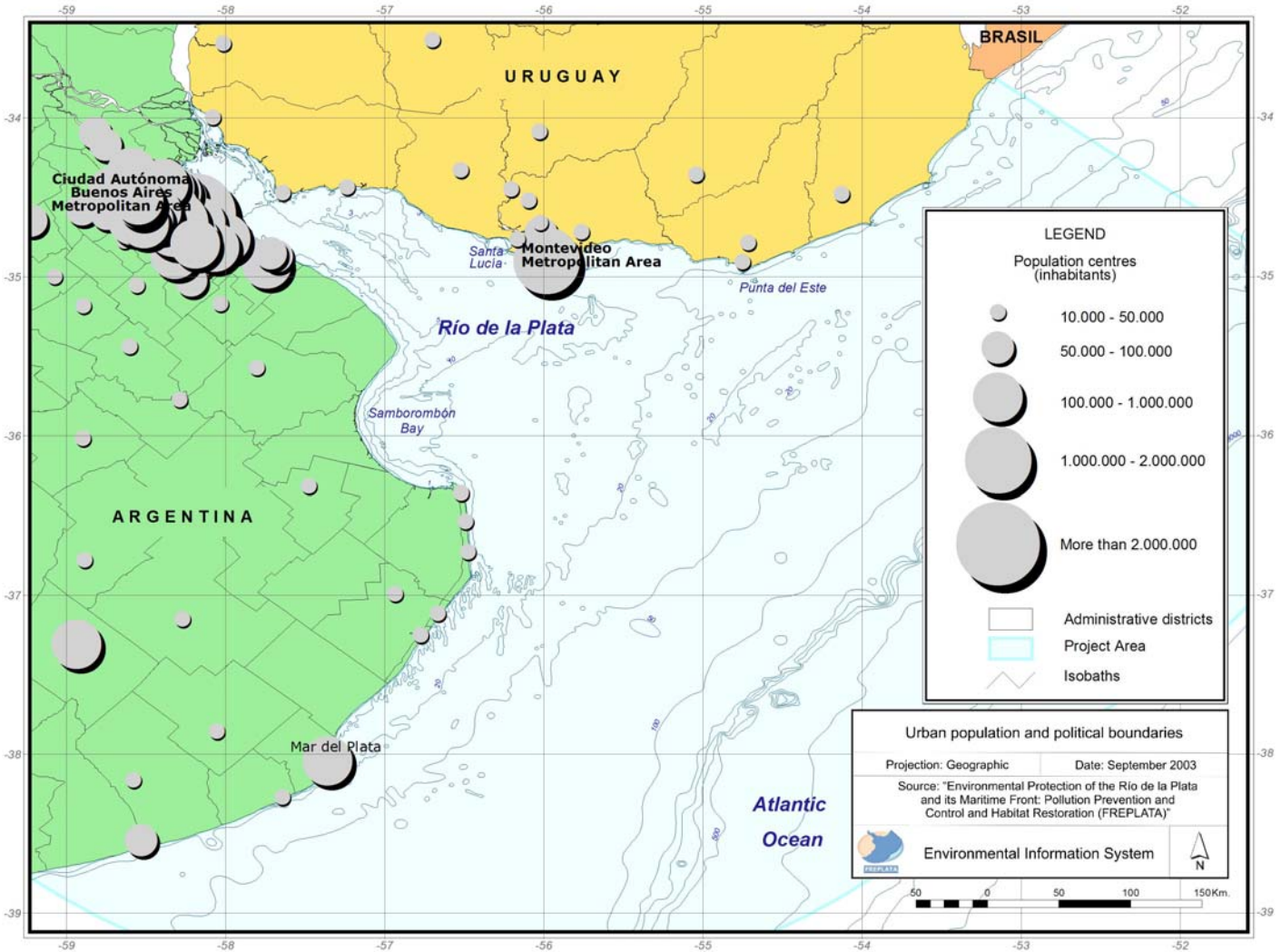


Figure 2.1. Distribution of urban population and political boundaries in the hinterland to the RPMF (Source: FREPLATA, 2005).

2.2.-The natural environment.

The FREPLATA Project has successfully integrated a very large knowledge base on the natural environment of the RPMF in order to create an operational baseline from which future change can be assessed.

2.2.1. Physical conditions.

The physical environment of the Río de la Plata and its Maritime Front depends on the dynamics between the flow of water from its vast basin (the fourth largest in the world) on one hand, and the winds, tides and currents of the South Western Atlantic on the other. The average flow of water into the system is some 24,000 m^3/sec., sufficient to maintain a considerable part of the system in a permanently freshwater state. However, this flow is very variable; the flow rate of water down the largest rivers (Paraná and Uruguay) seems to be increasing since the 1970's but suffers huge variations, especially during 'ENSO' (El Niño Southern Oscillation) years when it may reach more than 60,000 m^3/sec. Such variability make it necessary to qualify all statements about the physical system very carefully – we talk about 'mean conditions' but the conditions at any moment of time may differ considerably.

The difficulty to predict conditions in the system is made more complex by variability in the coastal seas. Variations in winds for example, particularly those blowing along its axis, can cause major changes in water level near the head of the Río de la Plata: storm surges and floods in SE winds or very low waters limiting navigation and drinking water supply following NW winds. Winds blowing perpendicular to its axis promote a pattern of circulation that can also result in large eddies[1] (gyres), most notably in Bahía Samborombón where they are a semi-permanent feature.

[1] Eddies are water movements, similar to vortexes that move in contrary sense to a main current.

The salinity conditions are somewhat similar for the two seasons; the transition waters of the Río de la Plata (mixed seawater and freshwater) can be seen further offshore in summer and are transported towards the coast of Brazil in winter due to strengthened NE currents. Temperature changes markedly between summer and winter and the range of temperature in the headwaters of the Río de la Plata is much greater than in adjacent coastal Atlantic Ocean (i.e. the freshwater part of the system is comparatively hotter in summer and colder in the winter).

Box 2.2. Physical characteristics of the Río de la Plata and its Maritime Front.

- Surface area of the Rio de la Plata: 35,500 km^2
- Length: 327 km
- Width at the mouth: 230 km (between Cabo San Antonio in Argentina and Punta del Este in Uruguay)
- Area of Plata Basin discharging to the RPMF: $3.1*10^6$ km^2.
- Average freshwater input from rivers: 694 km^3/year (5^{th} highest globally)
- Tides: Semidiurnal with large diurnal variations
- Tidal range: 0.3 – 1.0 metres
- Salinity gradient: 0 – 34 PSU
- Concentration of suspended solids: 50 – 300 mg/l
- Surface area of the Maritime Front: 216,000 km^2 (oceanic space that consists of the Common Fishing Zone of the Treaty)

Freshwater tends to float over seawater in wedge form – and to some extent this occurs in the RPMF (Figures 2.2).
Mixing occurs across an area of rather abrupt change called a 'front'. As its name indicates, the Río de la Plata and its Maritime Front is characterised by this phenomenon, actually three fronts, the most notable of which is at the seaward limit of the Río de la Plata itself.

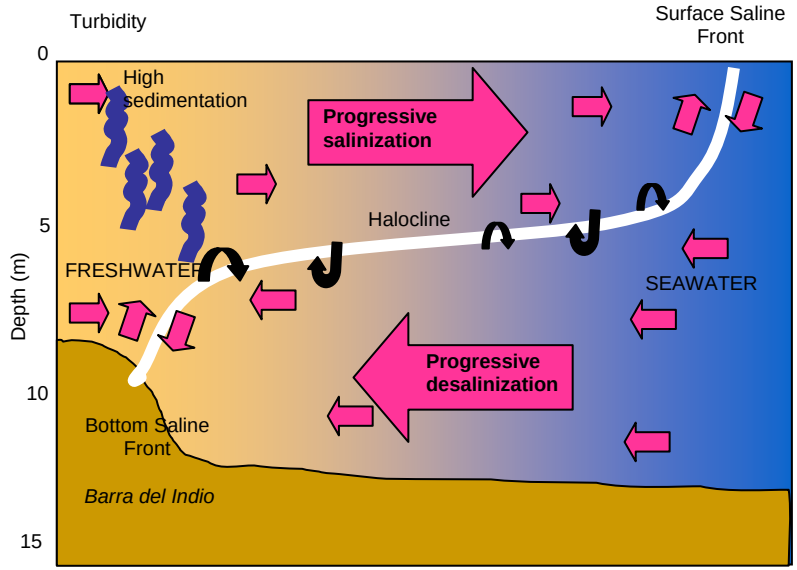


Figure 2.2. Conceptual outline of salinity distribution in a longitudinal cut of the Río de la Plata. Red arrows indicate the waters dynamics (Source: Acha and Mianzán, 2003).

2.2.2. Habitats.

The fronts in the RPMF and the five aquatic environments they contain are fundamentally important for its geology, chemistry, ecology and management. They are illustrated in Figure 2.3 and will now be described in more detail:

1. Freshwater environment.

- Salinity range: <2 PSU[2]
- Surface area: 10,500 km^2
- Predominantly soft (very fine) sediments

This area extends until the imaginary line that unites Punta Piedras – Punta Tigre, this area has the characteristics of a huge river and is rich in freshwater species, some of which migrate into the river systems of the Plata Basin. It is situated in front of one of the most populous regions of Argentina (Autonomous City of Buenos Aires and its Metropolitan Area).

Between this zone and the next, there is a turbidity front that is key to understanding the geology, chemistry and ecology of the system (Box 2.3.).

2. Brackish (transitional) zone.

- Salinity range: 2-25 PSU
- Surface area: 19,700 km^2
- Predominantly soft (fine) sediments

This area extends from the imaginary line that unites Punta Piedras - Punta Tigre until the imaginary line among Punta Rasa - Punta del Este. This is the region where freshwater and seawater are mixed by wind and current energy. It is characterized by strong currents along the Uruguayan coast. Mixing is not uniform; in some situations, there may be a strong gradient of salinity with fresher water in the surface layer than at the bottom. The biota in this zone must be resistant to large changes of salinity.

[2] The abbreviation *PSU* refers to 'practical salinity units', an international unit corresponding approximately to parts per thousand of dissolved salt.

Box 2.3. The importance of the turbidity front.

When rivers meet the sea, it is common to observe a zone of very turbid water. This is caused by two simultaneous processes:

(1) Some natural substances (organic and inorganic) dissolved in freshwater flocculate out and precipitate when the salinity suddenly increases.

(2) Salt water pushing into the inlet from the sea travels along the bottom (because it is denser and therefore heavier) and this acts like a wedge, forcing light material that has settled on the floor back into suspension. The 'light material' includes the substances that have flocculated as well as associated bacteria and some sediment.

The material that forms the turbidity front is chemically very active and many substances are attracted to its surface (a process known as adsorption), or are incorporated into it (by absorption). This mechanism tends to remove contaminants such as heavy metals from the water, as well as some organic contaminants. In effect, it protects the downstream coastal zone from some of the contaminants introduced in the river basin. On the other hand, it also causes a build-up of these contaminants in the turbidity front itself. Since the front is also area of great biological activity, there is a danger that the accumulated contaminants can enter the trophic chain with deleterious consequences.

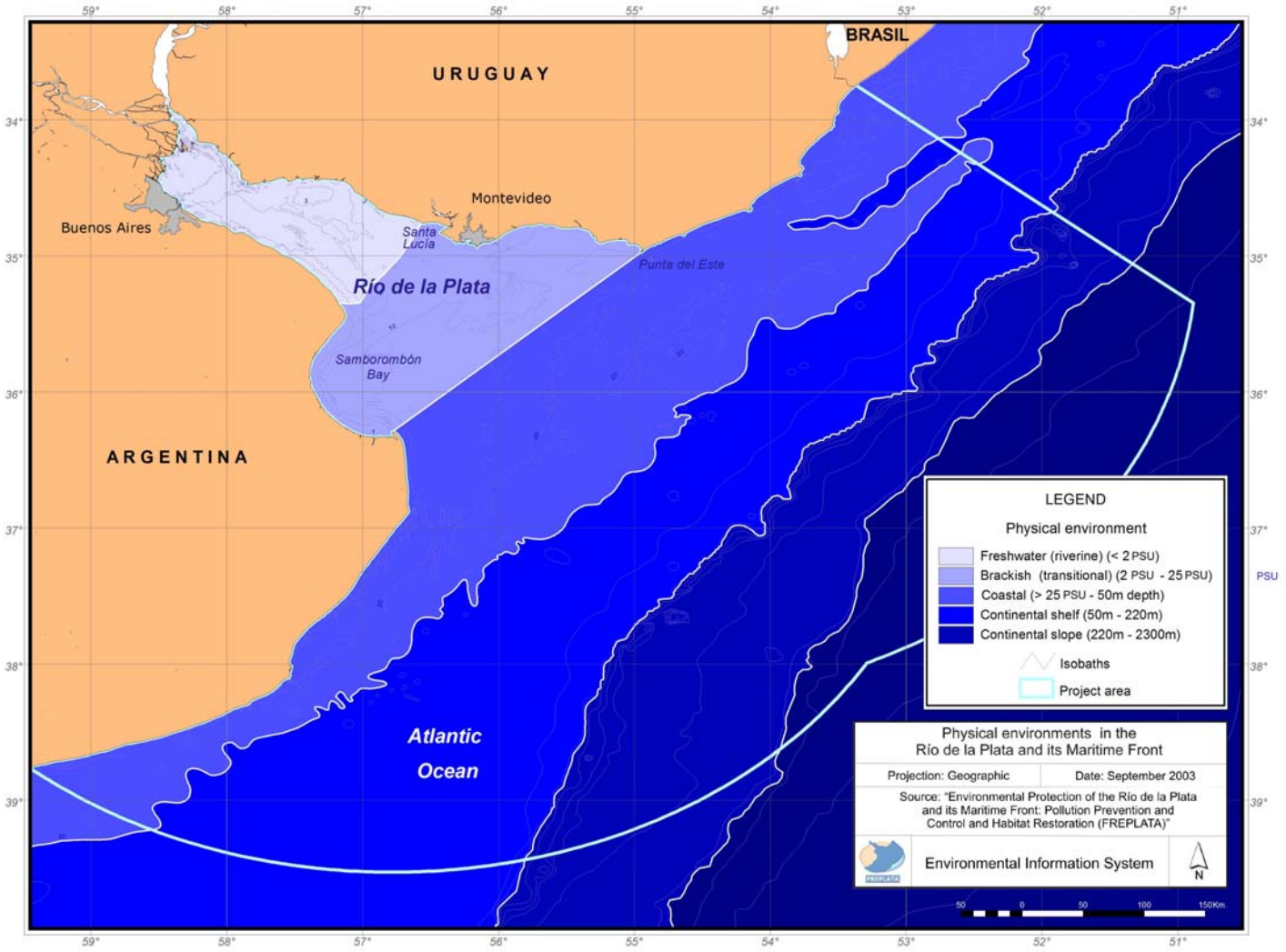


Figure 2.3. Zonation of the RPMF and position of the key environments and fronts (Source: FREPLATA, 2005).

3. Coastal waters

- Salinity range: > 25 PSU
- Surface area: 67,900 km^2
- Predominantly sandy sediments

This is a region that extends from the coast until the isobath of 50 meters and this is an area where freshwater and seawater continues to mix. However, the water remains in the area for long enough for large communities of free floating microscopic algae (phytoplankton) to develop using the nutrient (nitrogen and phosphorus compounds) that are transported down the river and from coastal sources. This forms the base of a rich food chain leading to an abundance of fish, crustaceans and mollusks. There is a front within this zone where the lower salinity coastal water meets seawater transported by coastal currents (Figure 2.3).

4. Continental shelf waters.

- Surface area: 78,100 km^2
- Predominantly sandy sediments

This is a region that extends from the isobath from the 50 meters to the isobath of 220 m. Coastal currents (seasonally the warm Brazil Coastal Current in summer and the cold Malvinas Current in winter) predominate in this region and provide connectivity with systems to the North and South. It is enriched by biological material carried from the Río de la Plata through the coastal zone. Hard substrates provide a good substrate for bivalve mollusks (e.g. mussels).

5. Continental slope waters.

- Surface area: 45,300 km^2

This is a region that extends from the isobath from the 220 meters to the isobath of 2300 m. There is usually a front between the continental shelf and this region. This is a truly oceanic region with characteristics that are mostly defined by the general circulation of the Southern Atlantic.

Table 2.1 indicates the biological richness of each of the zones. The very large number of mollusk species in the coastal zone is a consequence of an efficient food supply, limited salinity range and relatively undisturbed sediments. On the other hand, high copepod diversity on the continental slope is indicative of the oceanic food chains in this region. Relatively few of the species are shared between the freshwater and marine (Zones 3-5) habitats; each has its characteristic fauna. However, because of the dynamic nature of the systems and its connection with neighboring systems, there are few truly endemic species.

Table 2.1 Number of animal species belonging to three representative classes: fish, mollusks, and copepods[3]. Mianzán (2002).

Zone	Fish	Mollusks	Copepods
Freshwater	53	144	31
Brackish	46	103	21
Coastal	60	474	29
Continental shelf	49	91	34
Continental slope	27	118	88
Total	146	757	98

2.2.3. Ecology of commercially exploitable species.

The importance of the characteristic zones and the processes that occur along fronts are illustrated in Figure 2.4 which shows the distribution of areas for reproduction (spawning areas) of key fish and squid species in the RPMF. The green area on the map corresponds to the turbidity maximum and the reproduction areas of brackish species such as the White Croaker (*Micropogonias furnieri)*, gobies (*Gobiosma parri*), or Brazilian menhaden (*Brevoortia aurea*).

[3] These are small crustaceans that graze on phytoplankton and are a key component in marine food chains leading to fish.

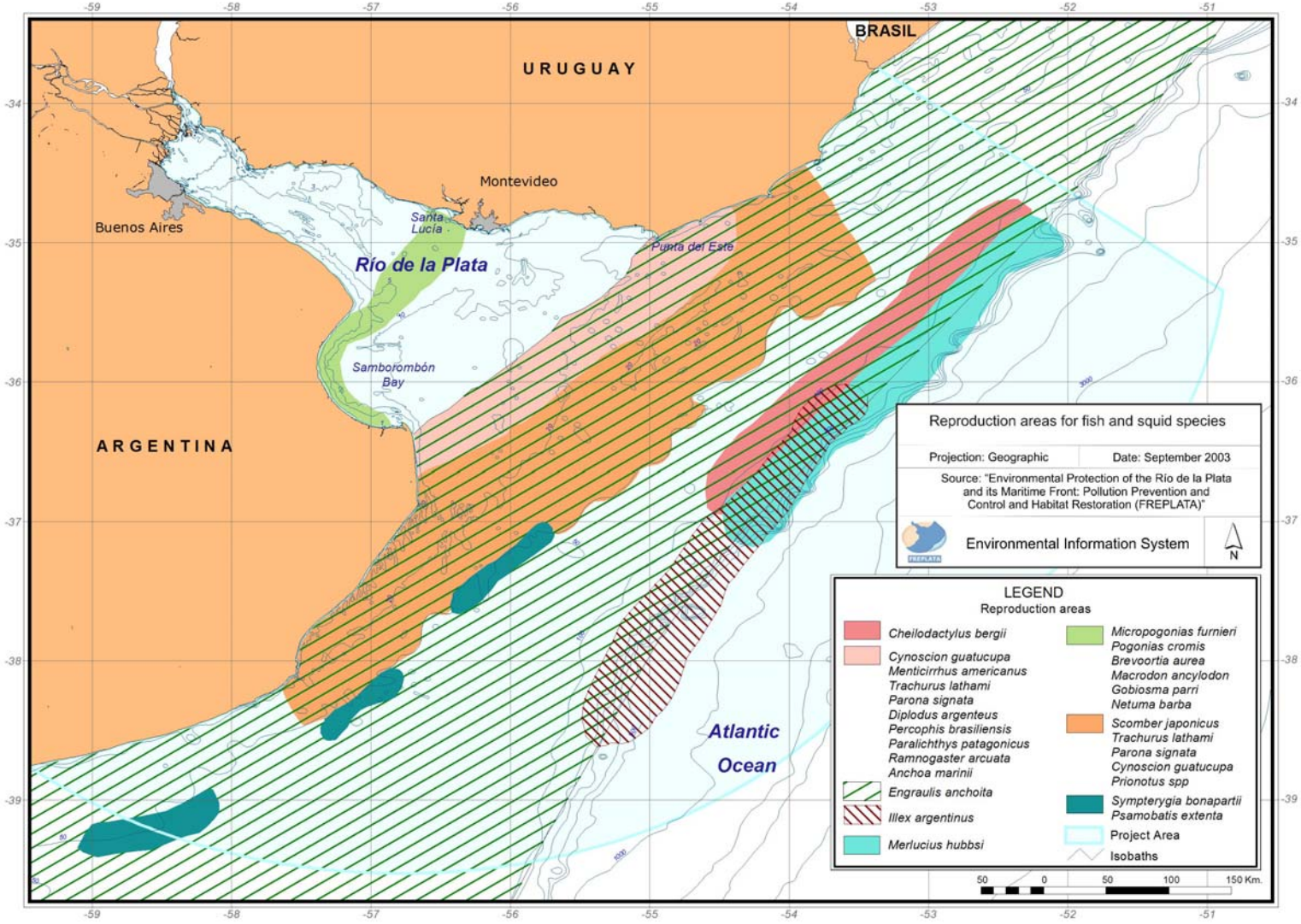


Figure 2.4. Main zones for reproduction (spawning) of fish and squid species (Source: FREPLATA, 2005).

There are no spawning areas in the central part of the brackish zone of the system. However, the fronts within the coastal water zone are areas of reproduction for a large number of species. The inner part of this zone (pink area) is characterized by species such as the striped weakfish (*Cynoscion guatucupa*), proposed as a biomonitor of organochlorine pesticides in fluvio-marine and near-coastal zones, the southern kingfish (*Menticirrhus americanus*) – a scianids, scad (e.g. *Trachurus lathami)*, sprats and the silver porgy (*Diplodus argenteus*). Further offshore (orange on the map) reproductive areas are also found for the chub mackerel (*Scomber japonicus*), as well as many of the species from the adjacent inshore area. The front that divides the continental shelf from the continental slope is a spawning area for hake (*Merlucius hubbsi*). Most importantly, it is the area for reproduction of squid (*Illex argentinius*) that supports an important fishery. The entire shelf is a spawning area for the argentine anchovy (*Engraulis anchoita)*.

The importance of this mapping exercise is that it illustrates the close association between key life stages of fish and oceanographic features of the region, particularly frontal areas. Figure 2.5, showing the distribution of commercially important invertebrate species (mussels, scallops and crabs) as well as 'charismatic[4] megafauna' (whales, sea lions and sea turtles) strengthens this point even further. Mussel beds are located in the area of the salinity front between the transitional waters of Río de la Plata and the coastal zone. Crabs reach a particularly high density in the nearshore areas of Bahía Samborombón, where water is entrained from the front of turbidity maximum.

As regards the charismatic megafauna, their presence (and huge conservation value) in the system is important. The coastal and nearshore distribution of the marine species (whales, turtles, sea lions) is partly because of the importance of coastal sites for breeding. In the case of whales and sea turtles, knowledge of their distribution offshore is very limited. Coastal sites, particularly wetlands, are also important for wintering, feeding and breeding areas for birds, several species of which are now considered as threatened or even critically endangered. Conservation of coastal zones is clearly important if a holistic approach is to be taken to management of the RPMF.

2.3.-Economy.

The land area adjacent to the RPMF is of huge economic importance to both countries; 36.1% (13.1 million habitants) of the population of Argentina and 70% of the population of Uruguay (2.35 million habitants) live near the shores of the RPMF. The two countries will be considered separately:

Argentina

The participation of the Autonomous City of Buenos Aires and the Buenos Aires Province in Argentina's gross domestic product (GDP) was 57.5% in 2000. The city is the district with most commerce (wholesale and retail), is the main centre for provision of services in the country, national administrative capital and the main hub for air, road and sea transport. Some 80% of its economic activity is based in services and commerce and the remaining 20% consists of the manufacturing industry (18% of the industrial production in the country). Buenos Aires Province has an important agricultural production: 40% of the national production of cereals and 37% of cattle. It has an important mining industry (construction material) and includes 46.4% of the nation's industrial production (principally oil refineries, chemicals, engineering, pharmaceuticals, milk products and refrigeration). Fisheries are a major activity with ports in Mar de Plata, Quequén and General Lavalle accommodating approximately 50 % of the national high seas fleet.

[4] Charismatic is a term used to reflect the level of public interest in these species (unlike most other non commercial aquatic organisms).

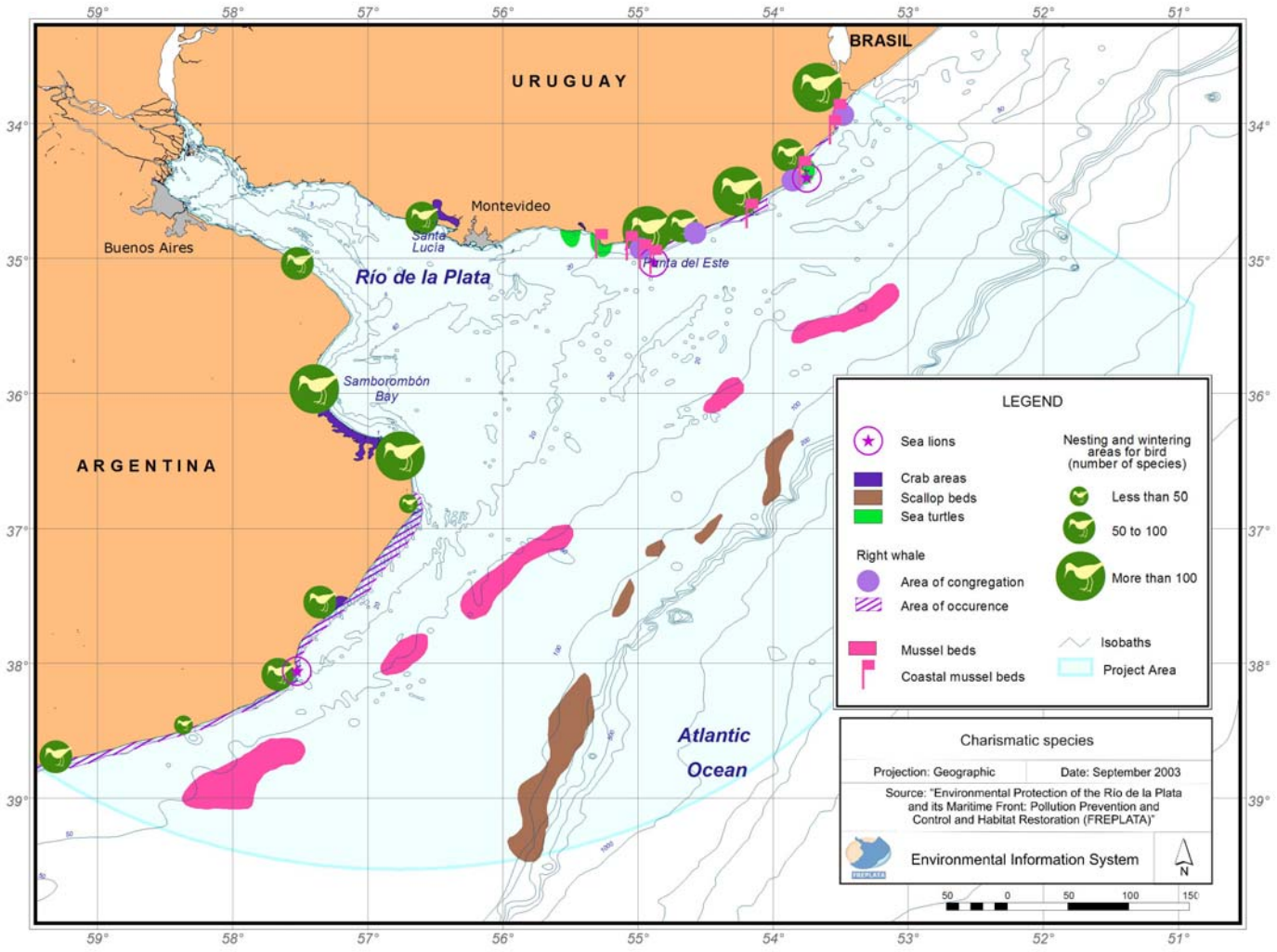


Figure 2.5. Distribution of (1) Keystone macro-invertebrates (mussels, scallops, crabs) and (2) 'Charismatic' megafauna (Source: FREPLATA, 2005).

Uruguay

The coastal zone of Uruguay includes six administrative divisions (*departamentos*): Colonia, San José, Canelones, Montevideo, Maldonado and Rocha. Jointly, these account for 87% of the national manufacturing industry, 82% of the services and 73% of the construction. Most of the economic activity is concentrated in Montevideo however, and the district accounts for 59% of the Gross National Product of Uruguay (including 71% of its industry and 66% of services).

Role of the MERCOSUR

The MERCOSUR was established by the Treaty of Asunción in 1991 to lead to a common market area between Argentina, Brazil, Paraguay and Uruguay. Since that time, trade between countries in the region has increased rapidly. In 1980, exports by Argentina and Uruguay to the other (current) MERCOSUR countries were 14.2% and 32.9% of their total trade respectively. In 2000, this had risen to 31.8% and 44.6%. Some of this success has been achieved through improved transport routes including new roads and fluvial transport in the Paraná and Paraguay rivers. Maritime trade with overseas still dominates, however. In 2000, Argentina exported 69.577 million tons of cargo by ship (84.1% of exports) and imported 17.877 million tons (82.8% of imports). For Uruguay, maritime exports were 2.65 million tons and imports 3.47 tons (60.24% of this was oil).

Fisheries

Fishing is one of the most important economic activities in the RPMF. Total catch in the Common Fishing Zone reached 269.467 tons in 1997 but diminished approximately in half starting from the 2001 (Figure 2.6). Several of the target species have reached or exceeded sustainable limits and both countries are taking urgent measures to conserve stocks. Clearly, recovery of the fisheries is an important priority for both countries. However, there remains a lack of clear consensus between the fishing industry and society on the regulatory framework necessary for this to happen.

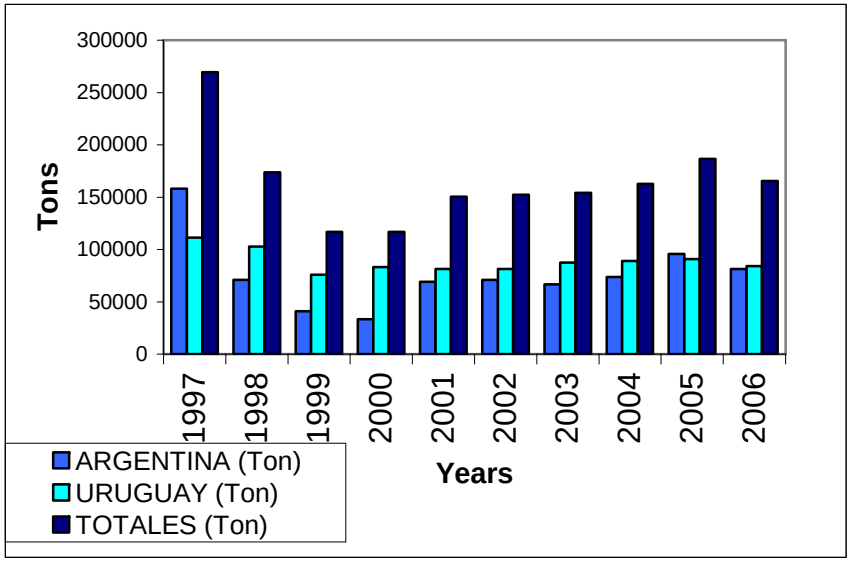


Figure 2.6. Total catch (tons) of main species in the Common Fishing Zone. (Source Argentinean catch: SAGPyA, informed to CTMFM. Sources Uruguayan catch: DINARA, informed to CTMFM).

2.4.-Social context.

Social situation

Given the predominance (and expansion) of the urban population in the region, it is important to understand their social realities, especially when planning actions for protecting the environment.

Poverty in the Metropolitan Area of the Autonomous City of Buenos Aires increased continuously through the decade of the 90s. In this

case, the largest conurbation in the region, there are areas with particularly large numbers of marginalized people, and these often coincide with places where environmental degradation is acute. Examples are the following rivers Matanza, Riachuelo, Reconquista, Luján and the Río de la Plata itself. These rivers have been receptors of effluent for many years. In the Matanza-Riachuelo basin alone, there are half a million people living precariously in unauthorized settlements. Only 50% of the population of the city is connected to the municipal sewerage system and many residents discharge their waste into wells in the shallow aquifer.

On the other hand, Buenos Aires obtains 75% of its drinking water from the Río de la Plata. The river represents a source of sustenance, a convenient place to dispose of waste and a constant threat from flooding and pollution. However, local authorities are not complacent and, since 1998, developed a Plan for Environmental Management of the Basin (Control of floods and prevention of pollution in the Matanza-Riachuelo Basin).

Montevideo's most serious problem is the urban expansion along a more extensive area to detriment of natural environment.

3. The system boundaries.

In order to apply ecosystem based management, it is important to understand the system boundaries. These can be defined in a number of different contexts according to the problem being managed. Figure 3.1 illustrates a hierarchy of scales from very local to global. Different issues require different management scales. The global transport of invasive species for example, cannot be tackled without actions at the global scale but some aspects of coastal pollution only require actions in one district or municipality of a single state (though this may need national-level legislation in response to needs articulated by an international agreement).

The political boundaries for the Río de la Plata and its Maritime Front have been established through the mechanisms outlined in 2.4. A more detailed account of the legislative issues will be given in Section 6 of this report. The current section will describe the boundaries themselves.

For the Río de la Plata, the area covered by the Treaty is stated as follows:

The Article 1 stipulates that the Río de la Plata extends from the Punta Gorda Parallel (its limit with the Río Uruguay) to the imaginary straight line that joins Punta de Este (República Oriental del Uruguay) with Punta Rasa of Cabo San Antonio (República Argentina), which is its limit with the Atlantic Ocean. In the Maritime Front, the Parties agreed in the Treaty to set up two bilateral special areas which overlap their respective economic exclusive zones: the Zona Común de Pesca (Common Fishing Zone) and the Zona de Prohibición de Acciones Contaminantes (Pollution Activities Prohibition Zone), in conformity with the dispositions of the Treaty of the Rio de la Plata and in the Joint Declaration regarding the External Limits of the Río de la Plata of January 30th, 1961.

The Article 2 defines a zone of exclusive jurisdiction adjacent to the coasts of each Party in the Río de la Plata. This zone has a width of seven nautical miles between the external limit of the Río de la Plata and the imaginary straight line between Colonia (República Oriental del Uruguay) with Punta Lara (República Argentina) and from this last line to the parallel of Punta Gorda has a width of two nautical miles. However, its outer limits shall be inflected as necessary so that they do not go beyond the edges of channels in waters shared by the Parties and so that port access channels are included.
Such limits shall be no closer than 500 meters to the edges of channels situated in shared waters, nor shall they be more than 500 meters from the edges and the mouth of port access channels.

At first sight, the boundaries agreed upon in the Treaty appear complex, but they are the outcome of careful negotiations between the countries. It is important to note however that for the purposes of agreeing *policies* for reducing the environmental pressures on the RPMF, it is often necessary to work within larger boundaries that encompass the source of the problem, as well as the problem itself. An example of this is the issue of land-based sources of pollution where it is necessary to incorporate the source of pollution within the boundary of the study and the boundary of any policy developed to resolve the problem. This issue will be discussed further in Section 6.

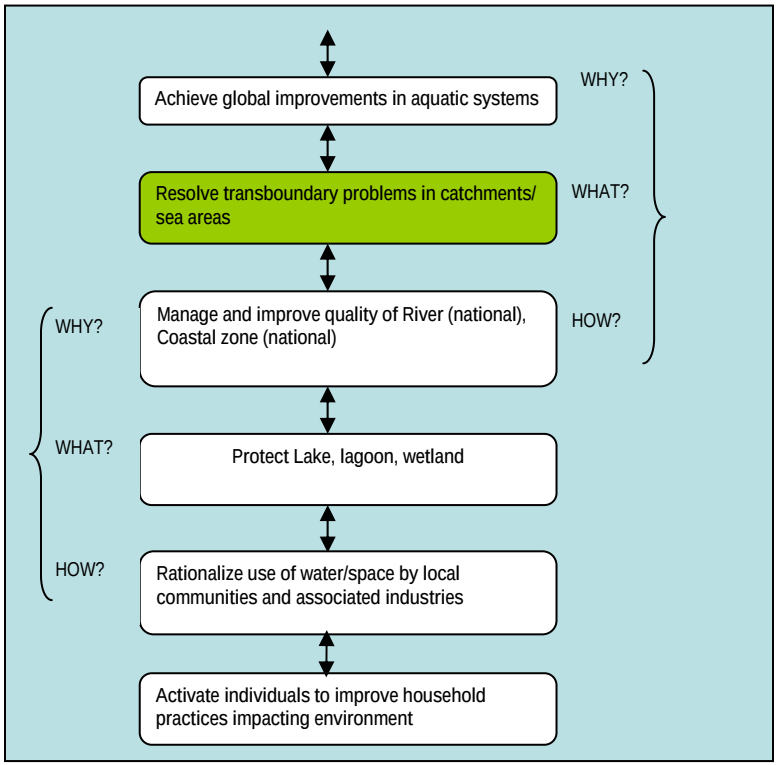


Figure 3.1. Hierarchy of scales illustrated through their management objectives. Management goals (the 'what' question) at any level in the hierarchy serves to address issues (the 'why?' statement) at a higher level and requires action (the 'how' statement) at a lower level. The 'why-what-how' scale can be moved to any point on the hierarchy. The scale applicable to FREPLATA is shaded green.

4. Transboundary issues and associated problems.

4.1.- Why are the problems transboundary?

The Río de la Plata and its Maritime Front is a transboundary aquatic system and as such, the effects of pollution and biodiversity loss are shared by the two States and impact them in a tangible manner. Furthermore, it is important to recall that the Río de la Plata and its Maritime Front is a very dynamic system and pollutants (especially heavy metals and persistent organic pollutants) are transported by the water column, sediments and living organisms.

The Precautionary Principle is one of the underlying principles adopted by both countries. This implies the need to adopt preventative measures when there is reasonable doubt or risk of causing harm; in this particular case where an activity on land or sea could increase the risk of health problems for humans or deterioration of the natural environment in the region.

With respect to transboundary environmental problems in the region, the following key points can be made:

a) The transboundary problems originate from activities on land as well as in the aquatic area.
b) As has been demonstrated by a large number of authors, water circulation in the FREPLATA study area is complex and is affected by various natural drivers; its dynamics can rapidly transport contaminants introduced at the coastal zone to distant parts of the system. In this manner, any pollutant introduced into the system in waters of one country poses a tangible risk to the waters of its neighbour.
c) Within the system, there is a turbidity maximum (corresponding to a 'front' between freshwater and seawater) to which energy from tides and currents transports polluted sediments from coastal sources such as the Metropolitan Area of Buenos Aires or from the Plata Basin, as well as solid wastes from terrestrial and aquatic sources.
d) The turbidity maximum is a zone where various species of demersal (associated to bottom) and pelagic fish aggregate to feed, spawn, and develop their early life stages. An example of a demersal species and commercially important is the white croaker (*Micopogonias furnieri*). There are other areas of aggregation, of different species, along the southern coastal margin (adjacent to the Argentinean coast of the Río de la Plata). This shore includes the coastal sector of the Metropolitan Area of Buenos Aires, where there is the largest concentration of urban/industrial development. Other sectors of this shore show low levels of pollution or are not polluted at all. This sector includes Bahía Samborombón, which is a nursery area for fish and an important habitat for a number of migratory bird species. It should be pointed out that physical processes cause dispersion of contaminants but food chain biomagnifications provide the ultimate link to humans, a fact clearly demonstrated in FREPLATA studies.
e) The Río de la Plata is the main center for ports and transshipments for Argentina and Uruguay and this presents major risks of transboundary pollution, either from accidents (e.g. the major oils spills from Magdalena, Buenos Aires Province in 1999, and Maldonado-Punta del Este area, Uruguay, in 1997) or operational activities related to shipping (e.g. dredging, waste discharge, introduction of opportunistic invader species through ballast water discharge, operational oil spills, bilge discharges of used oil

polluted with polyaromatic hydrocarbons, etc.). The lack of suitable reception facilities for ballast water, shipboard waste, sewage water makes it difficult for shipping companies to comply with international regulations (e.g. MARPOL).

f) The development of the fishing industry in the common use water of the Río de la Plata and in the Common Fisheries Zone established in the Treaty requires the adoption of adequate management measure in order to avoid it, having an adverse impact on biodiversity.

4.2.- The main transboundary problems identified.

By following the approach used by the Global International Waters Assessment (GIWA) it was possible to identify the following priority transboundary problems related to environmental degradation:

1. Chemical pollution (includes oil)
2. Microbiological pollution
3. Eutrophication and harmful algal blooms
4. Suspended solids
5. Introduction of exotic species
6. Alteration / Destruction of natural habitats
7. Loss of biological diversity

Subsequent work to understand the main causal chains that have led to problems will be summarized in section 5 of this report.

A detailed analysis of the scientific evidence supporting these findings is provided in Table 4.1. The problems can be grouped into two types (1) Pollution (presenting a direct threat to human health through direct exposure or the trophic chain) and (2) Ecosystem alterations (as a result of habitat and/or biodiversity loss, eutrophication, invasive species introduction and the overexploitation of living renewable resources). These two major issues are closely associated since pollution also impacts on aquatic biota, and invasive species and harmful blooms can threaten human health.

Figures 4.1 to 4.3 illustrate the transboundary issues for the cases of pollution and invasive species. Figure 4.1 is a schematic summary of **pollution** data from surveys conducted as part of FREPLATA. It clearly illustrates the importance of the turbidity maximum for determining the distribution of pollutants (for the reasons explained in Box 2.3.). The position of this turbidity maximum is significant in the geographical context of the region. Many pollutants introduced in the post populous part of Argentina (Metropolitan Area of Buenos Aires), or from upstream parts of the Plata Basin, will be detained in the turbidity maximum, and may become buried in the underlying sediments. Pollutants introduced on the Uruguayan coast in the region of Montevideo will enter the system seawards from the turbidity maximum and have a different kind of impact on the system, especially as this is the region of strongest seaward currents.

Fortunately, coastal pollution has not yet affected severly the common use areas. The case of chromium (Figure 4.2) illustrates this point well. This figure shows the distribution of chromium in sediments in the area covered by the Treaty. Chromium is a toxic heavy metal originating from metallurgic industries and tanneries. It rarely represents a major threat to human health in marine systems. The data has been classified in terms of safe levels (below the guidance levels for action) – green dots; above precautionary limits (between the guidance levels and the probably effect levels) - yellow dots; and hazardous concentrations (above the level of probable effects) - shown as red dots. The distribution of the data with respect to the guidance and probable effects levels are shown in the graph in the bottom right-hand corner of the figure 4.1. Note that the guidance and 'effects' levels are different for freshwater and seawater. Sediments would be regarded as hazardous in only one case (in the turbidity maximum). However, a number of points exceeded guidance levels (Environment Canada 2002), particularly in the southern part of the freshwater zone, in Bahía Samborombón and in

one station in front of Montevideo. A similar situation was observed with copper but no station exceeded the 'effects' level for lead or cadmium and few were registered above guidance levels.
The situation is quite different for stations with coastal waters, particularly in the South. Sediments along the entire freshwater sector of Argentina frequently exceeded the 'effects' level for chromium, mercury, lead and PCBs. In the case of Uruguay, such high concentrations were observed only adjacent to the port of Montevideo.
There is little evidence of major bioconcentration of contaminants through the food chain in the RPMF. However, in the region close to pollution sources, some very high concentrations have been registered. Indeed concentrations up to 9 μg/g of PCBs were registered in freshwater tarpon (Sábalo – *Prochilodus lineatus*) and Argentinean law now prohibits its capture in the Río de la Plata. Tarpon caught near the very polluted Riachuelo River in Buenos Aires contained up to 4 μg/g of lead, a very high concentration that would pose a hazard for human consumption. There is a slight risk of polluted fish from hot spot areas migrating into adjacent areas and the situation should be monitored carefully from time to time. Studies of biological effects of pollution (i.e. effects to aquatic animals) have not been conducted systematically.

Issues of **microbiological pollution** are discussed in Table 4.1. This is largely a nearshore problem that impedes the use of coastal waters for recreation and poses threats to humans through the consumption of polluted seafood (especially mussels). There is little current evidence of its transboundary nature. A more complex issue however, is that of the vibrium of cholera. This has been found in large areas in the system by a number of studies such as that of Binsztein *et al*., (2004). These authors found the cholera was viable but nonculturable (VNC) but stated that "under favorable conditions, the VNC form of *V. cholerae* can revert to the pathogenic, transmissible state". Recent studies have shown that *V. chlorerae* is almost ubiquitous in tropical waters and care must be taken on the interpretation of this finding. However, careful monitoring will be needed in the future.

Historical trends in **Eutrophication** (the overenrichment of the water with nutrients) in the Rio de la Plata are poorly understood. Recent studies have indicated considerable contemporary levels of eutrophication that are associated with nutrient runoff from the agricultural sector as well as from urban effluent. The dynamics of the nutrient cycle is very complex given the physical characteristics of the Rio de la Plata.

There appears to be a growing incidence of **harmful algal blooms** (HABs) that may be symptomatic of this phenomenon. This problem is illustrated in Figure 4.3. There are two distinct types of HAB in the region, those associated with freshwater and those characteristic of marine (including brackish systems).

The most notable freshwater HABs are from blue-green algae (cyanophytes). Dense blooms of these species are a nuisance and can cause oxygen depletion, but a particular problem in the Río de la Plata is the species *Microcystis aeruginosa.* Some strains of *Microcystis* sp. may produce toxins that have been reported to result in health problems to animals that drink the water, and minor skin irritation and gastrointestinal discomfort in humans that come in contact with toxic blooms.

In the brackish and marine regions of the system, dinoflagellates are responsible for HABs. These are phytoplankton species, only some of which are toxic. Unfortunately, some of the toxins they produce are pathogenic and others cause major fish kills. Toxins generally reach humans via shellfish in which they tend to become concentrated. The following types of toxin have been reported in the region:

(1) *Paralytic shellfish poison (PSP)*, a problem that affects all coastal areas of Argentina and Uruguay in the region of the Maritime Front. Sporadic outbreaks occur between spring and summer (occasionally in autumn). There have been a number of incidents of humans affected by this toxin.
(2) *Amnesic shellfish poison (ASP)*, which has serious affects on the neurological system in humans. The first case of ASP was reported in July 2000 on the continental shelf of Buenos Aires.
(3) *Diarrheic Shellfish Poisoning (DSP)*, which produces nausea and diarrhea in human consumers of affected shellfish but has not led to fatalities or other serious complications. The species responsible for this phenomenon has been detected in waters of the RPMF but it is not known if this is causing disease.

Invasive species are a growing problem in the region. Their presence is best recorded in the freshwater part of the system where two species have caused major change:

(1) Golden mussels (*Limnoperna fortunei*), introduced accidentally from China around 1991. This is rapidly spreading upstream into the Paraná, Paraguay and Uruguay rivers (at about 240 km per year). It blocks water intakes as well as causing huge changes in the structure of biological communities.
(2) Asian clam (*Corbicula* sp), introduced in the 60s and 70s from SE Asia, perhaps even as live food for ships' crews. It has also become distributed in much of the Plata Basin and causes huge problems for water supply systems. It has altered food chains by favoring fish species that are its predators and by propitiating aquatic plants growth.

In the brackish zone of the RPMF, information is only beginning to emerge regarding the extent of invasions. Not all of these have arrived in ballast waters or attached to the hulls of ships. The Asian carp (*Cyprinus carpio*) was introduced into ponds in Buenos Aires Province in 1925 but gradually escaped, affecting the entire freshwater zone Río de la Plata and penetrating brackish regions as far as Río Samborombón. It appears to be displacing some native species though the full implications of its presence have not been fully studied.

Suspended solids are a problem in the Río de la Plata (where the channels require continual dredging) but these are brought naturally by the tributary rivers. Management of spoils from dredging is a problem however, and where the dredged material is seriously polluted, this represents a transboundary problem.

The **destruction of natural habitats** in the RPMF is one of the most serious transboundary problems. This occurs as a consequence of three main pressures: (1) trawling; (2) dredging of navigation channels and subsequent dumping of dredged spoils; and (3) alterations of marginal coastal ecotones (lagoons, wetlands and shores).

This problem is illustrated in Figure 4.4, which shows the intensity of trawling and channel dredging. Trawling data is limited to the Argentinean industrial fleet (no data available for Uruguay) and is largely in the range of about 2,000 to 20,000 hours/year/degree square in waters below 50 meters depth. Roughly speaking, 20,000 hours of trawling would cover about 5-10% of the area of a square. This is less than for the intensively trawled areas of Europe and the USA where damage to benthic systems has been clearly demonstrated, but nevertheless warrants more detailed study. It should be borne in mind that this is only partial data and that Uruguayan fishing effort is at least as big as that of Argentina.

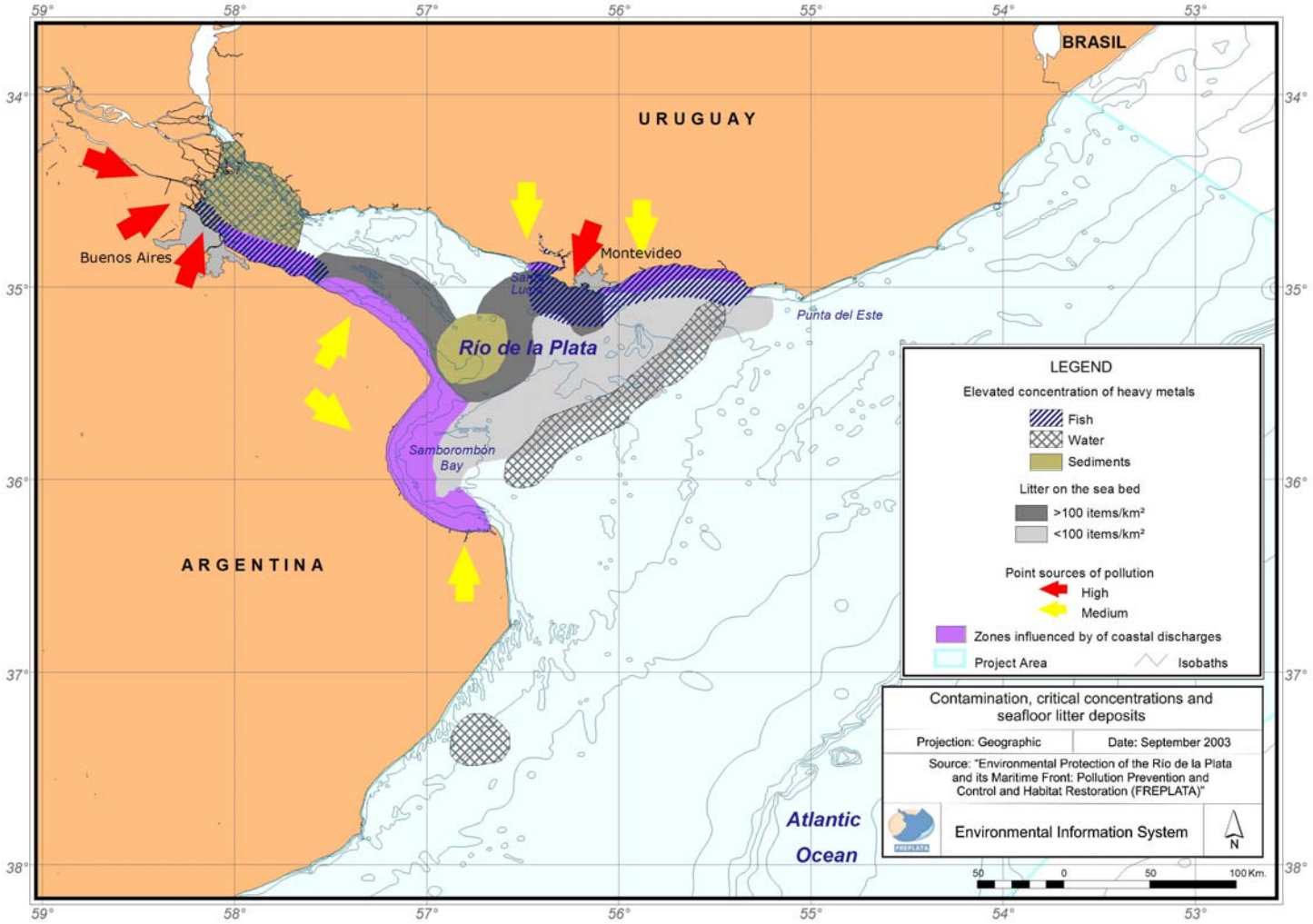


Figure 4.1. Distribution of heavy metals and litter in relation to the turbidity maximum front and point sources of pollution (Source: FREPLATA, 2005).

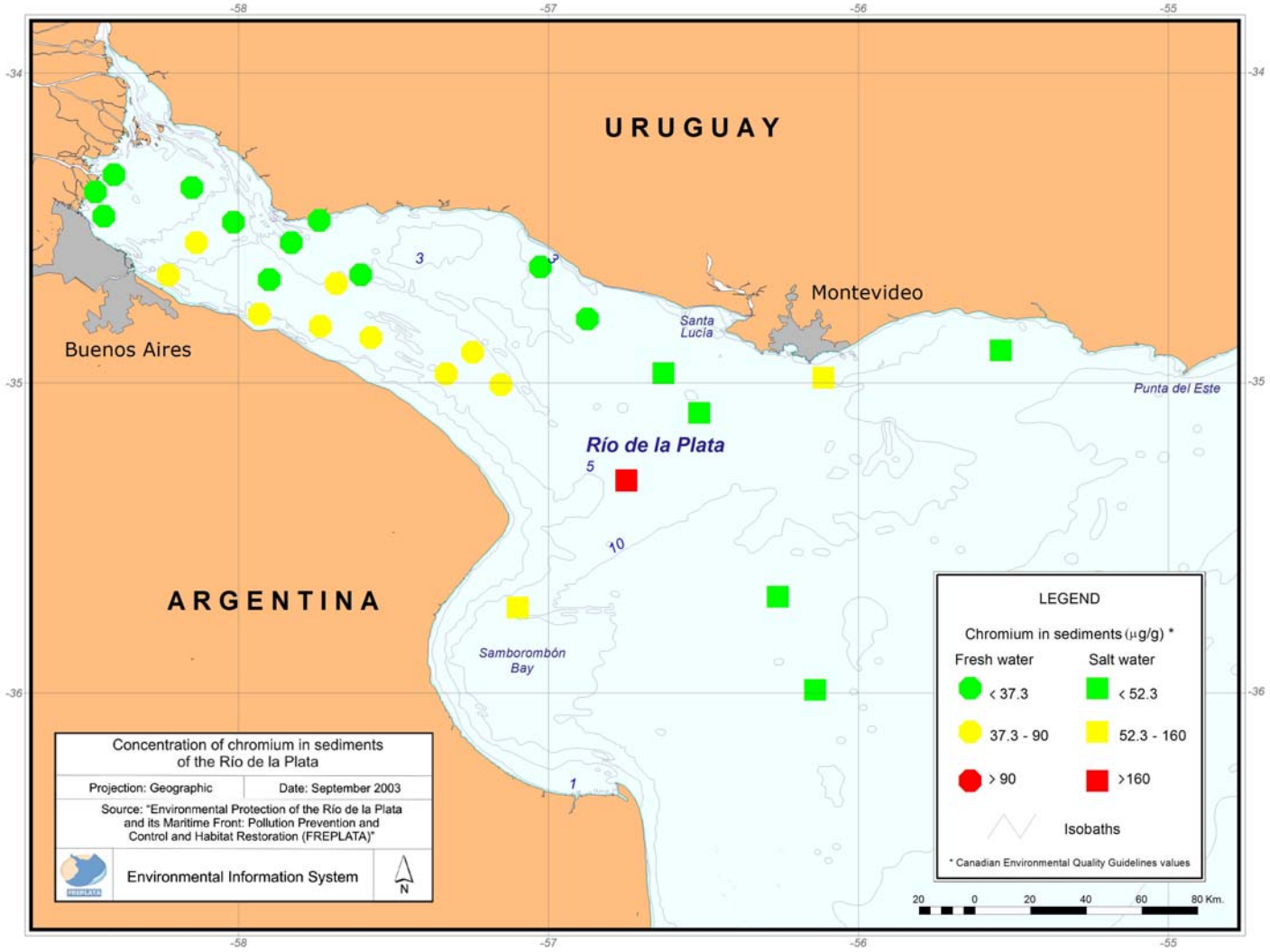


Figure 4.2. Distribution of chromium in sediments from the RPMF (Source: FREPLATA, 2005).

Studies by FREPLATA and associated projects such as ECOPLATA (in Uruguay) have shown major alteration (physical infrastructure and invasive species) in lagoons, wetlands and shores in the region. Many of these habitats serve as nursery areas for fish species and it is very likely to have impacted fisheries and biological diversity in the RPMF.

The **impact on biological diversity** is a problem that would accrue from most of the other problems outlined above. In addition to these, it is important to note that there is heavy fishing pressure in the region. It is worth mentioning that FAO data shows most stocks in the area to be exploited to their limits, and in some cases overexploited.

There are problems related to discards, incidental capture (of non-target species) and by-catch. All of these have negative implications for biological diversity, as well as for the sustainability of fishing itself. Evidence from many other parts of the world indicates that overfishing is the prelude to unpredictable shifts in the ecosystem, some of which may be irreversible in the short and medium term.

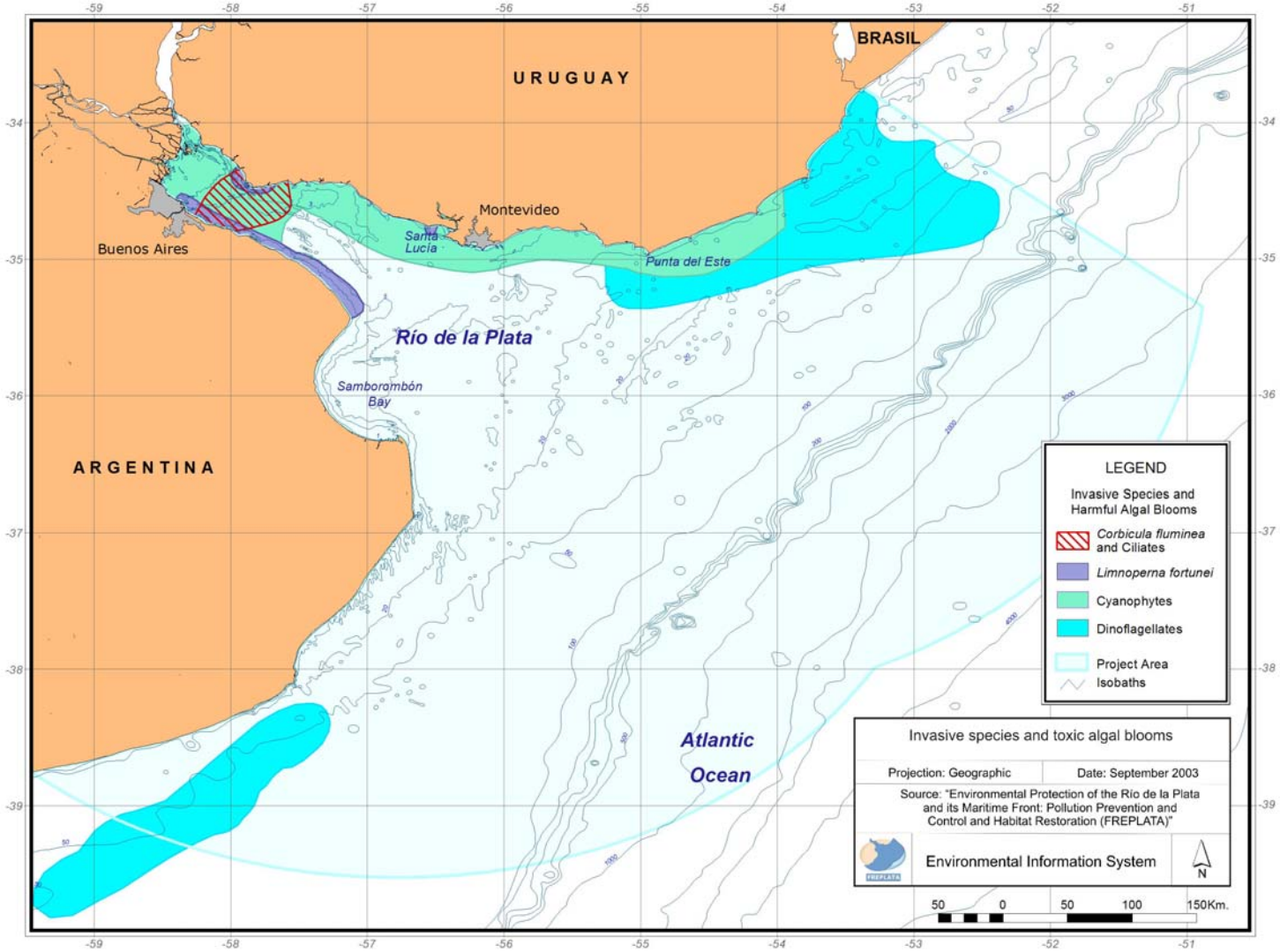


Figure 4.3. Distribution of invasive species and harmful algal blooms in the RPMF (Source: FREPLATA, 2005).

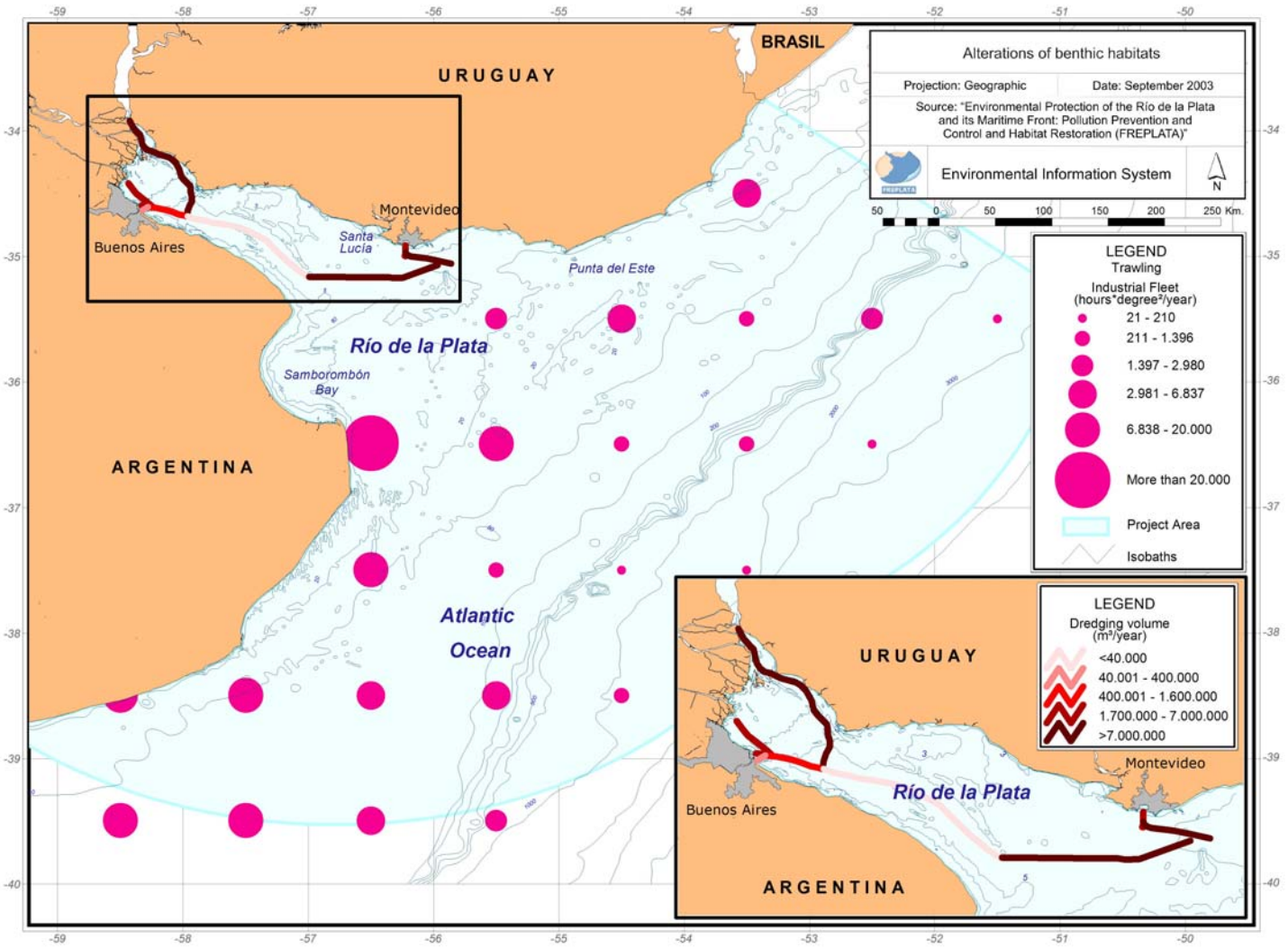


Figure 4.4. Indicators of alterations of benthic habitats (Source: FREPLATA, 2005).

Table 4.1. Major transboundary problems identified and their scientific evidence base.

Issue	Problem	Evidence base	Transboundary nature of the problem	Comments
Pollution	**Heavy metal pollution**	Elevated metal concentrations are clearly associated with coastal zones in urban and industrialized areas. There is evidence that the heavy metals are concentrated in commercial fish species such as *Micropogonias furnieri, Cynoscion guatucupa* y *Mugil liza.* (FCS, 1997; Carsen *et al*., 2004; Marcovechio, 2004; FREPLATA, 2005; Volpedo y Fernández Cirelli, 2006). In a limited number of cases the metal concentrations pose a risk to human health.	The peculiarities of dynamics of the Río de la Plata and the fluvio-marine geochemistry result in the accumulation of metals in particular areas of the system and resuspended them in the water column. Furthermore, the biota affected by these metals (through their bioconcentration) is mostly mobile throughout the system. Pollutants accumulated in sediments and the associated water column may impact key habitats and spawning and nursery areas of fish. Dredging operations to represent a particularly important risk for metal resuspended, as does the dumping of dredged materials.	The main pollution problems in the system are observed in the nearshore zone as a result of land based discharges. Particular attention is drawn to the maximum turbidity zone (or front) where fine sediments accumulate from the Plata Basin (particularly from the Paraná River), as well as to the Argentinean coastal nearshore zone of the Río de la Plata where sediments tend to be resuspended. The zone of maximum turbidity serves as an area for solid wastes to accumulate (such as plastic waste from municipal garbage from the cities of Buenos Aires, La Plata y Montevideo; Acha *et al*., 2003). Coastal pollution is also particularly severe adjacent to the maximum turbidity zone (Bazán and Janiot, 1991; Janiot *et al*., 2003; Carsen *et al*., 2004). The southern coastal margin of the system (Argentinean coast of the Río de la Plata) is an area that constitutes an extensive hot-spot for pollution; or rather a succession of hot spots more than 100 km long and 2-3 km wide. In this strip, very high levels of contaminants are observed in sediments, biota and the water column. The reduction of transboundary impacts of land-based pollution (including microbiological) require that urban effluents be addressed. Investments by the respective governments in sanitation will need to include treatment options.
	Persistent organic pollutants (POPs) and petroleum hydrocarbons	Petroleum hydrocarbons represent a continuous risk for transboundary pollution, given the heavy (and increasing) shipping traffic. There is a notable area of pollution hot spots of varying dimensions located in a 100 km belt close to the southern shore of the system. This includes rather high levels of POPs, particularly PCBs and pesticides, in water, sediments and biota.	There appears to be a steady rise in the discharge of POPs to the system, affecting the quality of exploitable fish and contaminating sediments and the water column (Colombo *et al*. 2000; 2003 a; 2003b; EWSAMER, 2002) Discharge of petroleum hydrocarbons has already impacted coastal margins as well as the main body of water shared between the two countries in the RPMF.	

Issue	Problem	Evidence base	Transboundary nature of the problem	Comments
	Microbial pollution	Some coastal areas are clearly affected by microbial pollution and there is evidence that sewage pollution includes potentially pathogenic viruses and parasites.	Most of the microbial pollution is limited to nearshore coastal areas (in the proximity of effluent sources). However, given the dynamics of the system, the area under risk extends well into the shared part of the RPMF. There is an additional risk from sewage from ships that is currently inadequately regulated.	Cholera (*Vibrium cholerae)*, has been detected in a form that is viable but non-culturable. It is considered to pose a significant risk for the system (as it may become increasingly viable in the future). There have been no outbreaks of cholera since the 19th century and Uruguay has been declared as cholera free. Given this situation, it is recommended to continue monitoring for *Vibrium cholerae* as there is a very small risk that it could be introduced from outside the system (Costagliola *et al*., 2005).
Eutrophication	**Harmful algal blooms (HABs)**	HABs caused by cyanophytes and dinoflagellates are regular events that have intensified in recent years. They affect biota (some species cause fish kills) and the human population directly (nuisance to recreation, dangerous marine toxins in seafood and respiratory problems in sensitive members of the coastal human population).	Blooms are mostly associated with increases in nutrient discharges from tributary rivers (including the Plata Basin) and these may impact any part of the RPMF.	Historical trends in eutrophication in the Río de la Plata are poorly understood. Recent studies have indicated considerable contemporary levels of eutrophication that are associated with nutrient runoff - particularly nitrogen compounds - from the agricultural sector (application of fertilisers, erosion, castle breeding). This situation helps to explain the large blooms of blue-green algae (cyanophytes) in the fresh and brackish regions of the RPMF. There has been clear evidence of an increase in incidents of 'red tides' caused by dinoflagellates, both in Argentina and Uruguay, as well as the shared waters of the RPMF (Carretto *et al*., 2004). Fortunately, there have been few human illnesses reported but the presence of species known to produce potentially fatal neurotoxins is a significant risk. It also poses a risk to the livelihood of artisanal fishers in both countries, notably those dedicated to exploiting blue mussel beds.

Issue	Problem	Evidence base	Transboundary nature of the problem	Comments
Sediments and Suspended Solids	**Sediment transport and sedimentation**	The deposition of suspended solids is a natural problem. The dynamics of the system and potential future changes in climate and upstream land use make it increasingly necessary to take action to mitigate the situation.	Siltation is a continuous problem for navigation in the RPMF, requiring constant dredging. This in turn sometimes mobilizes polluted sediment that is subsequently transported and dumped in another part of the system. Some sediments in the areas adjacent to the southern coast of the RPMF are highly polluted and pose a considerable risk (FCS, 1997; Colombo *et al*.,. 2003; 2003b; Carsen *et al*., 2004). Erosion is not a transboundary problem.	The amount of sediments dredged annually in the Río de la Plata is enormous; approximately 25,000,000 m^3 (FREPLATA, 2005)
Loss of biodiversity	**Destruction of benthic habitats (related to fishing) and those of coastal margins**	Habitat destruction is caused by unsustainable methods of resource extraction (such as trawling), dredging of undisturbed areas and certain types of pollution.	Habitat destruction is a transboundary problem because it affects migratory or highly mobile species, including many commercial fish species and decreases ecosystem resilience. The loss of coastal habitats (such as wetlands and intertidal zones), threatens biodiversity, recruitment of fish and crustaceans to commercial stocks, and migratory birds feeding or over-wintering. Trawling is a transboundary problem in the RPMF because most of it occurs in the common fishing zone.	Trawling is one of the most common fishing techniques in the RPMF (used in the main fisheries for hake and white croakers). According to official data of the Undersecretary for Fisheries and Aquiculture in Argentina (SSP-SAGPyA), some areas are trawled 4 or 5 times per year, with consequent removal of most benthos. These numbers would be much higher if the effects of the Uruguayan fleet were considered. In addition to the impacts on benthic diversity, fisheries production itself may suffer since the lost benthos is the main food for several fish species.

Issue	Problem	Evidence base	Transboundary nature of the problem	Comments
	Overfishing	The loss of biodiversity in the RPMF is reflected in the number of species, some of which are endemic, that are classified as endangered or requiring conservation.	Biodiversity loss is clearly a transboundary problem in the system.	Fishing produces impacts through overfishing, excessive by-catch, incidental capture, and habitat loss. Some gear, especially trawls, gillnets and long lines, catch a number of non-commercial species. This sometimes leads to significant loss of ecosystem resilience, damaging a large number of populations of species such as rays, sharks, sea birds, sea turtles and marine mammals. The problem of overfishing is often combined with habitat destruction, pollution and the introduction of exotic species. It is difficult to isolate the individual causes of ecosystem degradation.
Introduction of exotic species	**Invasive species**	For the SW Atlantic, 31 exotic species and 46 or unknown origin have been recorded (Orensanz *et al*., 2002). Though most of these may be found in the RPMF (Penchaszadeh, 2005), empirical evidence of their impacts exists in few cases, mostly in the interior zone of the Río de la Plata.	Invasive species are an inherently transboundary problem. In the RPMF, most of the exotic species come from SE Asia, transported in ships' ballast water. Another route to the system is through escape from aquaculture operations; examples being carp that escaped from fish farms in Argentina and can now be found along the coast of Uruguay, and white sturgeon that are cultivated in Uruguay.	The best known cases are: *Limnoperna fortunei* (golden mussels), *Corbicula fluminea* (Asian clam) and *Cyprinus carpio* (carp). In the transitional and marine waters of the RPMF, there are less reports of invasive species and even less knowledge of there impacts. The other cases are, *Ficopomatus enigmaticus* (polychaete, reef builder), *Rapana venosa* (carnivorous sea-snail that has caused serious damage in other systems), *Balanus glandula y B. amphitrite* (cirripeds).

4.3.-Stakeholder perceptions of the issues.

A major effort was made by FREPLATA specialists to assess the perceptions of stakeholders regarding the environmental problems of the RPMF. The term 'stakeholder' is employed to describe anyone with a role or legitimate interest in the problem, its solution or the use or protection of the ecosystem and its resources. In the FREPLATA surveys, 338 stakeholders were consulted (equally divided between the two countries. These included the following segments (a full list of stakeholders is published in the FREPLATA stakeholder survey report): Figure 4.5.

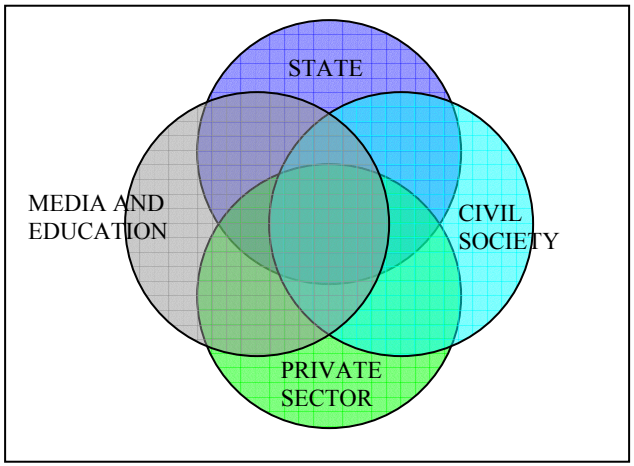


Figure 4.5. Stakeholders interaction.

Through questionnaires, workshops and focus groups, the work focused on the following priority themes:

- Responsible fishing.
- Pollution reduction in the Río de la Plata.
- Land use without damaging coastal habitats.
- Conservation of Biological Diversity.
- Implementation and improved management of aquatic protected areas.
- Economic development that takes account of conservation of natural resources and environmental quality.
- Strengthening the participation of the society in environmental decision making.
- Strengthening regional cooperation in environmental management of transboundary aquatic systems.
- Improving information flow regarding environmental impact and management of industrial and urban wastes.

Each stakeholder was requested to prioritize these themes using a scale from 1-9. The overall results are illustrated in Figure 4.6 (a more detailed sector-by-sector analysis may be found in the original report). The nine themes have been reordered by aggregate priority and the corresponding scores illustrated for each country.

In general, there is a strong similarity between the opinions of stakeholders from both countries. However, respondents from Argentina gave the highest priority to pollution reduction, whereas this took seventh place for the case of Uruguay. This appears to reflect the technical information presented in section 4.2; pollution is more serious along the coast of Metropolitan Area of Buenos Aires City than in Uruguayan coast, Argentinean people are concerned about it. Both groups gave a very high priority to *'Economic development that takes account of conservation of natural resources and environmental quality'*, a re-statement of the principle of sustainable development. This is very encouraging and will be discussed further in later sections of this report.

Of the transboundary environmental issues, the following stakeholder priorities emerge:
Uruguay: Biodiversity conservation> Coastal habitats> Pollution> Protected Areas> Responsible Fishing.

Argentina: Pollution> Biodiversity conservation> Coastal habitats> Protected Areas> Responsible Fishing.

In assigning the order of priorities, it is noted that the differences between successive scores are often minor but it is clear that less priority is afforded to offshore issues (fishing, marine protected areas) than the visible issues nearer home. This may well reflect the attention given to these issues in the media and through formal education rather than a judgment based upon technical information.

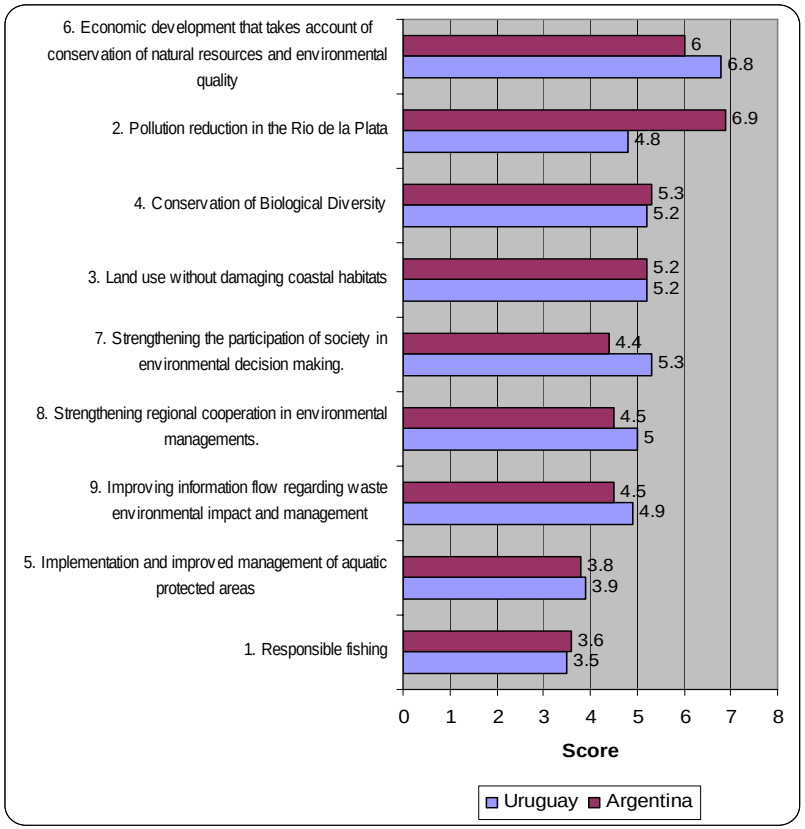


Figure 4.6. Stakeholder analysis of priority themes. (Source: FREPLATA, 2005).

4.4.-Summary of transboundary priorities.

Assigning priority to environmental issues is largely a value judgment; there is no absolute measure of importance. Nevertheless, it is possible to distinguish human caused issues that have a significant transboundary component. This was done in Table 4.1 and the accompanying text. In each case, significant gaps in knowledge remain, giving rise to uncertainty regarding the impacts of the problems identified. An objective analysis would take the following form (Table 4.2):

Table 4.2. Tentative prioritization of issues. *minor impact to ***** major impact.

Issue	Local impact	Transboundary impact	Uncertainty
Pollution	*****	***	**
Eutrophication	****	***	***
Sediments and suspended solids	**	*	**
Loss of biological diversity	*****	*****	****
Introduction of exotic species	****	****	****

The table reflects the detailed discussions in Table 4.1 and is broadly consistent with the stakeholder assessment for local impacts. However, it is argued that the stakeholder assessment does not fully reflect the transboundary issues because of limited technical information available to many of the stakeholders. Hopefully, the TDA will help to change this situation though large uncertainties in scientific knowledge remain.

5. Research the causes of the transboundary problems.

5.1.-Understanding causality.

In order to resolve the environmental problem, local or transboundary, it is necessary to understand the causes of the problem. It is not sufficient to understand the immediate causes but to explore the underlying causes that are often rooted in the economy, structures of governance and stakeholder engagement in the issues. These are often complex and interwoven; indeed their complexity is often a reason for inaction in dealing with them as it is very difficult to assign responsibilities and define 'who does what' in the subsequent Strategic Action Program if the causal links are not understood.

Box 5.1 shows the model that was employed in FREPLATA for understanding causality. Understanding the drivers of change also allowed an analysis to be made of future scenarios for the system. The institutional and legal issues will be summarized in Section 6. The current section will initially focus on examining current causes and prioritizing them. It will also examine the stakeholder perspectives of some of the underlying issues.

5.2.-Current environmental pressures.

Earlier chapters have indicated some of the direct pressures on the RPMF resulting from economic activity. These are summarized on Table 5.1.

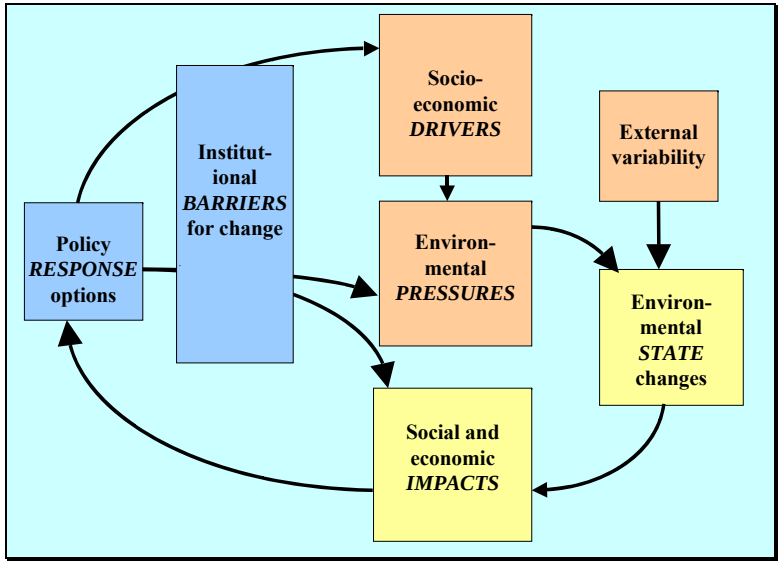
The complexity of these pressures is illustrated in Figure 5.1 which examines the coastal pollution sources and associated state changes in selected districts along the coast of Metropolitan Area of Buenos Aires. The schematic figure shows sources of pollution and the principle contaminants of concern that were used to classify the waters in terms of their pollution status.

Table 5.1. Key pressures associated with transboundary issues.

Issue	Problem	Key Environmental Pressures
Pollution	Heavy metal pollution	• Streams and small rivers carrying effluent discharges from industry, particularly in the metropolitan areas of Buenos Aires and Montevideo. • Municipal discharge. • Redistribution of sediments following dredging.
	Persistent organic pollutants (POPs) and petroleum hydrocarbons	• Streams and small rivers draining agricultural areas. • Upstream sources from the Plata Basin. • Municipal discharge. • Industrial chemical effluent. • Operational oil spills. • Atmospheric deposition.
	Microbial Pollution	• Discharge of poorly treated municipal sewage. • Discharge from ships. • Agricultural and food processing waste discharged to streams/rivers.
Eutrophication	Harmful algal blooms (HABs)	• Nutrients introduced via streams and rivers as a result of agricultural activities. • Municipal effluent.
Sediments and suspended solids	Sediments transport and sedimentation	• High natural loads of sediments from the Paraná River.
Loss of biological diversity	Destruction of benthic habitats (related to fishing) and those of coastal margins	• Inappropriate use of fishing techniques including trawling. • Dredging of shipping channels. • Construction of coastal infrastructure that impedes water circulation or destroys wetlands, shores or other habitats.
	Overfishing	• Excessive fishing effort.
Introduction of exotic species	Invasive species	• Discharge of ballast water from ships. • Transport of fouling organisms attached to ships' hulls. • Accidental releases from aquaculture centers.

Box 5.1. The DPSIR model.

The current analysis employed the Drivers – Pressures – State Changes-Impacts – Response (DPSIR) model widely used by organizations such as the OECD, European Environment Agency and UNEP. Its current form is illustrated in Figure following:



The DPSIR model, modified to show the institutional barriers to change (Source: Mee, 2005)

The schematic diagram has the following key elements:

Environmental state changes: These are the measurable changes in the environment that result from a combination of human and natural pressure. In the context of aquatic systems, it is important to show that a change is really occurring or is very likely to be occurring (where information on biological or ecosystem effects is not readily available).

Environmental pressures: These are the immediate human-related causes of the state change, for example, the discharge of a pollutant from a factory or municipality.

Socio-economic drivers: These are the economic or social activities that lead to the pressure. The economy is usually divided into sectors and it is important to understand the relationship between the environmental pressure and the activities of the sector. Beyond the sectoral nature economy, there are often a number of social and economic root causes that drive economic activity in a particular direction and determine the practices the sectors adopt.

External variability: This includes natural variability in the system and the consequences of long-term climate change, some of which is also due to human activities.

Social and economic impacts: These are the economic costs and changes to the welfare of stakeholders as a result of environmental state changes. Not all of these are easily measurable because, for example, the loss of a particular species, habitat or landscape may affect aesthetic or 'existence' values that are hard to measure economically but nevertheless important.

Policy response options are the proposed solutions to the problem and are often triggered by demands from affected stakeholders. Solutions close to the drivers are more likely to be sustainable but are usually hardest to negotiate. Solutions to the pressures may include 'end of pipe' solutions (such as waste water treatment plants). Solutions at the level of impact consist of compensation for the damages incurred.

Institutional barriers for change are a recognition that policy by itself does not usually bring about the desired change. It is necessary to understand the institutional (legal and economic) framework and negotiate feasible and cost-effective solutions that often require (or result in) its reform. This is the essence of the Strategic Action Program approach of the GEF.

The current TDA examines the part of the diagram illustrated with Yellow and orange boxes. Causality is measured in terms of the D-P-S-I relationship. For the Global Environmental Facility, the term ***status*** is often employed instead of 'state' and drivers and pressures are collectively described as ***stress***, the objective being institutional and legal reforms and investments to bring about ***stress reduction***.

The map (Figure 5.1.) also illustrates the proximity to polluted areas of water dumping on the coast. This explains the greater popular concern in Buenos Aires regarding pollution. Additionally, the diagram shows the shipping channels that require continual dredging. It is apparent that polluted sediments deposited in these channels will be redistributed when the dredging spoils are dumped.

It is self evident that a detailed examination of individual pollution sources will be required when the Strategic Action Program (SAP) is negotiated for the RPMF. It is customary to prepare the National Action Plan (NAP) at this stage and this process provides an opportunity to revisit strategies for dealing with problems that are predominantly of national interest.

5.3.-The Sectoral Analysis.

In order to understand the relationship between environmental problems in the region and their key sectoral drivers, a sectoral analysis has been conducted. This is presented in Table 5.2. Spaces left blank on the table indicate improbable sector-problem combinations. This table enables corrective actions to be prioritised, though only dealing with top priority sector-problem combination would be unlikely to resolve the environmental problems in their totality as it is often the combined pressure that causes the problems.

5.4.- Root causes and cause and effect.

Figure 5.2 identifies root causes drivers and presents their overall relationship with key pressure on the environment of the RPMF. These will be used to examine possible future trends for the system.

Transboundary problem	Industrial Sector	Agricultural Sector	Port s	Municipal Services	Aquatic Transport	Fisheries
Chemical and petrochemical Pollution	1	3	5	4	2	5
Microbiological Pollution	5	4	3	1	2	5
Eutrophication	3	2	4	1	5	3
Suspended solids	-	-	-	-	-	-
Habitat destruction	1	3	5	4	2	2
Biodiversity loss	1	4	2	5	3	1
Introduction of exotic species	-	3	2	-	1	3

Table 5.2. Sectoral analysis showing the relative contribution of various sectors to transboundary problems. The data is ordered by relative contribution (1 = top contribution, 5 = lowest contribution).

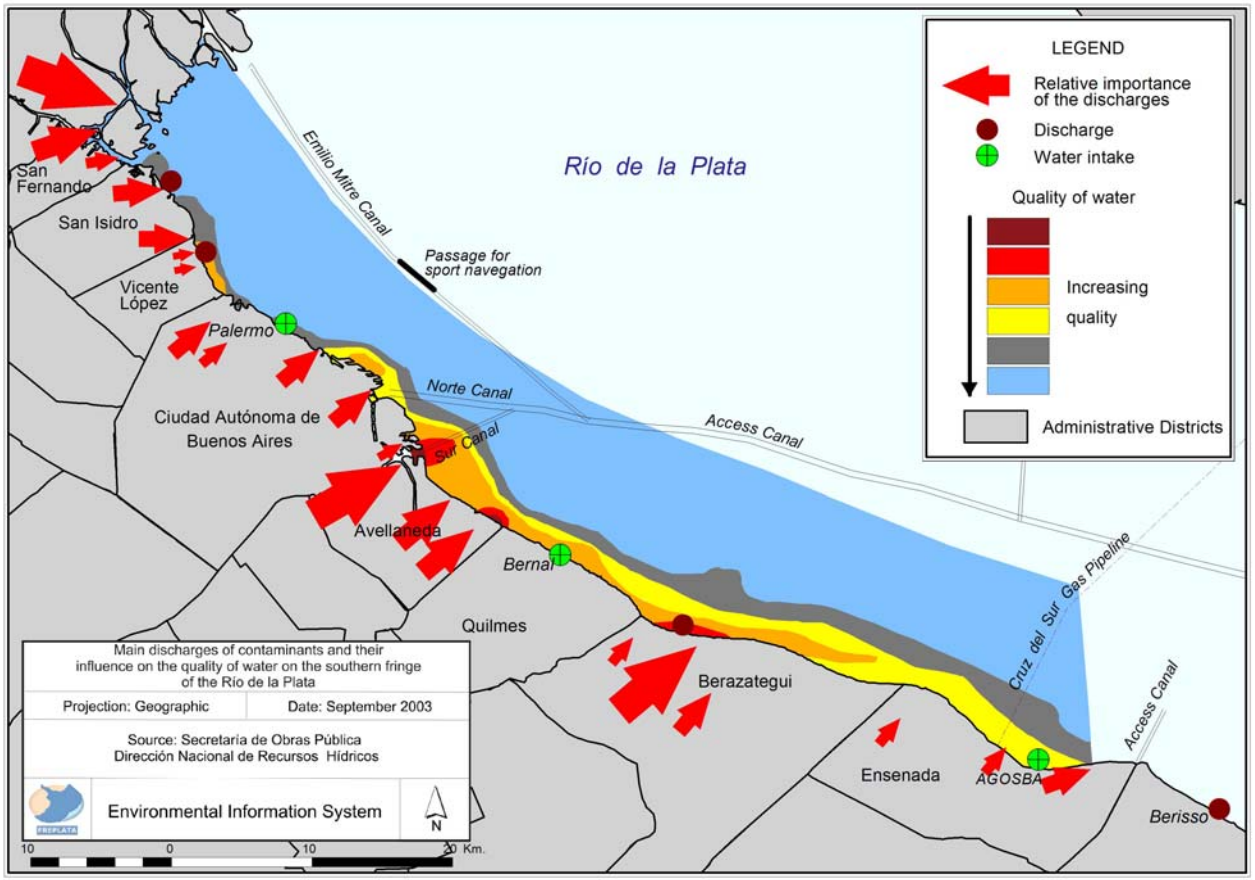


Figure 5.1. Water quality pressures and state changes in the Autonomous City of Buenos Aires and selected coastal municipalities of Buenos Aires Province (Source: FREPLATA, 2005).

The root cause drivers indicated in Figure 5.2 are chosen for their relevance and because there are substantial data set to support them. The drivers are described as follows:

1. Population growth
As shown in Box 2.1 population in the region has risen sharply (mostly in Argentina) and how it is becoming increasingly urbanized. This places increase demands on the system for water and for sewage disposal as well as transport and food supply.

2. Social and economic development
Information is readily available on economic development in the form of indices such as Gross Domestic Product (GDP), which measures expenditure on tradable goods and services, and the Human Development Indicator that incorporates measures of human welfare.

3. Agroindustrial activities
These are tending to increase in both countries, enhanced by global markets. We have shown in Section 2.3 that the metropolitan areas of Buenos Aires and Montevideo generate 65% and 87% of the industrial GDP of their respective countries. Watercourses flowing through industrial municipalities such as Riachuelo in Buenos Aires or Pantanoso in Montevideo are already heavily polluted.

4. Aquatic transport
In Section 2.3 we demonstrated the importance of this sector. The Río de la Plata is a transport hub for maritime transport and increasingly for fluvial transport to the vast hinterland to drainage by the Paraná and Paraguay rivers. Some 92 million tons of cargo were shipped through its ports in 2003. 10.7 million tons of this was fluvial.

5. Climate change
This will inevitably have a major impact on the system in the future, though its effects are not currently evident (they may be present, but are difficult to distinguish from natural variability in the short term). It will be important to evaluate the likely consequence of climate change in order to develop adaptive measures.

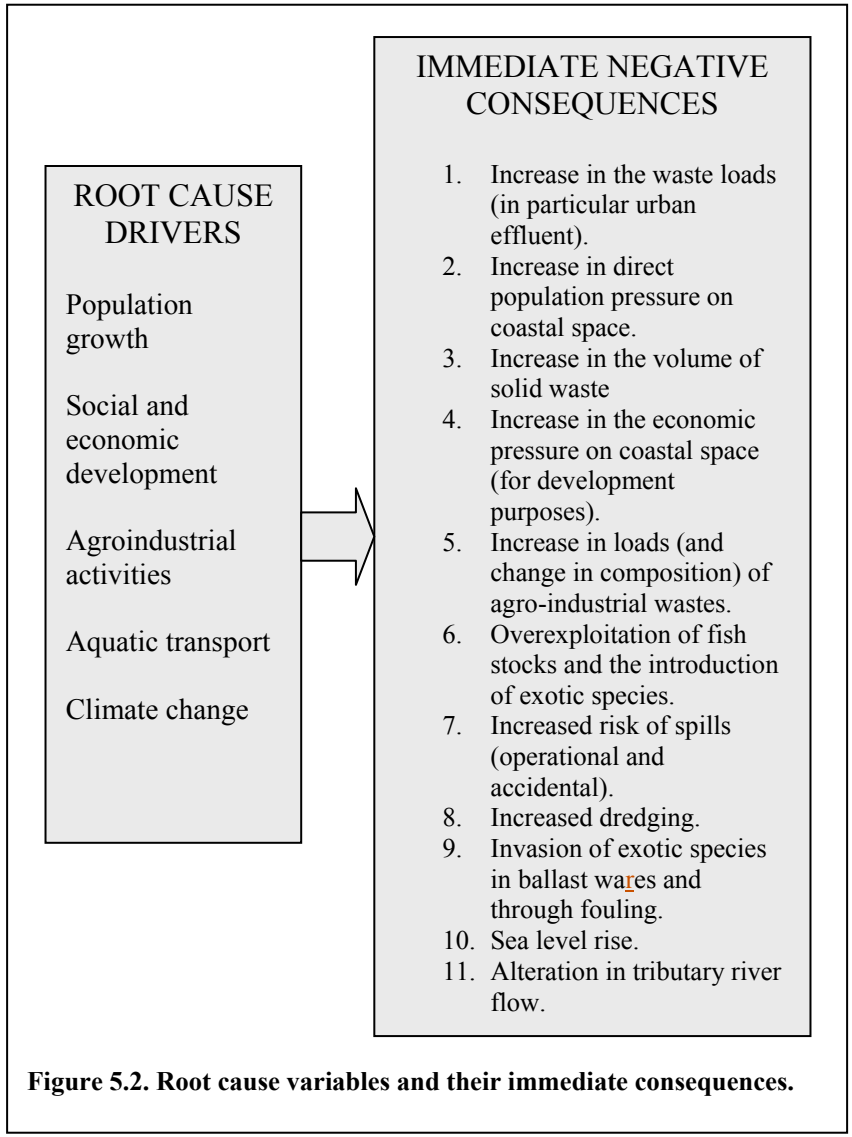


Figure 5.2. Root cause variables and their immediate consequences.

5.5.-Trends and emergent issues.

Sufficient is known of the past and current trends in the five root cause drivers to be able to model their potential behavior in the future. There is no intention to predict the future, simply to provide a number of possible scenarios that encompass the likely future situation at 25 and 50 years from present. The three scenarios adopted model high, medium and low growth. Currently, there is no indication which of these pathways is the most likely.

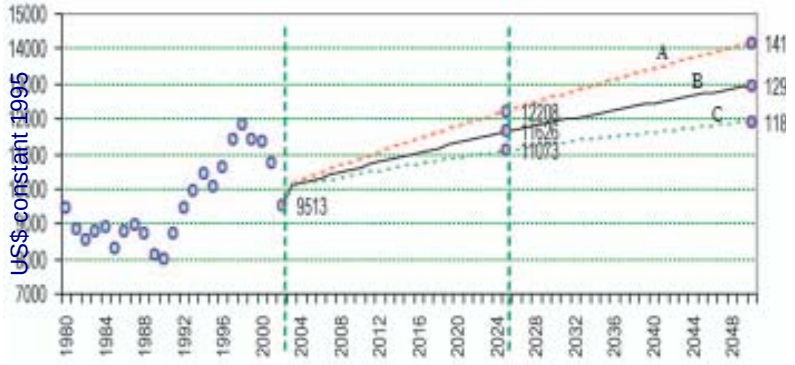


Figure 5.3. Past evolution of per capita GDP in the RPMF region and projection for three scenarios.

Two examples are shown of this modeling work. The first, in Figure 5.3, illustrates the model for growth in GDP. The past trend shows the sharp economic decline that hit the region after 1999 and illustrates the difficulty in predictive modeling; few would have anticipated the scale of the economic setback. The second example (Figure 5.4) is for the case of shipping. Here, the trend is much clearer from the outset; all three scenarios show a significant increase in cargo volume.

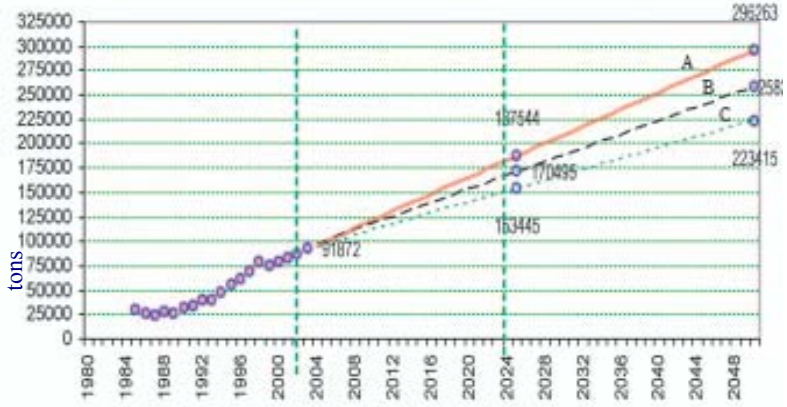


Figure 5.4 Cargo (tons) carried by ships in the region and possible tendencies for three possible scenarios: A maximum GDP; B intermediate GDP and C minimum GDP.

The output of this analysis is shown in Table 5.3 and provides a basis for examining the potential environmental implications of growth in the region. It must be stressed that the scenarios presented here are evitable; they can be changed by human intervention following the principles of sustainable development. However, they help to demonstrate what may well happen if no such action is taken. They also demonstrate that the protection of the RPMF cannot be achieved in isolation from the wide spectrum of actions required to pursue a policy of sustainable development, a policy already embraced by both countries and by the neighboring countries in the Plata Basin, but one that presents many challenges to implement.

Table 5.3. Estimated values for the root cause variables following the three scenarios.

Root cause variable		Possible scenarios					
		A (maximum growth)		B (intermediate growth)		C (minimum growth)	
	2000	2025	2050	2025	2050	2025	2050
Population size (millions of inhab.)	15.27	18.86	22.47	17.97	20.64	17.11	18.89
Economic growth GDP per cap; US$, 1995)	11,324	12,208	14,150	11,626	12,953	11,073	11,895
Industrial activity (Industrial GDP; millions of US$, 1995)	39,483	59,073	82,971	53,070	71,202	47,653	60,580
Aquatic transport (millions tons cargo)	79.5	187.5	296.6	170.5	28.7	153.5	223.4
Climate change (sea level, average cm for Argentina and Uruguay)	1.2	19	37.5	2.9	5.8	2.2	4.3

5.6.- Social impacts and perspectives for action.

The information presented in Table 5.3 suggests that pressures on the RPMF are likely to increase unless appropriate policies are developed. This is explored further in Table 5.4 where the impact on the system to produce goods and services (Box 5.2) is modeled based on the combination of projections of root cause drivers in Table 5.3. Note that the most severe impacts are both local and transboundary. Drinking water supply is local issues (potentially vulnerable to transboundary pollution) whereas habitats are natural assets under national sovereignty that supply goods and services that are of national and transboundary interest.

Table 5.4. Impact of socioeconomic development on the flow of environmental goods and services in the region. 3 = most severe. Sum 1 shows the impact magnitude. Sum 2 shows the impact vulnerability

	Possible negative consequences	Impact on the use of goods and services in the region					Sum 1
		Drinking water	Habitats for flora & fauna	Fisheries resources	Recreation	Transport	
Population growth	Increase in the waste loads (in particular urban effluent)	3	2	2	2	0	9
	Increase in direct population pressure on coastal space	3	2	2	3	0	10
Socio-econ. development	Increase in the volume of solid waste	2	2	2	2	0	8
	Increase in the economic pressure on coastal space (for development purposes)	2	2	1	2	0	7
Food production	Increase in loads (and change in composition) of agro-industrial wastes	3	3	2	2	0	10
	Overexploitation of fish stocks and the introduction of exotic species	0	3	3	1	0	7
Aquatic transport	Increased risk of spills (operational and accidental)	3	3	2	3	1	12
	Increased dredging	1	2	1	1	0	5
	Invasion of exotic species in ballast wares and through fouling	1	3	2	1	0	7
Climate change	Sea level rise	1	1	1	2	0	5
	Alteration in tributary river flow	2	2	3	2	1	10
	Sum 2	21	25	21	21	2	

The table in Annex 1 presents the overall sequence between the root causes of environmental degradation, their immediate consequences (pressures), the state changes they produce to the natural environment and the social impacts. The table also lists potential options for priority actions to resolve the problems indicated. The options need to be evaluated carefully as part of the Strategic Action Program process and are intended as indicative at this stage. Note that many of them are repeated across the various problem areas demonstrating that there are common needs to be addressed.

5.7.- Stakeholder views on causes of environmental problems in the RPMF.

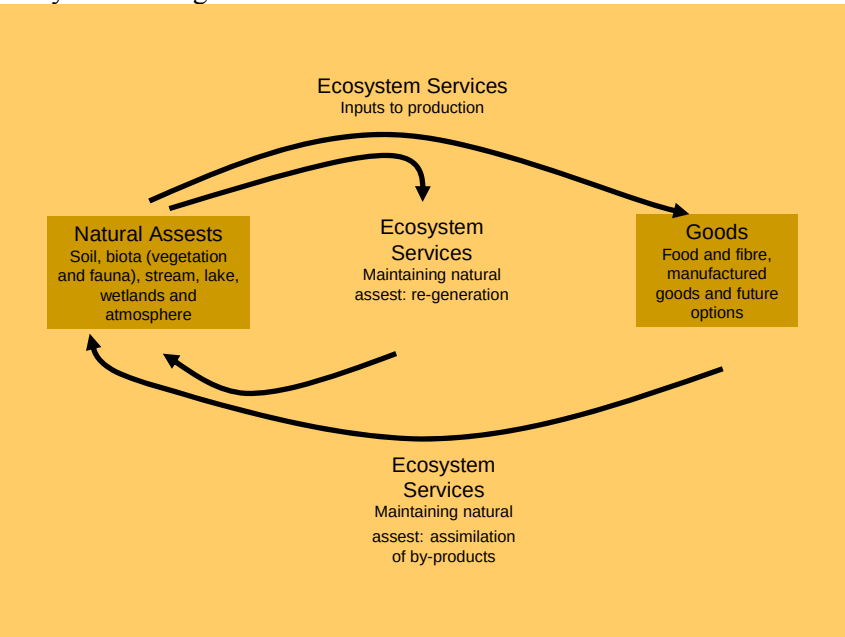
The stakeholder surveys introduced in section 4.3 of this report also provide valuable insight on understanding and opinions regarding causality. Table 5.5 is a map of the outcome of the survey showing how individual groups of stakeholders prioritize a number of issues that include environmental concerns and responses. The first five statements are a reflection of environmental issues and the subsequent four reflect the ability of the two countries to respond to them.

At first sight, the information appears to show no clear pattern. However, careful examination reveals some important information:

1. Stakeholders in both countries regard sustainable development (statement 6) as a clear priority. Social and economic development has been indicated as a major driver for environmental degradation (Annex 1) so the importance given to "economic development that takes account of conservation of natural resources and environmental quality" is an indication of willingness to develop sustainable responses.
2. Much lower priority was assigned to strengthening regional cooperation and improving information flow in Argentina and in Uruguay. This suggests that Uruguayan stakeholders are more concerned about transboundary problems originating in Argentina than vice versa. This corresponds well with our finding regarding pollution but not with other issues.
3. A very low priority was assigned to protected areas and fisheries, a finding that contrasts with the scientific evidence summarized in this report. This suggests that information flow is inadequate on marine issues in the region.
4. There is a clear difference in perception of the need to strengthen participation of society in environmental decision making between Argentina and Uruguay. This issue was given a very low priority in Argentina compared with Uruguay. Even civil society representatives limited themselves to declaring this as a medium priority in Argentina whereas civil society and the national media gave it a high rating in Uruguay. The origin of this difference is unclear as both countries currently appear to enjoy a high level of participatory democracy.

Box. 5.2. What are ecosystem goods and services?.

Inevitably, most human activities on the planet have an impact, sometimes reversible, on natural ecosystems. We draw upon natural assets as factors of production for most of the goods we use on a day to day basis. However, we also make free use of the environment for the disposal of waste. In this sense, we sometimes use natural assets twice, primarily as a free source of goods and secondly as a way of disposing of the goods and energy or the waste generated in their production. This gradually diminishes the pool of 'natural assets', risking not only the supply of goods and services to human but also the ability of ecosystems to regenerate and maintain the natural assets themselves.



Public accounting (e.g. measures such as Gross Domestic Product) usually only considers the flow of money associated with the production (or purchase) of goods as a reflection of human labour; it gives us little indication of the degree to which natural assets are becoming exhausted. This is why there is a growing interest in developing accounting systems that consider the sustainability of natural assets (and the flow of goods and services) and the hidden costs of development.

Table 5.5. Priorities by main stakeholder groups. H: high priority, L: low priority, M: medium priority.

Argentina (n= 160)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Education - Teachers	L	M	L	M	L	M	L	L	L
Education – Students	L	M	L	H	L	M	L	L	L
Multinational companies	L	H	L	M	L	M	L	L	L
Large National companies	M	M	M	M	H	L	L	L	L
Small National companies	L	M	L	L	L	M	L	L	L
Chambers of Commerce	M	M	L	L	L	H	L	L	L
State – National	M	M	L	L	L	M	L	L	L
State – Provincial	M	L	L	L	L	L	M	M	L
State – Buenos Aires (city)	L	H	H	L	L	M	L	M	M
State – Municipalities	L	H	L	L	L	M	L	M	L
Local Media	L	H	L	L	L	M	M	L	M
National Media	L	H	M	M	L	L	L	L	L
Civil Society	L	H	L	L	L	M	M	L	L
Uruguay (n= 168)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Private company	L	L	H	M	L	H	L	M	M
Public sector company	L	M	M	M	L	M	M	H	M
State – National	L	M	M	L	L	H	L	H	L
State - Municipal	L	M	M	H	L	H	M	L	M
Civil Society (RPMF)	L	M	M	M	L	M	H	M	M
Civil Society (Others)	M	M	L	M	L	H	H	M	M
Education – Univ and tech	L	M	M	M	L	H	M	L	M
Education - others	L	L	M	L	L	H	L	M	M
Local Media	L	L	M	M	L	L	M	L	M
National Media	L	L	L	M	L	H	H	M	L

1. Responsible fishing.
2. Pollution reduction in the Río de la Plata.
3. Land use without damaging coastal habitats.
4. Conservation of Biological Diversity.
5. Implementation and improved management of aquatic protected areas.
6. Economic development that takes account of conservation of natural resources and environmental quality.
7. Strengthening the participation of society in environmental decision making.
8. Strengthening regional cooperation in environmental management of transboundary aquatic systems.
9. Improving information flow regarding environmental impact and management of industrial and urban wastes.

6. The key concern: governance and investments for managing and resolving transboundary issues.

6.1.- Introduction.

The development and the implementation of the best options and alternatives for the resolution of the identified high-priority problems in the TDA requires an extensive approach, that includes all the activities and instruments necessary to establish and to put in practice the policies and to carry out and to make fulfill the administrative, legal and institutional reforms necessary for the implementation of the SAP.

The approach of governance analysis, understands that not all aspects of sustainable development can be solved exclusively by governments and that decision making powers are also exercised by other stakeholders and social organizations. Therefore, governance issues emerge like transversal causes that are related to the majority of the identified problems.

The governance analysis includes three dimensions: the legal frame, the institutional frame and the mechanisms of participation of the stakeholder and the citizenship.

6.2.- Legal Juridical Framework

Norms are the rules by which society operates, either formally through policy and law, or informally through culture and traditions. Normative law can include 'hard law' of a regulatory nature (enforceable through the judiciary system) and 'soft law' such as declarations and other type of agreements designed to state current policy commitments. In the RPMF both kinds of law exist at two levels; international and internal. The following are the main types of instrument:

International (Table 6.1)

- *Instruments of global international law* - hard law such as the Law of the Sea Convention, and soft law such as Agenda 21 and the Johannesburg Declaration (both stating an international consensus on the process of sustainable development).
- *Regional instruments* of which the hard law provisions of the Plata Basin Treaty (1969) and the Treaty of Asunción (1991), establishing the Southern Common Market (MERCOSUR) are particularly important.
- *Bilateral instruments* of which the Treaty of the Río de la Plata and its Maritime Front is the most relevant. There are a considerable number of agreements on shared rives.

Internal

- *National (or Federal) laws and policies*, of which there are a very large number with relevance to the issues in the RPMF.
- *Provincial or Departmental laws and policies*. There is an asymmetry between Argentina and Uruguay because the former is a federal state and the latter is unitary and, as a consequence there are major difference in the level of decentralization of power to make laws and policies.

Table 6.1. Principal regional and bilateral agreements of direct relevance to the RPMF, and their institutional arrangements.

Agreement	Countries /Institutions	Relevance for the RPMF
Treaty of the Río de la Plata and its Maritime Front (1973).	Argentina, Uruguay Binational commissions: Administrative Commission for the Río de la Plata (CARP) and Bi-national Technical Commission for the Maritime Front (CTMFM)	The Treaty provides a normative and institutional frame consistent for the protection of the aquatic environment in the RPMF and promotes a regime of jurisdictional and common responsibility in the *"waters of common use"* and *"common zone of fishing"* (both defined by the Treaty)
Treaty of the Plata Basin (1969)	Argentina, Bolivia, Brazil, Paraguay, Uruguay Inter-governmental Committee for the Plata Basin (technical body)	Has a coordinating role to ensure harmonic and balanced development in the Basin.
Treaty of Asunción for the establishment of a Southern Common Market (MERCOSUR, 1991).	Argentina, Brazil, Paraguay, Uruguay and Venezuela (recently incorporated) Has a permanent secretariat in Montevideo and a number of standing committees and councils, the most relevant being the Sub-group (Nº 6) on Environment.	Ensures the opening of regional markets and the acceleration of economic development. Has direct relevance to commerce and investments.
Agreement on Fluvial Transport in the Paraguay-Paraná.(Puerto Cáceres-Nueva Palmira) Waterway (1992).	Argentina, Bolivia, Brazil, Paraguay, Uruguay Intergovernmental Committee for the Waterway. Agreement Commission (technical body)	Established to assure navigation in the Paraguay and Paraná rivers (until Cáceres in Brazil).
Operational Network of Cooperation between Maritime Authorities (ROCRAM-1983).	The majority of the marine countries in Latin America. Has a rotating general secretariat between the countries members of the network.	Established to provide guidelines for harmonization norms for protecting the marine environment, marine security and training of professionals in the maritime and fisheries sectors.

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6.2.1. The Treaty of the Río de la Plata and its Maritime Front.

This key agreement was briefly introduced in Section 2 and its geographical boundaries described in Section 3; the present section will examine its remit and operation.
It is important to bear in mind two key points from earlier sections: The Treaty deals with two main aquatic zones: the Río de la Plata and the Common Fishing Zone. These are separated by:

1) The External Limit of the Río de la Plata declared by Argentina and Uruguay in 1961 and mentioned in the Treaty. The external limit of the Río de la Plata corresponds with the transition zone from predominantly freshwater to saline waters and the maximum turbidity zone described in Box 3.1.
2) With regards to the binational commissions CARP and CTMFM, Commission has its own jurisdiction. This does not include, in principle, the exclusive jurisdiction fringe adjacent to the shoreline of each country in the Río de la Plata, nor the territorial sea of both countries in the Maritime Front. However, the Treaty establishes the procedure so that the Commissions can carry out specific activities in those areas, for instance scientific research.

Nevertheless, it is important to keep in mind the Treaty states a general obligation to protect and preserve the aquatic environment in general terms, with particular emphasis on the prevention of pollution (article 48) and establishes a complete ser of rules with that purpose.

Beyond geographical considerations, the two Commissions have different technical functions. The widest range of duties and responsibilities is that assigned to CTMFM in the marine environment (the Common Fishing Zone established in Article 73 of the Treaty). These include the norms for scientific research focused on (1) the assessment, conservation and preservation of living resources, and their rational exploration, and (2) the prevention and elimination of pollution and any harmful consequences of the exploration and use of the marine environment. It also has the function to formulate recommendations and present projects designed to ensuring that the value and balance of bio-ecological systems are maintained. CTMFM is required to produce norms and measures regarding the rational exploitation of species in the common fisheries zone and for the prevention and elimination of pollution. The Parties are given flexibility to assign new tasks to the CTMFM.
In the case of CARP, its responsibilities for research are identical to CTMFM, but they apply to the River. It is not expected to formulate recommendations and its normative function is focused on "fisheries activities in the Río de la Plata in relation to the conservation and preservation of living resources". In relation to pollution, the Parties are given flexibility to assign new tasks to each Commission.

The Commissions are international organizations with juridical personality composed by the Delegations of each country and which meet on a monthly basis. It has Technical and Administrative Secretaries and a number of Subcommissions on specific issues, including environmental affairs. Each Commission directs its communications to the Parties through the respective Ministry of Foreign Affairs. However, the Commissions can directly request technical information from the different governmental agencies of the Parties.

6.2.2. Relationship with National legislation.

Both countries have a wide spectrum of national legislation of direct bearing on the protection of the environment in the RPMF. Studies by FREPLATA have indicated a total of 49 new acts of primary legislation in the region since 1990, 35 in Argentina and 32 in Uruguay. Of these, 18 consist of national ratification of wider international agreements. This reflects the importance of international law as an influence on national agendas.

6.2.3. Decentralization of legal duties and responsibilities.

There are great similarities between the legal systems in the two countries. One important difference however, is that Argentina has a federal political organization, whereas Uruguay has a unitary organization, with a significant degree of decentralization. This reflects their differences in surface and population. In Argentina, the Autonomous City of Buenos Aires and Buenos Aires Province have independent political structures and relationships to the Federal administration. Argentina is subdivided in provinces and these are subdivided in municipalities and the Autonomous City of Buenos Aires in circumscriptions, while Uruguay is subdivided in "Departments".
Decentralization of duties and responsibilities is a continuing process in Argentina and it will be important to engage with the appropriate structures during the negotiation process for the Strategic Action Programme. Table 6.2 indicates the major differences between the two countries with respect to competence on a wide range of environmental matters.

6.2.4. Institutional arrangements.

We have outlined some of the institutional arrangements at the binational level. Both countries are introducing new legislation which frequently leads to significant developments in the existing institutional arrangements for the protection of the environment. Among the key scientific institutions one can mention the Buenos Aires University (UBA), the National University of La Plata (UNLP), the Limnology Institute "Raúl Ringuelet" (ILPLA), the Natural History Argentinean Museum "Bernardino Rivadavia" (MACN), the National Council of Scientific and Technical Investigations (CONICET), the National Institute for Fisheries Research and Development (INIDEP) and the Navy Hydrography Service (SHN, part of the Navy). The Autonomous City of Buenos Aires has created a Ministry of the Environment. In Buenos Aires Province, those issues depend of the Secretary of Environmental Policy (depend to the Chief of Cabinet). There are a considerable number of additional ministries and sub-dependencies involved in issues relevant for the protection of the Río de la Plata and its Maritime Front environment.
In Uruguay, despite its unitary political organization, there exists a significant degree of functional and territorial decentralization. The key institutional actors include the National Directorate for the Environment (DINAMA), the recently created National Directorate for Water and Sanitation (DINASA), both in the sphere of the Ministry for Housing, Territorial Planning and Environment (MVOTMA), the Uruguayan Coastguard (part of the Navy), and the National Directorate for Aquatic Resources (DINARA) in the Ministry of Livestock, Agriculture and Fisheries. There exists a technical advisory interagency organization, with representation of stakeholder organizations (COTAMA). Other relevant governmental actors are the National Port Administration (ANP), with several areas of responsibility for conservation and protection of the aquatic environment in port areas, and the State Sanitary Works (responsible

for the water supply and sewerage, except in Montevideo). The Governments of the six coastal Departments have a number of responsibilities which have to do with the control of effluents and protection of coastal areas.

6.2.5. Analysis of the strengths and weaknesses of legislation related to the environment of the RPMF.

Table 6.3 presents a summary of the strengths of the current legal regime and the weaknesses it faces. There is a growing recognition in the region on the need to further coordinate environmental policies and institutions at the national level. This will be an important issue for discussion during the SAP preparatory process.

6.3.- Institutions and their Responsibilities for the Development of the Transboundary Diagnostic Analysis.

The institutional and operational framework of FREPLATA was established in the project document signed by the CARP-CTMFM Consortium and the United Nations Development Programme in November 1999 and presented in the figure 6.3.

Administrative Commission for the Río de la Plata (CARP) and Bi-national Technical Commission for the Maritime Front (CTMFM).

These two international organizations were established by Argentina and Uruguay in accordance with the provisions of the Treaty of the Río de la Plata and its Maritime Front which had been signed by both countries in 1973. The Commissions have the legal status required for the execution of their functions and communicate with the Governments of the Parties through the respective Ministries of Foreign Affairs of Argentina and Uruguay.

CARP-CTMFM Consortium

The Commissions constituted this Consortium on July 19th, 1998, through a joint resolution, to establish the executing organization of FREPLATA.

Commission of Direction of the CARP-CTMFM Consortium (CDC)

This consists of the Presidents of the delegations of Argentina and Uruguay in each of the Commissions. It has executive responsibility for FREPLATA and will be responsible for ensuring the adoption of the SAP in representation of the two countries.

Coordinating Committee

This advises on the strategy and coordination to the project, and contributes to the tasks of obtaining the co-financing and strengthening private sector participation. It includes the Board of Directors of the CARP-CTMFM Consortium, representatives of government organizations from Argentina and Uruguay and two representatives of the United Nations Development Programme, UNDP (from Buenos Aires and Montevideo respectively).

They participated fully in formulating the research needs for supporting the TDA process, developing appropriate methodology and executing the research.

Project Execution Unit (UE)

This is responsible for the execution of project activities and their day-to-day administration. The work is structured in six areas:

Biodiversity, Pollution, Legal and Institutional, Social and Economic, Environmental Information System, Education and Communication.

The Unit comprises of an international coordinator, sectoral specialist and their assistants, an administrator and supporting staff.

Technical Assessment Groups

This provides advice to the project team and to promote institutional participation in the preparation of the TDA and the SAP. These groups consisted of a wide range of Argentinean and Uruguayan. Within these groups Intersectoral Working Groups stand out.

Table 6.2. Legislation in Argentina and Uruguay associated to environmental management. Tick marks indicate areas of competence, crosses indicate areas where the authority is not competent within existing legislation and dashes indicate areas for non-relevant combinations.

Area of competence	República Argentina			República Oriental del Uruguay						
	Nation	Buenos Aires Province	Autonomous City of Buenos Aires	Nation	Governments of the Departments *Decrees and resolutions on each theme at the level of Department*					
					Colonia	San José	Montevideo	Canelones	Maldonado	Rocha
A healthy environment	√	√	√	√	√	√	√	√	√	√
Water quality	√	√	x	√	x	x	√	x	x	x
Aquifer (ground water) quality	√	√	x	√	-	-	-	-	-	-
Discharge of sewage effluent	-	√	x	-	x	x	√	√	√	x
Limits of discharge (industrial effluent)	-	√	x	√	x	x	√	x	x	x
Water use	√	√	x	√	x	x	x	x	x	x
Air quality	√	√	√	√	x	x	x	x	x	x
Atmospheric discharge limits (gaseous, point sources)	x	√	√	X	x	x	x	x	x	x
Atmospheric discharge limits (mobile sources)	√	√	√	√	x	x	x	x	x	x
Management of industrial hazardous waste	√	√	x	√	x	x	x	x	x	x
Management of urban solid waste	√	√	√	-	√	√	√	√	√	√
Dredging spoils	√	√	x	√	x	x	x	x	x	x
Treatment of urban sewage	√	√	x	√	x	x	x	x	x	x
Coastal zone	x	√	√	√	√	√	x	√	x	x
Soil quality	√	√	x	√	x	x	x	x	x	x
Agrochemicals	√	√	x	√	x	x	x	x	x	x
Land use planning	x	√	√	√	x	√	√	x	√	x
Biodiversity	√	√	√	√	-	-	-	-	-	-
Environmental impact assessment	√	√	√	√	x	x	√	x	√	x
Ports	√	√	x	√	-	-	-	-	-	-
Navigation	√	-	-	√	-	-	-	-	-	-
Parks and protected areas	√	√	√	√	x	√	√	x	√	√
Protection of fauna	√	√	√	√	x	x	x	x	x	x
Fisheries	√	√	x	√	-	-	-	-	-	-

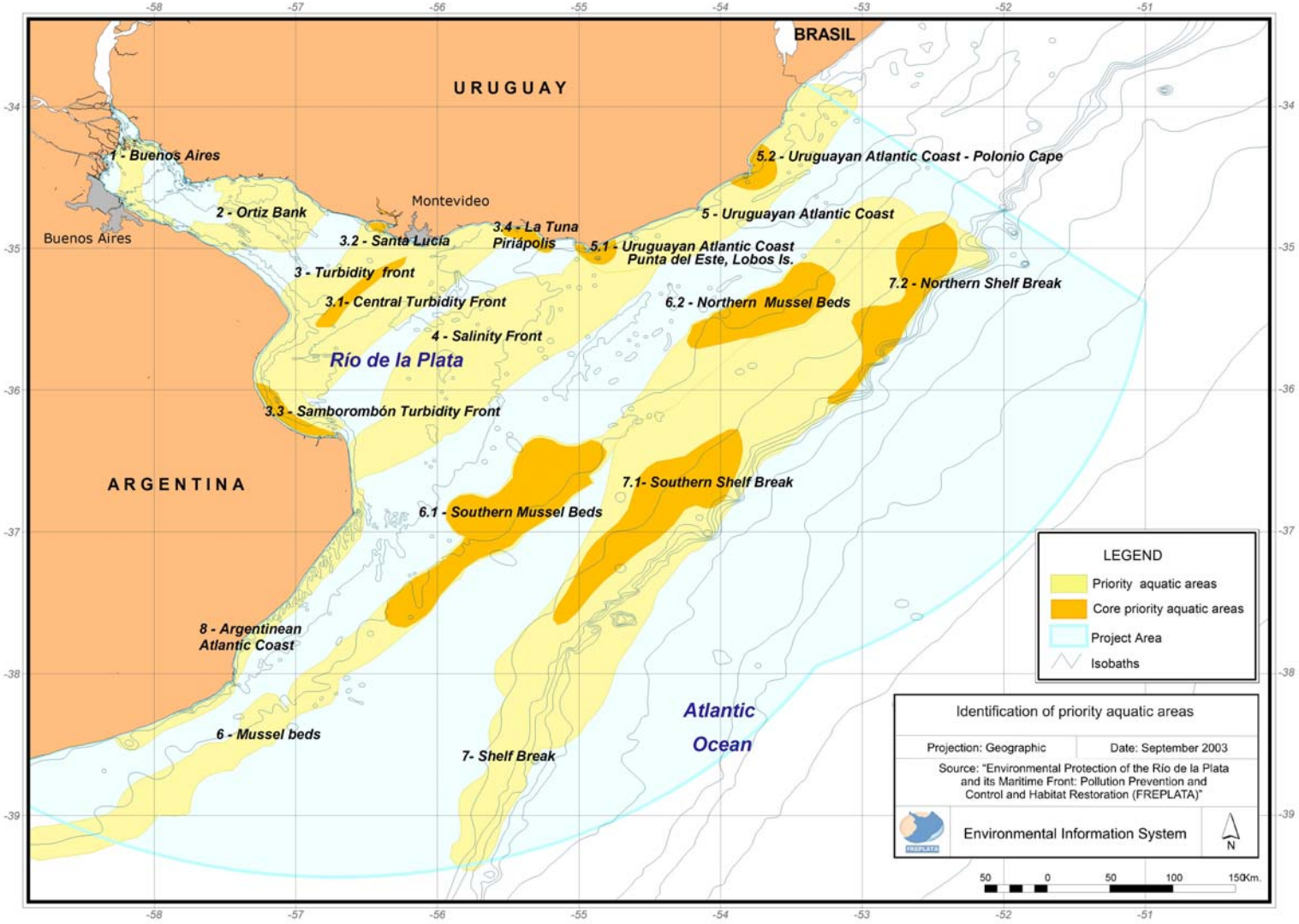

Figure 6.1.Priority aquatic areas for protection identified during FREPLATA, phase one.

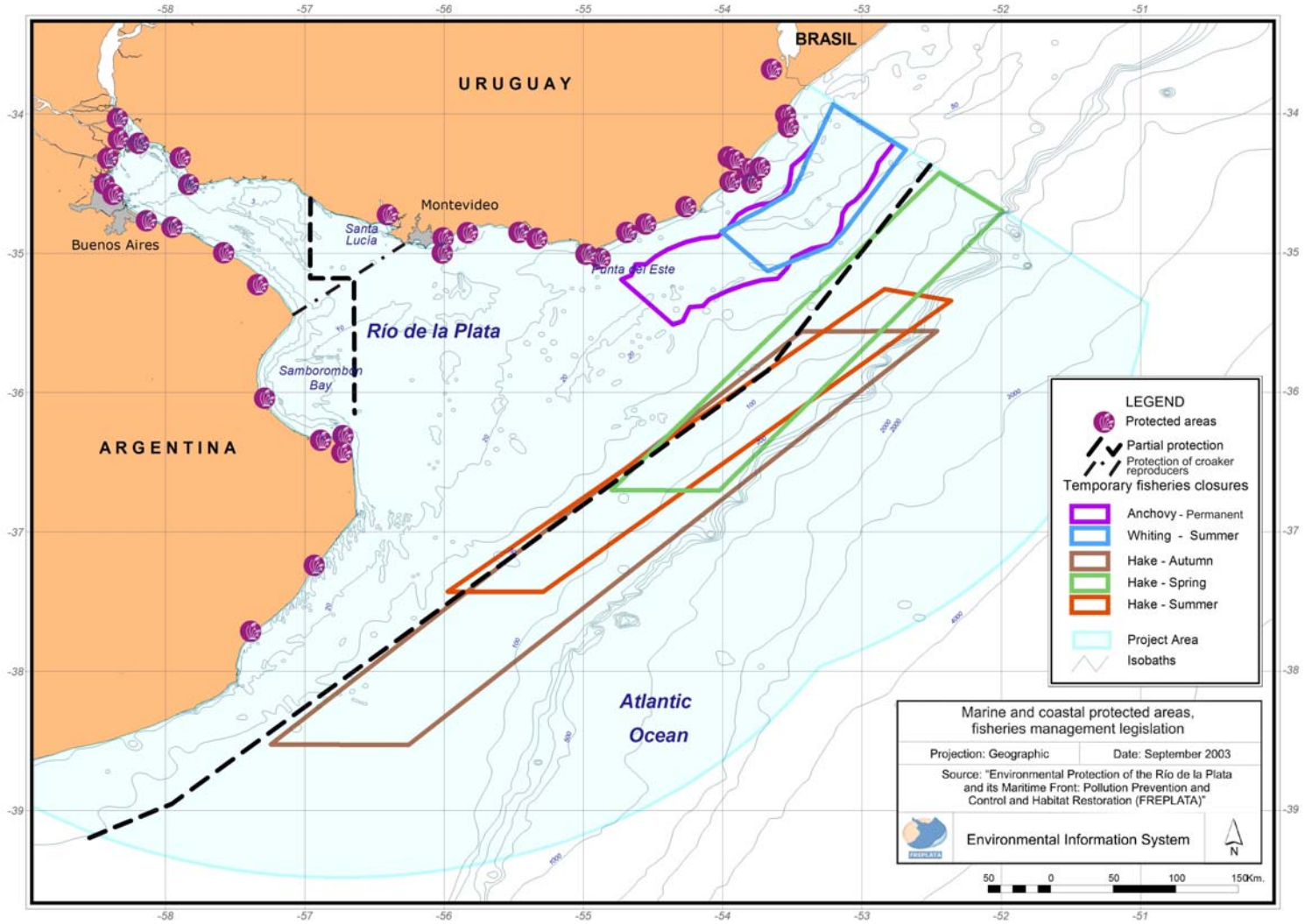

Figure 6.2. Areas with legal protection (Source: FREPLATA; 2005). Note: The hake zones are typical. The zone of protection of croaker reproducers covered from October 31 to March 1° of every year.

International organization and co-financers

The Global Environment Facility (GEF) is the main project donor. Its support is implemented by the United Nations Development Programme (UNDP). Additional support has been obtained from the Inter-American Development Bank and the Fond Française pour L'Environnement Mondial, (technical support agency of the French Government).

Table 6.3.Analysis of strengths and weaknesses of the current legal system.

Strengths	Weaknesses
▪ Strong scientific bases for the use and conservation of aquatic systems, including the Río de la Plata and its Maritime Front ▪ Existence of the System of Information	▪ Sectoral focus, and limited integration of information between both countries. ▪ Information disarticulated between organisms and countries.
▪ Treaty of the Río de la Plata and its Maritime Front (1973) provides a normative and institutional framework and institutional for the protection of the aquatic environment in the RPMF and promotes a regime of common responsibility.	▪ The Treaty does not have competition in the coastal zones therefore each country adopts legislation that creates advisable and this way there is disarticulation and superposition of jurisdictions, especial in Argentina.
▪ Shared cultural and legal inheritance both at the conceptual level as well as in terms of the structure and function of the legal frameworks. ▪ Parties to international environmental agreements dealing with sustainable development.	▪ Differences between the two countries' policy framework limit integration objectives.
▪ Solid institutions a the different governmental levels	▪ Insufficient human resource capacity, limited financial resources, fragmented and unarticulated actions.

6.4.-Relevance of current structures and powers, the case of protected areas.

Figure 6.1 and Figure 6.2 show the relationship between current measures for protecting aquatic life and the vulnerable areas assessment conducted by FREPLATA. There is a strong coincidence between the two maps. However, both Commissions depending on the geographic area involved, have for some time now, been establishing different kinds of protected areas for purposes of stock conservation, in the offshore areas of the Río de la Plata and in the Common Fishing Zone. Those measures include areas where trawling is completely and permanently prohibited, areas where only trawlers of less than a specific length can operate and, finally, temporary closed areas for trawling. These management tools are implemented with the objective of stock conservation. This experience showed that the Treaty and the two binational Commissions provide the legal and institutional means for the definition of common policies and legislation for the protection of

stocks in those offshore areas, although, as it is often the case, the challenge is always how to ensure compliance and effective enforcement.

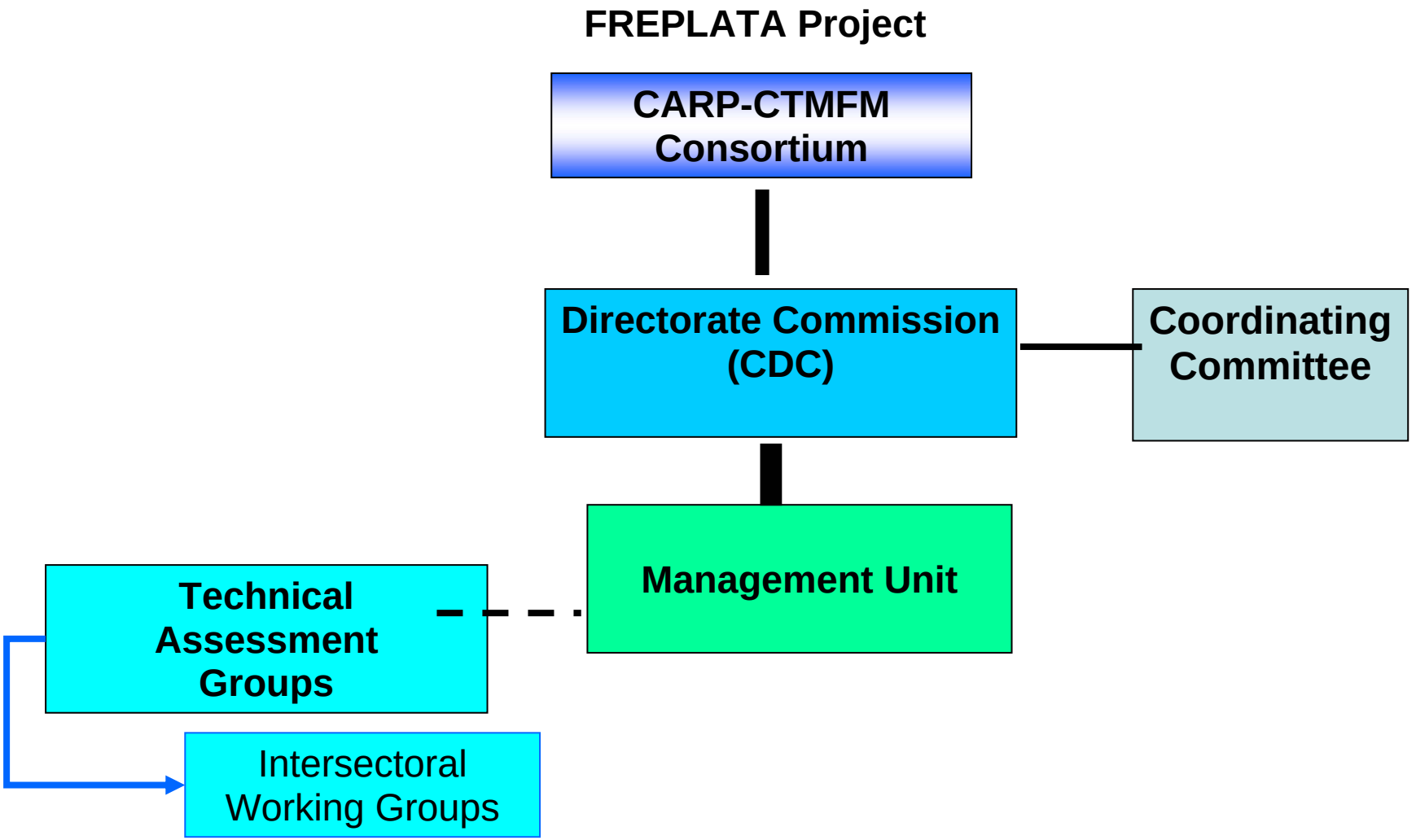

Figure 6.3. Institutional organization used in the TDA.

6.5.-Social participation of stakeholders involved in the governance.

The identification of agents and institutions key involved in the study, administration and management of resources of the RPMF offered important information on the knowledge of system and bonds between transboundary problems and root causes, and allowed to identify so much the present restrictions and barriers for implementation of actions as existing opportunities at current structures and systems (development of capacities, alert networks, training, etc.).

The stakeholder participation involved in TDA preparation, was promoted through the Technical Groups of Evaluation that were formed by numerous specialists and representatives of civil society institutions.

With respect to governance, both governments are committed to enhancing the participation of civil society. There is a wide experience in this field in both countries and there are a number of very active NGOs. These have been protagonists for improving environmental education and keeping environmental issues on the political agenda. Despite this, it is clear that there still insufficient diffusion of information on transboundary environmental issues. This lack of information was revealed in the stakeholders surveys conducted by FREPLATA which provided clear evidence of diminishing interest in environmental issues away from the coast.

6.6.- Economic instruments.

Economic instruments, including taxes, fees, levies and incentives, are an important tool for discouraging activities that damage the environment and for financing remedial measures. The two main principles underlying their application are the Polluter Pays Principle and User Fees. Studies conducted during the late 1990s evaluation of their effectiveness within the TDA preparation process revealed the following:

Problems with current instruments for environmental management:

(a) The majority of instruments applied are of a legal rather than technical and economic nature. There are a number of norms that are currently impossible to apply because of the unavailability of appropriate technology, their economic cost or the lack of a strategy for innovation in the private sector. This has the outcome that a number of norms are not sanctioned or remain unimplemented, given that strict application would result in massive closure of industries, particularly small – medium sized enterprises, leading to a high social cost.

(b) There is a problem of overlapping instruments that have been developed to achieve different objectives (and sometimes with contradictory criteria). In some cases there are conflicts between pollution control systems and systems for environmental impact assessment. On other occasions, instruments are applied with dissimilar objectives such as the use of emission standards. As mentioned earlier, there are overlaps in jurisdiction (local, regional and national) and a lack of coordination within sectors of the same administration.

(c) State reforms in the 1990s often focused on reducing personnel and downscaling budgets and this sometimes reduced the capacity to monitor and regulate.

(d) There has, until now, been no systematic evaluation of the results or effectiveness of environmental management instruments. In many cases new instruments have been introduced without removing or modifying the existing ones.

Strengths and weaknesses of current economic instruments in the region:

In Argentina the implementation of economic instruments has resulted in new institutional capacity for water management. Tools for management, regulation and monitoring have been developed and a geographical information system (GIS) has been established in the Directorate for Aquatic Pollution Control. Despite this series of norms, considered to be comprehensive, the current system of instruments has not succeeded to achieve the goal of reducing industrial pollution for the following reasons:

- The charges were not designed as economic incentives for environmental policy (i.e. for changing polluters' behavior) but focused on covering the operating costs of provincial of national agencies.
- There have been insufficient human resources and fiscal measures for full implementation, and in recent years there was a problem of discontinuity within institutions responsible for their operation. This led to much mobility of personnel.
- Effective evaluation and process monitoring measures have not been implemented. Institutional overlap also diminished the effectiveness of the system as the control mechanisms were sometimes the responsibility of more than one organization; some companies could be taxed by the State and the Province.
- There has been no concerted dialogue between the private sector and the regulatory organizations during the design of the instruments and their social viability was not tested properly. This leads to a risk of conflict between the objectives of reducing pollution and keeping factories running.

On the other hand, in Argentina in the 1990s initiatives were developed for public-private partnerships in the management of industrial effluents. A good example was the program for pollution control in Zárate-Campana (out of the FREPLATA area) which achieved a positive relationship between private industry and government that led to treatment facilities for the elimination of cyanide in liquid effluents.

In Uruguay, strictly speaking there are no economic instruments in place. There are fees for services such as drinking water or sanitation but these have not been designed to change behavior towards the environment. Currently, the entire basis of environmental legislation in the country is the 'command-control' paradigm.

Public-private partnerships have been relevant for improving the application of specific environmental policies. The use of legal mechanisms accompanied by a strategy of voluntary agreements with the private sector has achieved significant progress in controlling pollution in the Department of Montevideo. The 'Industrial Pollution Reduction Plan' in the framework of a wider agreement, was agreed between the Environmental Commission and the Uruguayan Chamber for Industry. This is guaranteeing real progress towards improving water quality in the main watercourses of the City.

Perspectives

The issue of integrated systems for environmental management that incorporate various kinds of instrument (legal and economic) is a matter that should be high on the agenda during the negotiations for a Strategic Program of Action for the RPMF. One of the main results of the FREPLATA workshops was interest from both the public and private sectors in the design and implementation of incentive mechanisms, particularly economic instruments for financing pollution control. This could be used to supplement the command-control provisions and increase their effectiveness.

7. Key gaps and uncertainties

The current version of the TDA has been developed on the basis of comprehensive reports produced by FREPLATA. They provide clear evidence of transboundary problems in the RPMF. As with most studies of this kind, there are always some gaps that can be identified with the advantage of hindsight. The following are areas that warrant further study in the future:

(1) Information on the biological effects of pollution in the RPMF. Techniques are now available to study the implications of various contaminants coexisting in the aquatic environment. Their application would help to clarify whether or not pollution constitutes a problem in the Maritime Front Area.

(2) More comprehensive information on the damage to communities and ecosystems in areas of intense resource extraction, particularly from trawling. Though there is clearly intense pressure from this activity, considerable uncertainty remains as to whether or not it is causing lasting damage and to which benthonic communities.

(3) Studies of the impact of resource exploitation on pelagic ecosystems. Studies from many other parts of word area demonstrating that this is one of biggest issues impacting the environment globally. It is unfortunate that this body of evidence has not yet been gathered for the RPMF, despite clear evidence of overexploitation of some of the target species (Figure 2.5.).

(4) Studies of the loss of economic value caused by ecosystem and landscape degradation. Such studies could be an important part of future decision making because they produce data that can be easily understood by those responsible for budgetary planning. Full studies of economic valuation are complex, but an initial appraisal would be very useful for policy development purposes. Hard choices will have to be made on which options to pursue and these should be informed by the possible economic information.

(5) Studies of migratory species that interact with neighboring systems. The RPMF is an open system that interacts with neighboring sea areas. An appraisal of the level of overlap would help to inform policymakers at national and international levels.

(6) Studies of the technology currently employed for pollution control and its technical and cost effectiveness. This would be useful when designing future interventions and economic instruments. It can be included as part of the SAP process.

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Annex 1. Causes and effects of human impact on the Río de la Plata and its Maritime Front and potential actions that may be considered during the development of a Strategic Action Programme (SAP).

Root cause variables	Immediate consequences (Pressures)	Negative impacts (State Changes) on the ecosystem[5]	Negative impacts on society	Options for priority action
POPULATION GROWTH	Increase in the waste loads (in particular urban effluents)	Increase in mortality or disease in sensitive species (CZ) Biomagnification of toxic substances in trophic chains (RP, MF) Alteration of reproductive or migratory behavior of sensitive species (T, RP, MF) Reduction in primary and/or secondary production in the ecosystem (RP,MF) Alteration of the physical or chemical characteristics of water and sediments (RP,CZ) Increase in the frequency or duration of harmful algal blooms (T,RP,MF) Increase in eutrophication (RP)	Danger of intoxication through direct contact with polluted water. Danger of intoxication from consumption of polluted species. Loss of recreational use and of economic value of the polluted water. Conflicts between jurisdictions and their competencies. Loss of sales of aquatic products because of public concerns. Fisheries loss. Loss of quality of water, biota and sediments. Increases in health expenditure. Increases in the cost of producing potable water.	*Legal frameworks coordinated between the various jurisdictions and organizations.* *Implementation of a societal strategy of environmental education and information* *Organized participation of civil society* *Coastal zone management plans* *Integrated and coordinated information systems* *Plans for capacity building for public and private sector decision makers* *Bi-national strategies for improving compliance of existing international juridical instruments* *Institutional strengthening programs* *Monitoring programs for accident early warning and water quality* *Maps showing sensitive areas* *Bi-national criteria for the quality of water, ecosystems and sediments* *Early warning systems for harmful algal blooms* *Strategies for managing and monitoring urban and industrial wastes* *Program for information and diffusion of environmental monitoring information* *Updated and technical and economically viable standards for urban and industrial effluents and discharges* *Sanitation plans with improved coverage and level of treatment*

[5] Types of impact: T = Transboundary; CZ = Coastal Zone; RP = Río de la Plata; MF = Maritime Front region; FZ = Frontal zones

Root cause variables	Immediate consequences (Pressures)	Negative impacts (State Changes) on the ecosystem[6]	Negative impacts on society	Options for priority action
POPULATION GROWTH	Increase in direct population pressure on coastal space	Coastal environments modified/deteriorated (CZ) Increase in coastal erosion (CZ) Reduction in natural habitats and/or degradation of protected areas (CZ, RP, MF) Changes in the biodiversity of species and the species composition of communities (RP, MF) Alteration of habitats (reduction, fragmentation) (CZ, RP, MF)	Conflicts in use of space Reduction in environmental quality. Changes in artisanal fishing Loss of value of the ecosystem (existence value as well as economic value) Loss in the tourism sector	*Legal frameworks coordinated between the various jurisdictions and organizations.* *Implementation of a societal strategy of environmental education and information* *Organized participation of civil society* *Coastal zone management plans* *Integrated and coordinated information systems* *Plans for capacity building for public and private sector decision makers* *Institutional strengthening programs* *Maps showing sensitive areas* *Policies of territorial spatial planning* *Bi-national strategies for biodiversity in the study area* *Management plans for species at risk* *Programs for sustainable tourism* *Mechanisms for local public participation in managing coastal zones and small catchments* *Programs for aquatic protected areas*

[6] Types of impact: T = Transboundary; CZ = Coastal Zone; RP = Río de la Plata; FM = Maritime Front region; FZ = Frontal zones

Root cause variables	Immediate consequences (Pressures)	Negative impacts (State Changes) on the ecosystem[7]	Negative impacts on society	Options for priority action
SOCIAL AND ECONOMIC DEVELOPMENT	Increase in the volume of solid waste	Alteration of habitats (CZ, RP, MF) Health impacts on species (CZ) Accumulation of solid wastes in the turbidity front (CZ, FZ)	Deterioration of the aesthetic quality and loss of value of landscapes. Increase in costs clean-up Increase in the costs in the artisanal fisheries sector through increased wear and tear Alteration of artisanal fisheries	*Legal frameworks coordinated between the various jurisdictions and organizations* *Implementation of a societal strategy of environmental education and information* *Organized participation of civil society* *Coastal zone management plans* *Integrated and coordinated information systems* *Plans for capacity building for public and private sector decision makers* *Bi-national strategies for the enactment of existing international legal instruments* *Programs for institutional strengthening* *Environmental sensitivity maps* *Territorial spatial planning policies* *Strategies for the environmental management, monitoring and evaluating solid wastes*
	Increase in the economic pressure on coastal space (for development purposes)	Coastal environments modified or degraded (CZ) Increase in coastal erosion (CZ) Loss of biological diversity (RP, MF) Alteration of components of the ecosystem (RP, MF, FZ)	Conflicts in the use of land space Loss of environmental quality Changes in artisanal fishing Loss of value of the ecosystem	*Legal frameworks coordinated between the various jurisdictions and organizations* *Implementation of a societal strategy of environmental education and information* *Organized participation of civil society* *Coastal zone management plans* *Integrated and coordinated information systems* *Plans for capacity building for public & private sector decision makers* *Programs for institutional strengthening* *Environmental sensitivity maps* *Territorial spatial planning policies* *Bi-national strategies for biodiversity conservation in the RPMF* *Management plans for species at risk* *Sustainable tourism programs*

[7] Types of impact: T = Transboundary; CZ = Coastal Zone; RP = Río de la Plata; MF = Maritime Front region; FZ = Frontal zones

Root cause variables	Immediate consequences (Pressures)	Negative impacts (State Changes) on the ecosystem[8]	Negative impacts on society	Options for priority action
AGROINDUSTRIAL ACTIVITIES	Increase in loads (and change in composition) of agro-industrial wastes	Increase of point and diffuse loads of organic and inorganic contaminants to the water body (T, CZ) Increase in mortality and/or disease in sensitive species (RP, CZ) Biomagnification of toxic substances via trophic chains (RP,MF) Alteration of reproductive and/or migratory behavior (T, RP, MF) Reduction of primary or secondary production of the ecosystem (RP) Increase in the incidence of harmful algal blooms (T, RP, MF)	Risks to human health Limits to sustainable development Decline in the quality of life Conflicts in the use of coastal/aquatic space Altered use of land space including urbanization processes in the coastal zone and key sectors in the basin Changes of mentality and conflicts of interest between different sectors of society regarding the exploitation of resources and water bodies Loss of ecological value	*Legal frameworks coordinated between the various jurisdictions and organizations* *Implementation of a societal strategy of environmental education and information* *Organized participation of civil society* *Coastal zone management plans* *Integrated and coordinated information systems* *Plans for capacity building for public and private sector decision makers* *Institutional strengthening programs* *Water quality monitoring and early warning programs* *Bi-national criteria for the quality of water, ecosystems and sediments* *Early warning systems for harmful algal blooms* *Strategies for managing and monitoring urban and industrial wastes* *Program for information and diffusion of environmental monitoring information* *Updated and technical and economically viable standards for urban and industrial effluents and discharges* *Instruments for improving public-private collaboration and partnerships* *Mechanisms for local public participation in managing coastal zones and small catchments* *Programs for air quality monitoring* *Plans for the promotion of clean technologies and sustainable management*

[8] Types of impact: T = Transboundary; CZ = Coastal Zone; RP = Río de la Plata; MF = Maritime Front region; FZ = Frontal zones

Root cause variables	Immediate consequences (Pressures)	Negative impacts (State Changes) on the ecosystem[9]	Negative impacts on society	Options for priority action
AGROINDUSTRIAL ACTIVITIES	Overexploitation of fish stocks and the introduction of exotic species	Alteration of reproductive and/or migratory behavior of sensitive species (T, RP, MF) Reduction of primary or secondary production of the ecosystem (RP) Alteration of biodiversity (RP, MF) Changes in productivity and/or biodiversity of ecosystems (CZ) Alteration of interspecies interactions in the ecosystem (RP, MF)	Loss of ecological value Loss of fisheries yield; transfer of the fishing effort to other species and fisheries impact on associated species Reduction of jobs in the fisheries sector Alteration of fisheries activities Crisis in the fisheries sector	*Legal frameworks coordinated between the various jurisdictions and organizations* *Implementation of a societal strategy of environmental education and information* *Organized participation of civil society* *Coastal zone management plans* *Integrated and coordinated information systems* *Plans for capacity building for public and private sector decision makers* *Bi-national strategies for improving compliance of existing international juridical instruments* *Bi-national strategies concerning the introduction and control of exotic species* *Strategies for integrated management and monitoring of fisheries resources* *Sustainable sectoral reform in the fisheries sector*

[9] Types of impact: T = Transboundary; CZ = Coastal Zone; RP = Río de la Plata; MF = Maritime Front region; FZ = Frontal zones

Root cause variables	Immediate consequences (Pressures)	Negative impacts (State Changes) on the ecosystem[10]	Negative impacts on society	Options for priority action
AQUATIC TRANSPORT	Increased risk of spills (operational and accidental)	Increase in mortality and/or disease in sensitive species (RP, CZ) Biomagnification of toxic substances via trophic chains (RP,MF) Alteration of reproductive and/or migratory behavior of sensitive species (T, RP, MF) Reduction of primary or secondary production of the ecosystem (RP)	Danger of intoxication through direct contact with polluted water Danger of intoxication from consumption of polluted species Loss of recreational use and of economic value of the polluted water Conflicts between jurisdictions and their competencies Loss of sales of aquatic products because of public concerns Fisheries loss	*Legal frameworks coordinated between the various jurisdictions and organizations* *Implementation of a societal strategy of environmental education and information* *Organized participation of civil society* *Coastal zone management plans and integrated and coordinated information systems* *Plans for capacity building for public and private sector decision makers* *Bi-national strategies for improving compliance of existing international juridical instruments* *Institutional strengthening programs* *Water quality monitoring and early warning programs* *Maps showing sensitive areas* *Program for information and diffusion of environmental monitoring information* *Programs for air quality monitoring* *Instruments for improving public-private collaboration and partnerships* *Information campaigns and awareness directed and the maritime and port communities*

[10] Types of impact: T = Transboundary; CZ = Coastal Zone; RP = Río de la Plata; MF = Maritime Front region; FZ = Frontal zones

Root cause variables	Immediate consequences (Pressures)	Negative impacts (State Changes) on the ecosystem[11]	Negative impacts on society	Options for priority action
AQUATIC TRANSPORT	Increased dredging	Alteration and loss of habitats (by dredging) (RP) Alteration of benthic community composition and species richness (RP) Loss of secondary production of the ecosystem (RP) Remobilization (dumping) of potentially contaminant sediments (RP, CZ)	Impacts on fishing Increase in health risks by inappropriate disposal of dredged spoils Loss of recreational use by inappropriate disposal of dredged spoils	*Legal frameworks coordinated between the various jurisdictions and organizations* *Implementation of a societal strategy of environmental education and information* *Organized participation of civil society* *Coastal zone management plans* *Integrated and coordinated information systems* *Plans for capacity building for public and private sector decision makers* *Bi-national strategies for improving compliance of existing international juridical instruments* *Bi-national criteria for the quality of water, ecosystems and sediments* *Bi-national strategies for the mitigation of the negative impacts of dredging*
	Invasion of exotic species in ballast wares and through fouling	Changes in the productivity and/or biodiversity of ecosystems (T, CZ, RP, MF) Alteration of the interspecies relationships of the ecosystem (RP, MF, FZ)	Alteration in fishing activity. Rapid deterioration of engineering material and infrastructure (e.g. water intakes) Increase in the cost of operation and maintenance of dams and water purification plants.	*Legal frameworks coordinated between the various jurisdictions and organizations.* *Implementation of a societal strategy of environmental education and information* *Organized participation of civil society* *Coastal zone management plans* *Integrated and coordinated information systems* *Plans for capacity building for public and private sector decision makers* *Bi-national strategies for improving compliance of existing international juridical instruments* *Bi-national strategies concerning the introduction and control of exotic species.* *Information campaigns and awareness directed and the maritime and port communities*

[11] Types of impact: T = Transboundary; CZ = Coastal Zone; RP = Río de la Plata; MF = Maritime Front region; FZ = Frontal zones

Root cause variables	Immediate consequences (Pressures)	Negative impacts (State Changes) on the ecosystem[11]	Negative impacts on society	Options for priority action
CLIMATE CHANGE	Sea level rise	Increase in coastal erosion (CZ) Alteration and loss of ecosystems (CZ)	Loss of physical space and coastal infrastructure Loss of aesthetic quality and devaluation of physical space	*Legal frameworks coordinated between the various jurisdictions and organizations* *Implementation of a societal strategy of environmental education and information* *Organized participation of civil society* *Coastal zone management plans* *Integrated and coordinated information systems* *Water quality monitoring and early warning programs* *Policies of terrestrial spatial planning* *Plans for monitoring and early warning for sea level rise*
	Alteration in tributary river flow	Increase in erosion in the hydrographic basin (T) Alteration and loss of ecosystems (CZ, RP) Alterations in the concentration of nutrients (RP, CZ) Increase in sediment loads to the system (CZ, RP)	Devaluation of physical spaces Increase in the vulnerability of the coastal population Alterations in navigation Alterations in the supply of electricity and drinking water	*Legal frameworks coordinated between the various jurisdictions and organizations* *Implementation of a societal strategy of environmental education and information* *Organized participation of civil society* *Coastal zone management plans* *Integrated and coordinated information systems* *Water quality monitoring and early warning programs* *Bi-national criteria for the quality of water, ecosystems and sediments* *Early warning systems for harmful algal blooms*