

## Diagnosis and Environmental Planning for Paranaguá - PR - Brazil

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### ABSTRACT

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The main goal of this study was to identify and analyse environmental problems related to human occupation at the south part of the city of Paranaguá PR, Brazil, aiming the diagnosis and conceptual evaluation of landscape use. For landscape use assessments and degradation diagnosis purposes, the environment was classified considering mainly geological and geomorphologic characteristics, such as declivity and sediment origin. The identification of potential environmental impacts was made by aerial photographs, Landsat-TM images, photographic records, surface sediment samples, water-column samples, and mainly observation visits to each classified unit. Surface sediment samples were taken with a Petit-Ponar sampler, in 13 station located in Paranagua Bay. In order to characterize the contamination level on sediments, the concentration of the following elements were analysed: arsenic (As), copper (Cu), cadmium (Cd), nickel (Ni), lead (Pb) e zinc (Zn). For the extraction of these elements, samples were treated with HCl 0.1N for 12 hours. This method has the advantage of determining contaminants which are weakly bind to the sediment, thus more available to the system. Analysis were performed by atomic absorption spectroscopy. According to the adopted criteria, sectors were classified as hills, mangroves, continental sediments and beach ridges urban and port industrial. Water quality and concentrations of metallic elements were determined at three sectors one control and two with the influence of urban and port/industrial activities, respectively The major upland impacts found were: deforestation due to disordered occupation, and solid waste emission through domestic and industrial sewage. The diagnosis of the actual situation was used as a basis for a management plan, once it allows the identification of impacts, and consequent environmental irregularities. Based on this considerations, suggestions for land use and management were presented, which offers a better approach for recuperation and protection of the studied ecosystem.

**ADDITIONAL INDEX WORDS:** *Port/industrial activities.*

### INTRODUCTION

The Brazilian coast, with 8.500km, presents several geo-systems as beaches, dunes, rocky shore, coastal line, mountains, mountain ranges and estuaries.

Different human occupation kinds established on the Brazilian coastal zone has been associated to the great abundance of natural resources in estuarine zones and shelter against storms.

Brazil, throughout its history, has been propelled by events which caused big changes on its territory and led to the current spatial organization, or, who knows, disorganization.

As a reflex of it, there are big cities in Brazilian coastline such as Rio de Janeiro, Salvador, Vitória, Santos and an increasing disordered occupation.

Paranaguá (figure 2) has its urban area limited by the bay on the North side, Emboguaçu River on West and Itiberê River on East. The city is enclosed between both rivers. Southwards there is an area of current expansion, due to the lack of natural barriers except the flooding areas which may be contained by landfills, with an increasing urbanization rate. This occupation is occurring in an disordered way and with no planning. The area has no infrastructure such as basic sanitation and potable water and only recently the electrical energy was installed. According to the inhabitants of Vila Esperança, land constitute a political promise and were occupied after the last elections.

Through the habitation patterns, it is noted that the level of quality of life is too low. This allied to the lack of infrastructure may lead to severe environmental problems.

On the west side of the Emboguaçu River is situated the Vila Guarani, famous by its illness cases associated to the lack of basic sanitation. On the river margins the mangrove forest has disappeared. Landfills cover the whole mangrove area occupied now by the housing development.

For the assessment of environmental risks and the elaboration of management planning of coastal systems, as the estuarine complex of Paranaguá Bay, it is indispensable to investigate, in quantitative and qualitative terms, the relative contribution of the environmental impacts from urban and

### METHODS

The identification of potential environmental impacts was performed by aerial photographs, Landsat-TM images, photographic records, surface sediment and water-column parameters, and mainly by observation visits to each classified unit. Surface sediment samples were taken with a Petit-Ponar sampler, in 13 station located in Paranagua Bay. In order to characterize the contamination level on sediments, the concentration of the following elements were analysed: arsenic (As), copper (Cu), cadmium (Cd), nickel (Ni), lead (Pb) e zinc (Zn). For the extraction of these elements, samples were treated with HCl 0.1N for 12 hours. This method has the advantage of determining contaminants which are weakly bind to the sediment, thus more available to the system. Analysis were performed by atomic absorption spectroscopy.

For water quality evaluation, 12 stations related to potential sources of pollution were sampled in Paranaguá Bay. In each station, superficial and bottom water samples were taken with a "Van Dorn" bottle. The following variables were determined:

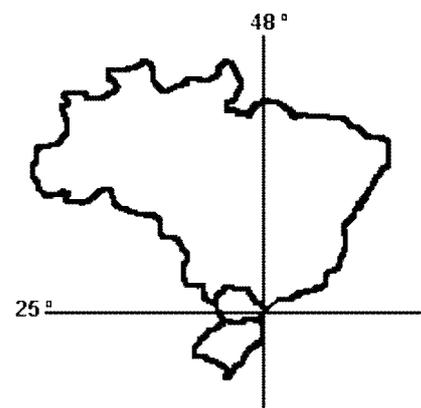


Figure 1. Paraná - Brazil.

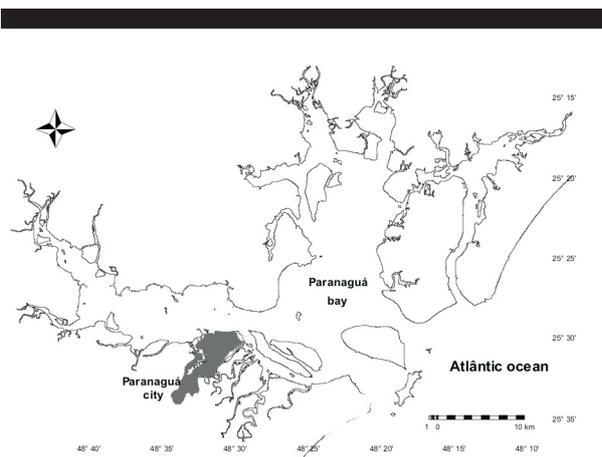


Figure 2. Paranaguá City.

temperature, salinity, pH, transparency, dissolved oxygen, dissolved organic nutrients, nitrogen, and total organic phosphorous (GRASSHOFF *et al.*, 1983), alkalinity, CO<sub>2</sub> (% saturation), and particulate suspended material (% saturation) (CARMOUZE, 1994), and chlorophyll (PARSONS *et al.*, 1984).

## RESULTS

Metallic elements occur naturally in most of the different compartments of the aquatic environment, such as rocks, soils, sediment, water and organisms. However, the increase of metal concentrations due to anthropogenic activities, port and industrial, associated to elevated toxicity, can trigger adverse effects to the aquatic ecosystems and to the human health (SALOMONS & FORSTNER, 1984;). In relation to the environmental contamination, metallic elements constitute an additional risk, since, contrasting with the organic contaminants, they are not degradable, being only transferred from one compartment to another.

In this work, concentrations of metallic elements were determined at three sectors: one control and two with the influence of urban and port/industrial activities, respectively.

This approach demonstrated that the elements Cr, Cu and Zn showed higher concentrations at the sector of urban influence, whereas the other investigated elements presented more elevated concentrations at the port/industrial sector (Table 01). Only Cd showed no significant difference between the three sectors. In contrast, as exhibited similar contributions from both sectors, urban and port/industrial. In general, the concentrations of the investigated elements were lower than the critical limit adopted for the total fraction in surficial sediments, according to Canadian guidelines. However, our results refer only to the fraction extracted with HCl 0,1N.

The water quality (Table 02) was investigated at the same sectors of the surficial sediments. From our results, no evidence of impact from the port/industrial activities was verified. Nevertheless, the influence of these activities could, probably, be detected by more specific analyses from water samples, such as phenols, oil and grease, and heavy metal. In contrast, the

Table 1. Concentration of elements ppm (mg/Kg).

Elements (mg/Kg)	Critical Limits *	Sector		
		Control	Urban	Port/ Industrial
Cadmium	0,676	0,06	0,05	0,04
Lead	30,24	0,04	0,10	6,03
Chrome	52,3	0,87	1,29	0,89
Copper	18,7	0,62	2,54	1,68
Arsenic	7,24	0,26	1,56	2,01
Nickel	15,9	0,34	0,56	7,13
Zinc	124,0	4,50	20,23	12,75

Note:\* Canadian Sediment Quality Guidelines.

Table 2. Mean Physics e chemistry parameters of water quality.

PARAMETERS	SECTOR		
	Control	Urban	Port/ Industrial
pH	7,7	7,9	8,0
% CO <sub>2</sub>	484,8	432,7	234,6
DO (mg/dm <sup>3</sup> )	5,4	6,3	7,2
DO (%sat)	75,8	90,3	97,7
TOP (mM)	0,5	0,5	0,6
TON (mM)	7,1	10,4	7,0
PO <sub>4</sub> (mM)	1,8	7,3	3,8
NO <sub>2</sub> (mM)	0,5	0,5	0,5
NO <sub>3</sub> (mM)	1,7	0,8	1,5
NH <sub>4</sub> (mM)	6,9	20,0	9,2
N:P (by atoms)	5,5	5,3	3,0
seston (mg/dm <sup>3</sup> )	33,0	35,5	34,4
BOD (mg/dm <sup>3</sup> )			0,5

sector with influence of the urban activities was well characterized, exhibiting higher concentrations of TON, phosphate and ammonium, related to the sewage contribution. Low pH and DO concomitantly with high CO<sub>2</sub> values at the control sector may be attributed to the degradation of natural organic matter associated to fluvial drainage of an area surrounded by mangrove forest.

## ENVIRONMENTAL PLANNING

Throughout the analyse and diagnose process, the current occupation state of the studied area could be evaluated. From the identification of the related problems, a tentative to dampen, solve and principally avert them, may be performed. In order to achieve this goal, it is necessary a series of actions, from the political consciousness to the application of a consistent environmental legislation.

The management plan (see Table 3) was elaborated based on recommendations from the Program Train-sea-coast Brazil (1998), indicated for costal zone management, the so denominated MIZC Integrated Management of the Coastal Zone. According to this program, this management is a continuous and dynamic process of decision making. Therefore, decisions about the use, development and protection of coastal resources are targeted in an integrated and planned study.

A management plan would be, by excellency, a plan with well defined objectives at all stages. Any no articulation between the stages can turn into unstable the whole project, which aims synchronicity and connections between al stages. The director plan from the city of Paranaguá needs to be fitted and subordinated to the management plan, because at the current time it only legislate upon urban area.

## FINAL REMARKS

The city of Paranaguá is situated on the fringes of an estuarine complex rich in live resources, which constitutes an important source of food for the local population.

Handcraft fishing, traditional and historical, is with no doubt an important local activity, which values the natural resources.

As the city developed more important became the fishing activity, constituting not only a source of food but jobs for the population too. At the present, more than 2,000 fishermen are linked to the "Fishman Paranaguá Association", which live from fish, shrimp and oyster culture, etc.

Table 3. *Stages for the implementation of the management plan.*

STAGES	ACTIONS	MEANS OF PROPAGATION TO THE PUBLIC	STRATEGIES TO INVOLVE THE STAKEHOLDERS	PROMPT
a) Articulation meetings with all people involved	Separate meeting with specific institutions to determine the Delegates and define interests and establishment of the management council, technique group and common objective's definition	CALLINGS AND INVITATIONS	TRANSPARENCY AT THE PROCESS, USING A UNIQUE LANGUAGE WITH ALL PEOPLE INVOLVED	6 MONTHS
B) PUBLIC OPINION	INTERVIEWS WITH THE LOCAL AND FLOATING COMMUNITY BY MEANS OF QUESTIONNAIRE, TAPE RECORDERS AND VIDEO CAMERAS.	REPORT PUBLISHED THROUGH DELEGATES OF THE INVOLVED INSTITUTIONS.	TRANSPARENCY AT THE PROCESS, USING A UNIQUE LANGUAGE WITH ALL PEOPLE INVOLVED	6 MONTHS
C) TERRITORIAL ORGANIZATION'S PROJECT COMPOSITION	BASED ON THE INFORMATION AND PROBLEMS BROUGHT UP AT THE NATURAL AND SOCIAL DIAGNOSIS.	MEETINGS WITH THE STAKEHOLDERS.		6 MONTHS
D) SEARCH FOR FINANTIAL RESOURCES	SENDING THE PROJECT TO FINANTIAL AGENCIES.	LETTERS AND CONFERENCES.		6 MONTHS
E) ENVIRONMENTAL EDUCATION'S PROGRAM IMPLEMENTATION	INVOLVEMENT OF THE COMMUNITY AND EDUCATION'S OFFICE	A BIG PROGRAM AT THE SCHOOLS, FIRMS AND PEOPLES ASSOCIATION		6 MONTHS
F) ENVIRONMENTAL MANAGEMENT IMPLEMENTATION	GOVERNAMENTAL, POLITICAL IMPLEMENTATION	GENERAL PRESS		6 MONTHS
G) MONITORING	PERIODICAL CONTROL OF THE IMPLANTED GOALS, BY MEANS OF: Queries; Supervision; Technical Survey and Database update	BIMONTHLY REPORTS ABOUT THE PROJECT'S SITUATION.	PERIODICAL MEETINGS.	CONTINUOS
H) EVALUATION	COMPARISON OF THEORY AND PRACTICE: IMPLEMENTATION'S SUCCESS ANALYZE	MEETINGS WITH THE STAKEHOLDERS.	TRANSPARENCY AT THE PROCESS, USING A UNIQUE LANGUAGE WITH ALL PEOPLE INVOLVED	CONTINUOS

Therefore the environmental must be attentive with many important ways of production like fishing.

Beyond of cited appropriation ways of nature, the tourism has been the less development. The region shows a great touristic potential because its amazing landscape. This potential must be explored in environmental plane.

This touristic potential's under use occurs because of the lack of techniques that by restrict reasons of the social distribution process' articulation, just don't happen in some places. A lot of times productive force's interests are stronger than other ones.

Other than being surrounded by an exuberant natural environment, the town has on its own urban site an historical architectural set, rich of events and history, but poor in preservation.

A preserved historical city, on a fraction of space, ingrown over green landscapes, would be ideal for the economies third sector expansion, turning tourism to be a more active and rational production sector; after all, it's an intelligent way of use being able to develop preservation.

Nowadays Paranaguá has a series of potentials being exploited, such as agricultural and fishing, some being under

exploited and others over exploited. According to time and place, the ones that are being under used turn to be over used and vice-versa. Constant and different uses are seen, without or almost with no planning and accomplishment of a management that provide appropriate uses for each potential. Even with all these uses, the "D. Pedro I" harbor is the one that turned out to be the most important and practically conditions the town's growing. It's nowadays essential to the permanence of a rising synchrony with Brazilian and worldwide economy, and consequently to the society's benefits, that by means of work look for quality of life. The harbor brings job, technique, organization and helps with the incorporation of techniques that evolve together with the city.

The harbor's tendency with the possible "fitters cycle" is to sheer and expand its business, which can provide a significant rise on the load and download operations. During the last years the rising of import operations, for example, has ascended from 3 millions to 6 millions per year. On the last two years the harbor has been adopting environmentalist practices which include it as a strong ally for environmental planning and rational development.

This may cause an increase of productive forces and consequently social evolution, making studies and planning important to the region, as diagnosis has shown that degradation occurs in very important ecosystems, as mangroves and salt marshes, beyond of Paranaguá's Bay itself.

As time goes on, it's hoped that society and nature at Paranaguá have an essential interaction. For the town to continue producing benefits, the best performance must be seeking, through ideas that express lucidity and perspicacity, for the accomplishment of an always intelligent interaction. However, for all these potentials to be used as ideal, collective effort between stakeholders and other involved people is essential. It would be impossible for any management plan to work out without the assurance of a collective and healthy articulation.

Therefore, it's clear that the political-social system must adapt itself to environmentalist ideas, which nowadays is not easy not even in Paranaguá, neither at any other place. The actual developmental system gives little space for this type of idea. With no doubt, changes are happening within an absolute minority, but most of the businessman still doesn't see collective projects as a good thing.

For that and because of that there's an idea of implanting an efficient environmental education system before the implementation of the Management Plan.

At the beginning of the articulation, all involved people should be aware that the time needed must overcome the prompt of the city's government, and because of that, everyone have to be together, mainly at the supervision and evaluation times, so that good results can enforce possible substitutes to maintain the plan.

It's now clear that the plan is not a simple shift of the natural resource's administrative method, but yet a complex attempt to revert culture and the relationship between society and nature for something better.

Men should use its knowledge and techniques for the process' equilibrium.

A management plan can provide the time for change, bringing up an overturn on the practice and at the culture about the ways to use the nature.

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