TAGUBAR

Institutional Capacity for the Environmental Rehabilitation and Sustainable Development of Guanabara Bay

Brazil

- DECISION SUPPORT SYSTEM

- ECOSYSTEM REHABILITATION

- ENVIRONMENT AND HEALTH

- ENVIRONMENTAL SUSTAINABILITY

- TECHNOLOGY INNOVATION

IUCN
The World Conservation Union

COOPERAZIONE ITALIANA

Ministero degli Affari Esteri

Background
and rationale

The sea-bottom of the Guanabara Bay in Rio de Janeiro is covered with a layer of highly toxic sludge, up to four metres deep. The different causes for this state of pollution range from the Bay's industrial zone, home to much of Brazil's petrochemical industry, to the sewage from the city and to the intense deforestation in the Bay's catchment area. The level of pollution is so high that any oxygen in the water is quickly absorbed by bacteria for their own survival, and there is no sufficient microbial activity to break down the organic waste. Thus the layers of waste on the bottom of the Bay are not being reduced by natural decomposition and the sludge has built up over the years. Also, the rate of sedimentation has been far greater than the rate at which rivers and tides can flush sediment off the Guanabara Bay.

The sludge contains high levels of heavy metals such as zinc, mercury and copper from industry. The metals enter the food chain and are very dangerous for the health of the local people who depend on seafood from the Bay for their sustenance. Although the Bay's fisheries capacity has decreased by 90% because of pollution, there are still thousands of people who earn their living through fishing activities in this area.

The Brazilian Government wants to clean up the Guanabara Bay, but the cost effectiveness and the long term sustainability of conventional methods are not encouraging. For example, the Bay could be dredged and the sludge concentrated on an artificial island. However, the dredging process would cause much of the heavy metals currently trapped in the sludge to become suspended in the water making it highly toxic. Another method would be to cover the Bay's bottom with a layer of artificial calcium-based product similar to concrete, which would trap the heavy metals and the sludge. However, the surface of the Bay's sea-bottom is 122 sq km, and the cost would amount to billions of dollars.

The technical complexity of this problem is increased by the dispersion of the existent scientific and technical information on the Bay among different institutions. Furthermore, present institutional capacities are not suitable to tackle systemically the complex social, economic and environmental causes and effects of the present and past pollution of the Bay. Within this context, the Italian funded TAGUBAR Project has been formulated to contribute to the rehabilitation of the Guanabara Bay through a systemic approach that integrates its social, economic and environmental implications.

Guanabara Bay, main sampling stations
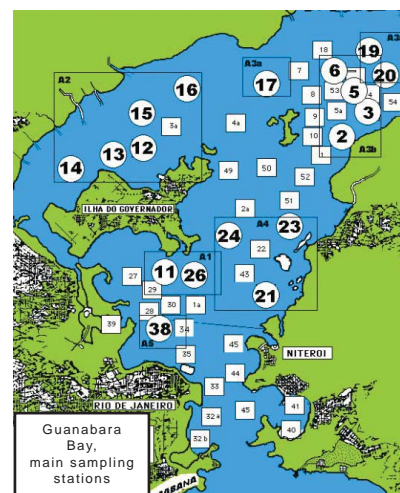
The intervention includes a pilot system for cleaning the Bay, institutional capacity building and pilot initiatives aimed at the sustainable use of natural resources by the local communities. The cleaning technology for the Bay was conceived in the framework of a previous Brazilian - Italian project for the environmental rehabilitation of the Vitòria coast in Espirito Santo State, where it proved very effective. It is now applied in a pilot area of the Guanabara Bay under the umbrella of the present Project, which takes in consideration the different environmental circumstances and foresees the adoption of the innovative systemic approach to ecosystem rehabilitation.
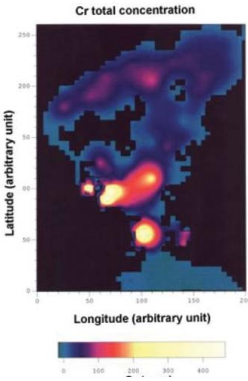
Top of the page:
urban development close to water

Left:
sewage affluent into a freshwater stream

Satellite image of Guanabara Bay

Cr total concentration

Chrome concentration in the Bay

The Italian Cooperation has entrusted the execution of the Project to the World Conservation Union (IUCN). Implementation is shared between IUCN and the University of Cà Foscari in Venice and is planned to last three years. Total funds amount to more than 2,4 million euros.

Goal, objectives and expected outputs

The development goal of the Project is to contribute to the economic and social development of the population of the Rio de Janeiro State and to the conservation of the State's natural resources. This objective will be achieved by enabling local Authorities to plan and implement a rehabilitation programme for polluted ecosystems, under a systemic management framework.

The specific objectives of the Project are the following.

- Strengthen the institutional capacity towards a systemic approach to plan and manage interventions in aquatic biomes, through the design and establishment of a Decision Support System (DSS), tailored to the management of the degraded and polluted ecosystem of the Guanabara Bay.

- Develop pilot initiatives within the systemic management framework, for the environmental and economic rehabilitation of the area, including fishery, tourism and recreational activities, and for the improvement of health, sanitary and livelihood conditions of the coastal population.

The expected results are as follows.

- A dynamic and geo-referenced database is established, for the storage of information on the socio-economic, geomorphological, urban, chemical, physico-chemical and biological conditions of the Guanabara Bay.
- The predictive management and monitoring models of the DSS are tailor-made for the Guanabara Bay ecosystem and are established at the institutional level.
- A networking system is operational, to link the Rio de Janeiro State institutions with local and national technical and administrative bodies.
- The module for the sediment units decontamination (MODUS) is designed and tested.
- Staff from the involved institutions is trained on chemical and biological monitoring techniques in a heavily degraded ecosystem and on the use of MODUS decontamination techniques.
- The master plan for the systemic management of the Guanabara ecosystem is designed.

- Staff from the institutions concerned is trained on the collection and integration of achieved technological results, through the use of the DSS, as part of the management of the local social and economic development process.
- The operational hardware, which includes the MODUS and relevant infrastructures, is tested and established.
- The DSS software/hardware complex, which integrates the above outputs, including the master plan, is used for the design and monitoring of the pilot systemic management initiatives.
- The ecosystem module of the Guanabara Bay is rehabilitated through the pilot initiatives, in terms of the environmental, social and economic conditions.
- Administrative, social, economic and conservation benefits are diffused to similar ecosystems at State, national and international levels.

Brazilian and Italian researchers working in the Bay

Sample of sludge from the sea bottom of Guanabara Bay

Left: deforestation on the Bay catchment area

Right: freshwater stream with a sewage inlet, feeding into the Bay

The Project approach will include the transfer of both technology and organisation systems and the involvement of Brazilian administrative and scientific institutions. It will also take into account the national and international relevant legislation.

Implementation and results

The Project is due to start in September 2002, and its implementation is structured around two phases.
The first phase will focus on building the scientific and institutional capacity of local institutions through on-the-job training programmes and the transfer of know-how and technology in the framework of the DSS establishment process. This will include database construction, analysis and modelling for planning and management. The newly acquired skills of the local Authorities will then be used in the second phase of the Project through a number of pilot initiatives, identified through a systemic management approach and aimed at the sustainable use of the Bay. These initiatives will contribute to improve the living conditions of the least advantaged communities settled in the Guanabara Bay.

The DSS will be the crucial tool for the systemic management of the Bay. This will involve the setting up of a system for the integration of information and data collected on the Bay, and will include a GIS database. The DSS will inform the decision-making process on the management of the Bay. Among others, it will allow the identification of key sources of pollution and relevant mitigation measures, as well as the identification of the best strategies for the improvement of water quality and the subsequent development of effective technologies.

The DSS will be structured as a modular applicative package integrating, in a unique working shell, both informative and analytical tools. It will enable effective representation, interpretation, systemic analyses and aggregation of data and information, relevant to the formulation of a management master plan for the Guanabara Bay ecosystem, and to the decision-making process on the implementation of the same master plan.

Within this framework, the MODUS pilot project for the decontamination of the Bay's waters foresees the creation of a 'bio-cap' on the sludge by pumping oxygen through the top layer of the sediment. The infusion of oxygen will start the decomposition process in the sludge allowing the sea-bottom to come back to life. If left undisturbed, this biologically active layer will prevent the heavy metals laying below it from dispersing into the water.

Various machines have been developed in Italy by the University of Cà Foscari in Venice to aerate the sediment. The machines will suck-in the top layer of the sludge, pass it through an aeration chamber, and deposit it back onto the Bay's bottom. A critical aspect of the process relates to the heavy metals in the sludge: to avoid their diffusion in the water, the sediment cannot be exceedingly stirred up. Various techniques were tested to ensure that the machine causes the minimum disturbance to the sludge. The prototype aeration machines will be tested in a pilot area off the North coast of the Ilha do Governador. Several teams of scientists, lead by the University of the State of Rio de Janeiro, will monitor the effectiveness of the machines over a three-year period. At the conclusion of the Project, with basis on the final evaluation of the technology performance, the Brazilian Government will decide on the most appropriate financial and operational framework for the extension of the methodology to a larger scale and the "bio-capping" of the sludge across the whole Bay.

Industrial development and sewage on one of the tourists' beaches of Guanabara Bay