

TRANSFERING WATER AMONG BASINS: AN ECOLOGICAL ASSESSMENT OF NORTHEAST BRAZILIAN RESERVOIRS

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The national project of the São Francisco river integration on northeast basins, lead by the Brazilian Ministry of National Integration, aims to transfer water from this river to different councils of the northeast semiarid region with limited water resources. This study aims to characterize the current ecological status of three northeast reservoirs that will receive water from the São Francisco River. In this work we present results from three monitoring campaigns, in 2009 and 2010, concerning physical-chemical and biological parameters. In relation to physical-chemical and microbiological parameters, the results demonstrated that some of them were in discordance with the legislated standards (total phosphorus, chlorophyll, and some metals). The phytoplankton community was similar in all reservoirs. A high diversity was found in chlorophyceae group, which contrasts with cyanobacteria blooms dominated by *Microcystis sp.*, *Anabaena sp.* and *Cylindrospermopsis raciborskii*. In general, the benthic macroinvertebrate community was represented by Mollusca as the predominant group. The *Eichhornia crassipes* and *Eichhornia azurea* were the most abundant macrophytes. A global analysis of results showed the existence of contamination problems in all reservoirs, probably due to effluents from domestic and agricultural activities that directly drain to their water bodies.

Keywords: brazilian semiarid, ecological assessment, water transfer, reservoir monitoring.

INTRODUCTION

The population of Northeast Brazil lives with the effects of drought in a semi-arid region, where the demand for water is greater than supply. An alternative to increase the water availability in the region, the implementation of the water transfer through the São Francisco River is being implemented by the Brazilian government. The São Francisco River drains an area of 640.000km², corresponding to 7.5% of the total Brazilian basin areas. The national project of the São Francisco River integration on northeast basins, lead by the Brazilian Ministry of National Integration, aims to transfer water from this river to different councils of the northeast semiarid region with limited water resources. These councils cover the states of Pernambuco (PE), Paraíba (PB), Rio Grande do Norte (RN) and Ceará (CE). Along its nearly 2,900 km length, the River crosses a diverse region, both in terms of its climatic and physical characterization and in terms of its environmental and social diversity. According OECD (2005), the São Francisco River basin and its coastal zone are areas of strategic importance to the development of a vast region, marked by socio-economic disparities and environmental vulnerabilities. The optimization and harmonization of various types of water uses – generation of electricity, shipping, irrigation, fishing, tourism and leisure, dilution of wastes, household and industrial water supply, mining, and others, including ensuring adequate flows for environmental uses – has been a constant challenge for the basin stakeholders. The increase of water provided by the project will allow the supply for all the people that live in the semiarid zone. State and regional projects of urban water supply should

be integrated into the pipeline system, benefiting with the increased of the water supply and water security (Santana Filho, 2007).

This study aims to characterize the current ecological status of three northeast reservoirs: Poço da Cruz and Itaparica, located in PE; and Boqueirão, located in PB that will receive water from the São Francisco river, in order to normalize the water supply for human population. Their storage capacities are respectively, 11 billion m³, 504 million m³ and 436 million m³. They are located in the eastern axis of the basin river integration project that will benefit regions of Pernambuco and Paraíba states. Provided for a maximum capacity of 28m³/s, the eastern axis will work with a continuous flow of 10 m³/s for the human supply.

METHODS

For the recognition of the study areas, field visits were made in order to observe the surroundings of the reservoirs, as well as the activities realized around. The analyses of water quality were done according to Standard Methods for the Examination of Water and Wastewater (1998). Three monitoring campaigns were realized, two in 2009 and one in 2010, concerning physical-chemical parameters (metals, nutrients, oxygen, temperature, etc) and different biological indicators: microbiological (thermotolerant coliforms and *Escherichia coli*); phytoplankton (chlorophyll-*a*, taxonomy and density); benthic macroinvertebrates (taxonomy and density); and macrophytes (taxonomy and biomass). Due to the high number of parameters obtained, multivariate analyses were performed (ordination and classification). In this way, the existence of spatial and temporal patterns of variation were investigated. Data interpretation was made taking into account the standards defined in the Brazilian law Conama Resolution n° 357/2005, in relation of the physical-chemical parameters and the cyanobacteria.

RESULTS

In relation to physical-chemical and microbiological parameters, the results demonstrated that some were in discordance with the legislated standards (total phosphorus, chlorophyll *a*, and some metals). It was observed concentrations of total phosphorus higher than recommended by the Brazilian legislation that is 0.03mg/L (Table 1). Higher concentrations of phosphorus have been recorded in Itaparica (Melo, 2007), and in Boqueirão (Guimarães *et al.*, 2005).

Table 1 – Total phosphorus concentration in Itaparica, Poço da Cruz and Boqueirão reservoirs

Reservoirs	Variation of total phosphorus concentration (mg/L)
Itaparica	0,03 a 5,2
Poço da Cruz	0,01 a 2,3
Boqueirão	0,03 a 4,8

In relation to the metals, the reservoir Poço da Cruz showed concentrations of copper and nickel in disagreement on at least one campaign. Also the Itaparica reservoir had abnormal levels of copper, nickel, lead and aluminum. While in the Boqueirão only the iron had problems. The phytoplankton community was similar in all reservoirs. A high diversity was found in chlorophyceae group, which contrasts with cyanobacteria blooms dominated by *Microcystis sp.*, *Anabaena sp.* and *Cylindrospermopsis raciborskii*. In Brazil, reports of *C. raciborskii* blooms have also been frequent, including the State of Pernambuco (Huszar *et al.* 2000; Nascimento *et al.* 2000; Bouvy *et al.*, 2000). The high

concentrations of phosphorus favor the occurrence of cyanobacterial blooms, which was verified by Sant'Anna & Azevedo (2000) in some Brazilian reservoirs. In general, the benthic macroinvertebrate community was represented by Platyhelminthes, Arthropods, Nematodes, Rotifers, Mollusca, Annelida, Crustacea and Mollusca as the predominant groups. The *Eichhornia crassipes* and *Eichhornia azurea* were the most abundant macrophytes, considered by different authors as macrophyte-problem due to their high degree of dispersion and infestation.

CONCLUSIONS

A global analysis of results showed the existence of contamination problems in studied reservoirs, probably due to effluents from domestic and agricultural activities that directly drain to their water bodies. Water resources management is a complex matter of a great strategic importance for sustainable development. It impacts almost all aspects of society and economy, mainly health, food production and security, domestic water supply and sanitation, energy, industry, and the functioning of ecosystems. Our existing freshwater resources are under a serious threat from overexploitation, pollution, and global warming. Given these trends, providing adequate water resources for agriculture, industry, and human consumption is one of the greatest challenges of the 21st century. In this context it is absolutely necessary to continue monitoring water quality in these four reservoirs, in order to compare and analyze the obtained results with climatic evolution (e.g. temperature, precipitation, evaporation), as global warming can cause additional changes, variability, and uncertainty.

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