



Temporal Variation in the parasitic Metazoan Communities of *Sympterygia bonapartii* (Condrichthyes) from the Bahía Blanca estuary in Presence of Anthropogenic Impact

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Abstract

The estuary of Bahía Blanca (39° 03'44 " S 62° 04'00 " W) occupies a large coastal area south of the province of Buenos Aires, Argentina. This area includes urban centers, several industrial parks and deep-water ports. The parasites sensitivity to pollutants and environmental disturbances makes many taxa useful indicators of environmental health and anthropogenic impact. In the present study, the variation in helminth communities of *Sympterygia bonapartii* was analyzed retrospectively after a period of 18 years. Infra-communities harbored an average of four times more parasites and became less equitable. A gradual increase in organic matter added to the parameters synergy caused by untreated sewage discharges, seems to have been the most important impact on helminth communities, altering the abundance, dominance and evenness. The present study proposes fish parasite analysis as a reliable model to monitor pollution in this ecosystem.

Keywords: Parasites; anthropogenic impact; parasites; eutrophication; environmental disturbances

Introduction

The estuary of Bahía Blanca (39° 03'44 " S 62° 04'00 " W) occupies a large coastal area south of the province of Buenos Aires, Argentina, where the cities of Bahía Blanca, Punta Alta, General Cerri and Ingeniero White are located. By definition an estuary is diluted by fresh water from land drainage [1] thus it conforms an adequate environment to perform pollution studies, considering that it is an area that includes urban centers, several industrial parks and deep-water ports [2, 3]. All the effluents are discharged with different degrees of pretreatment, so they generate different impacts on the ecosystem. Bahía Blanca estuary has been the object of a large amount of environmental studies along the last 35 years [4-6]. The parasitic sensitivity to pollutants and environmental disturbances make many parasite taxa useful indicators of environmental health and anthropogenic impact [7]. Both parasite communities and their hosts can be regarded as comprehensive bioindicators of ecosystem health an environmental stability [8,9] Parasites can be used as effect indicators and as accumulation

indicators because of the variety of ways in which they respond to anthropogenic pollution. Effect indicators are parasites that are used to detect environmental impacts through their changes in physiology, chemical composition, behavior, or number [10,11]. *Sympterygia bonapartii* Muller & Henle, 1841 is a coastal species present from 34 ° to 52 ° S. It is a common component of the Bahía Blanca estuary. Due to its benthonic habits, it is considered a good model to monitor the anthropogenic impact on the estuarial ecosystem. Studies on parasitism in fish through the time scale are scarce. In the present study, the variation in helminth communities of this host was analyzed retrospectively after a period of 18 years.

The parasite communities of 77 rays examined in 1992 and 73 rays in 2007/10 were compared. Prevalence, intensity, parasite abundance, richness and specific diversity were calculated. Prevalences ("G" test) and parasite abundances (U-Mann-Whitney) were compared. Average values for richness, diversity (Brillouin) and evenness were estimated. Some taxa were updated according

to [12]. Nine parasite species were registered in 1992 and eight in 2007/10 with a total of 193 and 812 helminths respectively. *Calicotyle macrocotyle*, *Otodistomum pristiophori*, *Rhinebothrium chilensis*, *Dollfusiiella acuta*, *Heteronybelinia mattisi*, *Proleptus acutus* and *Terranova galeocerdonis*, were common species at both times, while *Proflicollis chasmagnathi* and *Pseudoanisakis argentinensis* were only registered in 1992. *Opecoeloides* sp. was only present in 2007. The total number of parasites was significantly different between periods ($U = 2080$, $p = 0.005$) however richness and diversity did not show significant differences ($U = 2597$, $p = 0.39$; $U = 560$, $p = 0.92$ respectively). In both periods, the dominant species was *R. chilensis* and about 70% of the fish harbored at least one parasitic species. In 2007/10 the dominance of rhinebothriidean was maintained but there was a marked increase in prevalence and a highly significant difference in the intensities of *D. acuta* ($G = 28.94$ $p < 0.001$; $U = 2050.5$ $p = 0.000$ respectively) and a decrease in *P. acutus*. The evenness was significantly different between periods ($U = 493.5$ $p = 0.002$). At the last period infra-communities harbored an average four times more parasites and became less equitable. The increase in the intensity of *D. acuta* was 26 times higher.

Discussion

Eutrophication as a process of anthropic origin adds greater amounts of nutrients, mainly nitrogen, phosphorus and organic matter that usually limits dissolved oxygen decreasing water quality. According to the Environmental Monitoring of the Internal Estuary Area (1997) [13], the global analysis of the dynamic oceanographic parameters evaluated (inorganic micronutrients, phytoplankton pigments, particulate organic matter and dissolved oxygen) showed a consistent behavior with the historical background for this area. The condition identified at that moment was an environment with excellent physiological capacity for the development of biological processes. However, at that time the need for monitoring phosphorus compounds to the system and its possible dispersion mechanism with the risk of producing eutrophication was considered. The total hydrocarbon levels that were detected in the studied environment showed that so far there was no massive income of these compounds to the system. In 2004, high phosphate values were reported in Bahía Blanca estuary, this might indicate that the sewage discharge constituted a significant contribution of phosphates to the ecosystem [14]. Six years later, a similar monitoring report of the same area evidenced some considerable changes: a significant increase in three parameters (temperature, salinity and pH) and an accumulation of heavy metals in the sediments of the system. The levels of polycyclic aromatic hydrocarbons in the surface sediments of the study area in the estuary, presented concentrations corresponding to moderate levels of anthropic impact and moderate to high degree of contamination. That monitoring studies indicated constant processes of eutrophication, presence of heavy metals, hydrocarbons and an increasing contribution of cadmium to the ecosystem. Ecophysiological parameters showed lower levels of dissolved oxygen, percentages of oxygen saturation, and high levels of organic matter [15].

The results of the present study are consistent with the expected helminths behavior in these situations (an increase of cestodes in eutrophied water and a decrease in nematodes in presence of hydrocarbons, pesticides and polychlorinated biphenyls (PCBs)) [11]. An increase of four times in the parasite burden, 26 times greater in *D. acuta* abundances, and a decrease in *P. acutus* abundances could be justified by the increase in eutrophication and presence the hydrocarbons. The reported information makes parasitologists to consider parasites not only as causes of disease but also as bioindicators of the environmental quality. The characteristics of fish parasite communities as reflected by their biodiversity were found to be significantly different between reference and polluted sites [16]. The environmental conditions in the estuary of Bahía Blanca seem to continue worse. The report of 2017 and 2018 pointed out the internal zone of the Bahía Blanca estuary as moderately eutrophic, with biological stress conditions, high levels of macronutrients and minimum values of dissolved oxygen in some stations [17].

Conclusion

A gradual increase in organic matter added to the parameter's synergy caused by untreated sewage discharges, seems to have been the most important impact on helminth communities, altering the abundances, dominances and evenness in the parasite communities of *Sympterygia bonapartii* along 18 years. The present study proposes fish parasite analysis as a reliable model to monitor pollution in this ecosystem.

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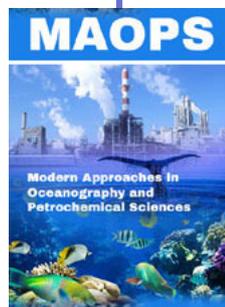
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