Spatial use of the nekton community in a subtropical shallow lake without piscivorous fish (Lake Blanca, Uruguay)

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Introduction
Lake Blanca (34°54′ S, 54°59′ W) is a subtropical shallow eutrophic system without piscivorous fish. Their absence was caused by an extreme decrease in the water level in 1998-1999 (Mazzro et al. 2003). The lake presents the typical biological structure of an exclusion experiment at ecosystem level. The nekton community is composed only by two species of fish: Jenynsia multidentata (Anablepidae) and Cryptonemertes decemmaculata (Jenyns, 1842) (Poecilidae), and a shrimp, Palaeomonetes argentinus (Nobili, 1901) (Mazzro et al. 2003).

This shallow lake is an extensive and complex littoral zone. From the shore line to the open water area we observed, an emergent plants zone (Schoenoplectus californicus L. and floating mats dominated by Typha latifolia L.), a submerged plants zone (Egeria densa and Ceratophyllum demersum L.), and finally emergent plants (only S. californicus L.). The objective of this work was to determine the spatial pattern and diel distribution of the nekton community and its relationship with environmental variables. Finally, we speculate about the possible cascading effects.

Methodology
The samples were collected seasonally: from winter 2003 to autumn 2004. Three strata (habitats) were defined according to the presence and life-form of the plants (submerged SP, emergent EP and open water OW), taking random five replicates from each one at midday and midnight. Nekton samples were taken at surface and bottom using minnow traps (40x40x60cm, 5cm hole). The catches were identified, sexed, counted (CPUE= number caught . hour -1 . minnow trap -1) and measured in the lab.

We performed simultaneously sampling for physical and chemical analyses. Similarities between samples were explored by non-metric MDS (Kruskal, 1964). The relationship between the environmental conditions and use of the space of the nektonic community was explored by Mantel’s tests. Significant differences in rank similarities between groups of samples were tested by ANOSIM (Clarke and Green, 1988), using 999 permutations. If significant differences were observed at a global level (P<0.05), the pairwise comparisons between samples groups were conducted (P=0.05/3; Bonferroni correction, (1935)). A Spearman correlations (Rs) were performed between variables analyzed.

Results
Community analysis
The differences among strata were always significant for season and diel variation (Table 1). SP and EP only presented significant differences during the day in the summer, while at night were always detected except in autumn (Table 2). The SP sites was significantly different from OW (for all the combinations of season and diel variation) (Table 2). Finally, EP and OW were significantly different for all the cases, excepted in autumn and in midday in spring (Table 2).

Statistical significant differences were found between depths, with the exception of the nocturnal samplers of winter and autumn (Table 1). At specific level, the most clear spatial pattern were registered during spring and summer. The adults and YOY of Jenynsia multidentata showed a differential spatial use. The first one preferred EP bottom, while the second were associated to surface of OW during day and night in spring and summer (Fig.1). Inverse correlations were detected between YOY and adults during the spring at midday, and during midnight in summer (Rs=-0.54, P<0.05; Rs=-0.48, P<0.10, respectively).

The shrimp presented a more complex spatial pattern. In spring the specimens with eggs, were found mainly in OW during the day and SP respectively). The adults and YOY of J. multidentata showed a differential spatial use. The first one preferred EP bottom, while the second were associated to surface of OW during day and night in spring and summer (Fig.1). Inverse correlations were detected between YOY and adults during the spring at midday, and during midnight in summer (Rs=-0.54, P<0.05; Rs=-0.48, P<0.10, respectively).

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Conclusions
The nekton use of space was not explained by the physical and chemical conditions, biological interactions could be the main explanatory factors.

The distribution of J. multidentata depend on the life-cycle stage. The diurnal distribution of adult J. multidentata, located preferentially in vegetated and deeper parts, is consistent with the hypothesis of minimization of predation risk, in this lake represented by piscivorous waterfowl.

The adults females of J. multidentata, larger and more abundant than males, could affect the space use of shrimps and fish (through competition, aggressive behaviour or cannibalism). The other species of YOY of J. multidentata, could be forced to move into less-safe habitats.

The high abundance of planktivores (J. multidentata), associated with the absence of piscivorous fish, and the important nutrient load in the system, could promote the development of phytoplankton bloom and a decrease in water quality.

References

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Figure 1. Non-metric MDS for samples of spring and summer. We excluded C. decemmaculata because J. multidentata has been found during all the cases. The positions in MDS were indicated for each species and its different life cycle stage. Stress = 0.15, N= SP, ▲ SP, ● SP, ○ OW.