

Incidence of land uses on the consumption of microplastics by fish communities in Uruguayan lowland streams

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Streams and rivers are considered to reflect their location and the activities that occur on their basins, their natural characteristics and geomorphological history (Wetzel *et al* 2000). Human activities tend to generate impacts and contaminants, and microplastics (MPs, < 5mm) are one of the most important emergent pollutant in water bodies, land, and air (García *et al*, 2020).

The interactions with biota that inhabits the different ecosystems seems inevitable, and their consequences can vary from ingestion and accumulation in the digestive tract, to even death (Foley *et al*, 2018).

There is scarce information on MPs dynamics in lowland streams and the impacts resulting from different land uses. This work analyzes, for the first time for Uruguay, the consumption of microplastics by fish communities in streams from watersheds with two contrasting land uses.

General Objective:

- Evaluate the incidence of MPs in the diet of fish communities from streams with contrasting land uses (i.e. extensive ranching and urbanization).

Specific objectives:

- Evaluate and compare the density of MPs in the stomach contents of fishes in 3 streams with extensive livestock farming and 3 streams with urban uses.
- Assess and compare the MPs load at the community level considering both types of land uses (i.e. extensive ranching and urban).

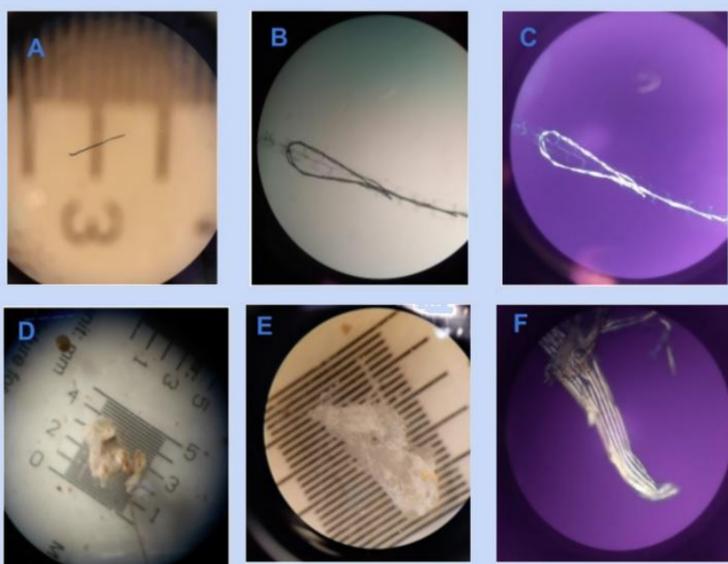


Figure 1. Microplastics (MPs) found in stomach samples. A, B and C are fibers, and D, E and F are fragments. C and F show a positive reaction of MPs to polarized light.

Stomachs were dissected from up to 5 individuals per species, and an alkaline digestion modified from Dehaut (2016) was performed. Each sample was then examined under a stereomicroscope, where MPs were identified, measured, photographed, and moved to a microscope with polarized light for corroboration (Figure 1).

Results:

- A total of 373 MPs were found, mostly fibers (85%) and particularly blue (67%).
- 189 individuals (i.e. 60% of the 314 analyzed) had MPs in their stomach, covering 29 different fish species.
- Ranching streams showed a significantly lower percentage of individuals with MPs than Urban streams (Test Mood's median, $\chi^2=6$, $p=0.014$) (Figure 2). However, there were no significant differences on the mean number of MPs ingested per individual between these two land uses.
- Ranching streams showed significantly lower MPs/g of fish than Urban streams (Test Mood's median, $\chi^2=6$, $p=0.014$).
- The species suffering the highest incidence of MPs were not the same if we consider the mean number of MPs/individual and MPs/gram.

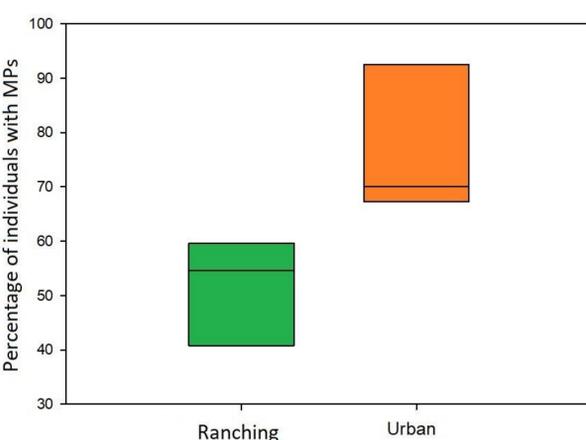


Figure 2. Median and extremes values for the percentage of individuals with microplastics (MPs) from Ranching (green) and Urban (orange) streams.

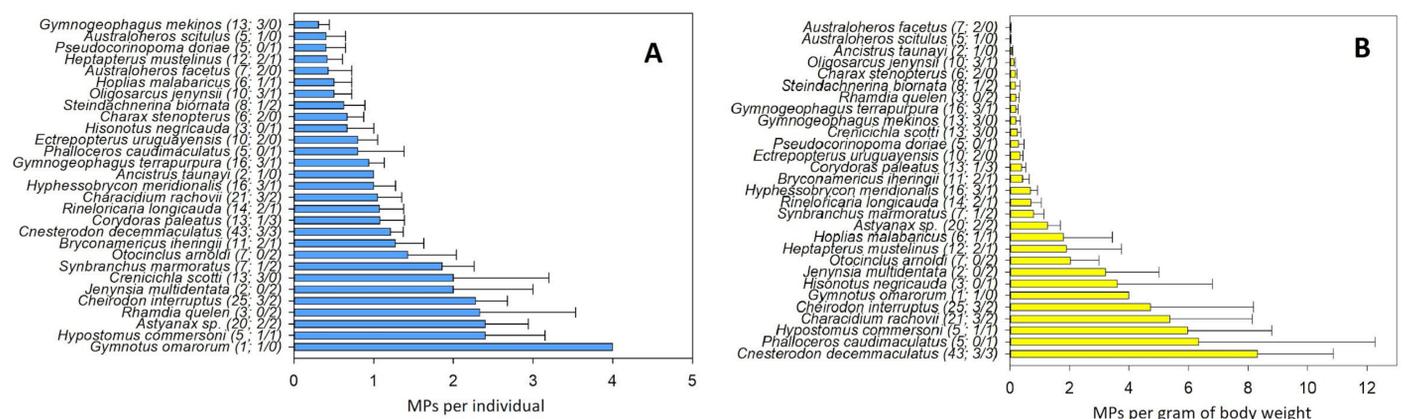


Figure 3. Mean number of microplastics (MPs) per individual per species (+EE) (A). Mean MPs per gram of individual fish (B). Both graphs present the species in increasing order. In parentheses: the number of individuals analyzed, and the number of rivers within each group the species was present, in both Ranchers and Urban streams, respectively.

Discussion and conclusions:

- This is the first attempt to understand MPs ingestion in lowland streams in Uruguay.
- The type of MPs found are consistent with previous works in the region (Pazos *et al*, 2017; García *et al* 2020).
- There is a significant difference between the amount of individuals in fish communities in lowland streams eating MPs, being Urban land uses associated with a higher consumption.
- The high percentage of individuals with MPs in Ranching streams leads to believe that human presence rather than urban areas might result in a higher presence of MPs in streams.
- Atmospheric deposition should be considered in future investigations.
- Analyzing MPs with regard to body weight, at stream and species level, provides a new way of understanding potential impacts. Smaller species like *Cnesterodon decemmaculatus*, might have the same average consumption than bigger species, but has a much higher MPs/gram of body weight ratio, which could suggest higher stress levels.
- Few studies consider MPs consumption at the community level and only consider individual level, but it should be assessed and it could give estimates to the amount of “active” MPs for trophic transfer.