ISO-INVA: Quantifying food web dynamics in invaded stream communities

iso INVA

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FRAMEWORK

Biological invasions are expanding worldwide at an increasing rate, and are a major driver of global environmental change, biodiversity loss, and biotic homogenization[1], particularly in freshwater ecosystems[2]. Most studies on fresh waters have focused on responses of native biota to invasive fishes and there is limited knowledge on ecosystem effects, specifically on food web structure.

This is important because most invasive fishes differ in functional traits from native fishes and may have direct and indirect impacts on communities, by creating novel trophic links and modifying or disrupting existing ones, that result in dramatically different food web architectures[3].

GOALS OF ISO-INVA

1. Clarifying how invasive fishes modify the food web structure in freshwater ecosystems
2. Quantifying how environmental change intensifies the effects of invasive fishes on food webs

STUDY SITE & METHODS

Focus will be on the Lower Guadiana Drainage (LGD; SW Iberia), which harbors a rich native fauna, being one of the most invaded drainages in the Iberian Peninsula and one of the main gateways of entry of invasive fishes in Portugal. Streams in the LGD exhibit high intermittency, restricting to pools of different size during the dry-season, and are subjected to distinct levels of invasion intensity.

Stable Isotopes Analysis (SIA) will be used to identify the major energy pathways in the ecosystem providing a broad and integrative picture of energy flow through food webs.

Fig. 1: Fish collection stored at the Museu Nacional de História Natural e da Ciência (MUHNAC).
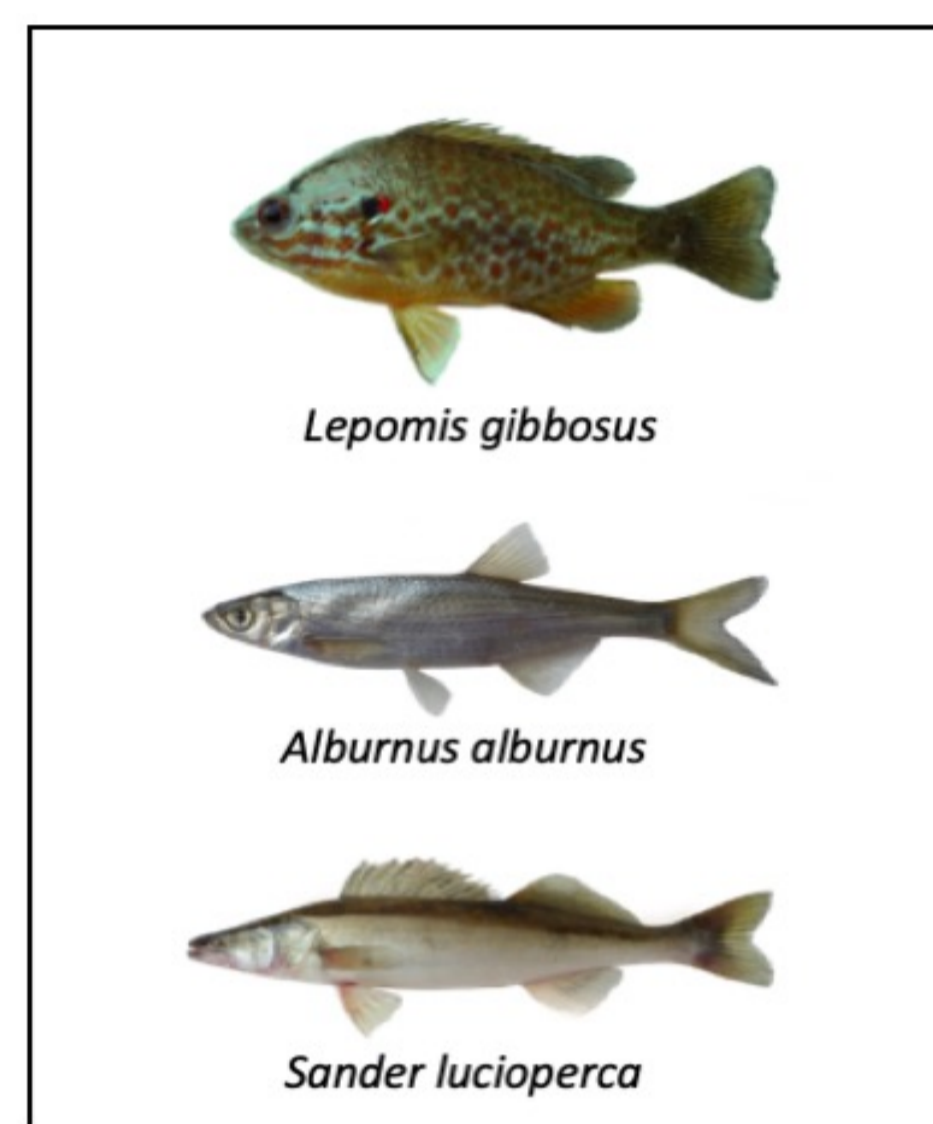

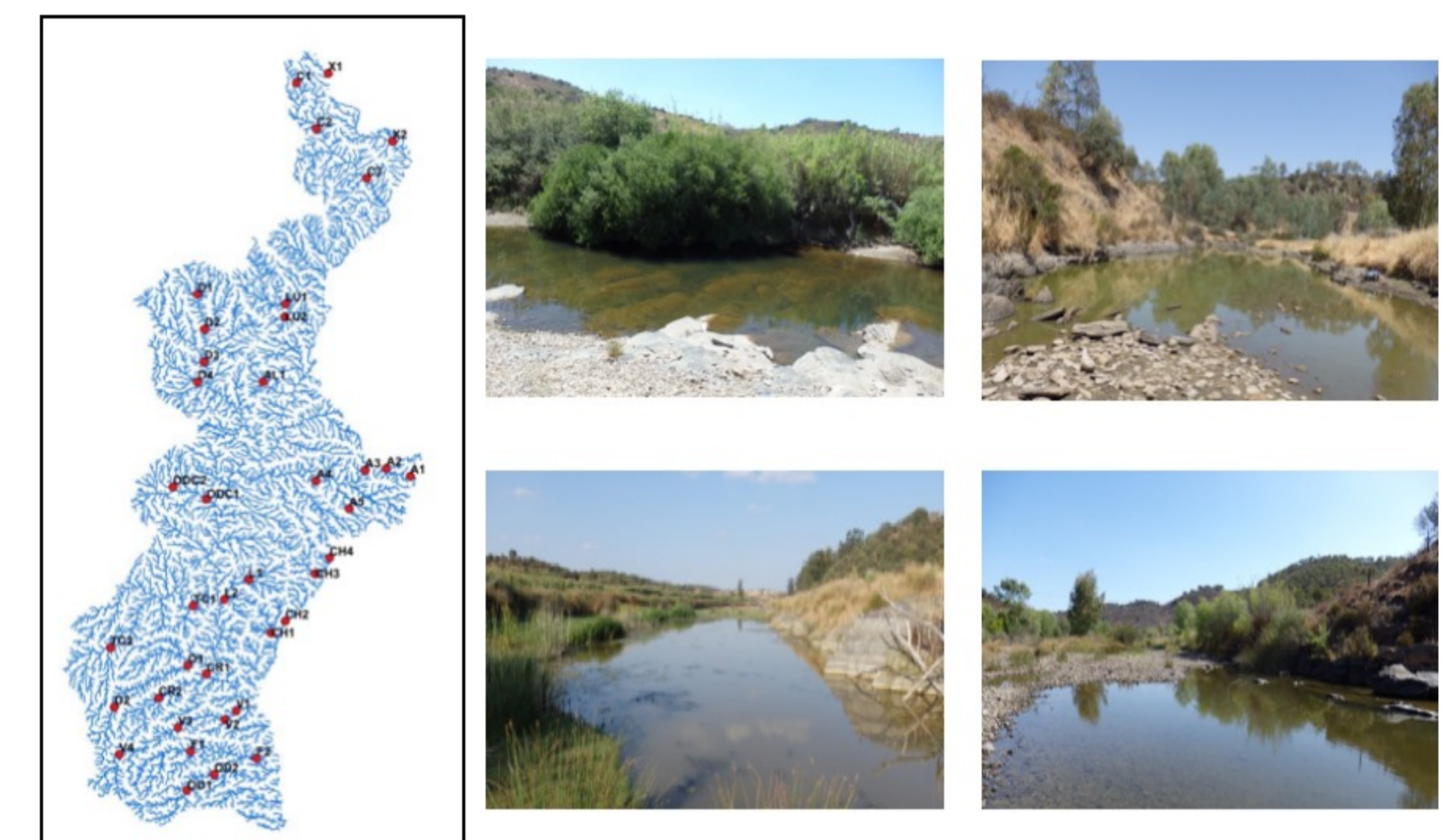**Fig. 2:** Major fish invaders found in the Lower Guadiana Drainage.

Fig. 3: Location and variety of remnant pools sampled in the Lower Guadiana Drainage in July 2019.

Task 1: Long term changes in community trophic structure

We will investigate longterm changes in food webs associated with inasive species, by quantifying variation in food webs over the past 30 years, based on contemporary and museum-archived fishes (Fig. 1).

SIA will run in a range of native and invasive species collected from 3 time periods (1979-1981; 2002-2004; 2019), coinciding with introductions of major invaders (e.g. *Lepomis gibbosus*, *Alburnus alburnus*, *Sander lucioperca*; Fig. 2).

Task 2: Environmental and Invader effects on the food web structure

We will quantify contemporary changes in trophic diversity caused by biological invasions and environmental variability. Sampling was conducted in July 2019, in 39 remnant pools distributed along the gradient of richness, abundance and functional diversity of invasive fish species in the LGD (Fig. 3). Fish were fin clipped and divided into 3 life stages for analysis: YOY, juveniles and adults (Fig.4). Environmental conditions were characterized using a set of variables known to influence fish communities and food resources (e.g. pool size, land use, productivity, etc.). Primary producers, zooplankton and benthic macroinvertebrates were assessed to characterize the most important trophic resources for fish (Fig. 5).

Task 3: Intraspecific functional influences in trophic structuring

We will explore intraspecific variability in morphological fish traits associated with food acquisition and locomotion, which are two key functions in habitat filtering and niche differentiation[4] (Fig. 6). Functional diversity indices will be quantified and tested for differences between native and invasive species at individual level[5]. Each functional diversity index will be analyzed separately to determine whether ecological processes (e.g. habitat filtering and niche differentiation) are the driving mechanism structuring the local coexistence of native and invasive fishes.

Task 4: Actions of public awareness about Fish Invasions

- Website and outreach material (e.g. leaflets, posters)
- Public Exhibition
- Seminar for researchers and professionals
- Scientific Conference

Fig. 4: Electrofishing sampling and fish analysis in the Lower Guadiana Drainage.

Fig. 5: Water filtration and zooplankton and macroinvertebrates sampling in the Lower Guadiana Drainage.
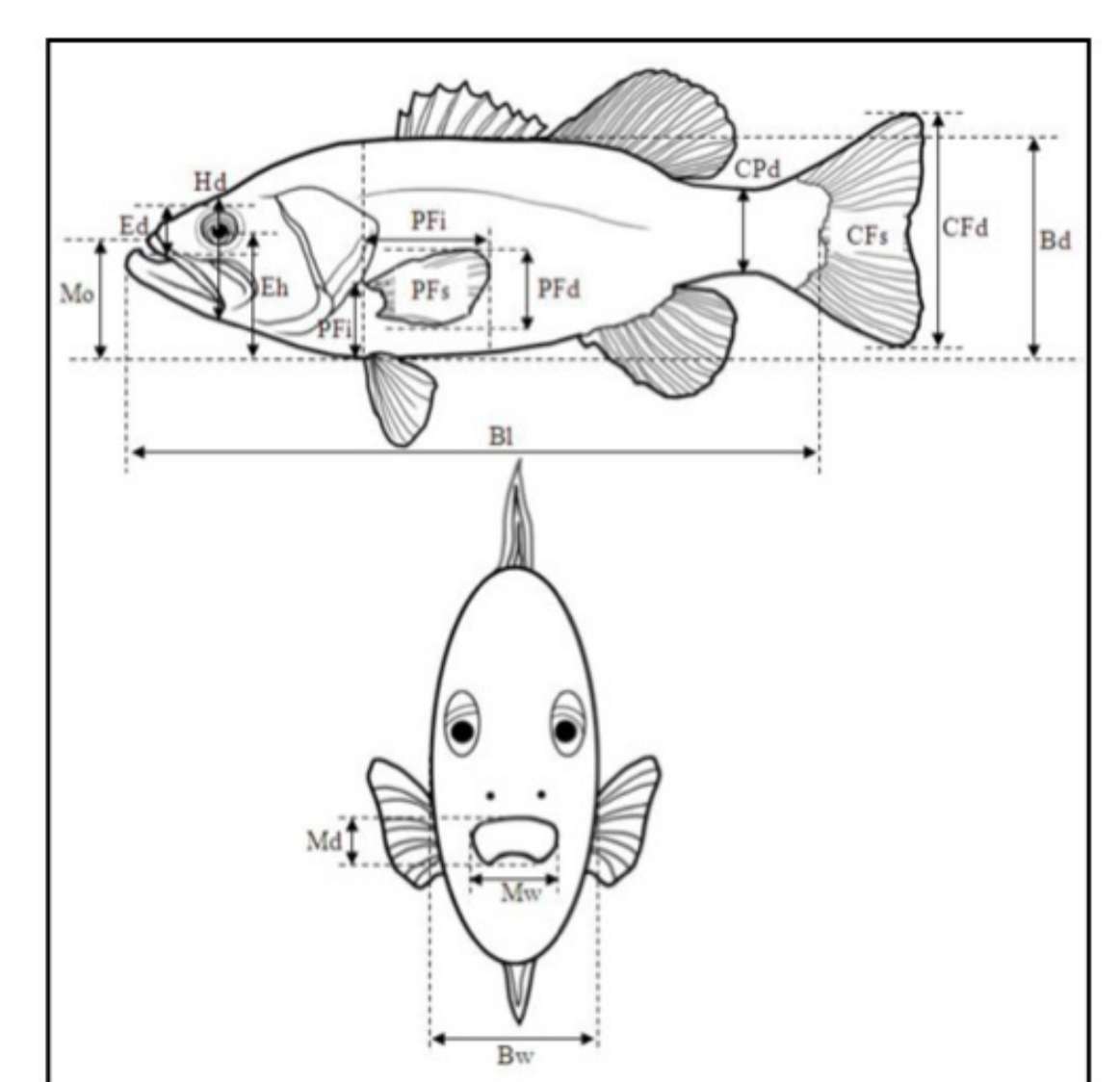

Fig. 6: External morphological traits associated with food acquisition and locomotion in fish.

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