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EXTENDED ABSTRACT

Diet of non-native pikeperch *Sander lucioperca* (Linnaeus, 1758) in Portugal: a first perspective on Tejo basin dietary patterns

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INTRODUCTION

The introduction rate of new species is expanding worldwide, being a major driver of biodiversity loss and biotic homogenisation (Strayer & Dudgeon 2010). Such phenomenon is particularly serious in Mediterranean regions (Anastácio et al. 2019) with the modification of habitats (construction of dams and barriers) associated with the establishment of non-native fish (hereafter NNF) (Radinger et al. 2019). The spread of these species promotes a cascade effect disrupting the food webs and ecosystems (Baxter et al. 2004, Clavero et al. 2013).

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Iberia is a bio-invasion hotspot for freshwater fish introductions containing nearly 30% of NNF relative to total number of present fish species (Leprieur et al. 2008, Leunda 2010). For instance, Portuguese freshwaters contain 20 NNF of a total of 64 fish species, and nearly half of these non-natives have arrived in the last 2 decades (1 new NNF/2 years) (Anastácio et al. 2019). Some of recent NNF are top predators with potential high impact to fish communities and aquatic food webs (Ribeiro & Leunda 2012).

The pikeperch (*Sander lucioperca*) arrived to mainland Portugal in 1997, being firstly reported in Ermal reservoir (Ave basin, NW Portugal) (Barros et al. 1998). In less than a decade, it was spread across mainland Portugal, reaching the Guadiana basin in 2005 (Ribeiro et al. 2009a, b). Only one study has addressed the pikeperch diet in Iberian freshwaters (Perez-Bote & Roso 2012), being important to evaluate its predation pressure in different habitats (lotic and lentic) within its invaded range. Here it is described the diet of pikeperch in Tejo basin and how the diet competition varies between different habitats.

METHODS

Pikeperch specimens were captured at three populations of Tejo river basin, two in lentic systems: Castelo de Bode and Belver reservoirs; and one in the main stem of the Tejo river. The fishes where supplied by professional fishermen using gillnets for the study. In the laboratory, individuals were measured for standard length (SL ± 1 mm), and weighted (± 0.01 g).

Stomach contents were identified to the lowest taxon possible, using the bones and hard parts such as otoliths, scales, cleithra, pharyngeal teeth and counted. Preys were grouped in the following categories: Native fish ("*Atherina boyeri*", "*Luciobarbus* spp.", "*Platichthys flesus*", "(*Pseudochondrostoma polylepis*", "*Squalius* spp."); Non-native Fish ("*Alburnus alburnus*", "Carp group" - composed by *Carassius* spp. and *Cyprinus carpio*, "*Gambusia holbrooki*", "*Lepomis gibbosus*", "*Micropterus salmoides*", "*Sander lucioperca*") and Others (Decapods, "*Procambarus clarkii*", and "*Atyaephyra desmarestii*", "Insecta" and "Non-identified fish").

The diet was assessed using the prey numerical abundance (%NA) based on the total number of preys in each sample (Hyslop 1980). Total prey richness was calculated in each population, to assess its feeding behaviour.

RESULTS

Altogether, 86 pikeperch stomachs were examined (range from 7.7 to 60.9 cm SL), of which 26.7% (n=23) were empty, yielding a total of 117 prey items. Analysis of stomach contents identified 15 prey categories belonging to three main groups Fish, Decapods and Insects.

The diet of pikeperch was mainly composed by fish and decapods with some variation in animal prey use between populations (Figure 1). The non-native cyprinid (A. alburnus) was the only prey item present in all the three populations being an important dietary component, particularly in the two lentic populations.

In lotic Tejo, the most consumed prey was the freshwater shrimp A. desmarestii (51.2%) followed by the native fish A. boyeri (17.1%) and other cyprinids: carp group, A. alburnus (7.3% each). In the Belver reservoir the non-native cyprinid A. alburnus was the prevalent preys followed by the freshwater shrimp, both accounting for (71.4%) and (21.4%) of total

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prey, respectively. The non-native crayfish P. clarkii was the main prey (29.4%) of pikeperch collected in Castelo de Bode reservoir. Fish preys such as A. alburnus 20.6% and the centrarchids L. gibbosus and M. salmoides (combined 32.4%), constituted secondary preys.

The total number of preys eaten in each population ranged between 4 in Belver reservoir and 9 preys in the two remainder populations. However, the Lotic Tejo population of pikeperch presented higher fish prey diversity, with 8 fish species, while Castelo de Bode reservoir pikeperch population had 5 different species.

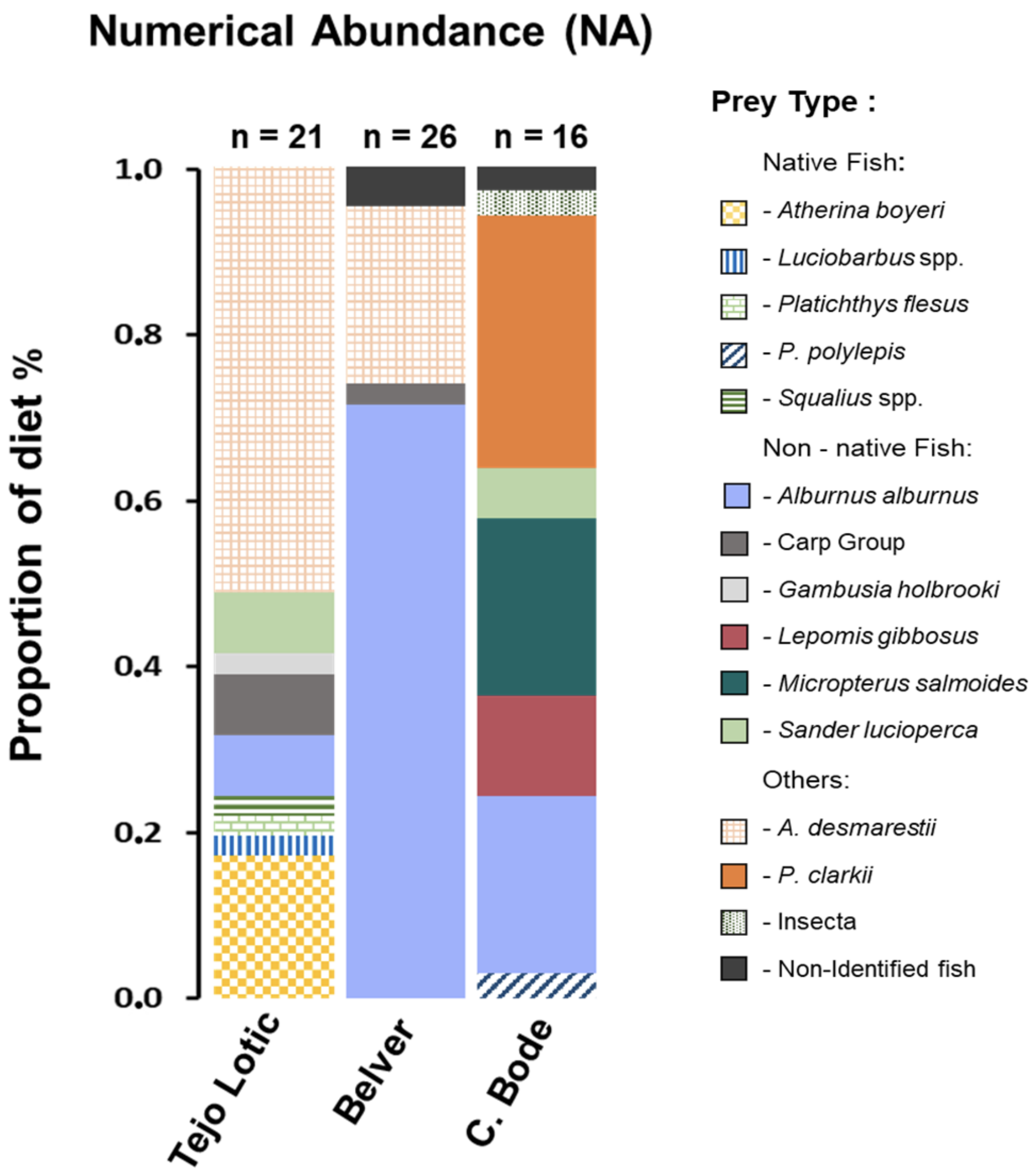

FIGURE 1. Variation of the numerical abundance (NA, %) of food items found in the stomachs of *Sander lucioperca* in the Tejo lotic, Belver and Castelo de Bode reservoirs.

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DISCUSSION

Pikeperch exhibited diet variation with staple prey varying across habitats. These variations in diet reflected changes in the use of main prey such as *A. desmarestii*, *P. clarkii* and *A. boyeri* and can be associated with local prey availability. Nevertheless, dietary patterns denoted an opportunistic ability to use locally abundant preys in each habitat, indicating the ability to utilize the most available food resources.

Fish prey richness seems to be higher in the lotic system with eight different categories (four native). In the lentic systems, prey diversity was considerably lower, mostly constituted by non-native species (*A. alburnus*, *P. clarkii* and centrarchids). Perez-Bote & Roso (2012) observed high level of cannibalism (≈50%) in Alcantâra reservoir (Tejo river), while in the current study pikeperch seemed to be occasionally cannibalistic (<15%). The potential impact on native fish communities appears to be higher in lotic system of the lower Tejo. In fact, this system has higher diversity of fish fauna than in the studied lentic systems, with some species being endemic to this region (Veríssimo et al. 2018).

Other studies on the diet of pikeperch, using Stable Isotopes Analysis (SIA), shown a higher trophic position in both ecosystems (lentic and lotic), even when compared with other predators such as pike (*Esox lucius*), or European catfish (*Silurus glanis*) (Kopp et al. 2009). The use of SIA in diet studies have shown to be more sensitive and robust when compared with Stomach Content Analysis (SCA), presenting a broader assessment on the impacts of invasive species through their trophic position. However, a combined SIA and SCA of pikeperch diet may give an, detailed and comprehensive, view of the prey species most consumed by pikeperch, better assessing the predation impact that may exert on the native fish communities (Nolan & Britton 2018).

This first perspective about pikeperch diet in Portugal, presents a broad view of the feeding traits of this non-native predator within different types of habitats. It is extremely important to deepen our knowledge about these newly predatory fish, particularly during early invasion stages when its dietary preferences exert higher impact on native fishes (Ribeiro & Leunda 2012).

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