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Research Article

Analyzing habitat preferences of *Capoeta razii* (Teleostei: Cyprinidae) at different ages in the Zarem stream, Iran

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Abstract: Understanding habitat preference is important in many terms such as management of fish populations, assessment of river health, river restoration, etc. In this regard, we chose *Capoeta razii*, one of the most abundant species in the Caspian Sea rivers, to study its habitat preferences in different ages. As pilot, Zarem Stream, a main tributary of Tajan River with low pressures and high habitat diversity, was selected. After collecting fish species in different random points, the environmental variables in the sampled areas were measured immediately after sampling. Habitat preferences analysis for different ages of this species showed that each age has almost own specific preference in terms of flow velocity, depth as well as abiotic and biotic substrate.

Keywords: Habitat suitability, Environmental variables, Freshwater, *Capoeta*, Iran.

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Introduction

Freshwater ecosystems and their resources are crucial part of human life and their health is often reflected in the structure and characteristics of the fish communities they support (Facey & Grossman 1990). Fishes need suitable environmental conditions to live and reproduce (Gebrekiros 2016), and their habitat includes all the required physical factors (e.g. temperature, water depth, current, waves, bottom types, cover, etc.) and chemical factors (e.g. oxygen levels, dissolved minerals, and other substances) (Bovee 1986; Bovee 1994; Yu & Lee 2002; Parasiewicz 2007; Morid et al. 2016). Moreover, habitat requirements for each stage of a fish's life cycle (egg, larvae, juvenile and adult) may also be quite different within the same water body (Melcher & Schmutz 2010). In areas where fish habitats have been changed or lost by humans, many important fish species have declined in numbers, become extinct, or have been replaced by other species more tolerant of the habitat changes (Pont et al. 2006; Schmutz et al. 2000, 2007).

The importance of habitat characteristics on community structure and species distribution has long been recognized (Bovee 1982; Parasiewicz 2001; Ahmadi-Nedushan et al. 2006; Parasiewicz 2007; Gebrekiros 2016). Iran is located in the Palearctic zoogeographical realm bordering oriental and African ones. Therefore, due to geographical and geological conditions coupled with climatologically diverse environment resulted in this enormous and specific diversity. Overall, the ichthyofauna of Iran comprises a total of 297 species including native, endemic and exotic species (Esmaeili et al. 2018). Some studies have been investigated habitat suitability of Iranian freshwater fishes (e.g. Asadi et al. 2014; Tabatabaei et al. 2015; Hoghoghi et al. 2016; Nasrolah Pourmoghadam et al. 2019), but none

Table 1. Substrates for instream microhabitat recording according to multi-habitat sampling protocol.

Substrate name for database	Substrate name	Abbreviation	Description	Type	Grain size [mm]
Mega-/ Macrolithal	Blocks	block	Large cobbles, boulders and blocks, bedrock; coarse blocks, head-sized cobbles, with a variable percentage of cobble, gravel and sand	mineral	>200
Mesolithal	Cobbles	cobble	Fist to hand-sized cobbles with a variable percentage of gravel and sand	mineral	>60-200
Microlithal	Coarse gravel	c-gravel	Coarse gravel (size of a pigeon egg to child's fist) with variable percentages of medium to fine gravel	mineral	>20-60
Akal	Fine gravel	f-gravel	Fine to medium-sized gravel	mineral	>2-20
Psammal	Sand	sand	Sand	mineral	>0.006–2
Argyllal	Loam	loam	Silt, loam, clay (inorganic)	mineral	<0.006
Technolithal	Artificial	techno	Artificial blocks often used as	mineral	>200
Xylal	Large wood	wood	Tree trunks, dead wood, branches, roots	biotic	
CPOM	Coarse particulate organic matter	cpom	Deposits of coarse particulate organic matter, e.g. fallen leaves	biotic	
FPOM	Fine particulate organic matter	fpom	Deposits of fine particulate organic matter, e.g. mud und sludge (organic)	biotic	
Algae	Algae	algae	Filamentous algae, algal tufts	biotic	
Sub_macrophytes	Submerged macrophytes	subm	Submerged macrophytes, including moss and Characeae	biotic	
Em_macrophytes	Emergent macrophytes	emm	Emergent macrophytes, e.g. Typha, Carex, Phragmites	biotic	
LPTP	Living parts of terrestrial plants	lptp	Fine roots, floating riparian vegetation	biotic	

of them focused on the different stages of fish`s life cycle, therefore, this study aimed to study habitat preferences of *Capoeta razii,* a dominant freshwater fishes in the southern Caspian Sea basin (Zamani Faradonbe et al. 2015; Jouladeh-Roudbar et al. 2017), in different ages.

Materials and Methods

Study area: Data were collected in a section of Zarem stream (Fig. 1) which is as main branch of the Tajan River locating in Mazandaran Province, Iran. This was chosen as a pilot river due to availability of diverse habitats and low pressures according to our visit and expert judgment and available documents (e.g. Mostafavi et al. 2015, 2019). We finally selected a section of this stream as a representative site.

Fig.1. Sampling site location in the Zarem Stream.

Abiotic and biotic data collection based on transect method: After defining the section, we measured flow velocity, depth, abiotic and biotic substrates on the different transects. Table 1 shows abiotic and biotic substrates variables with

Table 2. The characteristics of sampling site on Zarem Stream.

Site	Coordinate (x,y)	Habitat type	Maximum width(m)	Wetted width(m)	Slope (%)	Elevation (m)
		Pool-riffle-run	19.8	6	2.9	**435**
Zaremrud	**T(◦c)**	**DO (mg/l)**	**pH**	**Salinity (0.0 ppt)**	**TDS (mg/l)**	**EC (µm/cm)**
	25	9.43	7.33	0.2	215.8	**426**

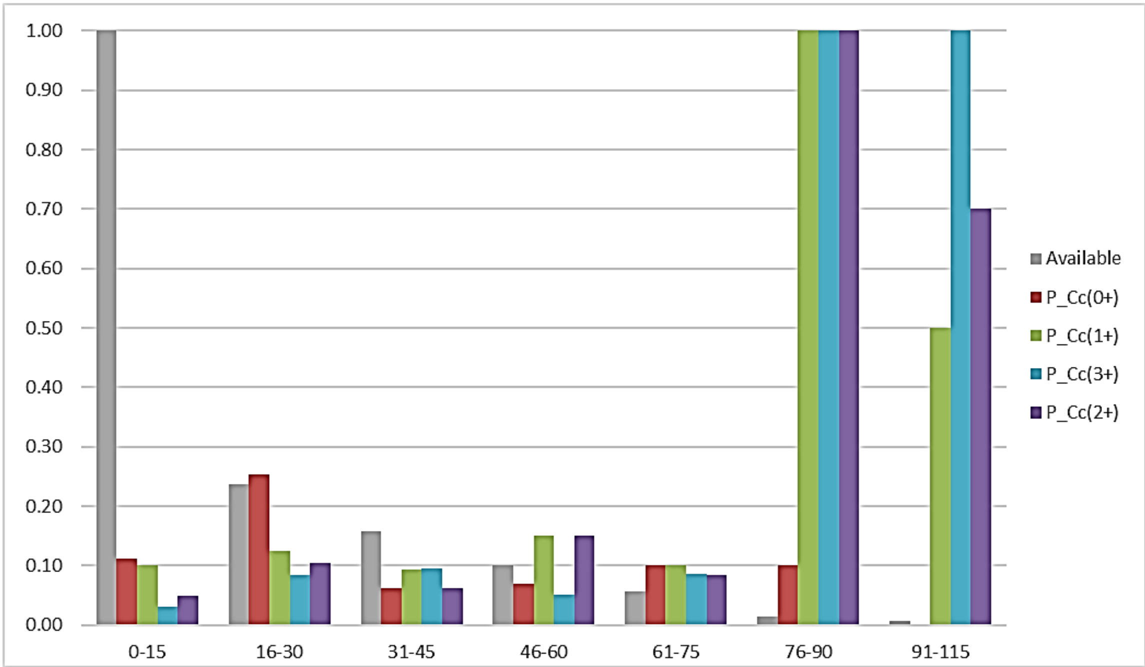

Fig.2. Available habitats with habitat preference curves of flow velocity for *Capoeta razii* at different ages (0+, 1+, 2+, 3+).

explanation.

Fish data collection: We sampled fishes using electrofishing device in different random points according to Parasiewicz (2007) to cover all microhabitat types. Afterwards, in each sampled point, the abundance of *C. razii* was counted separately and some scales were also taken to determine the age of fishes in the laboratory. Moreover, in each sampled point, all above-mentioned environmental variables were measured similarly and immediately.

Data analysis: Available habitat and preference curves were developed for each microhabitat variable using frequency-of-use graphs (FUG, Raleigh et al. 1986), relevant to each age-class of each key species as follow:

$$FUGi = fi / f[max]$$

Where fi is class frequency and f[max] is maximum class frequency. For preference curves we used the Ivlev index (Ivlev1961) as follow:

$$Preference = U / A$$

Where U is class frequency of habitat used and A class frequency of habitat available.

Results

The environmental characteristics of the Zarem Stream at sampling sites are shown in Table. According to Figure 2, the most preferable flow velocity for 0^+ is 16-30 cm/s and for 1^+, 2^+, 3^+ 76-115. The most preferable depth for 0^+ is 16-60 cm, 1^+ and 2^+ 16-90 and 3^+ 16-115 based on (Fig. 3). Figure 4 shows that all ages prefer Macrolithal, Mesolithal and Microlithal. Furthermore, 0^+, 1^+ and 2^+ prefer Argyllal, but 3^+ not prefer it. Moreover, it is necessary to be indicted that Akal was not preferable for all ages. Regarding biotic substrate preference,

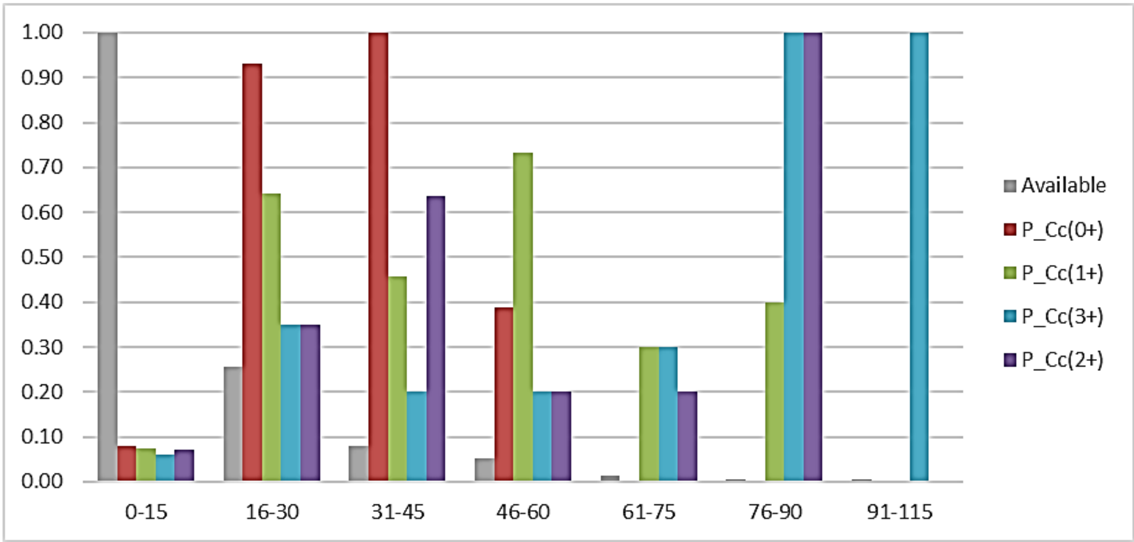

Fig.3. Available habitats with habitat preference curves of depth for *Capoeta razii* at different ages (0+, 1+, 2+, 3+).

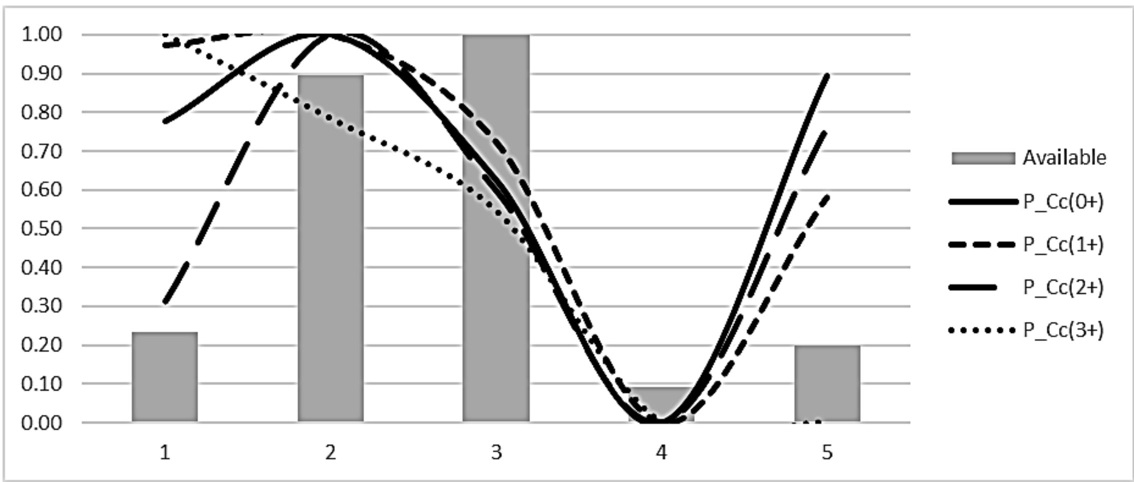

Fig.4. Available habitats with habitat preference curves of abiotic substrate for *Capoeta razii* at different ages (0+, 1+, 2+, 3+) (Macrolithal:1, Mesolithal: 2, Microlithal: 3, Akal: 4, Argyllal:5).

the results revealed that all ages mostly prefer LPTP (i.e. Fine roots and floating riparian vegetation) although 1^+ and 3^+ also prefer CPOM (i.e. coarse particulate organic matter) and FPOM (i.e. fine particulate organic matter) to some extent (Fig. 5).

Discussion

Streams are important habitats due to providing shelter and feeding opportunities for a wide range of aquatic organisms e.g. fish, insects, plants, mollusks, birds and mammals (Melcher et al. 2012; Gebrekiros 2016). These aquatic species are dependent on running waters for their whole or parts of their lifecycle (Schmutz et al. 2000). In general, habitat can be conceptualized as the physical and chemical characteristics of a stream that determine suitability for habitation and reproduction of stream organisms (Gebrekiros 2016). Habitat diversity influences the structure and composition of fish communities in streams (Karr 1981; Hughes at al.1998; Oberdorff et al. 2001). More diverse habitat conditions support a greater range of species and age classes. It can also mediate biotic interactions such as competition (Kramer 1983) and predation (Golterman 1975).

The results of the present study showed that there was differences between different ages of *C. razii* in terms of their habitat preference, particularly between 0^+ and other age groups in flow velocity and

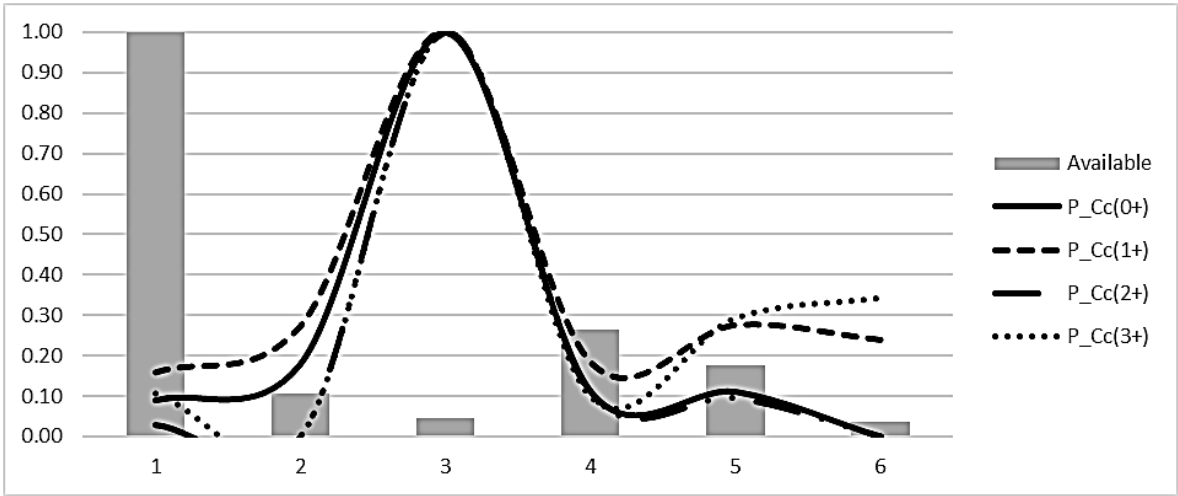

Fig.5. Available habitats with habitat preference curves of biotic substrate for *Capoeta razii* at different ages (0+, 1+, 2+, 3+) (Algae:1, Sub_macrophytes: 2, LPTP:3, Xylal: 4, CPOM:5, FPOM:6).

depth, or between 3^+ and other age groups regarding abiotic factors, also between 3^+ and 1^+ with 0^+ and 2_+ about abiotic factors. All these differences represent that the habitat of the studied river is diverse showing good ecological status according to Mostafavi et al. (2015, 2019), because fish communities can have a high degree of variability due to human modifications of streams and the surrounding landscape, presence or absence of exotic species, and natural effects (Schinegger et al. 2012, 2013; Mostafavi et al. 2015). Although our finding shows different habitat preferences of different age groups, but the results are related to the autumn and may differ in other seasons.

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مقاله پژوهشی

بررسی ترجیحات زیستگاه سیاه ماهی رازی (Teleostei: Cyprinidae) *Capoeta razii* در سنین مختلف در رودخانه زارم، ایران

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چکیده: شناخت ترجیح زیستگاهی به دلایل متعددی از قبیل مدیریت جمعیت ماهی، ارزیابی سلامت رودخانه، احیای رودخانه و غیره حائز اهمیت می‌باشد. در این راستا، ترجیحات زیستگاهی گونه سیاه ماهی رازی (*Capoeta razii*)، که یکی از گونه‌ها با بیشترین فراوانی در رودخانه‌های حوضه جنوبی دریای خزر است در این مطالعه بررسی شد. رودخانه زارم که از سرشاخه‌های مهم رودخانه تجن با کمترین مداخلات انسانی و تنوع زیستگاهی بالا است به‌عنوان پایلوت انتخاب شد. پس از جمع‌آوری ماهی‌ها در نقاط مختلف به‌صورت تصادفی، متغیرهای محیطی در نقاط نمونه‌برداری بلافاصله اندازه‌گیری شدند. تحلیل ترجیحات زیستگاهی برای سنین مختلف این گونه نشان داد که هر سن تقریباً از نظر سرعت جریان، عمق و همچنین بستر غیر زنده و زنده اولویت خاصی دارد.

کلمات‌کلیدی: مطلوبیت زیستگاه، متغیرهای محیطی، آب‌شیرین، سیاه‌ماهی، ایران.