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DISTRIBUTION OF THE NON-INDIGENOUS FISH SPECIES, *LEPOMIS GIBBOSUS* (LINNAEUS, 1758), IN ALBANIA

SUMMARY

Pumpkin seed, *Lepomis gibbosus* L., is a native fish species to the eastern North America and is introduced to Europe freshwaters during the late nineteenth century and now appears to be wide spread in numerous countries. During the last two decades, the species spread rapidly into the Albanian inland water bodies. The distribution and abundance of invasive fish species *Lepomis gibbosus* L. inhabiting different water ecosystems, natural or man-made, standing or running ones was investigated. The study was carried out during a period of 10 years mostly during active breeding period for pumpkinseeds. The investigated water bodies are located along different water basins of Albania. Habitat quality was assessed after fish sampling. The following biological and physical habitat variables were considered: dissolved oxygen (mg l^{-1}), pH, and water temperature (^{o}C) measured with multi-parametric probes; electro conductivity (μS/cm) was measured with portable conduct meter. Substrate composition was visually estimated in a 1-m-wide band centered across each assessed area.

INTRODUCTION

The pumpkinseed sunfish, *Lepomis gibbosus*, was first imported in Europe for recreational fishery and as an aquarium and garden pond fish at the end of the 19th century, while nowadays it is one of the most successfully introduced fish species (Holcik, 1991; Garcia-Berthou and Moreno-Amich, 2000; Van Kleef *et al*., 2008; Uzunova *et al*., 2010). During the last years, the species spread rapidly into the Albanian inland water bodies (Shumka *et al*., 2008; Shumka and Apostolou, 2018; Pietrock *et al*., 2022).

Within last couple of decades, the intensive use and impacts to freshwater ecosystems in Albania has seriously affected the biotic components (Copp *et al*., 2004; Shumka and Apostolou, 2018; Pietrock *et al*., 2022). The effective management of fisheries resources requires detailed knowledge of the fish populations and habitats to be managed, and knowledge of the relationships between the populations and non-biotic factors and their habitats. The data about fish populations (species, abundance, population's size, etc) and communities is required to be completed through relevant monitoring practices and scientific approaches. Nowadays the sampling method usually involves capturing fish and further analyses, although it may, in some cases, be acquired by simply observing fish in their habitats.

The indigenous fish populations and particularly endemic fish species in the project survey area are threatened by several anthropogenic activities and factors like: (i) Water pollution caused mostly due to a lack of the waste water treatment facilities as well as a lack of integrated management approaches; (ii) Relatively unregulated fishery practices and illegal fishing, use of destructive methods of fishing; (iii) Non- indigenous fish species, accelerated abundance with unpredicted sequences to native endemic species; (iv) Impacts on specific spawning grounds for specific species particularly due to serious impacts caused by water use in the agriculture sector with a constant presence of run-offs and no abatement plans; (v) Poor integration of fishery management practices into the entire management of the area (including protected one as Prespa National park, Shebenik Jabllanica National Park, Nature Monuments Lake Merhoe, etc) which is recognized for its rich biodiversity and abundance of species; (vi) Low rate of local awareness for the fish biodiversity, conservation threats. The awareness and knowledge is just limited to a couple of commercial fish species.

The fish assemblage of the area is rapidly changing and similarly to wider Mediterranean area it is expected that will follow in a situation of increased anthropogenic impacts and climate changes by the introduction of alien species (Copp and Fox, 2007). Being situated at the proximity with different natural Lakes as Dumrea, neighboring one and associated tributaries and systems where the assemblages are rapidly changing, there is a relatively a high risk of changes regarding the composition and share. In our case with alien species, we have to consider both exotic ones and those translocated from other ecoregions. In the table 5 are gives indications of the rate of endemic species of project focus area.

MATERIAL AND METHODS

Study area

Samples were taken from 15 water ecosystem and 19 stations located at accessible sites, representative for the particular water body (Fig. 1). Fish sampling was conducted during the spring and summer periods (April and August, 2016-2022) covering also the periods once the territorial males guard their nest, situated mainly

in the littoral zone. All sampled localities considered during this survey were both natural one and human induced for different purposes.

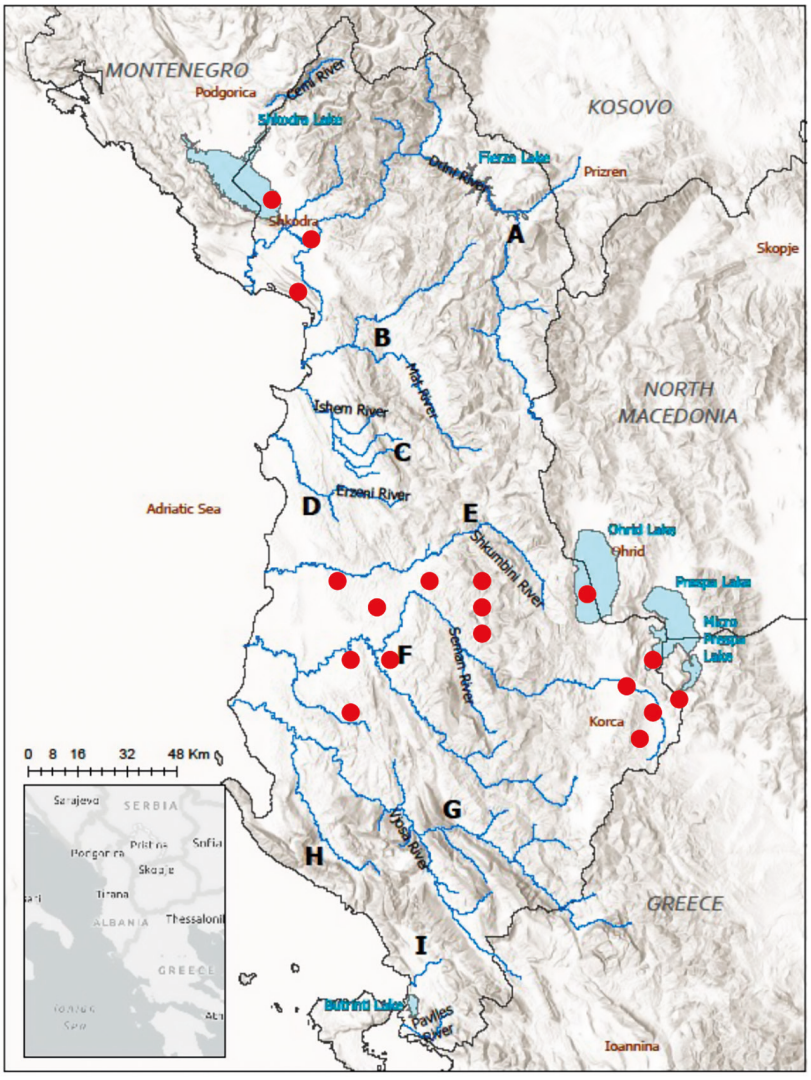

Fig. 1- Fish sampling localities considered for sampling Pumpkin seed in Albania (in red) and different water drainages in Albania arranged as follows: Drini (Ohrid-Drin-Skadar system including the Buna River) (A), Mat (B), Ishëm (C), Erzen (D), Shkumbin (E), Seman (consisting of two major tributaries - Devoll and Osum) (F), Vjosë (Aoos in Greece) river systems (G), several short rivers flowing from the Cikes Mountains to the southernmost part of the Adriatic Sea and to the northernmost part of the Ionian Sea (H), the area around the Butrint lagoon (rivers Bistrica and Pavllo) (I).

Sampling approaches

Each locality was sampled with electrofishing device, seine nets and in case of Lake Prespa with multi-mesh size nets to identify species composition and estimate the relative abundance of ecosystem fish in the littoral zone fish assemblage and not only. The collected fishes were counted and identified to species. Several specimens of pumpkinseeds were preserved in 70% alcohol. Native fishes were counted at site and released.

Habitat and fish assessment

Habitat quality was assessed after fish sampling. We measured the following chemical and physical parameters within sampling localities: dissolved oxygen (mg l^{-1}), pH, and water temperature (^{o}C) were measured with PHYWE 2018 Oxi 330i and PHYWE pH 330i, respectively. Electro conductivity (μS/cm) was measured with portable conductometer. Emergent and submerged aquatic vegetation (% of section area) was classified in four categories: (1) missing, (2) sparse, (3) intermediate and (4) dense. Costal vegetation was classified as: 1 – reed belt; 2 - mixed broad-leaved; 3 - grass. Size measurements included total (TL) and standard (SL) length. The fish were weighted (W, g) to the nearest 0.1 g. Food content of selected i.e. average abundance in stomach was assessed at 30 specimens.

CPUE expressed in biomass of species per locality (g/100m^2) per sampled area in case of electrofishing and seine net net surface (20m length of the net multiplied by sampled length of area). Species evenness and richness between sub basins were obtained from data and also species length frequency for all species caught. All processed and analysed data are archived as data sets in a MetaData excel file.

RESULTS

A total of 2330 fishes belonging to 23 species from 8 families were obtained from the survey. Among the aliens the most widespread species were: Stone moroko (*Pseudorasbora parva),* prussian carp (*Carassius* gibelio) followed by Bitterling (*Rhodeus amarus*), the sunfish pumpkinseed (*Lepomis gibosus)*, Mosquitofish (*Gambusia holbrooki*), European trench (*Tinca tinca*). Further on the aquaculture used species as: carp (*Cyprinis carpio*), Grass carp (*Ctenopharyngodon idella*), Silver carp (*Hypophthalmichthys molitrix*), Bihead carp (*Hypophthalmichthys nobilis*) and Common bream (*Abramis brama*) were also recorded during fish survey.

It is worth to note that pumpkinseeds occurred in an increased abundance in the five of our surveyed water bodies. So within this water bodies (Small Prespa Lake, Banja Lake, Poloska Reservoir, Belshi 1-Dumrea and Belshi 2) out of total 1015 specimens the pumpkinseed was represented with 59, showing higher presence in Banja Lake (Fig. 2). Following different references, pumpkinseeds prefer still waters (Crivelli and Mestre, 1988; Copp *et al*., 2002).

UZUNOVA *et al*. (2002) emphasized that in general, fishes which could spread widely are those highly adaptable to adverse environmental factors mainly in result of water pollution and habitat degradation. In the following table (Tab. 1) are presented the mean values for environmental parameters measured at 19 sites considered during our survey.

Tab. 1- Mean values for environmental parameters measured at 19 sites. Type of water body (1-natural lake; 2-river and 3-man made; Water body shore type (1=steep; 2 = slant); bottom substrate in % (mud; sand: 0.06-0.2 cm; gravel: 0.2-2 cm; boulders: 2- 20.0 cm); dissolve oxygen content (mg/l); temperature (°C); electric conductivity (µS/cm).

No.	Name of water body	Coordinates	Type of water body	Shore type	Substrate	Tepterature (°C)	DO (mg/l)	Conductivity (µS/cm)	pH
1	Poloska	40°35‘10.36“N 20°57‘17.78“E	3	2	mud	26	7.7	380	8.1
2	Devolli 1	20°58‘42.77“E 40°36‘50.02“N	2	2	sand	19	8.7	410	7.8
3	Devolli 2	40°41‘15.11“N 20°56‘27.68“E	2	2	sand-mud	21	8.6	398	7-7
4	Small Prespa	40°41‘6.40“N 21° 0‘59.94“E	1	2	mud	24	8.7	242	7.9
5	Great Prespa	40°46‘36.12“N 20°54‘57.51“E	1	2	mud-sand	23	9.9	245	7.8
6	Podgorie	40°49‘16.95“N 20°45‘5.89“E	3	2	mud	26	7.5	415	8
7	Drainage	40°44‘50.55“N 19°37‘13.90“E	3	2	mud	25	5.4	540	8.4
8	Murizi	40°43‘31.51“N 19°43‘51.96“E	3	1	mud	28	8.9	350	8.1
9	Seman	40°48‘48.42“N 19°45‘24.06“E	2	2	mud-gravel	24	8.8	376	7.9
10	Thana	40°51‘54.55“N 19°50‘31.53“E	3	1	mud	26	8	335	7.67
11	Ohrid	41° 2‘21.02“N 20°39‘3.36“E	1	1	sand-gravel	17	11.03	224	7.9
12	Merhoe	40°56‘36.94“N 19°52‘20.34“E	1	1	sand-mud	23	9	310	8.1
13	Banja	40°57‘4.63“N 20° 5‘44.74“E	3	1	mud	27	8.8	290	8
14	Dumrea	40°55‘4.90“N 19°52‘7.29“E	1	2	mud	27	7.7	332	8.1
15	Belshi	40°58‘38.84“N 19°53‘30.48“E	1	2	mud	28	7.7	330	8.2
16	Drainage 2	40°53‘48.15“N 19°39‘53.17“E	3	2	mud	24	5.1	560	8.5
17	Gjadri	41°53‘10.00“N 19°34‘44.85“E	2	2	mud	22	9.2	310	8.2
18	Shkodra	42°4‘46.42“N 19°26‘41.23“E	1	2	mud-gravel	27	9	289	8
19	V Dejes	42° 0‘28.17“N 19°36‘37.92“E	3	1	gravel	21	10.2	266	7.9

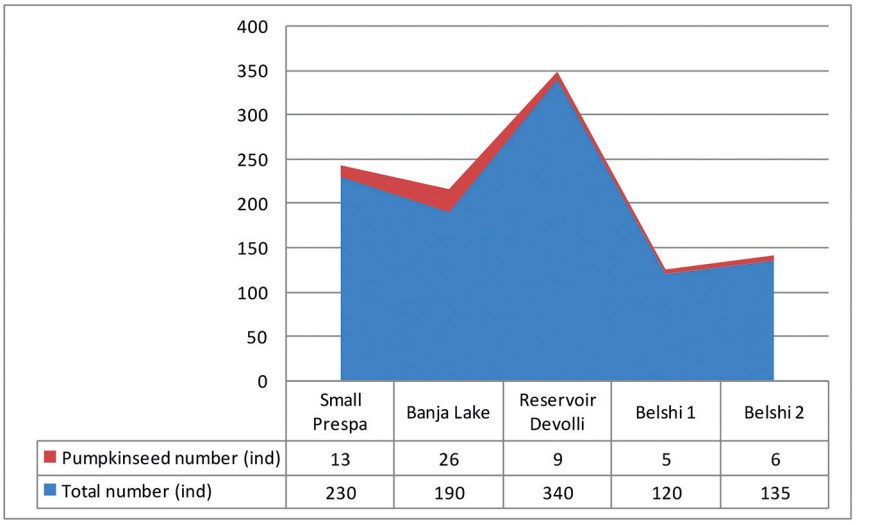

Fig. 2- The absolute data of pumpkinseeds towards total number of individuals of different species in five water bodies with higher presence.

DISCUSSION AND CONCLUSIONS

Increased presence (in both relative and absolute share), of non-native species remain a serious threat to the aquatic ecosystems at the focus area. As it has been confirmed earlier with regard to considered water bodies, about 10 species have been introduced during the last century: *Cyprinus carpio, Carassius gibelio, Carassius gibelio X Carassius aurata, Lepomis gibosus, Pseudorasbora parva* and *Rhodeus amarus*are considered naturalized in the system, particularly in the five considered ecosystems. Further on the other species as Chinese carps *Ctenopharyngodon idella, Hypophthalmichthys molitrix, Hypophthalmichthys nobilis, Abramis brama* due to regular stocking are mostly present in both surveyed lakes. During our survey we did recorded also specimen of mosquitofish (*Gambusia holbrooki*) in three survey locations including lakes of Dumrea and reservoirs.

Carassius gibelio (Prussian carp) appeared in the Lakes system (part of our survey) in the mid 70' of the last century (Shumka *et al*., 2008) and following communication with local fisherman's it was very rare until 1980. The expansion thereafter was followed by an invasion in the Dumrea lakes and also river system and rarely in its tributaries, Devolli. There is an increase of presence of Stone moroko (*Pseudorasbora parva*) all over the country with sings of increase at the Lake sampling localities.

Following our data it seems that the human induced water bodies are the best areas for presence and spread of pumpkinseeds (Fig.1.), while eutrophication and increased sedimentation rate are also favorable towards invasion as this has been proven in case of Small Prespa Lake.

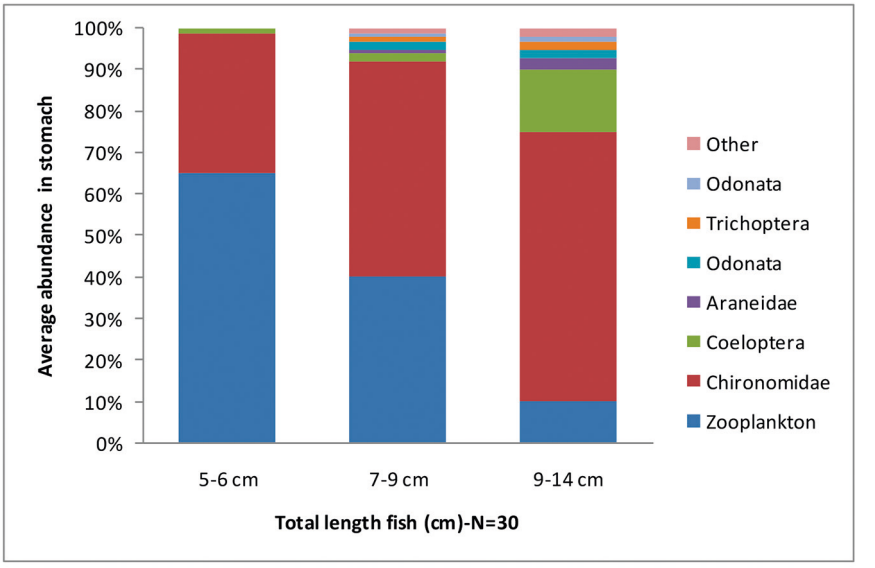

Fig. 3- The average abundance of food content in the stomach of 30 analyzed specimens of *Lepomis gibbosus.*

The gradient of food structure (analyzed via presence in fish stomach) significantly changes with increased specimens edge, so the dominance of zooplankton share at the fish of class size 5-6 cm gradually decreases and is substituted by Chironomidae. So, at the fishes of class size 9-14 cm the Chironomidae constitute 63% of food content.

The ecological effect of pumpkinseed on native species and habitats is determined as adverse, and it has been reported to be responsible for the decline of other fish species (Welcome, 1988; Godinho, 2004), gastropods (Osenberg *et al*., 1988) and other invertebrates (van Kleef *et al*., 2008). It is considered that the presence, increase in abundance or the area of occupation of invasive species may be indicative of environmental degradation (Kennard *et al*., 2005). Therefore, monitoring invasive species is a good tool both for detecting other drivers of environmental degradation and for understanding their direct impacts on biodiversity and ecosystem processes.

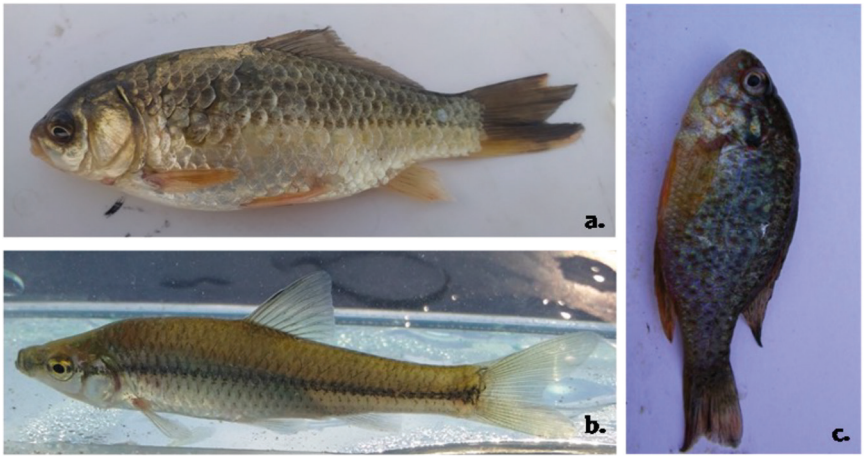

Fig. 4- Fish species: (a) *Carassius gibelio*; (b) *Pseudorasbora.parva*; (c) *Lepomis gibbosus.*

Presence of *Lepomis gibbosus* and area distribution in Albania is a serious concern for indigenous species. Currently there is little experience with pumpkinseed control. Options need to be explored, such as introducing native competitors and predators and the use of biodegradable piscicides. Probably more important is reducing the number of introductions of *Lepomis gibbosus*.

This requires limitation of the sale of the species and other measures to reduce introductions such as a growing public awareness of the ecological consequences of introducing invasive species, followed by an adequate control and enforcement of legislation concerning invasive species.

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