Small-scale fisheries in Istrian waters (northern Adriatic): preliminary results on catch analysis and presence of thermophilic species

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Abstract. Small-scale gillnet fisheries in northern Adriatic have latterly shown certain alterations, mainly related to more frequent occurrence of thermophilic species due to ongoing climate changes. This research presents data on gillnet catch in Istrian waters (Raša and Medulin Bay) in order to show the ratio of thermophilic fish species in the total catch. Net deployment was performed twice a month, from October 2020 to January 2021. A total of 29 fish species were recorded, five of which are categorized as thermophilic: leerfish (*Lichia amia*), pompano (*Trachinotus ovatus*), greater amberjack (*Seriola dumerili*), Mediterranean barracuda (*Sphyraena sphyraena*) and bluefish (*Pomatomus saltatrix*). This category was represented with 4.68% of the weight in the total catch. *L. amia* was the most represented thermophilic species with 70.23% of the total catch weight of thermophilic species. Among native species, bullet tuna (*Auxis rochei*) was the most represented (49.78%), followed by the gilthead sea bream, *Sparus aurata* (30.17%). Results have shown significant presence of thermophilic fish species in the gillnet catch in Istrian waters during the main fishing season. Although that could have significant implications in terms of conservation, management and sustainable use of the living resources, seasonal exploitation of thermophilic species could be considered as an opportunity for local fishermen.

Keywords: small-scale fisheries, Istrian waters, catch analysis, thermophilic species

1. Introduction

A wide range of different fishing strategies related to target species, fishing gear and fishing grounds, have been developed in small-scale fishing in the Adriatic Basin, as well as throughout the Mediterranean. Fishing activities are carried out on coastal grounds by adopting passive gears (gillnets and trammel nets) which, by providing greater selectivity than towed gear, have limited impact on fish resources, and are less destructive than towed gears with limited environmental impact, including ecologically important habitats such as spawning areas, nursery grounds, feeding grounds and migration routes (Grati et al., 2013; Colloca et al., 2015). Gear selection is made yearly when the equipment is purchased and prepared, and daily mainly depending on variables such as the amount and value of recent catches, market demand, weather conditions, and information or rumors of catches by other fishermen (Forcada et al., 2010). Despite frequent adoption of gillnets in fisheries along the eastern Adriatic coast, accurate data on the composition of catches are still not sufficiently available. This lack of information raises concerns since the Istrian region, an integral part of the northern Adriatic Sea, is one of the most important fishing areas in the Mediterranean Sea (Mazzoldi et al., 2014). These gaps often have the effect of confining small-scale fishermen to a marginal role and undermine the potential for their sustainable growth (Grati et al., 2013; Colloca et al., 2015), although it has a priceless socio-economical value in local societies (FAO, 2015). In coastal Istrian waters, from the end of summer and beginning of winter, fishermen use gillnets to target commercially valuable species, mainly gilthead seabream, *Sparus aurata*, seabass, *Dicentrarchus labrax*, different *Mugillidae* species, etc. However, in the last two decades, reports of catching fish species unknown to the market, which have been characterized as thermophilic, have become more frequent (Azzuro, 2008; Iveša et al., 2018), while on the other hand, typical commercial species are overexploited (FAO, 2015).

Given the available estimates of future surface warming in the Mediterranean (Adloff et al., 2015), the progressive establishment and colonization of thermophilic species in new areas could create new fishing opportunities. Considering the ongoing warming scenario, the ability of small-scale fishermen to adapt to

the life-cycle changes of target species in the Adriatic Sea involves a further potential impact on these fisheries (Azzurro, 2011). However, they can also generate adverse effects in ecological sensitivity (Lloret et al., 2015). Therefore, this research aims to present data on fish catch composition in gillnets in two essential fishing grounds in Istrian coastal waters (Raša and Medulin Bay) during the primary fishing season (autumn and early winter).

2. Materials and methods

This research was conducted from autumn 2020 (October) to early winter 2021 (January). On two locations (Raša and Medulin Bay) in the coastal area of the Istrian peninsula (Northern Adriatic Sea, Figure 1), 80-84 mm stretched mesh size gillnets, 4-8 m height and 150 m in length each, were used in 10 fishing operations. A total of 3,150 m of gillnets were deployed throughout the research period. Gillnets were laid at depths that varied between 4 and 30 m. The nets were deployed close to the coast twice a month around dusk and retrieved the following day. After hauling fish were divided into two categories: thermophilic (Azzurro, 2008) and native species. Each fish was identified, counted and weighed, and the weight fraction of each species in the total catch during the entire sampling period was calculated. Microsoft Excel 2016 was used for data processing.

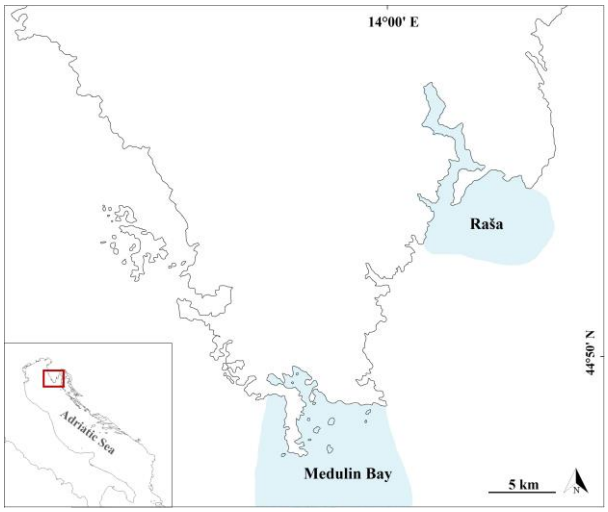

Figure 1. Sampling locations in northern Adriatic Sea.

3. Results and discussion

During the research period form October 2020 to January 2021, a total of 29 fish species was recorded in the total gillnet catch (Table 1). Five species are categorized as thermophilic: leerfish, *Lichia amia*, pompano, *Trachinotus ovatus*, greater amberjack, *Seriola dumerili*, Mediterranean barracuda, *Sphyraena sphyraena* and bluefish, *Pomatomus saltatrix*. Figure 2 shows the weight fraction of native and thermophilic fish species in the total catch, and the weight fraction of different species within the group of thermophilic and native fish species recorded in the total catch during the research period.

Table 1. Weight fraction of all fish species recorded in the gillnet catch from October 2020 to January 2021 (* marks thermophilic species).

Species	Weight fraction
Auxis rochei	47.45%
Sparus aurata	28.76%
*Lichia amia**	3.28%
Diplodus vulgaris	2.82%
Sarda sarda	2.76%
Dicentrarchus labrax	2.64%
Merluccius merluccius	2.36%
Chelon ramada	2.34%
Pagellus erythrinus	1.25%
Chelon aurata	1.10%
Trachurus trachurus	1.04%
*Seriola dumerili**	0.76%
Conger conger	0.44%
*Trachinotus ovatus**	0.41%
Trigla lucerna	0.36%
Boops boops	0.29%
Scomber japonicus	0.27%
Raja miraletus	0.26%
Scomber scomber	0.25%
Pagrus pagrus	0.18%
Mullus surmuletus	0.18%
Zeus faber	0.18%
*Pomatomus saltatrix**	0.16%
Dentex dentex	0.15%
Oblada melanura	0.10%
Mullus barbatus	0.08%
Scorpena porcus	0.06%
*Sphyraena sphyraena**	0.06%
Trachinus draco	0.01%

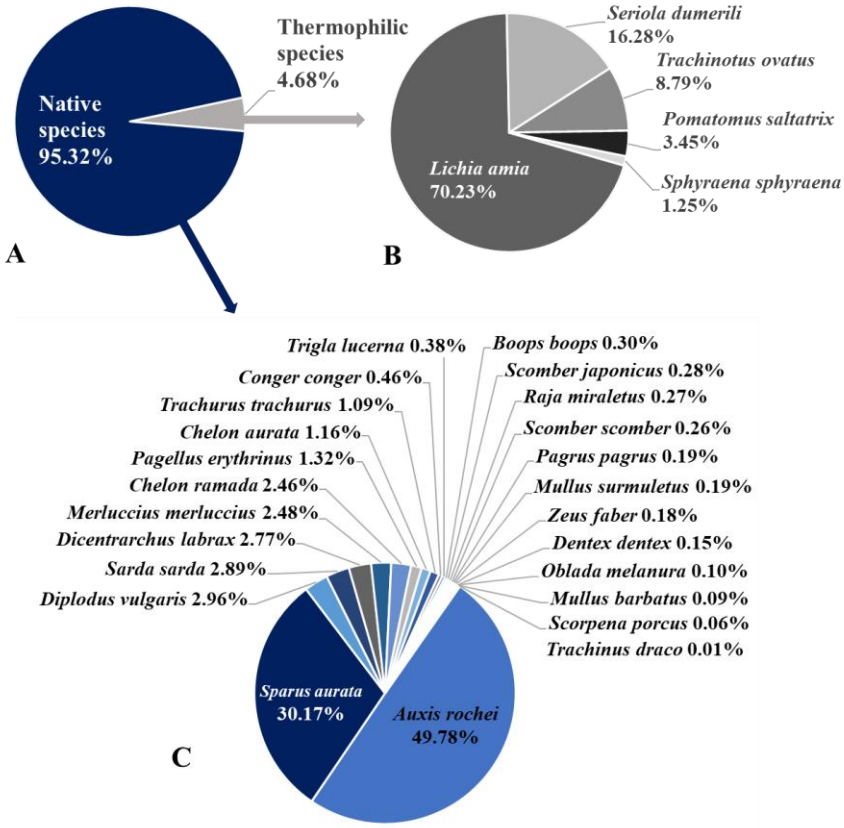

Figure 2. Weight fraction of fish species recorded in the total gillnet catch during sampling period from October 2020 to January 2021 (A = total catch, B = thermophilic species, C = native species).

The weight fraction of thermophilic fish species in total catch was 4.68%. *L.amia*, with 70.23%, was the most represented in the thermophilic group. Among the native species, bullet tuna, *Auxis rochei*, and gilthead sea bream, *Sparus aurata*, were the most represented (49.78% and 30.1% respectively). Even though thermophilic species made a notable portion of the total catch, they were not recorded during January, which was the coldest part of our sampling period (Figure 3).

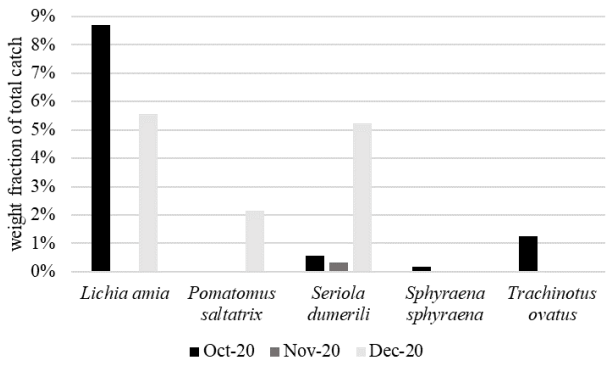

Figure 3. Monthly weight fraction of thermophilic species in the total catch from October 2020 to January 2021.

Although gillnets are the main fishing tool in small-scale-fisheries along the eastern Adriatic coast, in the light of insufficient data on the composition of their catches (Grati et al., 2018; Stagličić et al., 2011), the conducted research gave a preliminary insight into the diversity of fish in the catch. The main target species in coastal areas of Istria during autumn and early winter months in gillnets is *S. aurata* (Grati et al., 2013), which is confirmed by this research as well. This species has shown a significant increase in wild populations during the last decades, possibly linked to climate change (Coscia et al., 2011).

The notable presence of five indigenous predatory thermophilic fish species in this research confirmed the hypotheses about their northward spread in the Adriatic. The same diversity of thermophilic species was noted in Medulin Bay a few years ago by visual census performed from July to October 2017 (Iveša et al., 2018). Due to their pronounced predatory characteristics, there is a potential possibility of their impact on economically important fish species. On the other hand, recorded thermophilic species are considered edible, but they are still not accepted as quality fish on local markets. Since some of them have started to appear in fish markets in Istria, an appropriate marketing approach could make them more acceptable for consumption.

Our preliminary results indicate that commercial species listed in the Regulation on the form, content and manner of keeping and delivering the data on catch of commercial fishing at sea (OG, 38/2018) should be revised. For example, the thermophilic species *Trachinotus ovatus* is currently qualified as uncommercial and since it was frequent in all the catch of this study it should be reconsidered to make an addendum in the species list. Since the Management plan for gillnets in Croatia is still not enacted, the timing for

these changes could be favorable. Given their evident presence, it is recommended to conduct further research in the coming period to collect more detailed data on the impact of thermophilic fish species on the local ichthyofauna. The monitoring of thermophilic species is essential for Istrian waters since similar areas in the Mediterranean Sea are vital for many fish species that utilize the shallow habitats during their early life cycle for food and shelter (De Raedemaecker et al., 2010; Kalogirou et al., 2012).

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