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Implications of small-scale fisheries in Istrian waters on cartilaginous species

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Abstract. In small-scale fishing in the northern Adriatic region, a certain percentage of catches consists of cartilaginous fish, and is still considered as bycatch. Despite global concerns about their overfishing, they are still understudied. In order to obtain data on the presence of cartilaginous fish in catches, 13 fishing trials using trammel nets were carried out from October 2020 to March 2021 at three fishing locations along the Istrian coast (northern Adriatic): Umag, Poreč and Cape Kamenjak. Nets were set in the afternoon and hauling was performed the next day. The stretched mesh sizes of the bottom trammel nets were 80 and 140 mm and the total length of the nets was 30,700 m. Among the 33 species with 403 specimens recorded in the total catch, six species with 23 specimens were cartilaginous: *Dasyatis pastinaca*, *Mustelus mustelus*, *Prionace glauca*, *Scyliorhinus canicula*, *Scyliorhinus stellaris*, *Torpedo marmorata*. Since our preliminary results show that cartilaginous species are common in Istrian waters, we suggest more accurate record keeping of their catches, considering existing fisheries management strategies.

Keywords: cartilaginous fish, bycatch, small-scale fisheries, Adriatic Sea

1. Introduction

In small-scale coastal fishing, which ranks second in terms of catch in the Republic of Croatia, just after pelagic fishing, gill nets and trammel nets are the most used fishing gears (Matić-Skoko et al., 2010). Trammel nets are not very selective and are quite effective in catching a wide range of organisms (Stergiou et al., 2006). They also capture a high diversity of species, which are mostly classified as non-target species (Batista et al., 2009), especially elasmobranchs (Beata et al., 2009). In this context, the incidental catch of vulnerable species such as elasmobranchs is considered one of the threats to the profitability and sustainability of fisheries as well as to wider marine biodiversity (FAO, 2011). Their landings reported to the Food and Agriculture Organization of the United Nations increased to a peak in 2003, and subsequently decreased by 20% (FAO, 2010, Frodella et al., 2016). However, recent global data show an increase of 42% of the trade in shark meat (FAO, 2015) and the true total catch is considered to be about 75% greater than reported (Worm et al., 2013). Most elasmobranchs catches are unregulated and often misidentified, unrecorded, aggregated or discarded at sea, resulting in a lack of species-specific landings information (Bornatowski et al., 2013., Cariani et al., 2017). However, bycatch volumes and species composition of elasmobranchs are poorly documented in the Mediterranean and data are rarely incorporated into national and international statistics (GFCM, 2014). Despite a wide range of efforts in different mitigation measures which are applied to reduce elasmobranchs bycatch, it is still a problem of global concern. In this context, lack of quantitative and qualitative data on incidental catch of elasmobranchs in fishing gears is one of the primary limitations (FAO, 2019). According to Campanelli et al. (2011), the northern Adriatic and its Istrian waters are the most productive area of the whole Mediterranean Sea. Therefore, in addition to researching the composition of fish catches in fishing gear widely used by local fishermen in Istria, it was necessary to investigate the share of elasmobranch species in the total catch.

Materials and methods

This study was performed from autumn 2020 (October) till the end of winter 2021 (March). Bottom trammel nets were used in 13 fishing operations on three locations (Umag, Poreč and Cape Kamenjak area) along the Istrian peninsula (northern Adriatic Sea, Figure 1). Mesh size of the inner panel of trammel nets was 80 and 140 mm respectively. A total of 30,700 m of trammel nets were deployed throughout the research period. The average depths at which the nets were laid was 40 m, on grounds typically used by local fisherman when targeting commercially valuable species that are seasonally abundant in the area. After hauling, each fish was identified, counted and weighed. Subsequently the fish were divided into bony (Class: Actinopterygii) and cartilaginous species (Class: Elasmobranchii). Numerical fraction of each individual bony and cartilaginous species in the total catch during the entire sampling period was calculated as well as monthly catch

during each month for elasmobranchs. Microsoft Excel 2016 was used for data processing.

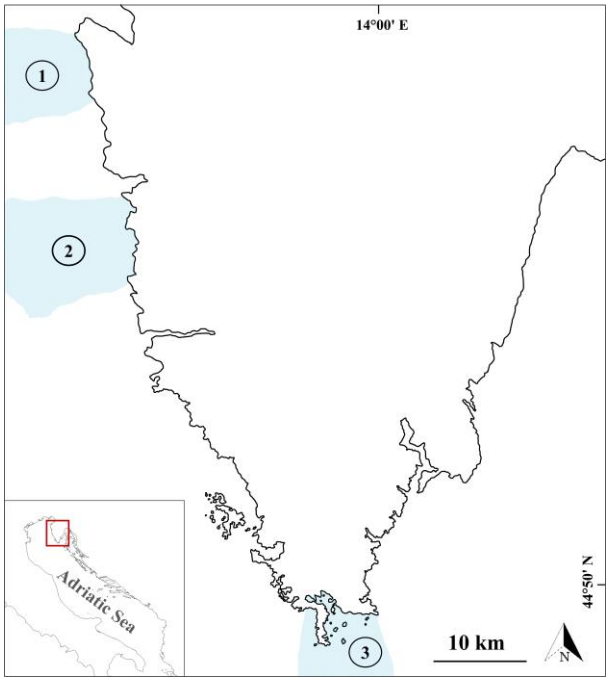

Figure 1. Sampling locations along the Istrian coast in northern Adriatic Sea (1: Umag, 2: Poreč, 3: Cape Kamenjak).

2. Results and discussion

A total of 33 fish species represented by 403 specimens were caught from October 2020 to March 2021 in bottom trammel nets on three fishing areas in Istrian waters (Table 1). Bony fish were numerically more abundant, and among all species the highest numerical ratio was recorded for *Solea vulgaris* (76,92%), confirming this fish as the main target species in the northern Adriatic small-scale fisheries during autumn and winter along the Istrian coast (Grati et al., 2018). Cartilaginous fish, elasmobranch, were represented with six species and 23 specimens: small-spotted catfish, *Scyliorhinus canicula*, nursehound, *Scyliorhinus stellaris*, marbled electric ray, *Torpedo marmorata*, common stingray, *Dasyatis pastinaca*, common smouth-hound, *Mustelus mustelus* and blueshark, *Prionace glauca*. In the total catch of elasmobranchs, highest numerical representation was recorded for *T. marmorata* (1.99%), while the strictly protected species *P. glauca* and *D. pastinaca* were presented with one specimen each (Figure 2). According to Follesa et al. (2018), apart from *S. canicula*, as the most abundant species caught in all fishing areas of the northern Mediterranean, *T. marmorata* had the highest frequency of occurrence on the continental shelf among the 41 recorded cartilaginous species, which is comparable to our data. The highest diversity of elasmobranchs in our study was recorded in December 2020, as well as the highest numerical ratio in the total catch (15.79%). Elasmobranchs were not recorded after January 2021 (Figure 3). The results have shown that captures of shark and rays represent a relatively small numerical percentage of total catches. Nevertheless, as it was accentuated by Stevens et al. (2000), influence of trammel nets on these species should be inspected further given the fact that they are widely used fishing gear in Istrian waters. Fishing pressure should be considered as one of the main variables affecting the abundance of chondrichthyans, but not the only one (Frodella et al., 2016). Decrease in the number of chondrichthyan species has been detected in the northern Adriatic from the middle of 20th century on (Jukić-Peladić et al., 2001, Coll et al., 2009, Ferretti et al., 2013, Follesa et al., 2018). This confirms the known structural depletion of the demersal community in terms of diversity during the last few decades. On the other hand, in the Bay of Medulin Iveša et al. (2021) have noticed a significant increase of *T.marmorata* and *D. pastinaca* in bottom trammel net catches during 2020 when comparing with the same period of 2018. These data, in contrast to our research. were obtained during the warmest part of the year.
Taking into account the preliminary scope of this research and the limited data from the literature, the need to continue the research within this study is evident.

able 1. Species recorded in trammel nets from October 2020 to March 2021 (* marks cartilaginous species).

Species	Number of specimens	Numerical fraction
Solea solea	310	76.92%
Pagellus erythrinus	9	2.23%
Scorpaena porcus	8	1.99%
Scorpaena scrofa	8	1.99%
*Torpedo marmorata**	8	1.99%
Sparus aurata	7	1.74%
*Scyliorhinus canicula**	6	1.49%
Phycis phycis	4	0.99%
*Scyliorhinus stellaris**	4	0.99%
Trigla lyra	4	0.99%
Merlangius merlangus	3	0.74%
*Mustelus mustelus**	3	0.74%
Scophthalmus rhombus	3	0.74%
Trigla lucerna	3	0.74%
Zeus faber	3	0.74%
Pagellus acarne	2	0.50%
Trachurus trachurus	2	0.50%
Citharus linguatula	1	0.25%
*Dasyatis pastinaca**	1	0.25%
Diplodus vulgaris	1	0.25%
Lithognathus mormyrus	1	0.25%
Lophius piscatorius	1	0.25%
Platichthys flesus	1	0.25%
*Prionace glauca**	1	0.25%
Sarpa salpa	1	0.25%
Scoarpena notata	1	0.25%
Scomber scomber	1	0.25%
Spicara smaris	1	0.25%
Symphodus ocellatus	1	0.25%
Trachinus draco	1	0.25%
Trigloporus lastoviza	1	0.25%
Trisopterus minutus	1	0.25%
Uranoscopus scaber	1	0.25%

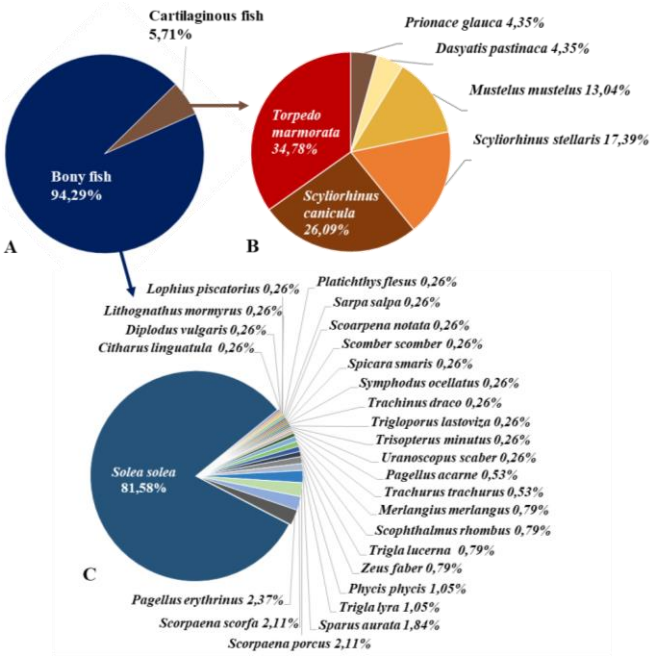

Figure 2. Numerical fraction of all fish species in the total catch during the entire sampling period from October 2020 to March 2021 (A = total catch, B = cartilaginous fish, C = bony fish).

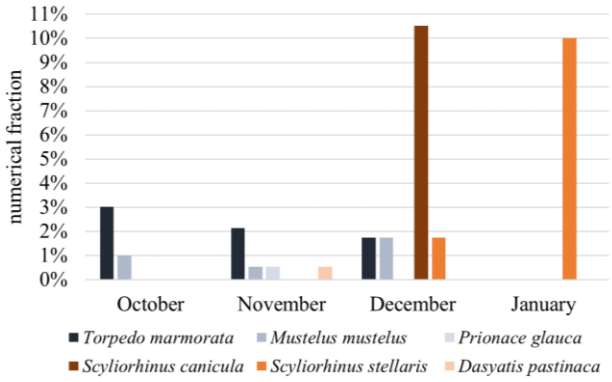

Figure 3. Numerical fraction of each cartilaginous species in the total monthly catch.

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