MINISTRY OF AGRICULTURE

INSTITUTE OF OCEANOGRAPHY AND FISHERIES

Final report on Pilot Study 1

Relative share of catches of recreational fisheries compared to commercial fisheries

15th March 2021

EUROPEAN UNION

Operativni program ZA POMORSTVO I RIBARSTVO

PROGRAM PRIKUPLJANJA PODATAKA U RIBARSTVU RH

Contents

1. Objectives. Aim of the pilot study

1.1. Objective of the study

The objective was to collect preliminary data on fishing effort, seasonality, total catch weight, catch fraction of the used fishing gear and qualitative and quantitative catch composition for the species listed in Table 3 of the Union Multiannual Program (EU-MAP III - eels and elasmobranchs). For this purpose, it was necessary to estimate the annual catch of individual species (weight and number). Given the lack of basic data and some objective obstacles in collecting data on this type of fishing in the RC (private data of licensed fishers cannot be used), the data collected (in this study) will serve as basis for developing adequate methodology and implementation of standard monitoring program for collecting data on recreational fishing.

1.2. Introduction

This pilot study meets the requirements of Chapter V art. 4 of the Union Multiannual Program (Commission Implementing Decision (EU) 2016/1251 of 12 July 2016 on adopting a multiannual Union Program for the collection, management and use of data in the fisheries and aquaculture sectors for the period 2017 to 2019; notified under document number C (2016) 4329). The present pilot study is envisaged within the Annual Plan for Data Collection in Fisheries of the Republic of Croatia in 2019.

In accordance with the Union Multiannual Program for the collection, management and use of data in the fisheries and aquaculture sectors for the period 2017 to 2019 (hereinafter "the Program") Member States are under mandatory obligation to carry out pilot studies with aim to assess the share of recreational fishery catches in relation to the total commercial fishery catch, and especially for the species determined by the Program (eels, cartilaginous and highly migratory pelagic species).

The Directorate of Fisheries, pursuant to the National Program, in the cooperation with the Institute of Oceanography and Fisheries in Split, collects and processes data on the catches of large blue fish at sport fishing competitions, and for the purpose of carrying out the pilot study, a questionnaire on fishing effort, total catches and, in particular, the catches of the above mentioned species prescribed by the Program, was conducted. More than 600 recreational and sport fishing license holders responded to this anonymous questionnaire, providing the valuable feedback on the dynamics of recreational and sport fishery in the Republic of Croatia in 2018. In addition, the Directorate of Fisheries keeps records of the number and type of licenses issued for recreational and sport fishing.

Even though the reporting on sportive and recreational fishery is not prescribed by the Marine Fisheries Act (Official Gazette 62/17, 130/17 and 14/19), the data is still collected due to both economic and sustainability reasons. The guidelines of the European Union for the next operational period also call for more attention to recreational and sport fishery in terms of impact assessment and management options. Gaining more detailed insight into the volume and importance of recreational and sport fishery in the Republic of Croatia is one of the goals of this pilot study.

1.3. Legislative framework

Recreational and sport fishing in the fishing sea of the Republic of Croatia is allowed only with the possession of daily, multi-day, monthly or annual licenses. The Ordinance on sport and recreational fishing at sea (OG 122/2017) prescribes type and quantity of fishing gear and equipment, which fisher is allowed to use, then the type of license required for sport or recreational fishing at sea and the license for bottom longline fishing and also the issuance fee for various licenses. Pursuant to the Ordinance, the licenses for sport and recreational fishing are issued by the Ministry of Agriculture and that for a specified purpose and period, as follows:

a) Daily and multi-day licenses for sport and recreational fishing are issued for:

- 1 (one) day
- 3 (three) days
- 7 (seven) days

b) Annual licenses for sport and recreational fishing issued for a calendar year

c) Special licenses for sport or recreational fishing in marine areas protected within categories of national park, special reserve and nature park, in accordance with the act of a public institution that manages the protected area

d) Special licenses required for the use of additional fishing gear and equipment, issued for:

- set longline fishing, for one or more longlines with total of up to 100 hooks
- fish traps, total of up to three (3) pieces
- with the use of artificial light, strictly for fish gigging or for trolling with cephalopods fishing hook.
- fish gig, total of one (1) piece
- big game fishing gear, max. of three sets (rod with reel) with one hook on each set, or with one lure on each.

These special licenses are issued exclusively on the basis of previously issued annual license.

1.4. Permitted gear and equipment

A fisher, the holder of an annual, daily or multi-day license may fish with the following quantity of fishing gear and equipment:

- casting (Cro. “odmet”), up to two (2) pieces in total
- handline (Cro. “kančanica”), up to two (2) pieces in total
- trolling fishing line (Cro. “panula”), up to two (2) pieces in total
- trolling line with hook for cephalopods fishing, up to two (2) pieces in total
- trap for giant sea worm (Cro.”trapula”), up to two (2) pieces in total
- fisher in boat-based fishing is allowed to use rod and reel with fishing line strength less than 30lb.

Pursuant to the Marine Fisheries Act (Official Gazette 62/17, 130/17 and 14/19) spearfishing is permitted only in sport fishing. Holders of annual license for sport or recreational fishing at sea, are entitled, in addition to the listed fishing gear and equipment, to purchase special licenses for: fishing with set longlines, fish traps ("vrša"), fish gigging with use of artificial light ("feral") and also the special license for angling gear (rod and reel) for big game fish without the 30 lbs limitation for fishing line strength. Fishing in protected areas (categories: national park, nature park and special reserve) is allowed with a special license, and in line with the regulations of the competent public institution.

1.5. Limitations

- Sport or recreational fish gigging with artificial light / from glass bottom boat is not allowed.
- Only rowing (use of oars) is allowed to move the Boat used in sport or recreational fish gigging with artificial light.
- Trolling with cephalopods fishing hook, with use of *artificial light, is NOT* allowed, in sport and recreational fishing- from March 1 to September 30, regardless of having the special license.
- Sport and recreational fishing at sea is not allowed at sites defined by decision of the local self-government or a concessionaire.
- Spearfishing (with speargun) while using SCUBA diving equipment is not allowed.
- Diver engaged in spearfishing must not be towed by boat nor use underwater scooter.
- Restrictions related to angling gear for big game fishing.
- Circular (so called: circle hook) is mandatory in big game fishing; the exception to this rule is the single-point J-hook (so-called: J-classic hook) when lure is used. Both hook and all the metal part used for connecting branch line (swivels, buckles and similar) must be of corroding material (not stainless steel).
- During fishing operations no attraction devices are allowed.
- Big game fishing at a distance of less than 1 Nm from Bluefin tuna farm is not allowed.

1.6. Information on licenses sold in 2018 and 2019

According to the license sale for year 2018, 30,804 fishers had annual or semi-annual license for sport fishing and for recreational fishing. As for the licenses valid for 1,3, 7 or 30 days 2, 434 fishers had license for sport and 19,038 for recreational fishing. In 2019, a total of 73,266 annual (yearly), half-year, daily and multi-day permits were sold, which is 3% less in comparison to 2018. As for annual licenses 28,963 were issued for sport and 17,215 for recreational fishing, while 5,210 and 21,878 licenses valid for 1,3,7, and 30 days were sold for sport and recreational fishing respectively.

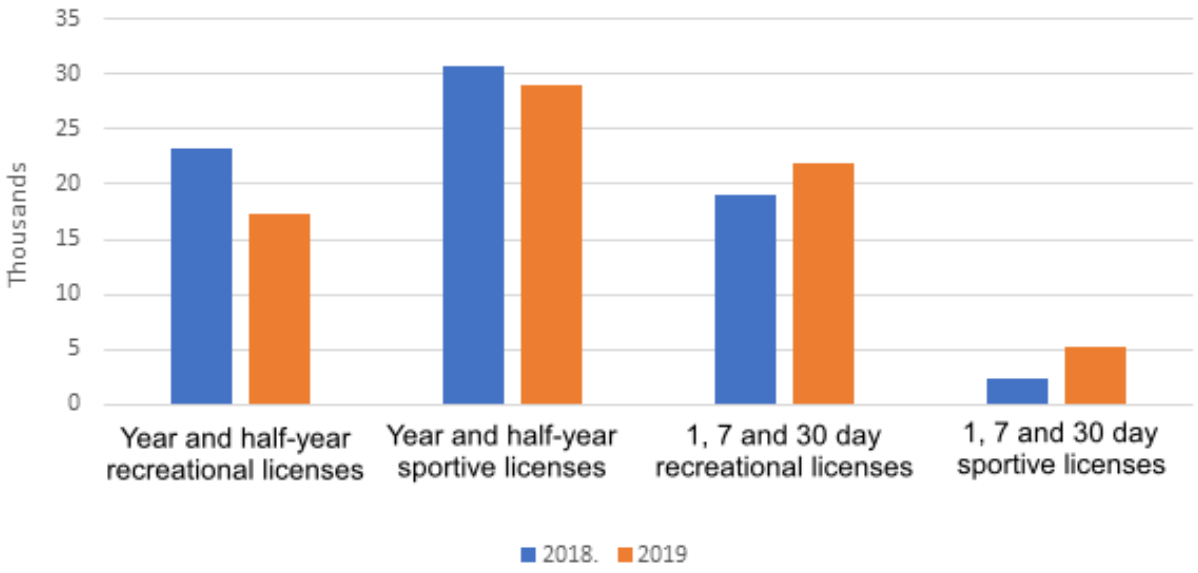

Table 1. Number and type of licenses sold for recreational and sport fishing in 2018 and 2019.

Since the legislation framework does not prescribe collecting the statistical data on sport and recreational fishing (except for sport competitions), the fishing area (fishing subzone) was determined based on the sales data for annual and semi-annual recreational and sport fishing licenses (Fig.2).

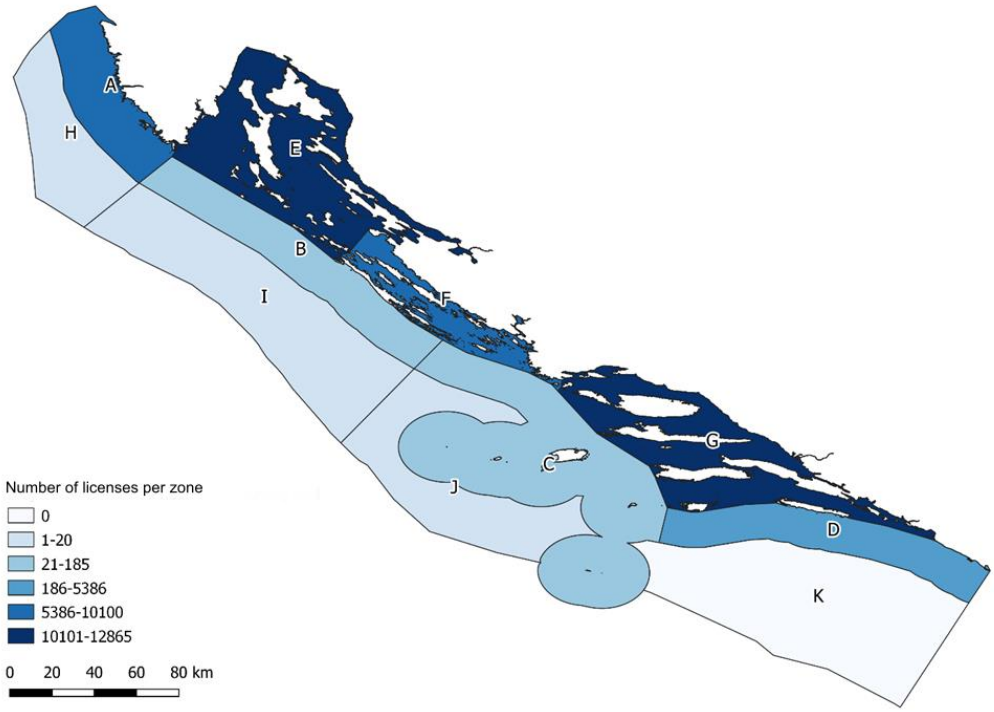

Figure 2. Fishing zones based on the sales data for annual and semi-annual recreational and sport fishing licenses (Fig.2).

In the absence of a unique criterion for determining the fishing activity area for the issued licenses, the fishing activity subzone was determined by the address of the local distributor (of fishing licenses). For licenses purchased through the web shop, the criterion was the fisher's residence (if the residence is in one of the coastal counties) and the fishing zone indicated in the license. The Licenses where fishing sub-zone could not be determined by any criteria were exempted from this assessment. The largest share annual and semi-annual sports and recreational licenses was issued for the zones E and G, followed by the zones A and F.

2. Duration, including if extended during 2020-2021

During the Pilot study in 2019 a questionnaire was designed and distributed among recreational fishermen via online survey through the recreational fisheries associations and social networks. Target population were sport and recreational licence holders in 2018 registered in The Ministry of Agriculture recreational fisheries licence register, so as non-registered recreational fishers that carried out activities on shore (eg. angling, spearing and fish caught using gigs) and on-board vessels.

Pilot study was not extended during 2020-2021. Only analyses of metadata stored in the licence register was conducted in 2020.

3. Marine/freshwater recreational fisheries, including a clear description of the geographical area of application

Marine recreational fisheries in Republic of Croatia.
FAO Fishing Area: Adriatic (Division 37.2.1)
GFCM Subarea: GSA 17 – Northern Adriatic Sea

4. Target species of the study (and gear where available)

In accordance to the Program, the required data included the following:

- catch quantities by individual species and other qualitative data (number, weight and length of specimens) needed to estimate the annual quantity of catch and release for species prescribed by the Program (European eel, Elasmobranchs and highly migratory pelagic species).

5. Materials and methods

Pilot study was performed in coordination between the Ministry of Agriculture (Directorate of Fisheries) and the Institute of Oceanography and Fisheries in Split.

Data for the purpose of this study was collected via on line questionnaire using Google Forms. The questionnaire was available to Internet users, with emphasis on social media users. The questionnaire was shared in the groups focused on recreational and sport fishing (Facebook). In addition to this, fishers were invited to participate in on line survey also by the relevant Internet portals and the web pages of relevant institutions (Ministry of Agriculture, Institute of

Oceanography and Fisheries). The questionnaire was anonymous: the respondents were not obliged to provide personal data (name, surname, the license number). The questionnaire was divided into two parts: the first part for collecting respondent's socio-demographic data (age) and fishing dynamics data (license type, fishing method, fishing gear used, estimated number of fishing days, the fishing zone s/he fishes in, etc.), while the second part referred to the catch of certain groups of marine organisms (with representative photographs of those marine organism, in order to reduce the risk of misidentification). It is important to pinpoint that the questionnaire was designed in a way to collect as much usable data as possible, while not being too demanding for respondent. For this reason, certain species were presented within broader biological groups (e.g. skates and rays). The complete list of questions, along with the questionnaire layout, is presented in Annex 1.

Standard methods of descriptive statistics were used in data processing. Given the nature of the data, and in particular the number of samples, giving the uniform parameters for all groups of organisms was not possible. For example, for eel, due to relatively low number of respondents who caught eel and the heterogeneity within that small sample, it was not possible to determine (to a satisfying measure) the average weights of eel per fishing gear and per day. Namely, to attain a relatively reliable calculation of this parameter, respondent should name a single fishing gear s/he uses to capture the organisms and also to indicate the number of fishing days when that gear was uses, and this was not always the case (for example, respondents would list different fishing gear used in fishing on some marine organisms).

The analysis of number and type of fishing gear used for certain groups of organisms was done by counting how many times a certain type of gear was used for fishing a certain group. Since a certain number of respondents mentioned more different fishing gear used for fishing one group of organisms, the number of fishing gear used is higher than the number of respondents.

In analyzing fishing by zones, that is, in determining the respondent's fishing zone and where certain marine organisms were caught, data from the most frequently used fishing zone was used. Given the nature of the data, the overview of catches by zones, presented in Results, must be taken with caution. Namely, the most frequently used zone is not necessarily the zone where a certain group of organisms was caught. The fact that relatively large number of fishers fish in several fishing zone further reduces the reliability of the catch zone data.

The average weight data from the IOF database were used to determine the catch weight share of a certain group within a wider group of marine organisms (e.g. the shares of skates/rays within demersal elasmobranchs). Given the nature of this data (incompatibility with fishing type and habitats) it should be taken with reserve, but can be considered informative. The average weight by species is presented in the results.

The data was processed using Microsoft Excel and Statsoft Statistica 7.

6. Expected outcomes and results obtained

6.1. Achievement of the original expected outcomes

The implementation of the Pilot Study on recreational and sport fishery began in March 2019. The study was conducted through online questionnaire, which was distributed in a ways described in **Materials and Methods** subsection.

By the beginning of May 2019, 604 respondents completed the questionnaire: 540 (89,5%) had annual, 9 (1,5%) semi-annual (1.5%) and 55 (9%) 1-day, 3-day or 7-day license. 14 out of 604 respondents were female (2.3%). Only data given by annual and semi-annual license holders (549) was used in this study and for this reason their number is taken as the number of respondents. The age of the respondents varied from younger than 20 years to those older than 80. Most respondents were in category of 31-40 years (38%), while the least numerous category was older than 81 years (2 respondents - 0.4%). Figure 3 shows the number of respondents by age.

The number of fishing gears used in fishing ranged from 1 to 9 per respondent. Most respondents (32%) use only 1 fishing gear in recreational fishing, while the use of 9 different fishing gears was mentioned by 3 respondents. Figure 4 shows the ratio between the number of fishing gear(s) used and the number of respondents.

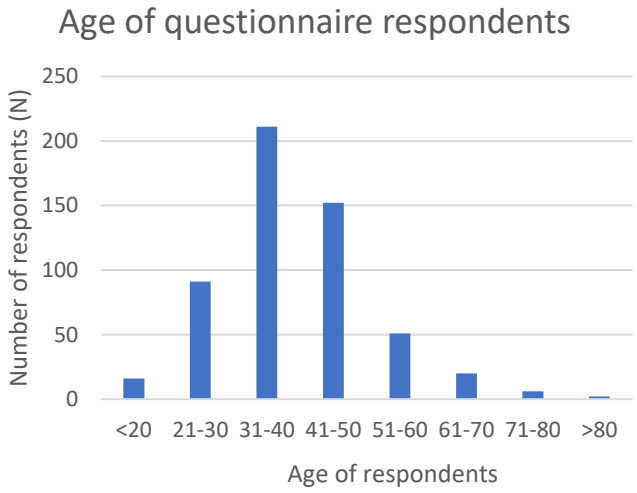

Figure 3. Overview of respondents' age structure **(**N=549)

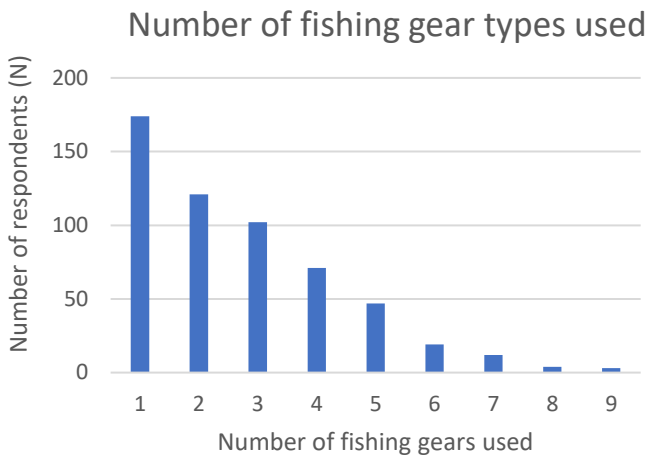

Figure 4. Overview of the number of used fishing gears per number of respondents (N=549)

As primary fishing gear (most frequently used) most respondents stated speargun (34%), casting ("*odmet"*) (21%) and hand line ("*kančanica"*) (18%). 8% respondents stated other hook - fishing techniques such as spinning, jigging and similar. Figure 5 shows the shares of frequency of use by a primary fishing gear.

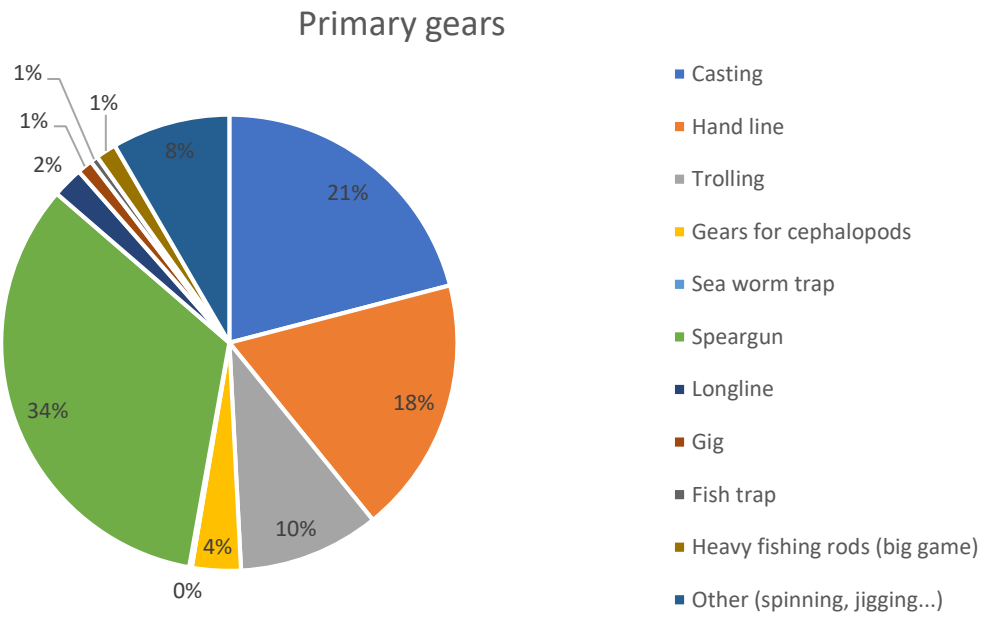

Figure 5. Frequency of primary (most frequently used) fishing gear used

Of the total number of respondents, 34% stated diving as the most frequent way of fishing, followed by boat-based and shore-based fishing with 30% and 25% respondents, while 11% of respondents fished equally frequently from shore and boat.

The total estimated weight of all marine organisms captured by 154 respondents was 10,134 kg. With the exception of 2 respondents who reported quantities of 1000 or more kg/year, most respondents (73%) reported catch quantities from 0.5–50 kg (Figure 6).

The mean value of total annual catch was 65.8 kg per respondent with a large standard deviation (± 144 kg) as the result of small number of respondents who reported large estimated catch. Exclusion of quantities over 1 tonnes, resulted in 51.5 kg (± 70 kg) of mean yearly weight. The mean daily catch quantity was 1.1 kg per respondent (N = 154). Table 1 shows the average daily weight for the three dominant fishing gears. This value could be approximated only for those three fishing gears and this analysis was performed only for the respondents whose number of fishing days using the primary fishing gear was less or higher by 10% of the total number of fishing days annually and only if that value could be calculated for more than 10 respondents.

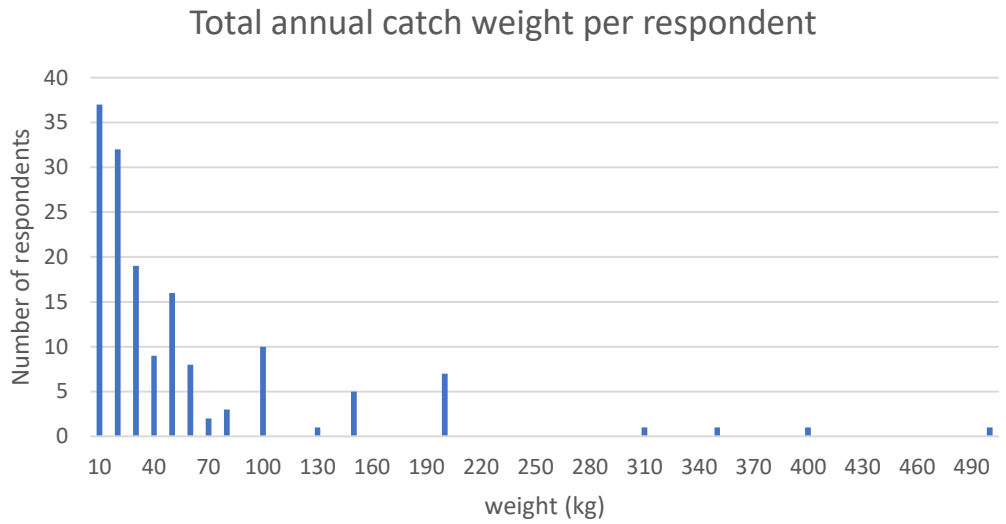

Figure 6. Total estimated catch weight per respondent (N=152, because for the graph clarity reasons 2 respondents who reported catch quantities > 1.000 kg/year were **not** included)

Table 1. Average value of the estimated total catch weight per day per fishing gear used (the estimates were given by the respondents who use that gear as their primary fishing gear)

Fishing gear	Daily average of total catch weight per fishing gear (kg)	N
Casting	0,7	12
Hand line	1,2	17
Speargun	1,4	40

The number of fishing subzones where the respondents fished varied from 1 to 18, but most respondents fished in 1 or 2 subzones (48% and 26% respectively), while only 4% fished in more than 6 subzones. Out of 538 respondents who replied to the question "In which of the fishing zones you perform fishing most frequently" majority replied zone E (34%) and zone G (29%). Figure 9 represents the numbers of respondents (out of total 538) by fishing zones which they singled out as the most frequently used.

The annual number of respondents' fishing days ranged from 3 to 360 (mean 62.4 days). The largest number of respondents (49.3%) spent in fishing 20 to 60 days (Figure 7). The total number of fishing days for all respondents (N = 549) was 34,293. Table 2 shows the total number of fishing days (for N=549) and the average number of fishing day per respondent for each quarter of the year 2018.

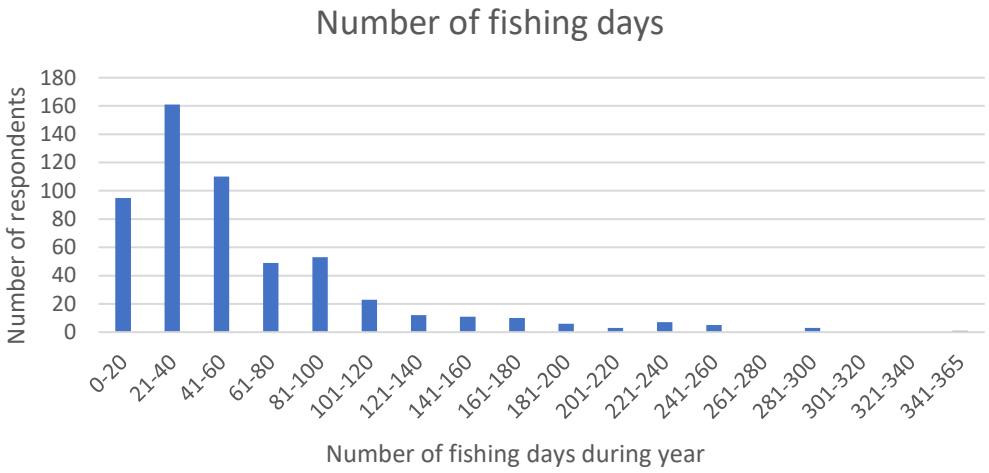

Figure 7. Representation by groups of the estimated number of fishing days per respondent.

Table 2. Total number (N=549) and average number of fishing days (per respondent) by quarterly annual periods.

Period of year 2018.	Total number of days(N=549)	Average number of days/ respondent
1.1.-31.3. (I Q)	7020	12,8
1.4.-30.6. (II Q)	8011	14,6
1.7.-30.9. (III Q)	11235	20,5*
1.10.-31.12.(IV Q)	8027	14,6

* - statistically significant difference in comparison to other quarters (ANOVA, Tukey post-hoc, $p<0,005$)

The total number of annual and semi-annual licenses issued in 2019 was 17,215 recreational and 28,963 for sport fishing. The number of licenses issued per zone is presented in Figure 8. As for the 3,321 annual licenses (recreational and sports combined) no fishing zone was specified i.e. the license holders did not specify the fishing zone. The share of the sport fishing license holders was determined using the number of respondents who stated that speargun was one of the used fishing gear, because spearfishing is allowed only with sport (and not recreational) fishing license. Out of 549 respondents, 271 (49.3%) used speargun which means that they had sport fishing license. The results of the $\chi 2$ test ($p < 0.05$) indicate that the ratio of recreational and sport fishermen represented in this study was statistically significantly different from the actual number of issued licenses. The results indicate deviation in the sample of respondents, which us caused by higher number of recreational than sport fishers who completed this online questionnaire.

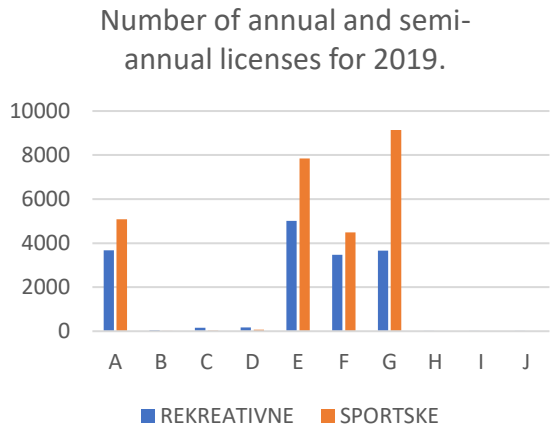

Figure 8. Number of annual and semi-annual recreational and sport fishing licenses, issued for 2019, in relation to fishing zone

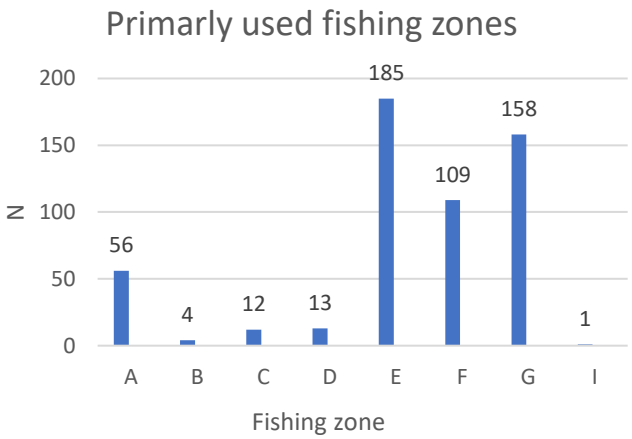

Figure 9. Frequency of fishing activity for the primarily used fishing zones (number of respondents per zone) (N=538)

EUROPEAN EEL (*Anguilla anguilla*)

Forty (7,5%) of all respondents replied that they caught eel during fishing activity. Most frequently (36%) used fishing gear was casting („odmet“). The usage frequency of fishing gears for fishing on eels is presented in Fig. **10**.

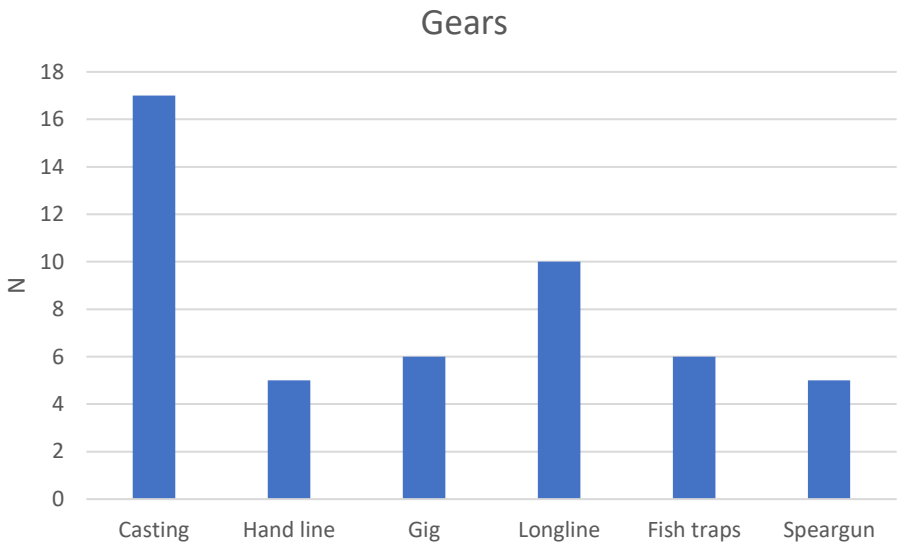

Figure 10. The usage frequency of fishing gears used for fishing on eels, by number of respondents.

The total number of caught eel specimens, estimated by respondents, was 488, with total estimated weight of 229,5 kg. The average eel catch weight per respondent (only those who caught eel) was 5,8 kg. Most of those who caught eels (80%) stated that caught 10 or less specimens annually. Only 4 respondents stated that they caught more than 30 specimens during year.

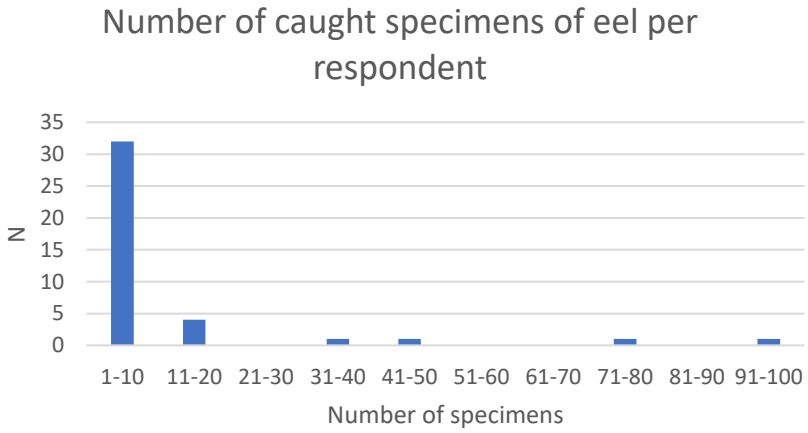

Figure 11. Number of captured eel specimens per number of respondents (N=40). The number of cauptured eels is based on respondents' estimate.

Table 3. Overview of the average estimated catch quantity per fishing zones and per number of respondents who caught eels

Zone*	Number of respondents who catch eels	Average number of specimens per respondent	Average total weight per respondent (kg)	Share of eel-fishing respondents in relation to total number of respondents per zone* or to total sample[1]
A	6	4,3	2,2	10,7%
E	13	7,1	3,5	7%
F	7	9,6	4,2	6,4%
G	14	21,3	10,5	9,5%
Σ	40	12,2	5,7	7,2%

* - the zones of the most frequent respondent's fishing activity were chosen as the fishing zone of capture and for this reason these results must be taken with reserve

[1-] for TOTAL

SKATES, ELECTRIC RAYS, STINGRAYS AND EAGLE STINGRAYS

Ninety five (17,3%) out of the total number of questionnaire respondents (N=549) replied that during fishing activity they caught skates, electric rays, stingrays and eagle stingrays. As the most frequently used fishing gear 44% of those 95 respondents mentioned longline. The usage frequency of fishing gears used in fishing on the mentioned species is shown in Fig. 12.

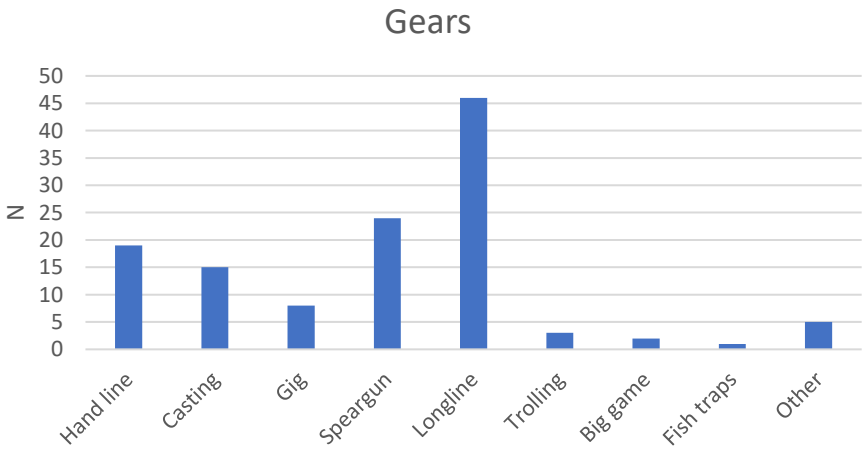

Figure 12. Overview of usage frequency for fishing gear used in fishing for skates, electric ray, stingrays and eagle stingrays

Forty six (8,4%) respondents caught skates, 40 (7,3%) electric rays, 21 (3,8%) stingrays and 63 (11,4%) eagle rays. Total number of captured organisms (N= 1.127) is presented in **Figure 13**.

The total weight of those organisms was 1.909 kg. Furthermore, 94% of the respondents who caught skates/rays annually catch less than 10 specimens. **Figure 14**. presents the number of captured specimens per respondent, while **Table 4** gives the number of respondents and the average catch weight, per fishing zone (the chosen zone of the most frequent fishing activities do note necessarily corresponds to the exact zone of fish). Furthermore, according to respondents' replies, approximately 62% of captured specimens were-upon capture-released alive. **Table 6.** provides an overview of the average daily catch weight per individual fishing gear.

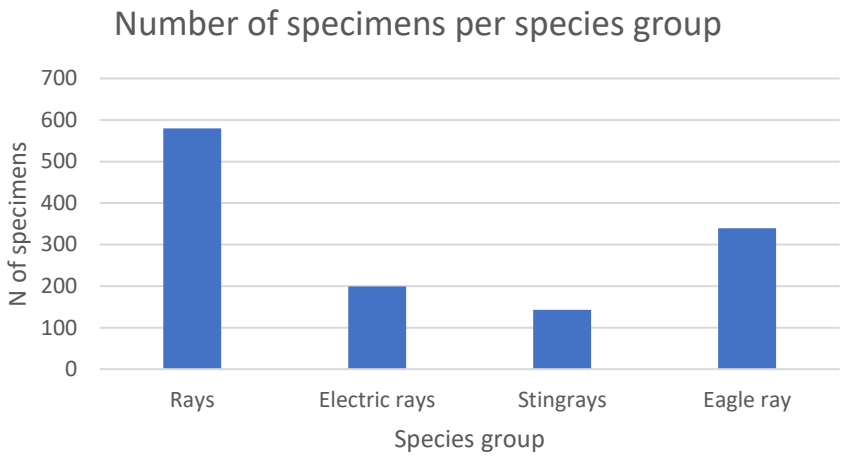

Figure 13. Overview of the total number of captured specimens of skates, electric rays, stingrays and eagle stingrays

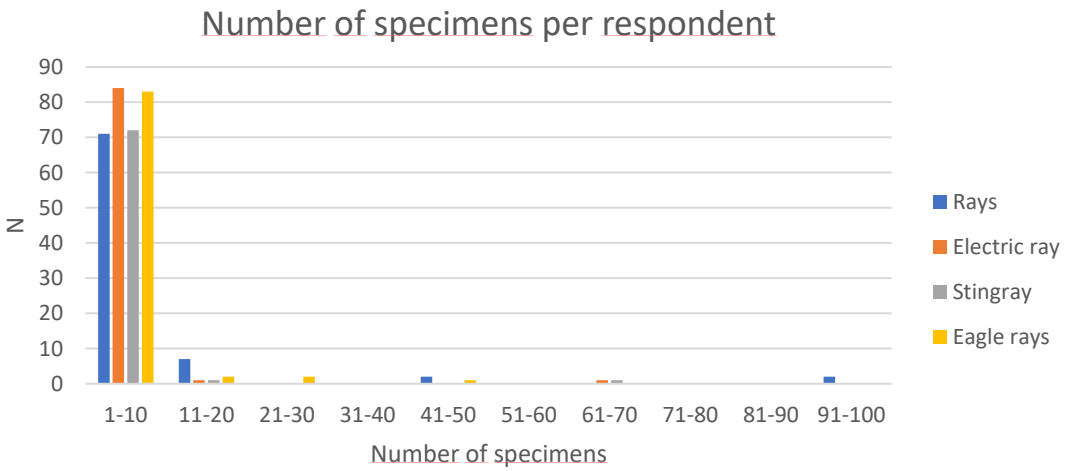

Figure 14. Overview of the estimated number of captured skates, electric rays, stingrays and eagle stingrays, per respondent

Table 4. Overview of the estimated catch quantity average values, per zones and per number of respondents who captured skates, electric rays, stingrays and eagle stingrays (average catch weights refer to all groups of organisms combined)

Zone*	Number of respondents who caught any of these species	Total weight average per respondent	Share of respondents in relation to total number of respondents per zone*, or to total sample
A	8	10,6	14,3%
B	2	17,5	50%
C	1	10,0	11%
D	3	9,7	8,3%
E	23	21,8	12,4%
F	30	16,6	27,5%
G	28	26,8	17,7%
Σ	95	20	17,3%

* - since the zones of the most respondent's frequent fishing activity were chosen to represent the eels fishing zone these results must be taken with reserve. (see **Fig. 9**)

Table 5. Overview of the estimated specimen numbers, per fishing zone and per respondents who captured skates, electric rays, stingrays and eagle stingrays (*B.I.* represents the number of respondents who captured the listed organisms in that zone)

Zone*	skates (N)	B.I.	Electric rays (N)	B.I.	Stingrays (N)	B.I.	Eagle rays (N)	B.I.
A	2	1	9	6	1	5	16	4
B	-	-	-	-	-	-	12	2
C	-	-	-	-	-	-	3	1
D	2	1	5	2	2	1	4	3
E	193	16	26	8	7	3	38	11
F	85	13	34	6	27	6	106	24
G	213	14	114	17	92	9	119	17
Σ	495	45	188	39	129	24	298	62

* - the zones of the most frequent respondent's fishing activity were chosen as the fishing zone of capture and for this reason these results must be taken with reserve; number of respondents per

zone is the number of respondents who singled out that particular zone as the most frequently used (for fishing activity)

Table 6. Average values of the total estimated catch weight of skates, electric rays, stingrays and eagle stingrays, per day of fishing gear usage (catches estimated by the respondents who in fishing for listed organisms use exclusively that fishing gear)

Fishing gear	Average weight per day (kg)	Number of respondents
Hand line	0,6	10
Casting	0,9	5
Gig	0,2	4
Speargun	0.8	18
Longline	1,7	33

In order to calculate the catch quantity share of certain species, compared to the total catch quantity of these groups of organisms, the following average catch weight values were used: 510 g for skates (*Raja miraletus i Raja clavata*), 666 g for marbled electric ray (*Torpedo marmorata*), 6.222 g for common stingray (*Dasyatis pastinaca*) and 2.100 g for eagle stingray (*Myliobatis aquila*). The calculated catch quantity share in the total catch is as follows: skates 14%, marble electric ray 7%, common stingray 44.5% and eagle stingrays 34.6%.

DEMERSAL SHARKS AND CATSHARKS

Out of total number of respondents 104 (19%) replied that during fishing activites they capture spurdog, blackspotted smooth-hound or catsharks. The most frequent fishing gear in fishing for those species were longline (40%) and hand line (35,4%). The usage frequency for gear used in fishing for the listed species is presented in figure 15. Table 7. gives the average number of captured specimens, per gear.

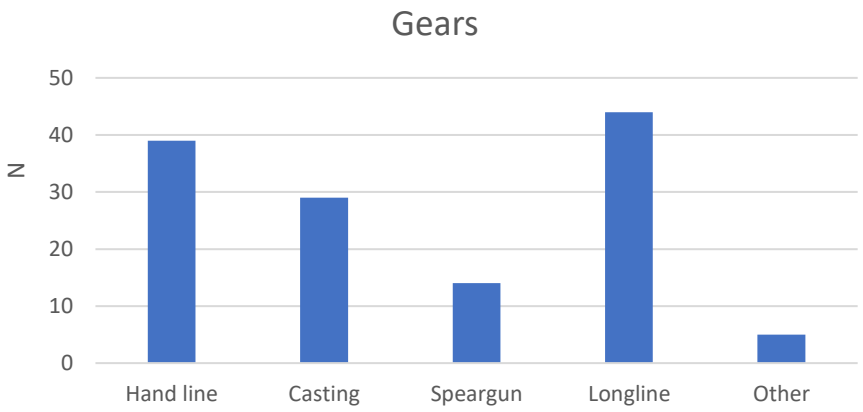

Figure 15. Overview of the usage frequency for fishing gear used in fishing for demersal sharks and spotted catsharks (some respondents mentioned more than one fishing gear used)

Table7. Overview of the average number of captured specimens per fishing gear, for spurdog, blackspotted smooth-hound or spotted catsharks (estimates given by respondents who captured the listed species; only data given by respondents who used only one fishing gear for the purpose was used).

Fishing gear	Average number of smooth-hound and spurdog specimens	N	Average number of catsharks specimens	N
Hand line	3,6	18	4,4	28
Casting	3,5	6	3	6
Speargun	1	1	4,8	9
Longline	11,7	27	20,3	26

Out of 104 respondents, 63 respondents caught spurdog and blackspotted smooth-hound, while 84 caught catsharks. Respondents reported total catch of 517 specimens of spurdog and blackspotted smooth-hound (average 8,2 specimens per respondent) and total of 872 specimens of spotted catsharks (average 10 specimens per respondent). The total weight of all specimens was 2.360 kg. The average catch weight per zone are presented in Table 8, while Figure 16 presents number of specimens per respondents who fished for these species. The share of live relased captures, as stated by respondents, was 58,2%. T**able 9**. gives number of captured specimens of individual groups, per zone and per number of respondents.

Table 8. Overview of the estimated catch quantities, per fishing zones and per number of respondents who fished for blackspotted smooth-hound, spurdog and catsharks (average weights refer to all groups of organisms)

Zone *	Number of respondents who fish species from these groups	Average total weight (per respondent (for both groups) (kg)	Share of respondents in relation to total number of respondents per zone*, or to total sample[1]
A	12	5	21,4%
C	1	30	8%
D	1	10	7,6%
E	26	23,6	14%
F	35	31,4	32,1%
G	28	19,5	17,7%
I	1	1	100%

Σ	91	22,9	16,5%[1]

*- the zones of the most frequent respondent's fishing activity were chosen as the fishing zone of capture and for this reason these results must be taken with reserve; number of respondents per zone is the number of respondents who singled out that particular zone as the most frequently used (for fishing activity).

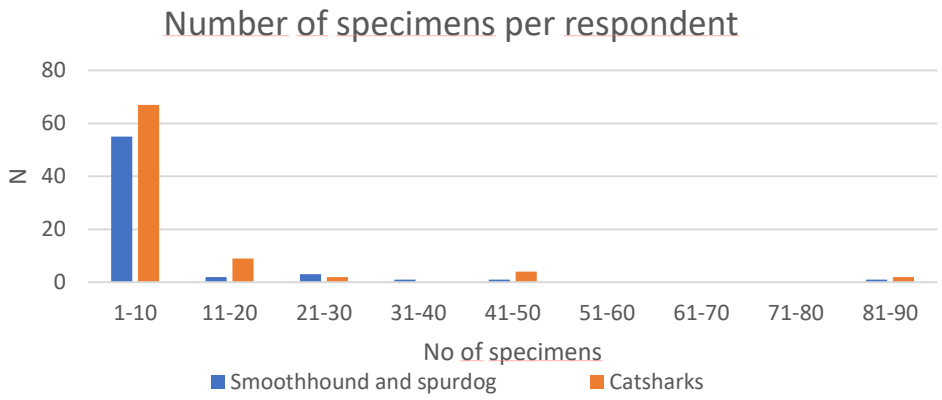

Figure 16. Overview of the number of captured specimens of blackspotted smooth-hound, spurdog and spotted catsharks, per respondents who fished for listed organisms

The following average catch weights were used to calculate the catch share of individual species in relation to the total catch quantities for both groups: 1.772 g for blackspotted smooth-hound and spurdog combined (*Mustelus mustelus* and *Squalus acanthias*) and 318 g for small-spotted catshark (*Scyliorhinus canicula*). The calculated catch weight share (of the total catch weight) was: 77% for blackspotted smooth-hound and 23% for spotted catsharks.

Table 9. Overview of the estimated number of specimens, per fishing zone and per number of respondents who fished for blackspotted smooth-hounds, spurdogs and spotted catsharks

ZONE	Smooth-hound and spurdog (N)	Number of respondents	Catsharks (N)	Number of respondents
A	19	4	53	10
B	-	-	-	-
C	10	1	30	1
D	2	1	-	-
E	153	14	220	23
F	136	20	251	29
G	197	23	313	20

I	-	-	5	1
Σ	517	63	872	84

PELAGIC ELASMOBRANCHS

Only 12 (2.2%), of the total number of respondents, replied that during fishing activity they captured some of one of the pelagic shark species (blue shark, porbeagle, shortfin makko, etc.). The most frequently used fishing gear were big game fishing gear (41,2%) and casting (29%). Respondents captured total of 107 specimens of various pelagic sharks and total catch weight was 593 kg. 83% or respondents who captured these sharks replies that they catch 5 or less specimens per year, while only 2 of these respondents catch 20 or more specimens. The respondents who captured these shark species were primarily users of the following fishing zone: zones A (1 respondent), B (1 respondent), C (2 respondents), E (2 respondents), F (3 respondents) and G (2 respondents).

MIGRATORY PELAGIC FISH

In total of 289 (52,6%) of all questionnaire respondents replied that during fishing activity they catch some of migratory pelagic fish (Atlantic bonito, little tunny, bullet tuna, common dolphinfish). Most frequently used fishing gear was trolling (40%). The usage frequency of the fishing gear used for the listed species is given in Figure 17.

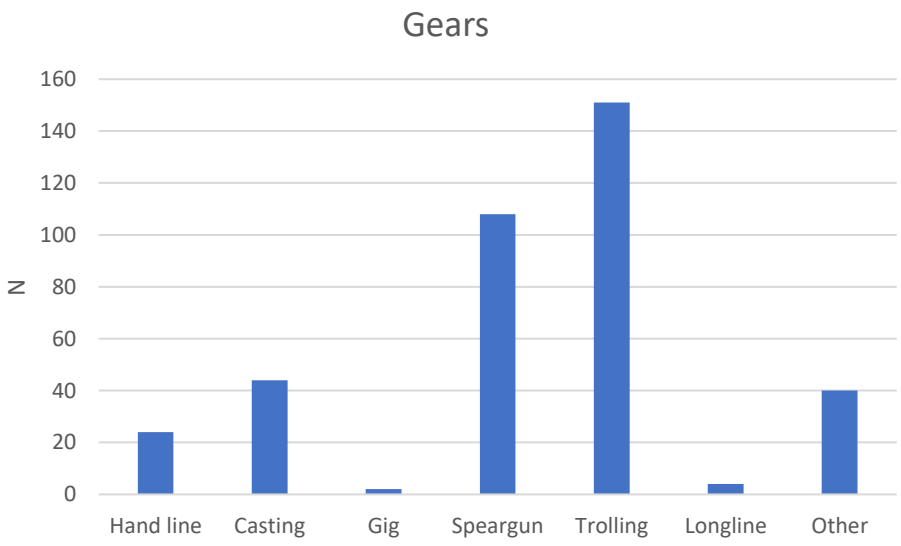

Figure 17. Overview of the usage frequency for fishing gears used for fishing migratory pelagic fish, per number of respondents

Total number of captured specimens is given in Figure 18. Total weight of all captured migratory pelagic fish was 8.059 kg, with average annual catch of 27,8 kg per respondent (only for those who reported capture of these species. Tables 9. and 10. present total catch quantity and the total

number of captured pelagic species, per zone. Table 11. presents the average catch weight of these organisms per day of using of different fishing gear.

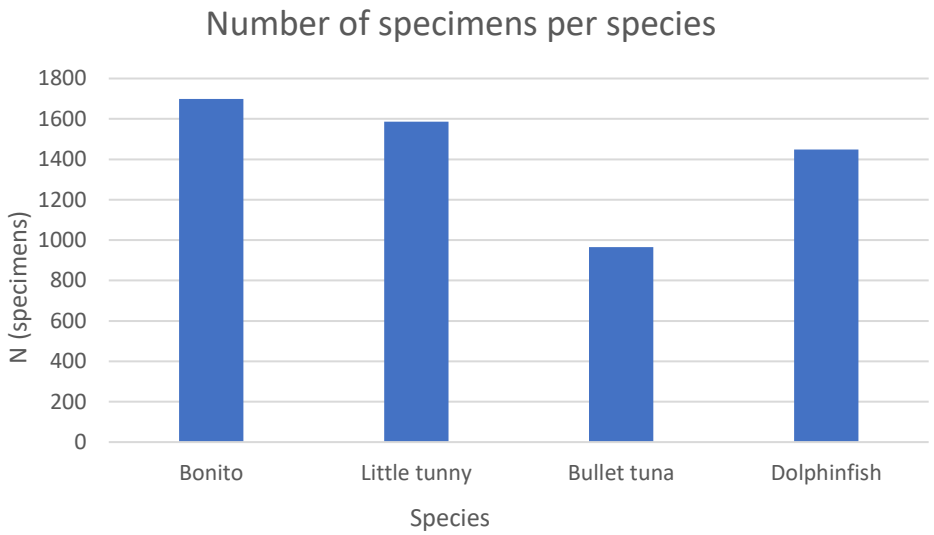

Figure 18. Overview of the total estimated number of captured migratory pelagic fish specimens (estimated by respondents).

Table 9. Overview of the total catch weight (combined: Atlantic bonito, little tunny, bullet tuna, common dolphinfish) as reported by respondents, by fishing zones

Zone*	Total weight (kg)	Number of respondents who for these species	Average catch weight per respondent (kg)	Share of respondents in relation to total number of respondents who fish in that zone *
A	296	23	12,8	41%
B	32	3	10,7	75%
C	371	5	74,2	41,6%
D	267	9	29,6	60%
E	1754	86	20,4	47,5%
F	1488	58	26,1	53,2%
G	3098	108	28,7	68,3%
I	10	1	15	100%

*- the zones of the most frequent respondent's fishing activity were chosen as the fishing zone of capture and for this reason these results must be taken with reserve; number of respondents per

zone is the number of respondents who singled out that particular zone as the most frequently used (for fishing activity).

Table 10. Overview of the number of captured specimens of individual species, by fishing zones, as reported by respondents (number of respondents who fished for certain species is given to the right of the number of certain species' specimens)

Zone	Atlantic bonito (N)	No respondents	Little tunny (N)	No respondents	Bullet tuna (N)	No respondents	Common dolphinfish (N)	No respondents
A	42	13	79	11	15	6	71	19
B	6	2	11	3	1	1	4	2
C	109	4	117	5	30	1	51	5
D	45	5	94	8	58	4	43	8
E	497	70	304	37	230	24	382	51
F	365	51	288	30	110	20	286	38
G	621	76	689	59	520	47	609	82
I	10	1	-	-	-	-	-	-
Σ	931	135	907	81	662	63	724	119

*-the zones of the most frequent respondent's fishing activity were chosen as the fishing zone of capture and for this reason these results must be taken with reserve; number of respondents per zone is the number of respondents who singled out that particular zone as the most frequently used (for fishing activity).

Table 11. Average catch weight of migratory pelagic fish, per day of using fishing gear (estimates by respondents who-in fishing for these species- use only that individual fishing gear)

Fishing gear	Average catch weight per day (kg)	Number of respondents
Hand line	0,7	3
Casting	1,6	18
Speargun	0,3	61
Trolling line	1,2	91

The following average catch weight values were used for calculating the catch quantity shares, within the total catch quantity of the group: 1.616 g for Atlantic bonito (*Sarda sarda*), 956 g for

little tunny (*Euthynus aletteratus*), 1.066 g for bullet tuna (*Auxis rochei*) and 443 g for common dolphin fish (*Coryphaena hippurus*). The individual species' catch quantity share was calculated as follows: Atlantic bonito 44,2%, little tunny 25,5 %, bullet tuna 20,8% and common dolphinfish 9,4%.

6.2 Deviations from planned with justification

No major deviations encountered.

6.3 Difficulties encountered

Non-probabilistic sampling was carried out as the web shop for fishing licenses did not allow for the use personal data for statistical purposes (due to GDPR considerations on the use of personal data and contact information of license holders).

6.4. Lessons learned

In 2021, several adaptations are planned in the fishing licence web shop, including a statement for the use of personal data for contact and statistical purposes. This will allow a switch to probabilistic sampling.

The purpose of this study was to establish the basic characteristics of recreational and sport fishing in Croatia, in terms of fishing effort, frequency of use of fishing gears and catches of species mentioned in Table III of the Multiannual Union Program for data collection and use in fisheries and aquaculture for 2017. -2019. and estimate the share of recreational fishing in relation to commercial fishing. These are primarily sensitive species such as eels, demersal and pelagic elasmobranchs and migratory pelagic fish that were the subject of this study. Previous research on recreational and sport fishing conducted in the Republic of Croatia was mainly based on data collected at sporting competitions (eg Soldo et al., 2005, 2007) or dealt with socio-economic aspects of this segment of fishing (Soldo et al., 2018). Also, the characterization of certain types of tools and techniques in the Republic of Croatia was the subject of research as part of a broader study at the Mediterranean level (Giovos et al, 2018). Systematic monitoring of catches in sport fishing with tools for big fish (Big Game fishing) is currently established within the DCF (data collection in fisheries) which is jointly conducted by the Directorate of Fisheries and the Institute of Oceanography and Fisheries in Split.

As there is currently no standardized protocol or obligation at EU level to collect data in recreational and sport fishing (except for the segment related to monitoring the catch of ICCAT species in sporting competitions), as well as harmonized methodologies for conducting pilot studies, in our case an online survey method was chosen as appropriate in terms of efficiency. Namely, the fact is that due to the size of our coast, the extremely large number of participants in this segment of fishing and the large number of tools used, a more detailed study would require significant temporal, human and financial capacity. This is probably one of the reasons why the Croatian scientific and professional literature is lacking in studies on this topic. However, it is important to emphasize that the data from the online survey inherently contain significant shortcomings such as the unrepresentativeness of the sample (the sample is non-probabilistic),

unknown non-response rate (namely, the part of the population that refuses to participate in the survey) and unreliability and inability to verify the data provided by respondents. For this reason, the use of data from this study can only be for the purpose of guiding future, more detailed studies or monitoring programs, and it is certainly necessary to limit the use of this data outside this framework. The unreliability of this type of survey was explained by Duda & Nobile (2010). On the other hand, the way of collecting data related to recreational and sport fishing via web platforms, either in terms of catch characterization or conducting surveys for scientific purposes, is not new at the Mediterranean level and similar studies have found scientific validation (eg Giovos et al, 2018 Sbrabaglia et al., 2020). In this sense, and taking into account the results of this study, except for a relatively small sample in terms of number of respondents, the main and key weakness of this study is the uncertainty of the data in terms of sample representativeness. Namely, the obtained data are not the result of random sampling, but it is about sampling the part of the population that had access to the survey and the desire to complete the survey. For this reason, for example, it can be assumed that part of the older population of recreational fishermen is less represented, as well as a large number of respondents who were not informed about the implementation of the survey. Also, it can be assumed that a certain part of licensed fishermen is not significantly active in fishing, and therefore not motivated to participate in the survey, as indicated by the relatively small number of respondents who were users of one-day, three-day and seven-day licenses. Furthermore, the deviation of the surveyed population in relation to the actual population of users of this fishing segment is an obstacle in the interpretation of the survey results. In addition, some of the collected data, such as data on the number of fishing days spent in fishing, the total amount of catches and the number and weight of caught individuals of target species are not based on actual data, but are estimates of respondents. Of course, it is necessary to take into account the fact that this type of survey is also susceptible to abuse in terms of insincere response, and the possibility of misidentification of species should not be neglected, especially among inexperienced fishermen. Namely, the possibility that some of the respondents replaced certain species with other species (for example, eel with conger eel etc.) is not excluded. However, with all the obstacles that this method of data collection brings, based on the information obtained, it is possible to draw the outlines of this segment of fishing in the Republic of Croatia. For example, based on the data from this study, it is possible to distinguish which types of fishing gear are significant components in recreational-sport fishing and indicate the relative presence of newer fishing techniques (spinning, jigging, etc.) that should be explored in future research.

Given the nature of the data from this study, and also given the extreme complexity and heterogeneity of this fishing segment, based on the data obtained in this study, it was not possible to approximate the total catches of selected groups of organisms at the national level. Namely, if we exclude the problem of representativeness, some of the important data that would be needed for such an assessment were not collected through a pilot study. From the available data, for example, it is not possible to determine whether it is a targeted fishery for the species that were included in the study or just a bycatch. Data on the frequency of use of a single gear by anglers using multiple gears are also not available. However, based on the obtained data, it is possible to conclude that the total quantities could be significant, especially if we take into account that even in this small sample, the number and biomass of individual species was negligible. If we take into account that the survey was attended by less than 1% of respondents in relation to the number of

licenses, and that the survey covered only users of annual and semi-annual licenses, it can be concluded that the total catches of individual species from this study could make a significant share. in relation to catches of the same species in commercial fishing. In the case of eels, the amount of estimated catches by respondents represents almost 40% of reported catches in commercial fishing (610 kg in 2018) and due to the specific habitat and limited distribution in its case, a comprehensive targeted study should be conducted in areas of known hunting grounds. Although preliminary, the data obtained by this research can in any case direct future research, with the aim of obtaining a better basis for such calculations. Such research should certainly be conceived on the basis of "metier", which should be preceded by the definition of "metier" by tools and target species. Also, future research should be based on random and stratified sampling, and given the large number of participants in this segment of fishing, a combination of diverse methods should be implemented (sampling by log-books, licence registers, telephone surveys, etc.). Also, it would be necessary to collect more detailed data on the qualitative and quantitative structure of catches in certain segments of recreational-sport fishing. Such data would certainly contribute to a better evaluation of the impact of this segment of fishing on marine communities, and in particular on vulnerable species to over-exploitation. Unfortunately, this pilot study did not cover a large number of sensitive and economically important species of marine organisms than the species prescribed by the Program, which should certainly be investigated and also systematically monitored in the future. Special emphasis should be given to the overlap of this segment of fishing with commercial fishing, both in terms of space and time, and in terms of exploited resources.

Given the number of users, but also the tools used in recreational fishing and the large number of target species, ie groups of target species, future research, and especially monitoring programs, should focus on the segments that are most biologically sensitive, in socio- economically most important and those that are most intensively exploited in terms of fishing effort. Furthermore, the data that future recreational and sport fishing monitoring programs in the Republic of Croatia should collect would certainly represent a valid basis for better regulation of this fishing segment.

7. Inclusion into regular sampling or not with justification

Data collection in recreational fisheries from 2022 will be carried out according to the new EUMAP, and relevant RCG Med&BS, RCG LP and RFMO (GFCM and ICCAT) obligations and recommendations.

8. Acknowledgements

Hereby we express our gratitude to all recreational and sport fishermen who participated in the survey and thus contributed to a better understanding of this segment of fishing in the Republic of Croatia. Our thanks also go toward media portals, group administrators on social networks and to anyone else who helped in any way in dissemination of this questionnaire.

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