

Article

An Assessment of Catches of Shore and Boat Recreational Angling along the Coast of the Adriatic Sea

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Abstract: Recreational fisheries involve millions of people globally, thus there is a growing recognition of the immense economic, sociocultural and ecological importance of recreational fishing as a significant component of global capture fisheries. However, recreational fishing is still not as controlled nor as well investigated as commercial fishing. Although the difference between commercial and recreational fisheries may be obvious, the definition of recreational fishing is not uniform, and the issue becomes more difficult in the case of sport fishing. The clear distinction between sport and recreational fisheries is vague, in particular due to a lack of definition of what constitutes a “recreational” or “sport” fishery. In this study, sport fisheries is considered as the competition-oriented subcategory of recreational fisheries, involving a subset of recreational fishers that participate in fishing competitions. Obtained results from the Adriatic Sea showed differences between shore and boat angling in terms of the species caught and the CPUE, while a comparison of the results from competition and out-of-competition boat angling revealed different tactics and targets of the recreational fishers, which are more efficient than sport fishers. Thus, there is an urgent need for all-inclusive management in the Mediterranean region, particularly because of the social and economic conflicts that may arise and intensify with the decline of the accessible fish resources.

Keywords: sport fisheries; recreational fisheries; shore angling; boat angling; competition; illegal fishing; Adriatic Sea



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1. Introduction

For a long time, the impact of recreational fishing worldwide on the marine ecosystem has been neglected, as it is a considered small and marginal issue. However, because of overexploitation, illegal, unreported and unregulated fishing, pollution, and climate change, catches and landings have been shrinking and fish stocks declining, often at alarming rates. Thus, more attention is focused on recreational fisheries as any fishing activity, commercial or recreational, may be harmful to fish and marine ecosystems. Subsequently, it has been noted that some coastal marine stocks in more industrialized nations are exclusively exploited for recreation, or intensive co-exploitation for commercial and recreational purposes occurs [1,2]. Nowadays, it is known that recreational fisheries involve millions of people globally, e.g., Hyder et al. [3] estimated the total number of European recreational marine fishers to be approximately 8.7 million, with 5.9 million and 2.8 million in the Atlantic and Mediterranean regions, respectively, with the highest numbers of recreational sea fishers coming from Norway and the UK in the Atlantic region, and the greatest numbers of fishers in the Mediterranean coming from Italy. Consequently, there is a growing recognition of the immense economic, sociocultural and ecological importance of recreational fishing as a significant component of global capture fisheries [1,4–9]. A recent study indicates that national economies can benefit from recreational fisheries significantly, based on the belief that the total expenditure exceeds EUR 25 billion a year in the EU [10]. Nevertheless, although now the general opinion is that both commercial and recreational fisheries can have similar environmental effects on fish, recreational fisheries is still not as controlled nor as well investigated as commercial fisheries. Furthermore, it is noted that there is

increasing tension in Europe between inshore fishermen, who fish for a livelihood, and recreational fishers that are competing in the same physical space of the same coastal areas for the same fish [11]. There is, therefore, a need to define, distinguish and evaluate this activity at the EU level, so that management strategies and measures can be implemented to establish a balance between commercial and recreational fishing activities [11]. However, even the definition of recreational fishing is not uniform. FAO [12] defines recreational fishing as fishing of aquatic animals (mainly fish) that do not constitute the individual's primary resource to meet basic nutritional needs and are not generally sold or otherwise traded on export, domestic or black markets. Regulation (EU) 2017/1004 of the European Union gives the following definition: recreational fisheries means non-commercial fishing activities exploiting marine biological resources for recreation, tourism or sport. Although this definition is widely accepted, it is not precise as not all non-commercial fishing can be defined as recreational in Europe, where several examples of subsistence (non-commercial, but not recreational) fisheries exist, mainly in northern European countries. On the other hand, while the difference between commercial and recreational fisheries may be clear, the issue becomes more difficult in the case of sport fishing. In Nordic countries, Toivonen et al. [13] define "sports fishermen" as a "recreational fisherman who mainly uses rod and line/spinning rod". In the EU, the Mediterranean sport and recreational marine fisheries are jointly defined (Council Regulation (EC) No 1967/2006) as leisure fisheries, which means fishing activities exploiting living aquatic resources for recreation or sport. The clear distinction between sport and recreational fisheries is vague, principally due to a lack of definition of what constitutes a "recreational" or "sport" fishery. Definitions vary between countries, regions and water-body types and, as with the recreational fishing activity in general, definitions focus on some combination of distinction in terms of time spent fishing, motivation for undertaking the activity, type of gear used or physical activity [11]. In the Republic of Croatia, marine sport and recreational fishery are defined by the Marine Fisheries Act as sport fishing for sports purposes and recreational fishing as fishing for recreation. Recreational fishing is best described as a purely recreational hobby for personal entertainment and consumption, while sport fishing is competition-oriented. A sport fishing license is issued by sport fishing clubs that are authorized by the national Croatian Marine Sport Fishing Association and the national administration, and only those that have obtained a sport fishing license can participate in various sport fishing competitions. However, when not participating in competitions, all sport fishermen practice recreational fisheries. Both fishing categories are carried out by obtaining the mandatory license for sport or recreational fishing with a fee, and while the majority of legislation regulating the fisheries is equal, there are some differences between these two categories in relation to fishing gear and technique, e.g., sport fishermen are solely authorized to be involved in spearfishing [7]. For both categories the total daily catch is restricted to 5 kg of fish plus one trophy specimen and any trade of the catch is strictly prohibited. The total number of sport and recreational fishers in Croatia has remained steady in recent years and is around 80,000 participants, while the minimum calculated economic revenue of sport-recreational fisheries amounts to nearly 100 million euros annually [7]. Generally, and for the purpose of this study, sport fisheries should be considered as the competition-oriented subcategory of recreational fisheries involving a subset of recreational fishers that are participating in fishing competitions.

Considering that sport fishing is competition-oriented, all the competitions are organized and supervised by the Croatian Marine Sport Fishing Association. The competitions are held according to the rules of national and/or international sports associations and are divided into four distinctive categories: spearfishing, big game fishing, and shore and boat angling.

Unlike commercial fisheries, where data on catch and effort are regularly collected for assessment and management purposes, data on sport and recreational fisheries that would allow for the estimation of catches, the detection of trends and the evaluation of impacts are scarce. That is especially pronounced in the Mediterranean region where fishing activity

has a long-standing tradition deeply rooted in local communities. Thus, the main objective of this study was, for the very first time, to describe the main characteristics of sport fishing catches obtained during shore and boat angling competitions in the Croatian Adriatic. Furthermore, sport fishing is competition-oriented which means that techniques and gear are regulated by competition rules, which do not necessarily reflect the fishing carried out by the same anglers but out of competition during their personal recreational activities. Thus, an additional objective of this study was to evaluate the differences between competition and out-of-competition angling.

2. Materials and Methods

On-site sampling of shore and boat sport fishing competitions was carried out in different locations along the eastern Adriatic coast (Figure 1). Fishing locations were chosen by the clubs themselves and approved by the Croatian Marine Sport Fishing Association. Their catches were analyzed, with each fish identified to the lowest possible taxon, measured (total length, nearest mm) and weighed (precision 0.1 g). The sampling of sport fishing competitions lasted for 5 years, starting in 2013 and ending in 2017, and included 35 competitions, 18 boat fishing and 17 shore fishing. All the competitions were country championships meaning that they included the best sport fishers who received an invitation based on the results of previous lower-level competitions. Each competition lasted 5 h, usually from 8 a.m. to 1 p.m.

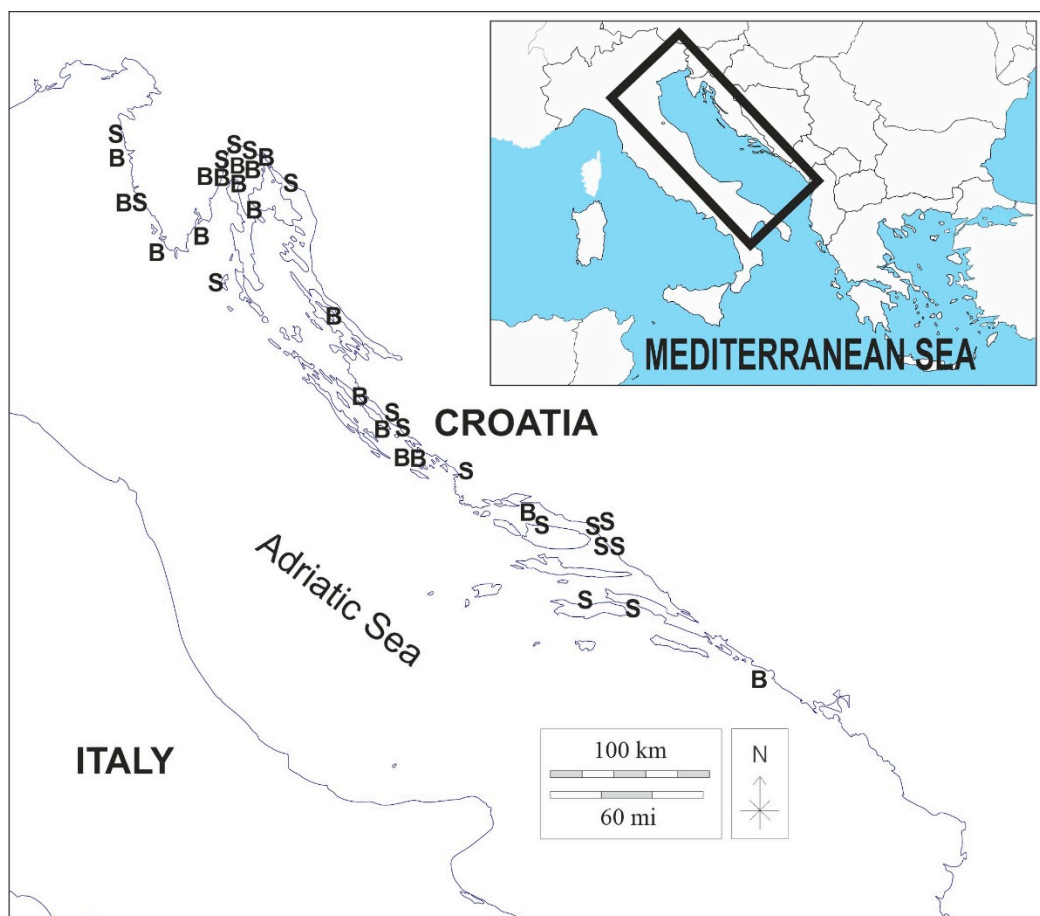


Figure 1. Study area with an indication of competition locations, S—shore angling, B—boat angling.

Shore angling competitions are held in precisely designated fishing sectors that are chosen according to criteria that can secure similar conditions (habitat, depth, shore characteristics, etc.) for all competitors. There are two categories of shore angling depending

on the shore characteristics: 1. Rock fishing, which is performed from the higher natural rocky shore, or from artificial human-made structures such as piers, breakwaters, seawalls, etc.; 2. Surf casting, which is usually performed from a sandy beach by casting a line far into the sea. Shore angling competitions analyzed in this study were exclusively in the rock fishing category.

Boat angling competitions use boats with a minimum length of 4 m. Each boat represents the fishing sector and is used by four anglers whose initial position on the boat is chosen randomly but rotated every 75 min. During fishing, the minimum distance between the boats is 50 m.

All anglers use rods. Although the rods used from the shore or the boat can differ in characteristics, the use of a particular rod is up to any angler's preference, as well as the size of the hook.

Artificial lures are forbidden during competitions, thus only natural baits were used and secured by the organizer. Each angler received the same amount and variety of natural bait, usually 3 kg of Mediterranean mussel, 250 g of sardine or shrimp, and 250 g of squid.

The total catch weight of the competition caught by all the participating anglers was used to calculate the average weight of fish caught per angler per hour (CPUE; g/angler/hour). After each competition, anglers were briefly interviewed regarding their fishing method, tactics and hook sizes used during fishing. To test for differences between the CPUE obtained in shore and boat angling, the Wilcoxon rank sum test was used.

In order to compare the CPUE and fishing tactics of boat angling during competitions and out of competition, as that could describe the difference between sport and recreational fisheries, a group of anglers was monitored and their catches were analyzed in detail during the competitions in 2018. The same group was then used for the analysis of catches during their private recreational boat angling without any official restrictions related to the amount and the variety of the natural bait or the size of the hook.

3. Results

3.1. Shore Angling Competitions

During the shore angling competitions, a total of 30,815 fish were caught and analyzed, weighing 1011.575 kg. Overall, 55 fish species were recorded (Table 1), belonging to 17 families, all bony fish (Osteichthyes). The highest number of species recorded was from the family Sparidae (15 species), followed by Labridae (8 species) and Gobiidae (6 species). In terms of abundance, the order is somewhat different as the most abundant with 17,786 fish were wrasses (Labridae), which is nearly 58% of all fish caught, followed by 5802 porgies (Sparidae) and 2629 gobies (Gobiidae). The order is the same in terms of weight, as caught wrasses weighed 523.8 kg (52% of the total weight), porgies 245.6 kg and gobies 76.7 kg.

The most dominant fish species caught during shore angling competitions was the Mediterranean rainbow wrasse, *Coris julis* (Linnaeus, 1758), with 15,053 caught specimens and a weight of 377.5 kg, followed by 3970 specimens of annular seabream, *Diplodus annularis* (Linnaeus, 1758), that weighed 136.3 kg, and 1869 specimens of East Atlantic peacock wrasse, *Symphodus tinca* (Linnaeus, 1758), which weighed 123.9 kg.

Table 1. The number and weight of species caught during shore angling competitions.

Species	No	W (g)
Osteichthyes		
Sparidae		
<i>Pagellus erythrinus</i>	551	35,586
<i>Diplodus annularis</i>	3970	136,307
<i>Boops boops</i>	590	29,460
<i>Diplodus vulgaris</i>	292	21,566

Table 1. Cont.

Species	No	W (g)
<i>Pagellus acarne</i>	22	665
<i>Diplodus sargus</i>	4	440
<i>Sparus aurata</i>	37	2284
<i>Lithognathus mormyrus</i>	10	832
<i>Diplodus puntazzo</i>	38	5336
<i>Sarpa salpa</i>	99	3924
<i>Oblada melanura</i>	20	779
<i>Spondyllosoma cantharus</i>	11	1123
<i>Spicara flexuosum</i>	63	2703
<i>Spicara maena</i>	92	4449
<i>Spicara smaris</i>	3	141
Labridae		
<i>Coris julis</i>	15,053	377,523
<i>Symphodus tinca</i>	1869	123,863
<i>Symphodus mediterraneus</i>	379	8506
<i>Labrus merula</i>	16	1958
<i>Symphodus roissali</i>	464	11,556
<i>Labrus mixtus</i>	2	158
<i>Symphodus rostratus</i>	1	29
<i>Thalassoma pavo</i>	2	80
Gobiidae		
<i>Gobius geniporus</i>	664	18,051
<i>Gobius cruentatus</i>	864	18,835
<i>Gobius paganellus</i>	511	10,251
<i>Gobius niger</i>	106	1601
<i>Gobius cobitis</i>	457	27,709
<i>Gobius kolombatovici</i>	27	302
Serranidae		
<i>Serranus scriba</i>	1745	72,909
<i>Serranus cabrilla</i>	287	10,125
<i>Serranus hepatus</i>	103	1973
<i>Epinephelus marginatus</i>	1	36
Carangidae		
<i>Trachurus trachurus</i>	1	156
Scorpaenidae		
<i>Scorpaena scrofa</i>	3	185
<i>Scorpaena porcus</i>	227	12,948
<i>Scorpaena notata</i>	5	222
Blennidae		
<i>Parablennius sanguinolentus</i>	1234	29,876
<i>Parablennius gattorugine</i>	381	14,664

Table 1. Cont.

Species	No	W (g)
<i>Lipophrys pavo</i>	5	60
<i>Lipophrys trigloides</i>	16	483
Mugilidae		
<i>Oedalechilus labeo</i>	3	166
<i>Mugil cephalus</i>	1	112
<i>Chelon labrosus</i>	1	28
Triglidae		
<i>Chelidonichthys lastoviza</i>	1	211
Trachinidae		
<i>Trachinus draco</i>	187	8173
<i>Trachinus radiatus</i>	20	1663
Gadidae		
<i>Trisopterus minutus</i>	1	141
Mullidae		
<i>Mullus surmuletus</i>	41	1903
<i>Mullus barbatus</i>	3	204
Pomacentridae		
<i>Chromis chromis</i>	313	7410
Belonidae		
<i>Belone belone</i>	15	1598
Clupeidae		
<i>Sardina pilchardus</i>	1	22
Atherinidae		
<i>Atherina hepsetus</i>	1	5
Uranoscopidae		
<i>Uranoscopus scaber</i>	2	285
Total	30,815	1,011,575

3.2. Boat Angling Competitions

A total of 38,129 fish were caught during the boat angling competitions weighing 2635.662 kg. A total of 45 species were recorded belonging to 16 families, all bony fish (Table 2). Porgies (Sparidae) were the most common with 16 species, followed by 4 species of wrasse (Labridae).

Porgies are, as in shore angling, also dominant in the catch in terms of abundance as 27,754 fish were from the Sparidae family, which is 72.8% of all fish caught. Wrasses are second with 6547 specimens, followed by 1210 specimens of sea bass (Serranidae), which represent 17.0% and 3.2% of the total fish, respectively. Considering the number of porgies caught, it is obvious that these fish are also dominant in terms of weight as the combined weight of porgies is 1874.9 kg, which is 71.1% of the total weight. Wrasses are represented in the total weight with 356.0 kg, while the Carangidae family, represented by only one species, the Atlantic horse mackerel, *Trachurus trachurus* (Linnaeus, 1758), was third with 81.9 kg.

The top three species caught by boat angling are the common pandora, *Pagellus erythrinus* (Linnaeus, 1758), with 11,149 specimens weighing 928.3 kg, followed by *C. julis*

(5835 specimens weighing 236.0 kg) and *Spicara flexuosum* Rafinesque, 1810 (5714 specimens weighing 229.2 kg).

Table 2. The number and weight of species caught during boat angling competitions.

Species	N	W (g)
Osteichthyes		
Sparidae		
<i>Pagellus erythrinus</i>	11,149	928,228
<i>Boops boops</i>	2566	175,506
<i>Diplodus vulgaris</i>	1468	135,599
<i>Diplodus annularis</i>	3364	220,246
<i>Pagellus acarne</i>	1698	22,891
<i>Sparus aurata</i>	203	31,354
<i>Spondyllosoma cantharus</i>	31	4417
<i>Diplodus puntazzo</i>	18	2919
<i>Pagrus pagrus</i>	1	66
<i>Oblada melanura</i>	28	1718
<i>Dentex dentex</i>	8	33,814
<i>Sarpa salpa</i>	11	773
<i>Lithognathus mormyrus</i>	31	5298
<i>Spicara flexuosum</i>	5714	229,165
<i>Spicara maena</i>	863	60,130
<i>Spicara smaris</i>	601	22,798
Labridae		
<i>Symphodus mediteraneus</i>	103	3615
<i>Labrus bimaculatus</i>	10	995
<i>Coris julis</i>	5835	236,053
<i>Symphodus tinca</i>	599	115,299
Trachinidae		
<i>Trachinus draco</i>	996	56,077
<i>Trachinus radiatus</i>	31	4074
<i>Trachinus araneus</i>	3	514
Scorpaenidae		
<i>Scorpaena scrofa</i>	5	1584
<i>Scorpaena notata</i>	4	270
<i>Scorpaena porcus</i>	38	2309
Gobiidae		
<i>Gobius niger</i>	274	6646
<i>Gobius geniporus</i>	208	6390
<i>Gobius cruentatus</i>	196	6166
Serranidae		
<i>Serranus hepatus</i>	648	37,912
<i>Serranus scriba</i>	562	32,139

Table 2. Cont.

Species	N	W (g)
Triglidae		
<i>Chelidonichthys lucerna</i>	4	974
<i>Chelidonichthys lastoviza</i>	19	2084
Blenniidae		
<i>Blennius ocellaris</i>	6	314
Carangidae		
<i>Trachurus trachurus</i>	946	81,894
Zeidae		
<i>Zeus faber</i>	6	2294
Clupeidae		
<i>Sardinella aurita</i>	12	1494
Belonidae		
<i>Belone belone</i>	22	1979
Cepolidae		
<i>Cepola macrophthalma</i>	23	503
Gadidae		
<i>Trisopterus minutus</i>	60	4351
<i>Merlangius merlangus</i>	14	1517
Scombridae		
<i>Scomber japonicus</i>	33	2417
<i>Scomber scombrus</i>	1	282
Mullidae		
<i>Mullus surmuletus</i>	19	1411
<i>Mullus barbatus</i>	4	311
Total	38,129	2,635,662

3.3. CPUE

The average CPUE for both fishing techniques is calculated based on the average weight of the fish caught per angler per hour per competition and it is presented in Figure 2. The Wilcoxon rank sum test revealed that the CPUEs obtained by shore and boat angling are significantly different ($p = 0.01$). Boat anglers catch more than shore anglers as the results show that the highest CPUE during boat angling was 629.1 g per angler per h, compared to the highest CPUE obtained during shore angling of 220.8 g/angler/h. Even more, during the 5 year period, the minimum average CPUE during boat angling was always higher than the maximum CPUE obtained during shore angling.

3.4. Sport vs. Recreational Fisheries

A group of four boat anglers was specifically monitored and their catches during competitions (sport fishing) and out of competition (recreational fishing) were analyzed. The anglers were monitored for how many times they cast the line into the sea during each hour of the 5 h period and how many fish they caught each hour. The average number of casts and fish caught were compared and presented in Table 3. During out-of-competition boat angling, the average CPUE was 941.4 g/angler/hour. The most dominant species caught was *D. vulgaris* which constitutes 45.0% of the total catch in abundance and 46.58%

in weight, followed by gilt-head seabream, *Sparus aurata* Linnaeus, 1758 (19.9% in numbers and 17.8% in weight), and *P. erythrinus* (14.4% in numbers and 16.28% in weight).

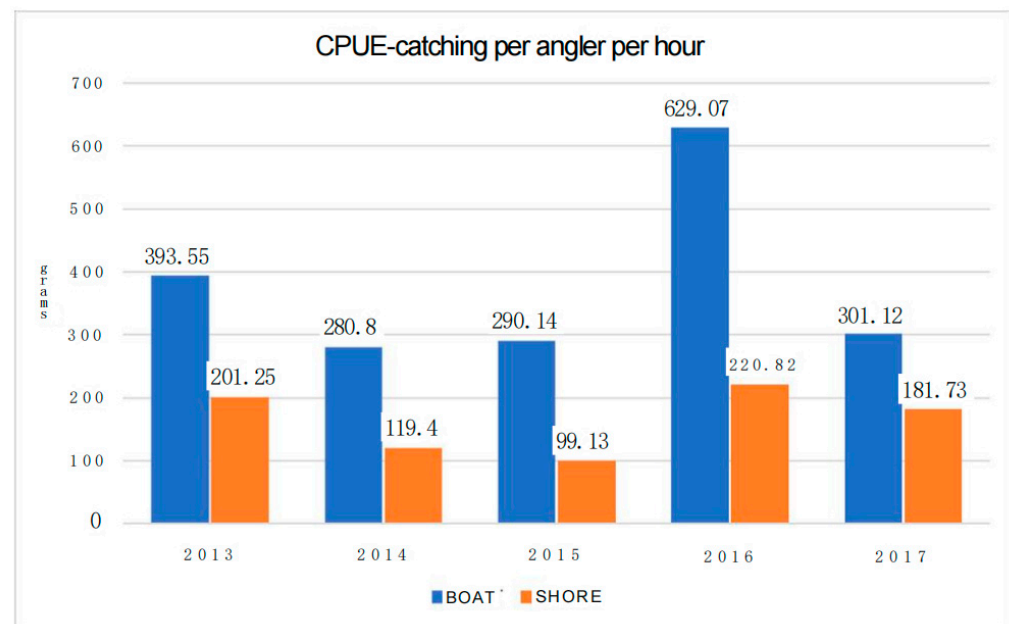


Figure 2. The average CPUE for boat and shore angling based on the average weight of fish caught per angler per hour per competition.

Table 3. The average number of casts and fish caught during boat angling competitions and out of competition for four anglers.

Fishing Period	Competition		Out-of-Competitions	
	No of Casts	No of Fish	No of Casts	No of Fish
1st hour	24	17	7	14
2nd hour	16	5	9	16
3rd hour	17	5	7	13
4th hour	10	1	8	14
5th hour	12	5	10	10
Total	79	33	41	67

The length and weight characteristics of these top three species caught out of competition were compared to those obtained during competitions (Table 4.)

Table 4. Length and weight characteristics of *D. vulgaris*, *S. aurata* and *P. erythrinus* caught during competitions and out of competition.

Species	Length Range (cm)	Competition			Out of Competition			
		Avg TL \pm SD	Weight Range (g)	Avg W \pm SD	Length Range (cm)	Avg TL \pm SD	Weight Range (g)	Avg W \pm SD
<i>D. vulgaris</i>	13–28	17.91 \pm 2.26	36–355	93.24 \pm 42.91	18–32	22.99 \pm 2.79	94–538	194.91 \pm 78.67
<i>S. aurata</i>	20–28	24.33 \pm 2.27	121–374	203.85 \pm 74.86	22–31	25.86 \pm 2.36	150–382	215.64 \pm 56.69
<i>P. erythrinus</i>	12–31	18.99 \pm 3.59	27–438	91.19 \pm 54.81	19–35	23.92 \pm 3.8	73–550	179.92 \pm 88.51

4. Discussion

The obtained results demonstrate the differences between shore and boat angling. Firstly, shore anglers catch more species than boat anglers (55 vs. 45). Hence, on the

one hand, the boat fishing list contains some species that are not caught during shore angling, particularly those which do not visit near-shore shallow areas, e.g., red bandfish *Cepola macrophthalma* (Linnaeus, 1758), garfish *Belone belone* (Linnaeus, 1761), and chub mackerel *Scomber japonicus* Houttuyn, 1782, while Atlantic horse mackerel *Trachurus trachurus* (Linnaeus, 1758) is within the top eight species caught by boat angling compared to just one specimen caught during the 5 year period by shore angling. On the other hand, during shore angling some species are often caught while they are never caught during boat angling, e.g., several wrasse species, gobies and combtooth blennies (Blenniidae). These variances can be explained by differences in habitat, as fishing from the shore includes a range of habitats, from tidal areas to deeper grounds. Those shore areas are inhabited by a larger variety of fish species compared to the more uniform grounds and depths accessible by boat fishing.

These lists of species coincide with some similar studies carried out in the Mediterranean, e.g., Agius Darmanin and Vella [14] investigated fishing catches during sport fishing competitions in shore angling around the Maltese islands, and in their study, porgies and wrasses were also dominant in catches, while the top two species caught are identical: *C. julis* and *D. annularis*.

The CPUE obtained by boat anglers is always significantly higher than the CPUE of shore anglers which can be explained by several reasons. Firstly, during shore fishing, the minimum landing size defined by the competition regulations for all fish is 10 cm, while the minimum landing size during boat fishing is 15 cm. Exceptions exist for species whose MLS is defined by the national/EU regulations and is always longer than 10 cm or 15 cm, respectively. Thus, the anglers' tactics and hook size are different as boat anglers are targeting bigger fish. Secondly, relatively larger fish are more accessible to boat anglers than to shore anglers which results in a larger CPUE in terms of weight. Comparing the CPUEs obtained by shore anglers from this study and from the Maltese islands reveals that those values are similar [14]. Agius Darmanin and Vella [14] reported a CPUE of 0.18 kg/angler/hour ($SD \pm 0.17$) while the CPUE obtained during the 5 years of this study ranged from 0.1–0.22 kg/angler/h. Another study from Turkey [6] also found that Sparidae are the most dominant in catches and that boat anglers are more efficient than shore anglers. However, the values of CPUE from Turkey were significantly higher (2.77 and 0.97 kg/angler/h for boat and shore angling, respectively), probably because the study was focused on anglers out of competition and because a different methodology was used (hours and catch were declared by anglers and not directly sampled during the study).

Interviews with anglers revealed that both shore and boat anglers have generally the same fishing tactics, as all are focused on catching as many as possible fish. As it is much easier to catch smaller fish, hook sizes and bait amounts are adjusted to those fish. The general angler's opinion is that, for a participant in competition-oriented fishing, it is better to target smaller specimens that will result in more weight, and consequently better results, than larger specimens that are in the minority compared to all accessible fish in their fishing zones. Targeting larger specimens can theoretically result in bigger weights, but anglers are not confident that, surrounded by other participants in their fishing zone, they will be able to catch only those infrequent larger fish. This tactic also explains the difference in results between catches obtained during competitions (sport fishing) and out of competition (recreational fishing). Sport anglers are interested in catching a higher overall weight, while recreational anglers target larger fish for their own consumption, thus the fishing techniques and gear are different. Sport anglers cast lines more frequently during the first hour of fishing, with constantly decreasing number of casts toward the end of the fishing period as they want to use the morning hours (usually the fishing period starts at 8am) as much as possible to catch small fish. Contrary to that tactic, the same anglers, when involved in their personal recreational fishing, cast lines much less and consistently throughout the whole fishing period, as, unburdened by the competition, they can target and wait for a larger fish. Furthermore, sport anglers are always surrounded by

many other anglers, including three anglers in the same boat, in the fishing zone that was assigned to them. Quite the opposite, during personal recreational fishing anglers choose the fishing zone according to their own preferences, including the number of other anglers in the vicinity being at a minimum. Consequently, the aforementioned explains why the top three species caught during recreational boat angling are different than during sport fishing, and why the mean average lengths and weights of the caught fish are larger, as well as the CPUE, during recreational fishing.

If sport fishers are observed separately from recreational fishers, this study shows that the impact of recreational fishers (out of competition) on coastal fish communities is much higher than that of sport fishers. Firstly, the number of sport fishing competitions is low in comparison to the total fishing effort of recreational fishers on an annual basis. Secondly, the fishing efficiency of recreational fishers over sport fishers is much higher, as recreational fishers, not bounded by competition regulations, catch much more, and can concentrate their effort on specific areas, time periods, species and sizes, resulting in higher impacts on targeted stocks.

Seeing sport fisheries as just a subset of the much larger recreational fisheries, the results obtained from this study, as well as from other studies carried out in the Mediterranean region [6,14–16], revealed that recreational fishing catches appear to be far from negligible. Some studies already noticed that in several regions catches from recreational fisheries are equal to or even greater than that of commercial fisheries [17,18]. Consequently, the economic impact of recreational fisheries is very significant [7]. Thus, considering the already noticeable competition between recreational and commercial fishing, there is an urgent need for all-inclusive management in the Mediterranean region, particularly because of the social and economic conflicts that may arise and intensify by the decline in accessible fish resources. If the number of participants involved in marine recreational fisheries in Croatia is multiplied by the maximum allowed daily catch (and this study shows that such a catch is easily reached) on a yearly basis, the total annual catch obtained by the marine sport and recreational fisheries is 2.4 times higher than the annual catch of commercial fisheries (146,000 vs. 61,577 tons). Additionally, it has to be noted that in the case of commercial fisheries, small pelagic fish constitute the majority of the catch, while those species are not even targeted by recreational fisheries. Of course, not all the fishers will consistently catch 5 kg of fish daily nor will spend every day of the year at the sea, but this value proves that the magnitude and impact of marine recreational fisheries, particularly on coastal fish communities, is far from low, and for many coastal fish species probably even more severe than from commercial fisheries. Thus, it is not a surprise that many commercial fishermen complain about injustice in the way their activities are highly regulated and subject to a number of administrative procedures, while recreational fishing is poorly regulated and inspected and not limited in the number of licenses. Hence, an additional problem is that an unknown proportion of recreational fishers, driven by the high demand for valuable species, especially in touristic areas, are selling their catch although it is strictly prohibited. This illegal activity is widespread over the entire Mediterranean region [6,19,20] but hard to monitor and inspect. The main reasons are the relatively small individual catches that are easy to be sold very fast, the high number of recreational fishers and boats at sea and, as in the case of the Croatian Adriatic, a very long coastline (more than 6000 km length) where systematic surveillance is ineffective. Therefore, inevitably, such activity and perception contribute to the rising conflict between commercial and recreational fisheries.

The European Union regulations expect that member states should ensure that recreational fisheries on their territory and in Union waters are conducted in a manner compatible with the objectives and the rules of the Common Fisheries Policy. However, a problem lies in the fact that there is no agreed definition for recreational fisheries. There is no specific European law enforcing recreational fishery laws, nor any standardization of regulation goals amongst countries in Europe as well as in the Mediterranean. The lack of an agreed definition makes it difficult to manage competition for fishing resources as the impact of recreational fisheries on stock is not being assessed [21]. This implies that, at first, a clear

and precise definition of marine recreational fisheries is needed for regulation and enforcement purposes. After unifying the definition, appropriate legislation, including license systems and data collection, has to be produced for recreational fisheries in order to ensure the conservation of biodiversity and the biologically sustainable use of marine resources, taking into account the socioeconomic benefits that this fishing activity provides to society in general.

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