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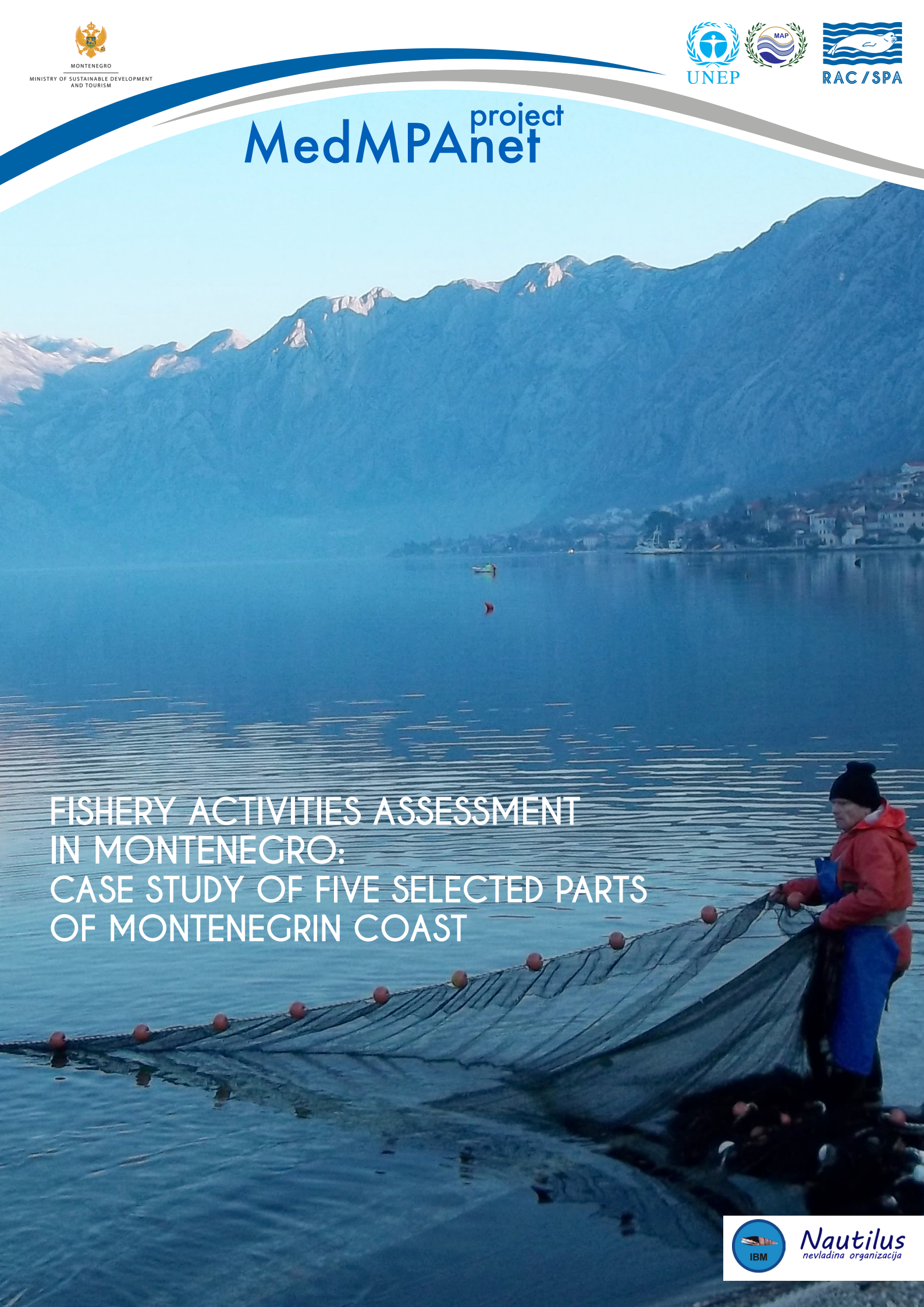

FISHERY ACTIVITIES ASSESSMENT IN MONTENEGRO: CASE STUDY OF FIVE SELECTED PARTS OF MONTENEGRIN COAST

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FISHERY ACTIVITIES ASSESSMENT IN MONTENEGRO : CASE STUDY OF FIVE SELECTED PARTS OF MONTENEGRIN COAST

MedMPAnet project

Regional Project for the Development of a Mediterranean Marine and Coastal Protected Areas (MPAs) Network through the boosting of MPA creation and management

Study required and financed by:

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1. INTRODUCTION

The Montenegro has a coastline of 294 km long, of which about two-thirds face the open sea, and one-third forms the Boka Kotorska Bay (105.7 km). The Montenegrin coast is a part of the Southern Adriatic, which is the oldest and deepest part of the Adriatic Sea. The Southern Adriatic has a relatively narrow continental shelf and a marked, steep slope; it reaches the maximum depth of 1223 m. Generally, the Adriatic Sea is shallow, because most of the bottom is on the continental shelf and a significantly smaller portion belongs to the continental slope (sea bottom at > 200 m depth). So, the major part of the Adriatic Sea belongs to the circalittoral zone. Muddy and sandy sediments cover almost the entire southern Adriatic Sea and they are present on the largest part of the continental shelf.

The benthic biocoenoses of the Adriatic correspond in general to those of the Mediterranean. Three main types of biocenoses in the Boka Kotorska Bay and the open Montenegrin waters are: biocenoses of coastal terrigenous muds, biocenoses of detritic bottoms, and one of the most important benthic biocenoses in the Adriatic Sea is biocenoses of muddy bottoms *Nephrops norvegicus–Thenea muricata*. According to Gamulin-Brida (1967) the biocenosis of the coastal terrigenous mud is well established along almost the entire south-eastern Adriatic, and is particularly well established in areas with relatively weak bottom currents (Fig. 1).

Along the Montenegro coastline there are three main fishing ports: Bar, Budva and Herceg Novi and one small port in Kotor important only for small-scale fisheries (Fig. 2). They are not fishing ports in the true sense of the word, as there are no organised landing sites or fish auction markets and fish is sold usually in market stalls and in restaurants. All of these ports are home ports for trawlers and seiners, as well as for boats of the small-scale coastal fishing.

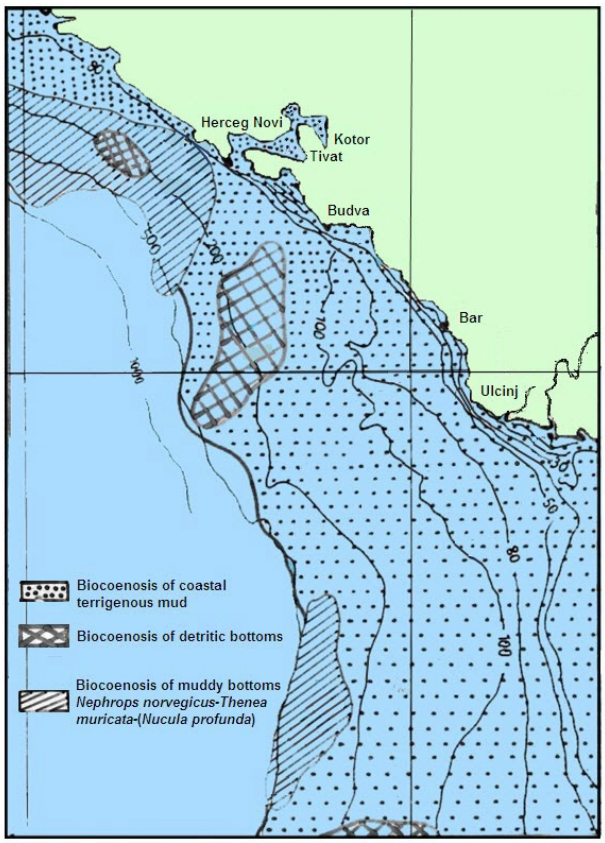

Figure 1. Main types of benthos biocenoses in the Montenegrin waters

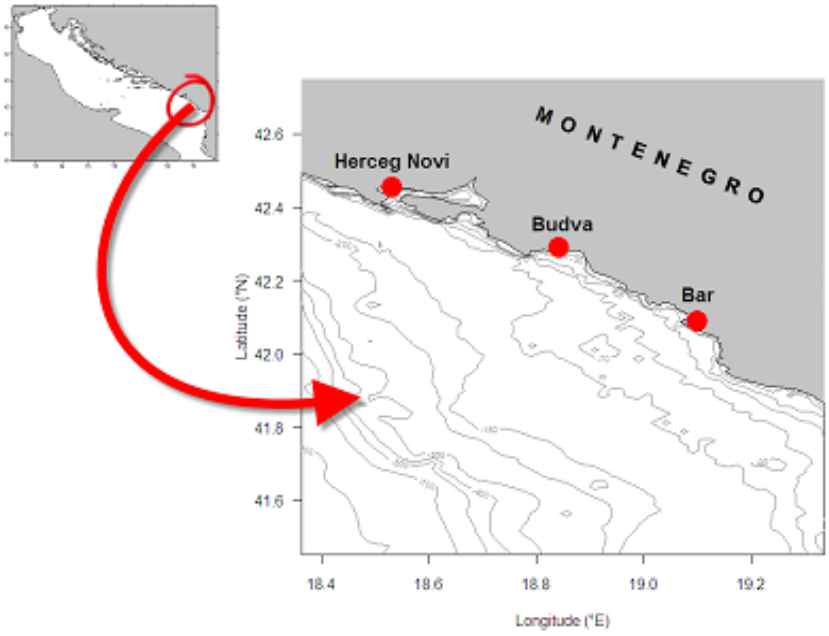

Figure 2. Fishing ports in Montenegro

According to the Law on Marine Fishery and Mariculture (Official Gazette of Montenegro 56/09) «the fishery sea of Montenegro includes marine and submarine area of internal seawaters, territorial sea and epi-continental area of Montenegro as defined by the Law governing the sea».

Fishing activities may be:

- commercial (large-scale commercial fishing and small-scale commercial fishing) ;
- sports-recreational ;
- fishing for scientific-research purposes.

The Montenegrin fisheries can be broken down into three main categories: trawling, seining and small-scale fisheries which operated on demersal and small pelagic resources.

Up until early 2011, the Montenegrin fishing fleet is comprised of about 170 vessels (most of which were part of the small-scale fisheries), 22 bottom trawlers (two of which exceed 24 m in length overall (LOA)), 8 purse-seiners, 3 multipurpose vessels (bottom trawling and purse seining) (two of which were over 24 m length over all).

In early 2011, according to the latest version of the Law on Marine Fisheries and Mariculture, new fishing licences were issued. According to the licences, the fishing fleet includes 99 vessels in total, as follows: 3 bottom trawlers >24 m LOA (two also licensed for mid-water trawling; all limited to the outside of 8 NM limit), 16 bottom trawlers, 12 purse seiners, 58 vessels in small-scale fisheries and 10 vessels in subsistence fisheries (these last 10 licences are valid until 22nd August, 2012, and will not be renewable afterwards).

The most significant fishing activity is trawling. As results of the vessels age and poor state of their equipment, the fishing activities of many bottom trawlers are restricted to inshore waters. Operating expenses are high and potential days-at-sea are reduced due to the recurrent need to repair old vessels, engines and gear. Most of the trawling activity takes place in the area from Budva to Bar, on muddy and sandy seabeds, at depths ranging between 40 and 200 m. It is worth noting that there is no fishing activity outside the 12 NM limit.

According to the Law on Marine Fishery and Mariculture «for the purpose of protecting general marine biodiversity in shallower zones of the littoral it is prohibited to fish with bottom trawls and floating trawls at the distance of three nautical miles that follows the configuration of the shore, or at the depth of 50 metres in case the isobath of 50 metres where that depth is reached at a distance shorter than three nautical miles». Trawlers are allowed to fish Caramote prawn *Melicertus kerathurus* inside the 3 NM limit in the January-April period, mainly around at the mouth of the Bojana river.

The trawl catches consists of a wide diversity of species, but only some of them are considered target species, either due to the volume of their landings or to their high economic value. The main target species are: the European hake (*Merluccius merluccius*), red mullet (*Mullus barbatus)* and deep-water pink shrimp (*Parapenaeus longirostris*).

Also important, but somewhat less, are the common squid (*Loligo vulgaris*), shortfin squid (*Illex coindetii*), octopus (*Octopus vulgaris* and *Eledone* spp.) and the Norway lobster (*Nephrops norvegicus*).

Small-scale coastal fishing is done on the territory of the Boka Kotorska bay and in the whole coastal area of Montenegro territorial sea. Small boats and a large number of various gears are used in this fishery (gillnets, trammel nets, traps for fish and crustaceans, floating (surface) and bottom long-lines, harpoons, angles for squids). One layer gillnets and three layer trammel nets are probably the most commonly used fishing gear along the coastal eastern Adriatic.

The fishing activities of small-scale fisheries, in terms of fishing days, are usually dependent only on the weather conditions. In the area of the Bay of Boka Kotorska fishing with the following means are prohibited: bottom trawls, floating trawls, and encircling large-scale fishing nets. European pilchard (*Sardina pilchardus*) and European anchovy (*Engraulis encrasicolus*) are important and main commercial species in beach-seine fisheries (hauling by fishermen via manpower to the coast) in the Boka Kotorska Bay, and are caught in small quantities by the purse seiners in the open sea. Bogue (*Boops boops*) is not an economically important species, but is heavily represented in small-scale fisheries (trammel nets). Chinese Fishing nets (Kalimere) are also used in the Bojana river to catch Grey Mullets and Eels.

The aim of our investigations was to determine which the fishing activities are in the following areas:

- Petrovac - Buljarica ;
- Island Lastavica -or Mamula ;
- Cape Platamuni – cape Žukovica ;
- Island Old Ulcinj ;
- Orahovac – Boka Kotorska Bay.

For each area we have interviewed people who are exclusively engaged in fishing in that area throughout the year, regardless of whether or not registered. That is their main activity. Interviews were conducted separately with each fisherman, we avoid gathering in groups because that way we have thought that we would get the right information because they are hiding information from each of other about the catch and positions.

Unfortunatelly, the level of exploitation is unknown beacuse the catches of the coastal fishing gears are not always recorded. Since it is practically impossible to get by all fishermen accurate data on catch, interviews were based on it to determine seasonal dynamics of particular fish species in a given area, the types of nets that are used by the seasons, which are the most dominant species in the catches etc. Based on these data, we attempted to establish one or more species that are specific to the area as well as the average number of fishing days achieved in this area to determine the exact number of fishermen who were present in the area throughout the year.

Also, each of the interviewed fishermen set out his vision of the problems in that area (illegal fishing, the use of explosives, divers with underwater spare guns and underwater lights, illegal entry of trawlers at depths of less than 50 m).

The fishery-independent data for area of interest, in this moment, are only reliable for the open territorial sea of Montenegro. This data are obtained from the national monitoring of the demersal resources on the whole area of the Montenegrin coast. In general, small-scale coastal fisheries activity in Montenegro are carried out in the stratum of area from 10 to 50 meters of the depth. This stratum at the open sea have area of 280 km^2.

Also, the significant number of fish species are common for trawl net for demersal fisheries and gill net and trammel net for small-scale coastal fisheries. For the purpose of this study we have taken into consideration that data which we have had from the national survey conducted in this stratum because they can be used to realize the state of this resources throught the time series from 2004, 2007 and 2011. All this surveys are based on the methodology regarding the MEDITS protocol. This means that each year, the position of the hauls are the same, duration of the haul is 30 minute and the processing of the catch are the same. The catch is divided into three categories: Fishes, Crustaceans and Cephalopods and the total number and the total weight are reported for each species.

For the area of the Orahovac, we gave the biomass estimation and catch composition from commercial fishermens that are obtained from the national monitoring of the beach purse seine fisheries in Boka Kotorska Bay during 2004-2007. Echosurvey was performed in Boka Kotorska Bay and accordingly from the acoustic data and catch data estimation of biomass was observed for small pelagic species.

2. STUDY AREA

2.1. CAPE PLATAMUNI-ŽUKOVICA

The area from the Cape Platamuni (Fig. 3) to Cape Žukovica is very attractive for both small-scale coastal fishing and large commercial fishing (trawling). The entire length of this part of the coast is very steep and almost 50 meters from the shore depth is of over 40 meters.

The bottom is muddy in the entire area, with the exception of the coastal part, which is mostly rocky. In this area there are no sandy beaches, except for a few small inlets not larger than 15 meters in length. Influx of fresh water from the land in this area is slight, there are two small streams, Carevića stream and Zagorska river, which are the most active during the winter and do not have a stronger impact on the mention area.

Sea currents are most of the year in the direction from south to north. In this area there are two sunken ships about 2 nautical miles from the coast, opposite the Zagorska river. One of them is «Maria Pompei», which is located at a depth of 70 meters. Around the ship is extremely sandy ground which is very attractive for fishing Common sole and Blackbellied angler.

Fishermen from Budva (Fig. 4) and small fishing village called Bigova (Fig. 5) gravitate to this area. According to data collected 12 fishermen fish throughout the year. Between fishermen there is no division of the territory because it is an area large enough for such a small number of fishermen. They are all very experienced and they all agree that this area is very tricky for fishing and beside modern equipment it is necessary to have extensive experience.

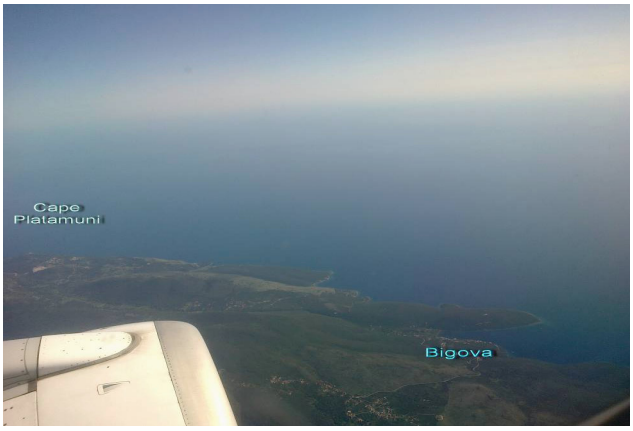

Figure 3. Platamuni region


Figure 4. Port of Budva

Figure 5. Port of Bigova

Basic features of vessels which operate in this area are given in Table 1.

All of the interviewed fishermen have a number of different sampling gears (Fig. 6) which are used seasonally. General characteristics of the sampling gear used in this area are described in Tables 2-4.

As has already been noted that most fishermen use special sampling gears seasonally, depending on the targeted catch, interviews were focused in this direction so that it comes to information about the species that are fished by season and their average weight. It was very difficult to determine the total catch because they do not keep accurate records of the catches and are not ready to talk about the amount that catches.

Figure 6. Gear in the Bigova port

Table 1. General characteristics of the vessels of the interviewed fishermen

	LOA	Power (HP)	Fuel	Equipment	valid licence
1	7.1	70	Diesel	GPS, SONAR	YES
2	7	46	Diesel	GPS, SONAR, EHOSOUNDER, RADAR	NO
3	9.1	2x91	Diesel	GPS, SONAR, EHOSOUNDER	YES
4	11	2x96	Diesel	GPS, SONAR, EHOSOUNDER	YES
5	9	98	Diesel	GPS, SONAR	NO
6	6.5	33	Diesel	GPS, SONAR	NO

Table 2. General characteristics of the sampling gear - gill net - used in Platamuni area

Gill nets	
Material	Polyamides
Length (m)	400 – 500
Height (m)	3 – 8
Mesh size (mm)	70-110
Weight (kg)	32 – 40

Table 3. General characteristics of the gear – trammel net - used in Platamuni area

Trammel net	
Material	Polyamides
Length (m)	400 – 500
Height (m)	3 – 5
Mesh size (mm)	45-60
Weight (kg)	28-40

Table 4. General characteristics of the gear- long lines - used in Platamuni area

Long lines	
Hook (type and measure)	Mustad 7 - 10
Mainline length (m)	600 - 1500
Mainline material and diameter (mm)	Plastic nylon, 1 - 6
Branch line length (m)	1 - 2.5
Branch line diameter (mm)	0.3 - 4
Distance between branch line (m)	2-5

2.1.1. SPRING

One layer gill net and three layer trammel net are used in this period of the year (Table 5, 6). The dawn and dusk are preferred for setting these nets. Fishing activity is conducted at depths of 30-60 meters depending on the target catch. Fishermen who use gill net in this period of the year usually fish the species shown in Table 5.

This time of year is very good for fishing according to presented species. Fish of the first category is caught whose price in the market is the largest and most part is sold in local restaurants. Although it was not possible to obtain data on the average amount that is caught, the structure and weight of individual species that are fished indicates that catches are pretty large, especially on Greater amberjack and Black-bellied angler.

This period of the year is the best period for catching Spiny lobster and the European lobster. The average weight range of 0.3 - 0.8 kg and are much less than the weight that caught a decade ago when the individual specimens were heavy and up to 2 kg.

The main reason for this situation fishermen have cited a large number of illegal SCUBA divers and underwater lights, particularly in the period May-August, when literally lobsters are harvested from the rocks along the entire area. According to them, they are well organized divers group which mostly come from the direction of Herceg-Novi.

Table 5. Species caught by gill nets during the spring in the Platamuni area

Species	Common name	Weight (kg)
Trachinotus ovatus	Derbio, Pompano	1.2 - 3
Zeus faber	John Dory	1.5 - 3
Psetta maxima	Turbot	0.5 - 0.8
Lophius budegassa	Black-bellied angler	0.4 - 0.6
Dentex dentex	Common dentex	0.3 - 2
Seriola dumerili	Greater amberjack	3 - 25
Pagrus pagrus	Common sea bream	0.4 - 1.2

Table 6. Species caught by trammel nets during the spring in the Platamuni area

Species	Common name	Weight (kg)
Palinurus elephas	Spiny lobster	0.3 - 0.8
Mullus barbatus	Red mullet	0.07 - 0.15
Lophius budegassa	Black-bellied angler	0.3 - 4.5
Scorpaenba scrofa	Red scorpionfish	0.5 - 3
Labrus merula	Brown wrasse	0.3 - 0.6
Diplodus sargus	White sea bream	0.4-0.8
Sparus aurata	Sea bream	0.3 - 1.2
Homarus gammarus	European lobster	0.4 - 0.8

2.1.2. SUMMER

This time of year, especially in the period from July through August, is characterized by the lowest fishing activity. A large number of sports-recreational vessels passing through, particularly large motor yachts which create a lot of noise and disturb fishing. Gill nets, trammel nets as well as bottom longlines are used in this period of the year. The number of caught species is smaller than in spring time. Fishing activity moves to greater depths 70-120 m. With increasing depth decreases the number of species in the catch, but in contrast the weight of the specimens caught is higher.

Fishermen who use gill net usually fish the following species in this period of the year (Table 7).

Fishermen who use trammel net usually fish the following species in this period of the year (Table 8).

Fishermen who use demersal longlines, following species commonly caught in this period of the year (Table 9).

Table 7. Species caught by gill nets in the summer in the Platamuni area

Species	Common name	Weight (kg)
Dentex gibbosus	Pink dentex	2.0 - 8.0
Zeus faber	John Dory	0.5 – 3
Lophius budegassa	Black-bellied angler	1.3 – 10
Merluccius merluccius	European hake	0.7 – 3
Psetta maxima	Turbot	1.2 - 2.5

Table 8. Species caught by trammel nets in the summer in the Platamuni area

Species	Common name	Weight (kg)
Palinurus elephas	Spiny lobster	0.3 - 0.8
Lophius budegassa	Black-bellied angler	1.2 - 2.0
Scorpaenba scrofa	Red scorpionfish	0.5 - 2.0
Trigla lucerna	Tub gurnard	2.0 - 6.0

Table 9. Species caught by demersal longlines in the summer in the Platamuni area

Species	Common name	Weight (kg)
Lophius budegassa	Black-bellied angler	1.3 - 6.0
Merluccius merluccius	European hake	1.0 - 4.0
Raja miraletus	Brown ray	0.6 - 2.0
Mustelus mustelus	Smoothhound	1.2 - 4
Squalus acanthias	Picked dogfish	1.0 - 3.0
Conger conger	Conger eel	0.8 - 3.0
Trigla lucerna	Tub gurnard	3.0 - 7.0
Dentex dentex	Common dentex	2.0- 6.0

2.1.3. AUTUMN

During this period, almost all fishermen use the higher gill nets from 4.5 - 8 meters. Fishing activity is at a depth of 15 - 60 meters. During this period in the catches prevailing the pelagic species such as Greater amberjack, Chub mackarel, Bullet tuna and Atlantic bonito. All of these species live in schools, and catches can be quite large. Autumn period, together with spring period are the most productive in terms of quantity of fish and the number of fishing days at sea. Species which are commonly caught in the autumn are shown in Table 10.

Table 10. Species caught by higher gill nets during the autumn in the Platamuni area

Species	Common name	Weight (kg)
Seriola dumerili	Greater amberjack	0.4 - 0.8
Sarda sarda	Atlantic bonito	0.5 - 2.5
Scomber japonicus	Chub mackarel	0.7 - 2.5
Auxis rochei	Bullet tuna	0.8 - 2.0
Spondylosoma cantharus	Black sea bream	0.3 - 0.6
Pagellus erythrinus	Common pandora	0.5 - 0.8
Diplodus sargus	White sea bream	0.3 - 0.7
Sparus aurata	Sea bream	0.6 - 1.2
Pagrus pagrus	Common sea bream	0.4 - 1.2
Sphyraena sphyraena	Barracuda	0.8 - 1.5

2.1.4. WINTER

Winter period is characterized by a smaller number of fishing days, which is understandable because the weather conditions do not allow more fishing activity. It has been mentioned that the fishermen are very experienced and well-equipped, and exploit every «good» day for fishing. Two types of trammel nets are almost exclusively used. The first type of trammel net has a height of 1.5-1.8 meters and have 28-32 mm mesh size, designed for catching octopus and cuttlefish, while the second type which has a height of 1.5-3.0 meters and have about 50-60 mm mesh size, is designed for catching species of family *Soleidae* and *Pleuronectidae*. This trammel nets called «popunice». Fishing activity is at depths of 30-80 meters depending on the target species.

The most productive seasons for fishing in this area are autumn and spring. Number of fishing days, which can be done in this area, is 150-220 days per year. Two distinctive species, according to the opinion of all the fishermen interviewed, are the Spiny lobster and Adriatic sole.

Fishermen have indicated the problems encountered in this area. The major problem is using of explosives (dynamite) from the coast as well as from the boats. Dynamite is used throughout the year, mostly in the period May-June and October-November. They believe that the prolonged use of dynamite in this area is caused the reduced number of species and the reduced amount of the catch.

Another problem is the illegal SCUBA divers with underwater lamps, whose activity is the highest in the summer season, and exclusively at night. They are very well organized and they carry a large part of the catch from this area.

As another problem, there is an illegal entry of trawlers at depths of less than 50 meters. Fishermen are often left without the fishing gears which trawlers tear.

Table 11. Species caught by trammel nets in the winter period in the Platamuni area

Species	Common name	Weight (kg)
Sepia officinalis	Common cuttlefish	0.2 - 1.2
Octopus vulgaris	Common octopus	0.4 - 4.0
Solea impar	Adriatic sole	0.4 - 0.8
Psetta maxima	Turbot	0.5 - 3.5
Trigla lucerna	Tub gurnard	1.2 - 2.0
Lophius budegassa	Black-bellied angler	1.5 - 5.0
Scorpaena scrofa	Red scorpionfish	0.5 - 1.0
Sparus aurata	Sea bream	0.4 - 0.6
Spondylosoma cantharus	Black sea bream	0.5 - 0.9
Diplodus vulgaris	Common two-banded sea bream	0.5 - 1.0

2.2. PETROVAC-BULJARICA

The area that is planned for the protection extends from the beach Drobni pijesak to the beach named Kraljičina plaža. This area is very attractive for fishing activity (Fig. 7). Local people who live in this area are very closely related to it, and almost all the natives engaged in fishing, both recreationally and professionally. They have a high level of experience, and they are quite well equipped in terms of technology.

The area is mostly rocky coastal area up to approximatelly 25 meters depth, with the exception of the Buljarica inlet where is mostly sandy. Moving toward greater depths rocky substrate replaces by sandy substrate to approximatelly 50-meters depth when the bottom becomes muddy.

In the area of Buljarica inlet there is a greater part of underwater springs whose activity is most pronounced in the winter. In this area there are a number of reef that have been very good for fishing, but mostly destroyed due to the use of explosives. Many fishermen say that the best area for fishing is area around the sunken Austro-Hungarian war ship named «Zenta» which is located at about 3 NM from shore across Buljarica inlet. Sea currents are for the most part of the year, in the direction from south to north.

In this area, only people from Petrovac and Buljarica (Fig. 8) are engaged in fishing. According to data collected, between 12 and 15 fishermen are engaged in fishing throughout the year. There are two groups of fishermen. The first group consists of mostly indigenous people who observe certain unwritten rules, such as: the nets are thrown at dusk and rise in the morning, at certain periods of the year throwing certain types of nets, during the spawning period do not catch the species that are spawn during that period of the year. These fishermen know the fish behaviour well and their biological seasonality. They are true friends and guardians of the sea.

Most of this group has a valid license or once had, but now due to various reasons (administrative, financial, etc.) are not able to provide the same. Opposite them, there is another group which is composed of small number of locals and newcomers who are doing just the opposite.

Their fishing nets literally standing in the sea all year round, when they pass by to see whether the catch, only to lift one end, review and immediately returned to the sea, which is contrary to all fishing regulations and laws. Also, they are often involved in various illegal activities (use of dynamite, night fishing by SCUBA dive and lamps). Basic characteristics of the vessels which fish in this area are given in Table 12.

Figure 7. Petrovac port

Table 12. Basic characteristics of the vessels fish in this area

	LOA	Power (HP)	Fuel	Equipment	valid licence
1	4.95	10	Mixed	GPS	YES
2	5.00	18	Diesel	GPS, SONAR	NO
3	6.00	10	Mixed	GPS	YES
4	6.85	147	Diesel	GPS, SONAR, EHOSOUNDER, RADAR	NO
5	4.99	12	Mixed	GPS	NO
6	9	70	Diesel	GPS, SONAR	NO

All of the interviewed fishermen have a number of different nets used seasonally. General characteristics of the fishing gear used in this area are given in the following Tables 13, 14 and 15.

Table 13. General characteristics of the gear - gill net - used in Petrovac area

Gill nets	
Material	Polyamides
Length (m)	200 – 500
Height (m)	1,5 – 8
Mesh size (mm)	28 - 46
Weight (kg)	32 – 40

Table 14. General characteristics of the gear – trammel net - used in Petrovac area

Trammel net	
Material	Polyamides
Length (m)	400 – 500
Height (m)	1,5 – 5
Mesh size (mm)	45 - 90
Weight (kg)	24 - 50

Table 15. General characteristics of the long lines - used in Petrovac area

Long lines	
Hook (type and measure)	Mustad 7 – 10
Mainline length (m)	500 – 1500
Mainline material and diameter (mm)	Plastic nylon, 1-6
Branch line length (m)	1 - 2.5
Branch line diameter (mm)	0.3 – 4
Distance between branch line (m)	2-5

As has already been noted that most fishermen use special tools seasonally, depending on the targeted catch, interviews were focused in this direction so that it comes to information about the species that are caught by season and their average weight.

It was very difficult to determine the total catch and catch per move, because even they do not keep an accurate record of, and otherwise are not eager to talk about the amount that catches.

Figure 8. Island Katic and Buljarica bay

2.2.1. SPRING

In this period of the year gill nets and trammel nets are used. Some fishermen use also demersal and pelagic longlines. Gill nets are used at depths of 15-45 meters while longlines are used at greater depths. Pelagic longlines and demersal longlines are used at a distance of 3-4 NM and 2-5 NM from the coast, respectively. The catches are diverse due to using the different types of nets.

Fishermen who use gill net catch the following species shown in Table 16.

Common species caught by trammel net in this period of the year are shown in Table 17.

Fishermen who use demersal longlines mostly catch the following species in this period of the year (Table 18).

Table 16. Species caught by gill nets and their weight in the spring period in the Petrovac area

Species	Common name	Weight (kg)
Trachurus trachurus	Atlantic horse mackerel	0.3 - 0.6
Spondylosoma cantharus	Black sea bream	0.3 - 0.4
Oblada melanura	Saddle bream	0.2 - 0.5
Boops boops	Bogue	0.2 – 0.4
Dentex dentex	Common dentex	1 – 2.5
Sparus aurata	Sea bream	0.3 – 0.6
Pagrus pagrus	Common sea bream	0.4 – 0.8
Diplodus sargus	White sea bream	0.3 - 0.7
Seriola dumerili	Greater amberjack	0.4 - 0.8
Sarda sarda	Atlantic bonito	0.5 - 2.5

Table 17. Species caught by trammel nets and their weight in the spring period in the Petrovac area

Species	Common name	Weight (kg)
Palinurus elephas	Spiny lobster	0.3 - 0.5
Mullus barbatus	Red mullet	0.1 - 0.15
Sepia officinalis	Common cuttlefish	0.2 - 0.8
Scorpaena scrofa	Red scorpionfish	0.5 – 1
Labrus merula	Brown wrasse	0.3 - 0.6
Diplodus sargus	White sea bream	0.4 - 1.5
Sparus aurata	Sea bream	0.3 - 1.2
Parapenaeus longirostris	Deep-water pink shrimp	0.01 - 0.02
Zeus faber	John Dory	0.5 - 1.5
Serranus cabrilla	Comber fish	0.2 - 0.4
Diplodus annularis	Annular Seabream	0.3 - 0.6
Scorpaena porcus	Black scorpionfish	0.2 - 0.5

Table 18. Species caught by demersal longlines in the spring period in the Petrovac area

Species	Common name	Weight (kg)
Dentex gibbosus	Pink dentex	2.0 - 12.0
Pagrus pagrus	Common sea bream	3.0 - 10.0
Epinephelus marginatus	Dusky Grouper	4.0 - 20.0
Merluccius merluccius	European hake	2.0 - 3.0

Beside these fishing gears some fishermen use pelagic longlines and they have a lot of success in catching Swordfish and Yellowfin tuna, which weights are given in the Table 19.
According to showed species, this time of the year is very good for fishing, fish of the first category is caught, whose market price is the highest.

Most fishermen are closely linked to local restaurants and hotels, in the sense that it is the family business where they have sold the catch, especially during the summer tourist season. Also, a certain portion of the catch is used exclusively for the household, and people from this area consume the more seafood products in relation to the entire Montenegrin coast. It is worth to note because the fish consumption in Montenegro is amongst the lowest in Europe (around 2 to 4 kg per capita).

As can be seen from the above tables spring is very good for fishing, and in terms of diversity, the largest number of species caught at this time of year. From the interviews, it was not possible to obtain data on the size of the catch, but the general assessment of all fishermen is that there are plenty of fish. Of course, all fishermen agree that the past ten years the catch halved, and the main reason cited a large number of night SCUBA diving and lamps, the use of dynamite during the year, especially in spring and summer. This area is characterized by «deep» throwing dynamite.

Specifically, in the reefs, where fish are collected, these people down the bait to the bottom a few consecutive days. Small fish are used as bait and every day certain amount of this fish is down to the sea bottom. In this way the fish are gathering for days, but then one day instead of small fish in the bait basket they put dynamite with delayed effect that when it gets to the bottom explodes. Of the total number of dead specimens dynamiters pick up to 15% of killed fish while the rest remain at the bottom. The depths at which this works are 40-70 meters. This “phenomenon” is sustained last 20 years and it is one of the main reasons for depletion of fish stocks in this area. Some fishermen have stopped throwing demersal longlines, because, as they state the places where they were throwing long lines were practically destroyed by throwing dynamite.

Table 19. Two common species caught by pelagic longlines in the spring period in the Petrovac area

Species	Common name	Weight (kg)
Xiphias gladius	Swordfish	10.0 - 30.0
Thunnus albacares	Yellowfin tuna	7.0 - 35.0

2.2.2. SUMMER

As in the Platamuni area, this time of the the year, especially in the period from July through August, is characterized by the lowest fishing activity (Table 20). Petrovac is extremely popular among tourists in recent years, the number of accommodations is increasing each year, and thus the number of visitors. With a large number of tourists increases the traffic on the sea, especially in the coastal areas, where it is evident a number of sports-recreational vessels along the entire area.

Fishing activity moves to greater depths. Gill nets, trammel nets and demersal longlines are used. In this season there is the minimum number of fishing days, despite the very favorable weather conditions. The number of species that are caught is much smaller in relation to the spring period.

Fishermen who use demersal longlines usually catch the following species in this period of the year (Table 20).

Fishermen who use trammel nets mostly catch the following species in this period of the year (Table 21).

Common species mostly caught by gill nets in this period of the year are shown in Table 22.

At this time of the year there are the same problems as in the spring period, provided that the divers activity is much higher compared to throwing dynamite.

Table 20. Common species caught by demersal longlines in the summer period in the Petrovac area

Species	Common name	Weight (kg)
Dentex gibbosus	Pink dentex	6.0 - 12.0
Pagrus pagrus	Common sea bream	3.0 -8.0

Table 21. Common species caught by trammel nets in the summer period in the Petrovac area

Species	Common name	Weight (kg)
Palinurus elephas	Spiny lobster	0.3 - 0.8
Mullus barbatus	Red mullet	0.07 - 0.15
Boops boops	Bogue	0.2 – 0.4
Scorpaena porcus	Black scorpionfish	0.2 - 0.5

Table 22. Common species caught by trammel nets in the summer period in the Petrovac area

Species	Common name	Weight (kg)
Diplodus annularis	Annular Seabream	0.3 - 0.6
Diplodus sargus	White sea bream	0.4 - 0.8
Sparus aurata	Sea bream	0.3 - 1.0
Pagellus erythrinus	Common pandora	0.5 - 0.8

2.2.3. AUTUMN

Fishing activity is increasing after the summer. Gill nets of high altitude (4 - 8 meters), with mesh size of 36 mm to 70 mm are used. Nets are thrown at various depths from 15-70 meters, depending on the target catch. Bottom longlines are also used at depths of 40-60 meters, and the number of hooks is in the range of 500-1500.

Gill nets catch the following species (Table 23).

While, bottom longlines catch the species showed in the Table 24.

This period of the year is characterized by a great catch of mullet, salema porgy, white sea bream and atlantic bonito, and most of the fishermen have decided to catch them by high gill net. With the appearance of shoals of gray mullet and salema porgy in the fishing area, intensifying the use of dynamite is a big problem. Divers are less present because the demand on the fish market is not a big.

Table 23. Species caught by gill nets in the autumn period in the Petrovac area

Species	Common name	Weight (kg)
Coryphaena hippurus	Common dolphinfish	1.0 - 3.0
Umbrina cirrosa	Ombrine	0.3 - 0.5
Lithognathus mormyrus	Sand steenbras	0.4 - 0.6
Seriola demerili	Greater amberjack	0.4 - 0.8
Mugil cephalus	Flathead mullet	0.5 - 2.5
Scomber japonicus	Chub mackarel	0.5 - 0.8
Trachurus trachurus	Atlantic horse mackerel	0.3 - 2.5
Sarda sarda	Atlantic bonito	0.5 - 2.5
Sarpa salpa	Salema porgy	0.3 - 0.7
Diplodus sargus	White sea bream	0.3 - 0.7

Table 24. Species caught by bottom longlines in the autumn period in the Petrovac area

Species	Common name	Weight (kg)
Dentex dentex	Pink dentex	1.5 - 6
Pagrus pagrus	Common sea bream	4.0 - 6.0
Conger conger	European conger	1.0 - 3.0

2.2.4. WINTER

Like in the autumn period fishermen use gill net and demersal longlines. Almost identical species are caught in winter, but the depth where fishing activity carried out is much less than in the autumn and do not exceed 40 meters. The size of the caught specimen is smaller as well as the total catch and the number of fishing days in this season is the smallest.

Species that are caught with gill net and bottom longlines in the winter are shown in the following Tables 25 and 26.

The most productive periods for fishing in this area are spring and autumn. All fishermen agree that there are three distinctive fish species: white sea bream, flathead mugil and salema porgy. Number of fishing days, which can be done in this area is 150-200 days per year. Fishermen have indicated the problems encountered in this area. First of all, the main problem is throwing the dynamite during the year as well as divers with lamps at night, whose presence is the most pronounced in the spring and summer. Also, as one of the main reasons for reduced fish stocks in this part of the Montenegrin coast, are numerous sewage drains near the coast, where without any treatment pour large amounts of detergents, especially during the summer.

Table 25. Species caught by gill nets in the winter period in the Petrovac area

Species	Common name	Weight (kg)
Diplodus sargus	White sea bream	0.4 - 0.6
Mugil cephalus	Flathead mullet	0.5 - 2.0
Umbrina cirrosa	Ombrine	0.3 - 0.5
Seriola demerili	Greater amberjack	0.4 - 0.8
Sarpa salpa	Salema porgy	0.5 - 0.7
Sparus aurata	Sea bream	0.4 - 0.6
Sarda sarda	Atlantic bonito	1.0 - 4.0

Table 26. Species caught by bottom longlines in the winter period in the Petrovac area

Species	Common name	Weight (kg)
Raja asterias	Starry ray	1.0 - 4.0
Trigla lucerna	Tub gurnard	3.0 - 7.0
Conger conger	European conger	1.0 - 3.0
Lophius budegassa	Black-bellied angler	3.0 – 10.0

2.3 ISLAND OLD ULCINJ

The area that is planned for protection is located northwest of city Ulcinj and includes Valdanos bay and several smaller bays toward the city Bar (Fig. 9 a,b). Unlike other bays, Valdanos bay is protected from both southern and northern winds and it often served to shelter ships during storms. The Valdanos Bay beach area is classified as a natural monument according to the Decision of the Republic Institute for the Protection of Nature no. 30/68. This place is very popular for fishing, as well as for underwater fishing. The largest number of fishermen coming from Ulcinj and Bar, as well as the lower part consists of people who live in the bays around the island. The whole area is sandy, with the exception of a narrow coastal area where is little rocky. The sea bottom is characterised by the presence of *Posidonia oceanica* meadow while there are a large quantities of dead shells. Maximum depth in this area does not exceed 50 meters. Sea currents are very strong and focused in the direction from south to north.

According to data collected in this area there are between 8 and 12 fishermen throughout the year. None of them has a legal permit for commercial fishing. Most people fish for sale, of which some have restaurants. Fishermen usually throw the nets before the night and rise early in the morning. Loss of gears is not uncommon, due to strong currents, and due to theft among fishermen.

Basic features of fish vessels in this area are given in Table 27.

All of the interviewed fishermen have a greater variety of fishing nets which are used seasonally. General characteristics of the fishing gear used in this area are given in the following Tables 28, 29 and 30.

As in the previous areas, because the most fishermen do not keep an accurate record of total catch and do not eager to talk about the amount that catches, interviews were focused in this direction so that it comes to information about the species that are caught by season and their average weight.

Figure 9a. Valdanos bay

Figure 9b. Island old Ucinj and Kruče bay

Table 27. Characteristics of interviewed fishermen boats

	LOA	Power (HP)	Fuel	Equipment	valid licence
1	4.10	4	Mixed	-	NO
2	5.50	4	Mixed	-	NO
3	5.95	18	Diesel	GPS, SONAR	NO
4	6.60	40	Diesel	GPS, SONAR, EHOSOUNDER	NO
5	4.99	10	Diesel	GPS	NO
6	4.10	4	Mixed	-	NO

Table 28. General characteristics of the gear - gill net - used in Old Ulcinj region

Gill nets	
Material	Polyamides
Length (m)	100 – 500
Height (m)	1,2 – 8
Mesh size (mm)	22 - 80
Weight (kg)	32 – 48

Table 29. General characteristics of the gear – trammel net - used in Old Ulcinj region.

Trammel net	
Material	Polyamides
Length (m)	400 – 500
Height (m)	1,8 – 6
Mesh size (mm)	45 - 55
Weight (kg)	24 - 45

Table 30. General characteristics of the long lines - used in Old Ulcinj region.

Long lines	
Hook (type and measure)	Mustad 7 – 10
Mainline length (m)	500 – 1500
Mainline material and diameter (mm)	Plastic nylon, 1-6
Branch line length (m)	1 - 2.5
Branch line diameter (mm)	0.3 – 4
Distance between branch line (m)	2-5

2.3.1. SPRING

In the spring, gill net and trammel net are also used. The fishing activity is conducted at depths between 10-35 meters. Height of gill net is 1.4-1.8 meters with mesh size of 22–28 mm, whereas the height of trammel net is in the range of 1.8-2.0 meters with mesh size of 40-45 mm.

Fishermen who use gill nets catch the following species and their average weight in the catch is given in the following Table 31.

Fishermen who use trammel nets catch the following species and their average weight in the catch are given in the following Table 32.

This time of year is very good for fishing. It is characterized by Caramote prawn catch in April and May. The value of this crustacean reaches 30 eur / kg on the market. Besides this species, solid amount of Adriatic Sole, Red mullet and Sea bream are caught.

Table 31. Species caught by gill nets in the spring period in the Old Ulcinj area

Species	Common name	Weight (kg)
Melicerthus kerathurus	Caramote prawn	0.02 - 0.03
Sepia officinalis	Common Cuttlefish	0.3 -1.2
Octopus vulgaris	Common octopus	0.8 - 2.5
Mullus barbatus	Red mullet	0.07 - 0.15
Pagellus erythrinus	Common pandora	0.5 - 0.8
Solea impar	Adriatic sole	0.6 - 2.5
Scorpaenba scrofa	Red scorpionfish	0.8 - 1.2
Sarpa salpa	Salema porgy	0.3 - 0.5
Oblada melanura	Saddle bream	0.2 - 0.5
Mugil cephalus	Flathead mullet	0.4 - 2.5
Lichia amia	Leerfish	0.5 - 3.5

Table 32. Species caught by trammel nets in the spring period in the Old Ulcinj area

Species	Common name	Weight (kg)
Mullus barbatus	Red mullet	0.05 - 0.08
Sparus aurata	Sea bream	0.3 - 0.9
Diplodus sargus	White sea bream	0.3 - 0.7
Palinurus elephas	Spiny lobster	0.3 - 0.8
Lithognathus mormyrus	Sand steenbras	0.2 - 0.8

2.3.2. SUMMER

The summer period is characterized by the use of gill net, trammel net and demersal long lines. Dimensions and nets construction are the same as in spring period. Although traffic at sea increases during the summer season, it does not affect the fishing activity, which is the highest in the summer and over the entire year due to the number of days with nice weather. Fishing activity occurs at depths between 10-45 meters. There is a large number of underwater fishermen, very well organized, with excellent equipment. The big problem in this area is also throwing dynamite, both from shore and from boats. As there is no control, dynamite «works» throughout the whole year with the most intense in the summer time.
Fishermen who use demersal longlines usually catch the following species in this period of the year (Table 33). Fishermen who use gill nets and trammel nets usually catch the following species in this period of the year (Table 34-35).

Table 33. Species caught by demersal longlines in the summer period in the Old Ulcinj area

Species	Common name	Weight (kg)
Sparus aurata	Sea bream	2.0 -3.0
Pagellus erythrinus	Common pandora	1.5 -2.0
Dentex dentex	Common dentex	1.5 - 6.0
Coryphaena hippurus	Dolphinfish	1.5 - 3.0
Squalus acanthias	Piked dogfish	1.0 - 3.0

Table 34. Common species caught by gill nets in the summer period in the Old Ulcinj area

Species	Common name	Weight (kg)
Dentex dentex	Common dentex	0.6 - 1.5
Lophius budegassa	Black-bellied angler	1.5 - 2.0
Raja asterias	Mediterranean starry ray	0.6 - 1.2
Solea impar	Adriatic sole	0.5 - 1.2
Palinurus elephas	Spiny lobster	0.3 - 0.8
Homarus gammarus	European lobster	0.4 - 2.0
Mullus barbatus	Red mullet	0.05 - 0.08
Scorpaenba scrofa	Red scorpionfish	0.5 - 1.0
Sepia officinalis	Common cuttlefish	0.3 - 0.8
Octopus vulgaris	Common octopus	0.8 - 2.5
Uranoscopus scaber	Atlantic stargazer	0.2 - 0.6
Labrus mixtus	Cuckoo wrasse	0.3 - 0.6

Table 35. Common species caught by trammel nets in the summer period in the Old Ulcinj area

Species	Common name	Weight (kg)
Melicerthus kerathurus	Caramote prawn	0.02 - 0.03
Mullus barbatus	Red mullet	0.05 - 0.08
Scorpaenba scrofa	Red scorpionfish	0.5 - 1.0
Boops boop	Bogue	0.1 - 0.6
Octopus vulgaris	Common octopus	0.4 - 1.5
Mugil cephalus	Flathead mullet	0.4 - 1.5
Trachinius draco	Greater weever	0.8 - 2.0

2.3.3. AUTUMN

Great fishing activity continues after the summer and two types of gill nets are used: the first type has a bigger height (8 - 10 meters), with mesh size of 40 mm to 70 mm, while the second type has smaller height of 1.8 meters with the mesh size of 28 mm. Also in this period of the year trammel net with height of 10-16 meters and mesh size of 40-45 mm is used. Nets are placed at various depths between 10-40 meters, depending on the target catch.
Species caught by gill net are listed in Table 36.
Species caught by trammel net are listed in Table 37.

Table 36. Species caught by gill nets in the autumn period in the Old Ulcinj area

Species	Common name	Weight (kg)
Seriola demerili	Greater amberjack	0.4 - 1.0
Mugil cephalus	Flathead mullet	0.4 - 1.5
Sparus aurata	Sea bream	0.3 - 0.9
Diplodus puntazzo	Sharpsnouted seabream	0.3 - 0.6
Melicerthus kerathurus	Caramote prawn	0.02 - 0.03
Pagellus erythrinus	Common pandora	0.5 - 0.8
Mullus barbatus	Red mullet	0.05 - 0.08
Raja asterias	Mediterranean starry ray	0.6 - 1.2

Table 37. Species caught by trammel nets in the autumn period in the Old Ulcinj area

Species	Common name	Weight (kg)
Sarda sarda	Atlantic bonito	0.5 - 2.5
Auxis rochei	Bullet tuna	0.8 - 2.0
Lichia amia	Leerfish	0.5 - 3.5
Seriola dumerili	Greater amberjack	0.4 - 0.8

2.3.4. WINTER

Winter period is also characterized by the use of two types of gill net. The first has a height of 4-6 meters with mesh size of 36 mm to 40 mm while the second type has bigger height of 11-14 meters and bigger mesh size of 70-80 mm. Winter catches were also good, although this period is characterized by the smallest number of fishing days.

Species caught by gill net in the winter are listed in Table 38.

Number of fishing days, which can be done in this area, is 150 – 200 days per year. Fishermen have indicated the problems encountered in this area. First of all, the main problem as in the previous areas is trowing the dynamite, then divers with flashlights at nigth whose presence is strongest in the summer time. The most common species in this area is Caramote prawn, followed by Adriatic sole and Flathead mullet.

Table 38. Species caught by different types of gill nets in the winter period in the Old Ulcinj area

Species	Common name	Weight (kg)
Sarpa salpa	Salema porgy	0.3 - 0.5
Mugil cephalus	Flathead mullet	0.4 - 1.5
Oblada melanura	Saddle bream	0.2 - 0.4
Sphyraena sphyraena	European barracuda	0.6 - 1.8
Sepia officinalis	Common cuttlefish	0.3 - 0.8
Octopus vulgaris	Common octopus	0.4 - 1.5
Dentex dentex	Common dentex	0.5 - 1.5
Trigla lucerna	Tub gurnard	1.2 - 2.0
Pagrus pagrus	Common sea bream	1.0 - 2.5
Solea impar	Adriatic sole	0.5 - 1.2
Psetta maxima	Turbot	1.0 - 2.5
Lophius budegassa	Black-bellied angler	1.5 - 2.0

2.4. ISLAND MAMULA

Island Mamula (former name was Lastavica) is located on the entrance to the Bokakotorska Bay between the peninsulas Prevlaka and Luštica. The island is circular in shape with a diameter of about 200 meters. There is the fortress on the island, which has been built in the 19th century. The primary purpose of the fortress was to defend the attack from the sea in Boka Kotorska Bay, while later during the World War II was used as a prison. Today it is a tourist attraction and is under state protection as a cultural monument.

The area that is planned for protection is very attractive for fishing activity, although in contrast to Platamuni and Petrovac much less. According to data collected 8-10 fishermen are present in this area during the year. There is no particular territorial division between the fishermen and what is particular is that the current number of fishermen is the maximum number that this area can satisfy in terms of territorial size. Specifically, the area between the peninsula Prevlaka and island Lastavica is prohibited for fishing activity, as this area is reserved as a waterway large cargo ships, cruisers and large yachts which visiting the Boka Kotorska Bay during the whole year. With the opening large marina in Tivat, and great interest of cruise companies to bringing tourists to the Bay of Kotor, requires that traffic biggest vessels increases from year to year, thus preventing any fishing activity in their fairway. In this zone of the cape Oštra to Cape Kobila (the inner part of the bay, which extends the entire length peninsula Prevlaka) is a forbidden zone for Montenegrin fishermen because of the still unresolved issue between the Croatia and Montenegro which argued over the ownership of Prevlaka.

Along the coast of the island there is rocky bottom to 15-20 meters of depth. The coast is steep and after 30 meters from the island reaches a depth of 40 meters, which means that the area under the rocky surface is very small. Rocky surface replaces sandy terrain, with sea grass meadows, to a depth of 40 meters. At greater depths the bottom is composed of fine silt.

The basic characteristics of the fish vessels in this area are given in Table 39.

All of the interviewed fishermen have a number of different nets which used seasonally. General characteristics of the fishing gear used in this area are given in the following tables 40, 41, 42 and 43.

Most of the fishermen who live in this area are oriented on the Herceg-Novi port (Fig. 11). Besides this port, there are two smaller ports in Zelenika and in Rose. In this area there are a large number of illegal fishermen, primarily in Herceg-Novi and all of the interviewed fishermen stated that illegal fishermen cause the most damage in terms of theft of nets, long lines, and tearing them at sea, etc.

As already stated, most fishermen use special gears seasonally, depending on the targeted catch, interviews were focused in this direction so as to obtain information on the species that are caught by season and their average weight.

Figure 11. Herceg – Novi port

Figure 12. Gear and fisherman from Herceg – Novi port

Figure 10. Island Lastavica – Mamula

Table 39. Characteristics of interviewed fishermen vessels

	LOA	Power (HP)	Fuel	Equipment	valid licence
1	7.8	40	Diesel	GPS, RADIO	YES
2	6.3	26	Diesel	GPS	YES
3	4.5	10	Mixed	GPS	YES
4	7.9	64	Diesel	RADIO, GPS, SONAR, ECHOSOUNDER	YES
5	5.32	11	Diesel	SONAR, GPS	YES
6	4.8	6	Mixed	GPS	YES
7	6.4	15	Diesel	GPS, ECHOSOUNDER	YES

Table 40. General characteristics of the gear - gill net - used in region of Lastavica Island

Gill nets	
Material	Polyamides
Length (m)	200 – 500
Height (m)	1,5 – 8
Mesh size (mm)	28 - 46
Weight (kg)	32 – 40

Table 41. General characteristics of the gear – trammel net - used in region of Lastavica Island

Trammel net	
Material	Polyamides
Length (m)	400 – 500
Height (m)	1,5 – 5
Mesh size (mm)	45 – 90
Weight (kg)	24 – 50

Table 42. General characteristics of the gear – purse seine net - used in region of Lastavica Island.

Purse seine net	
Material	Polyamides
Length (m)	100 – 120
Height (m)	1,5 – 5
Mesh size (mm)	10 – 30
Weight (kg)	70 – 150

Table 43. General characteristics of the demersal and pelagic long lines - used in region of Lastavica Island.

Long lines	
Hook (type and measure in mm)	Demersal, 8 – 12 mm
Number of hook	100 – 500
Mainline length (m)	500 – 1500
Branch line length (m)	1 - 2.5
Distance between branch line (m)	2-5

Long lines	
Hook (type and measure in mm)	Pelagic, 35 – 45 mm
Number of hook	200 – 1000
Mainline length (m)	500 – 1500
Branch line length (m)	1 - 2.5
Distance between branch line (m)	2-5

2.4.1. SPRING

Trammel net and purse seine net are used in spring period. Also some fishermen use pelagic longlines. Trammel nets are used at depths up to 30 meters. Pelagic longlines are setting in front of the island at a distance of 0.5 - 1 NM. With regard to using different types of gears, catches are diverse. Trammel net used in this period has the height of 1.5 to 2 meters, and a mesh size from 28 to 34 mm depending on the fisherman.

Fishermen who use trammel net and pelagic longlines usually catch the following species in this period of the year (Table 44, 45).

During this period, the fishing is conducted by purse seine net at night under artificial light and with this type of net small pelagic species are caught. Fishing takes place at night, the fish are collected under artificial light. Weather conditions have to be extremely good with no wind. This nets is unable to fish during a full moon.

Fish species that are caught with purse seine net in the spring are presented in Table 46.

Most fishermen agree that this is the best time for fishing. Unlike areas Platamuni and Petrovac, there is almost no use of dynamite for fishing because this area is constantly under the control of both the Montenegrin police and Croatian border service. But at the end of the spring and early summer appear the divers and increases the number of illegal fishermen.

Table 44. Species caught by trammel nets in the spring period in the Mamula island

Species	Common name	Weight (kg)
Sepia officinalis	Common cuttlefish	0.3 - 1.0
Dentex dentex	Common dentex	0.5 - 2.5
Pagrus pagrus	Common sea bream	0.5 - 2.0
Sparus aurata	Sea bream	0.4 - 0.8
Oblada melanura	Saddle bream	0.2 - 0.5
Boops boop	Bogue	0.1 - 0.6
Sarpa salpa	Salema porgy	0.3 - 0.8

Table 45. Species caught by pelagic longlines in the spring period in the Mamula island

Species	Common name	Weight (kg)
Xiphias gladius	Swordfish	12.0 - 25.0
Thunnus albacares	Yellowfin tuna	10.0 - 35.0
Prionace glauca	Blue shark	25.0 – 40.0

Table 46. Species caught by purse seine net in the spring period in the Mamula island

Species	Common name	Weight (kg)
Boops boop	Bogue	0.1 - 0.6
Sardina pilchardus	European pilchard	0.02 - 0.04
Engraulis encrasicolus	European anchovy	0.01 - 0.02
Trachurus trachurus	Atlantic horse mackerel	0.3 - 0.6
Scomber japonicus	Chub mackerel	0.3 - 0.8

2.4.2. SUMMER

The summer period is also characterized by a good catch and solid species diversity. Most fishermen use two types of gill nets. The first type of gill net are higher and has height of 6-8 meters with mesh size of 50-72 mm and are primarily intended for catching Chub mackarel and Atlantic horse mackarel. Another type of gill net has smaller height of 1.5-2.5 meters with 32 mm to 40 mm mesh size targeting mainly European hake and Red mullet. The depth at which the nets are setting ranged from 30 to 50 meters.

Species that are caught with gill net are listed in Table 47.

Except gill net in this period are also used pelagic and demersal longline. Although they did not specify the quantities caught, fishermen who use longlines are very satisfy with their catch.

Pelagic long lines catch a similar species as in the spring period (Table 48).

Demersal long lines catch the following species listed in Table 49.

Typical for this time of the year is extremely high traffic on the sea near the fishing zone, especially in the period July-August. During this period, most fishermen are left without their gears. Most unprofessional handling vessels and passing close to the nets, causing that sports-recreational boats tearing nets or withdraw a portion, which often results in the loss of gears. Also, it is very frequent theft of tools by others.

Table 47. Species caught by gill nets in the summer period in the Mamula island

Species	Common name	Weight (kg)
Scomber japonicus	Chub mackerel	0.4 - 1.5
Trachurus trachurus	Atlantic horse mackerel	0.3 - 2.0
Sarpa salpa	Salema porgy	0.3 - 0.8
Sparus aurata	Sea bream	0.4 - 0.8
Oblada melanura	Saddle bream	0.2 - 0.5
Merluccius merluccius	European hake	0.2 - 1.5
Mullus barbatus	Red mullet	0.07 - 0.15
Pagellus erythrinus	Common pandora	0.5 - 0.8

Table 48. Species caught by pelagic longlines in the summer period in the Mamula island

Species	Common name	Weight (kg)
Xiphias gladius	Swordfish	12.0 - 25.0
Prionace glauca	Blue shark	15.0 – 40.0

Table 49. Species caught by demersal longlines in the summer period in the Mamula island

Species	Common name	Weight (kg)
Merluccius merluccius	European hake	0.5 - 5.0
Dentex gibbosus	Pink dentex	2.0 - 12.0
Pagrus pagrus	Common sea bream	4.0 - 7.0
Lophius budegassa	Black-bellied angler	3.0 - 10.0
Raja miraletus	Brown ray	1.0 – 3.5

2.4.3. AUTUMN

Gill net and trammel net are used in autumn period of the year. Characteristics of gill net used in this time of year has the height of 5-8 feet with 50 mm mesh size. The depth at which the nets is setting ranges from 15 to 35 meters. Most common species in the catches are Atlantic bonito and tuna Bullet. Trammel net used in the fall have mesh size of 28-32 mm and height of 1.5-1.8 meters. This type of nets are used at depths of 25-50 meters. Fishermen catch the species in table 51 with this net (Table 51).

Divers and illegal fishermen are less present, so that at this time the fishermen have a lot less problems compared to the summer.

Table 50. Species caught by gill nets in the autumn period in the Mamula island

Species	Common name	Weight (kg)
Sarda sarda	Atlantic bonito	0.5 - 2.5
Auxis rochei	Bullet tuna	0.8 - 2.0
Seriola demerili	Greater amberjack	0.4 - 0.8
Mugil cephalus	Flathead mullet	0.5 - 1.2
Sarpa salpa	Salema porgy	0.3 - 0.8
Oblada melanura	Saddle bream	0.2 - 0.5

Table 51. Species caught by trammel nets in the autumn period in the Mamula island

Species	Common name	Weight (kg)
Mullus barbatus	Red mullet	0.05 - 0.10
Mullus surmuletus	Striped red mullet	0.1 - 0.2
Scorpaenba scrofa	Red scorpionfish	0.5 - 1.0
Scorpaena porcus	Scorpionfish	0.2 - 0.5
Uranoscopus scaber	Atlantic stargazer	0.2 - 0.4
Palinurus elephas	Spiny lobster	0.3 - 0.8
Dentex dentex	Common dentex	0.5 - 1.5
Octopus vulgaris	Common octopus	0.4 - 1.0
Zeus faber	John dory	0.5 - 1.2
Pagellus erythrinus	Common pandora	0.5 - 0.8
Symphodus tinca	Peacock wrasse	0.2 - 0.4

2.4.4. Winter

Winter period is usually reserved for pelagic and semi pelagic species. These species are caught by gill net with height of 6-8 meters and mesh size of 40-72 mm as well as with purse seine nets under artificial light. Also some fishermen use demersal longlines, because in the winter they have a good catch of Tub gurnard, Rays and European hake. The minimum number of fishing days is achieve in this period of the year, mostly because of bad weather.

Species that are caught by gill net in this period of the year are listed in Table 52.

Purse seine nets catch the species in table 53.

Larger specimens of high-quality fish are caught by demersal longlines in this period of the year (Table 54). The most productive seasons for fishing in this area are spring and autumn. Number of fishing days, which can be done in this area is from 200 to 250 days per year. All fishermen agree that in this area characteristic species of fish among pelagic and semi-pelagic species are: Bogue, Atlantic bonito and Atlantic horse mackerel, while among demersal species the most are Striped red mullet, European hake and Salema Porgy.

Table 52. Species caught by gill nets in the winter period in the Mamula island

Species	Common name	Weight (kg)
Mugil cephalus	Flathead mullet	0.5 - 2.0
Sarda sarda	Atlantic bonito	0.5 - 2.5
Trachurus trachurus	Atlantic horse mackerel	0.3 - 2.0
Sarpa salpa	Salema porgy	0.3 - 0.8
Oblada melanura	Saddle bream	0.2 - 0.5

Table 53. Species caught by purse seine nets in the winter period in the Mamula island

Species	Common name	Weight (kg)
Boops boop	Bogue	0.1 - 0.6
Sardina pilchardus	European pilchard	0.02 - 0.04
Engraulis encrasicolus	European anchovy	0.01 - 0.02
Trachurus trachurus	Atlantic horse mackerel	0.3 - 0.6
Scomber japonicus	Chub mackerel	0.3 - 0.8
Sphyraena sphyraena	European barracuda	0.8 - 1.2

Table 54. Species caught by demersal longlines in the winter period in the Mamula island

Species	Common name	Weight (kg)
Trigla lucerna	Tub gurnard	2.0 - 9.0
Merluccius merluccius	European hake	1.0 - 4.0
Raja miraletus	Brown ray	1.0 - 2.5
Lophius budegassa	Black-bellied angler	2.0 - 6.0

2.5. ORAHOVAC-BOKA KOTORSKA BAY

Boka Kotorska bay represents the most sinuous part of the Adriatic coast. The specific position of this bay in relation to other sites in the Adriatic is determined by its geographical situation and by characteristic abiotic and biotic environmental factors. The entire length of the Boka Kotorska Bay (literally «inlet» and also known as the Bay of Kotor) is 15 NM or 28 km while the length of the coastline is 105.7 km. This bay is subdivided into four smaller bays i.e. Kotor bay, Risan bay, Tivat bay and Herceg-Novi bay. The width at the entry to the bay is 2.95 km, while at strait Verige, narrowest point in the bay, it is only 340 m.

The average depth of the whole bay is 27.6 m and in each of the bays the depth increases toward the center. The bottom of this bay is predominantly covered by thick strata of fine mud. One of the most characteristic properties of this bay is its very abundant precipitation and run off which influence very considerably on hydrographycal circumstances of this bay. Beside submarine sources (especially in Kotor, Risan and Tivat bay) there are many springs and wells alongside the seashore. Some of this springs are not active during the whole year or its capacity is deduced during summer at minimum. Because of that the great seasonal variations of temperature and salinity take places in this bay.

It is well known that the Boka Kotorska is the place with the greatest rainfall in the year (Crkvice near Risan is the first place in Europe cca 5 000 mm). So, enormous fresh water masses inflow in this relatively small and closed bay especially during the winter. Sea currents are rather irregular and their directions and strength are influenced by winds, atmospheric pressure and mixing of fresh and sea water. In summer, the currents are weaker, while in other seasons, they are considerably stronger.

The fishing activity of this bay is mainly refering on pelagic fishing because the catch by trawl nets is forbidden in this bay. In fact, fishing with bottom trawls, floating trawls and encircling large-scale fishing nets are prohibited in this area. This is one of the fishing regulations because this area is known as natural spawning and nursery ground for small pelagic fishes. Juvenile anchovies and sardines are caught in the whole area by using beach seines and artificial light. This type of fishing is traditional for centuries in the Boka Kotorska bay.

The immature anchovies are caught in the following way. The small boat carrying the lantern attracts fish for 3-4 hours at about 300 m off the shore. The power of light is usually 800 cd. When enough fish congregates, the boat with lantern is circled by another boat which surrounds the fish with the net. One side of the net is kept on the shore and once the fish school is surrounded, two sides of the net are brought together.

The fishermen tow the net toward the shore, and the boat with lantern quickly crosses over the net, causing the fish to concentrate into the sack of the net and be towed out. The mesh size of the sack is 4.5-8 mm. The main problem with this type of fishing is mesh size of the nets as they exclusively collect immature individuals. This is against the Law on Marine Fisheries and Mariculture, which states that mesh size in any part of the net should not be less than 10 mm, while the minimal allowed length of fish is 12 cm for sardines and 11 cm for anchovies.

Figure 13. Fishermen with different fishing gear

Figure 14. Small boat with lantern (''ferao'')

Basic data on commercial boats used in small-scale fishing are given in the Table 55.

Table 55. Basic data of the boats of the interviewed fishermen

	LOA	Engine power (kW)	Length of net (m)	Mesh size (mm)	Aggregate for light (cd)
1	4	4	87	4.5	1 x 800
2	6.6	2.9	100	6	1 x 800
3	4.9	3.3	120	6.5	1 x 800
4	5.18	2.9	100	5	1 x 800
5	5.5	absent	120	8	2 x 400

As has been already noted, small-scale coastal fishing is conducted on the territory of the Boka Kotorska bay where small boats and a large number of various gears are used (one layer gillnets, three layer trammel nets, beach seine nets, traps for fish and crustaceans). The fishing activities of small-scale fisheries, in terms of fishing days, are usually dependent only on the weather conditions. The catches are usually not recorded, so the level of exploitation is still unknown.

In this area, using of different fishing gear is not so related with the certain season but with presence of fish. The coastal beach seine is designed primarily for night time and fishing with it is carried out on bottoms up to 30 m depth. The mostly represented species besides anchovy and sardine are bogue, Mediterranean sand smelt, fish of the genus *Diplodus*, family Mugilidae. There are different beach seine nets depending on caught species (Table 56).

Table 56. Common species caught by different types of beach seine net

Species	Common name
Boops boops	Bogue
Sardina pilchardus	European pilchard
Engraulis encrasicolus	European anchovy
Trachurus trachurus	Atlantic horse mackerel
Scomber japonicus	Chub mackerel
Atherina hepsetus	Mediterranean sand smelt

Especially in summer period, fishermen use the beach seine called ''šabakun'', but according the Law it can be used in the period from 1 June to 1 March. Šabakun is designed for fishing Atlantic bonito, mullets (Mugilidae) and Greater amberjack (*Seriola dumerilii*).

Figure 15. Fishing operations in Dobrota

Figure 16. Fishing operations in Orahovac

According to the survey information, almost all fishermen have carried out this activity for more than 10 years, in some cases for 20 years, following a family tradition. Among the major problems affecting the small-scale fishering are many cruisers that come in bay and causes damage or loss of small-scale fishing gears. Fishermen in this bay also use the one layer gill net and three layers trammel net which are set on the bottom or at a certain distance above it.

Table 57. Common species caught by gill and trammel net

Species	Common name
Boops boops	Bogue
Sarda sarda	Atlantic bonito
Pagellus erythrinus	Common pandora
Trachurus trachurus	Atlantic horse mackerel
Scomber japonicus	Chub mackerel
Lichia amia	Leerfish

2.6. BIOMASS ESTIMATION AND STATE OF RESOURCES IN THE INVESTIGATED AREA

For the area of Orahovac we provide the data about CPUE (catch per unit of effort) for the period of 2004-2005 and 2006-2007. For the first year of investigation CPUE was 156.44 kg per haul. Percentage of the species in the total catch was: European anchovy (*Engraulis encrasicolus*) 37.17%, European pilchard (*Sardina pilchardus*) 59.17% and OPS (other pelagic species) was 3.65%.

During the investigated period 2006-2007 average CPUE was slightly lower – 141.92 kg per haul. Percentage of the species in the total cacth was: European anchovy (*Engraulis encrasicolus*) 37.00%, European pilchard (*Sardina pilchardus*) 59.71% and OPS (other pelagic species) was 3.30%.

In 2005 echosurvey was performed in Boka Kotorska Bay along the transect of 14 Nm. Estimate of biomass was performed according the acoustic data collected by echo survey, as well as the biological data on average length and percent in weight of all species caught in this period. Biological data used for biomass estimate were:

- Mean length of European anchovies = 7.60 cm; percent in total catch = 29.3%
- Mean length of European pilchards = 7.67 cm; percent in total catch = 66.0%
- Mean length of other pelagic species = 26.01cm; percent in total catch = 4.7%
- Combination of this data and acoustic data obtained from echosurvey give the biomass as follow:
- Biomass of European anchovies = 144.4 tone, average density 10.3 t/ Nm^2
- Biomass European pilchards = 324.9 tona, average density 23.2 t/ Nm^2
- Biomass of other pelagic species = 23.2 tone, average density 1.7 t/ Nm^2

Total estimated biomass was 429.3 tons, with average density 30.66 t/ Nm^2. This estimated biomass was only mass below the ship's route. Due to the lack of available time to perform the transect methods, we believe that the real biomass was three time larger and for European sardine it was approximately 974.7 tons and for European anchovy 433.2 tons.

States of demersal resources for the open sea of Montenegrin coast are given in the historical overview of the research from the national surveys that were performed in 2004, 2007 and 2011. The position and duration of the haul are the same each year, as well as the boat and trawl net to ensure that data we obtain can be comparable between every year. This national survey are performed up to 800 meters depth, but for the purpose of this study we give data and biomass estimation up to 50 meters depth, because the activity of the small-scale fisheries in all part of Montenegrin coast are mostly up to 50 meters depth. After performed survey and processing data, according to the swept area, all this data are extrapolated on the stratum from 10 – 50 meters, which is area of 280 square kilometers. We give for each survey number of detected species, number of individuals per square kilometer per each species, weight per kilograms per each species per square kilometers and total biomass per stratum. Also, per each year we give percent of the Fish, Crustacea and Cephalopods in total catch.

In 2004 estimated biomass was 128.38 tons and total number of observed species was 18. The highest biomass had the Small-spotted catshark (*Scyliorhinus canicula*) and Picarel (*Spicara smaris*) which are no-commercial species and this two species are present with 41% in total biomass up to 50 meters depth in this year. Then follows, Spotted flounder, European hake, Common pandora, Common octopus, Deep-water rose shrimp and Black sole. This 6 species represent the 55% of the total biomass in this stratum. Another 10 species take part only 9% regarding total biomass (Table 58).

Table 58. Species composition, abundance index per species and density index per species on the Montenegrin coast up to 50 meters depth in 2004

SCIENTIFIC NAME	SPECIES CODE	MIN DEPTH(N)	MAX DEPTH(N)	N/Km²	Kg/Km²
Scyliorhinus canicula	SCYOCAN	10	50	239.36	105.32
Spicara smaris	SPICSMA	10	50	4643.50	81.38
Citharus linguatula (macrolepidotus)	CITHMAC	10	50	2968.01	67.02
Merluccius merluccius	MERLMER	10	50	2202.07	57.45
Pagellus erythrinus	PAGEERY	10	50	1292.52	52.66
Octopus vulgaris	OCTOVUL	10	50	191.48	47.87
Parapenaeus longirostris	PAPELON	10	50	2345.69	17.71
Solea impar	SOLEIMP	10	50	47.87	9.57
Serranus hepatus	SERAHEP	10	50	478.71	4.79
Lepidotrigla cavillone	LEPTCAV	10	50	239.36	4.31
Trachurus trachurus	TRACTRA	10	50	143.61	3.83
Diplodus annularis	DIPLANN	10	50	47.87	1.91
Deltentosteus (Gobius) quadrimaculatus	GOBIQUA	10	50	143.61	1.91
Trigla lucerna	TRIGLUC	10	50	47.87	1.20
Trigloporus lastoviza	TRIPLAS	10	50	47.87	0.72
Scorpaena notata	SCORNOT	10	50	47.87	0.48
Zeus faber	ZEUSFAB	10	50	47.87	0.24
Trachurus mediterraneus	TRACMED	10	50	47.87	0.14
Total	**18 species**	**10**	**50**	**15223.03**	**458.51**
Estimated biomass on the stratum 10-50m (in tons)					**128.38**

The percentage ratio in abundance and density between categories are follows (Fig. 17) :

- Fish species prevailed with 83.3% of abundance and 85.7% in density.
- Cephalopods were represented 1.3% in abundance and 10.4% in density.
- Crustacea, made 15.4% in abundance and 3.9% in density.

In 2007 estimated biomass was 343.66 tons and total number of observed species was 23. The highest biomass (more than 100 kg/km²) is observed in Common pandora, Red mullet, European hake and Blackbellied angler. This four species represent 74.3% of the total biomass in 2007. Picarel, Common cuttlefish, Spiny lobster and Common octopus represent also the significant part of total catch and it is 14.4%. Another 15 species take part of 11.3% regarding total biomass (Table 59).

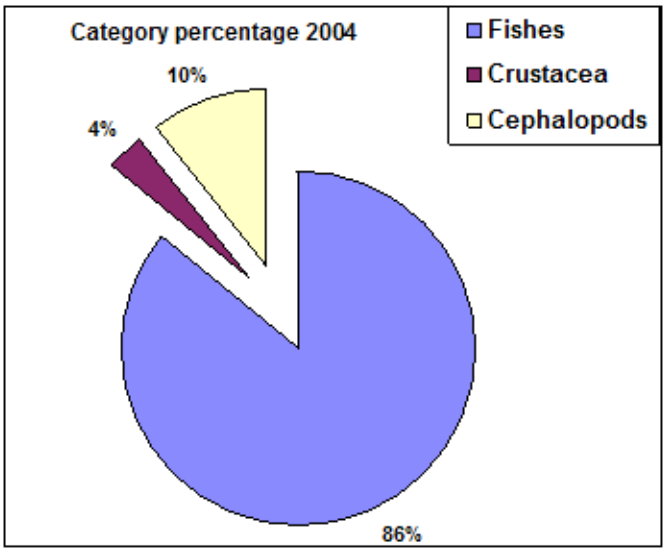

Figure 17. Percentage density ratio between categories (Fishes, Crustacea and Cephalopods) in 2004.

Table 59. Species composition, abundance index per species and density index per species on the Montenegrin coast up to 50 meters depth in 2007

SCIENTIFIC NAME	SPECIES CODE	MIN DEPTH(M)	MAX DEPTH(M)	N/Km²	Kg/Km²
Pagellus erythrinus	PAGEERY	10	50	14332.47	422.30
Mullus barbatus	MULLBAR	10	50	10237.48	259.78
Merluccius merluccius	MERLMER	10	50	2073.09	127.97
Lophius budegassa	LOPHBUD	10	50	25.59	102.37
Spicara flexuosa	SPICFLE	10	50	3839.05	75.50
Sepia officinalis	SEPIOFF	10	50	127.97	43.51
Palinurus elephas	PALIELE	10	50	25.59	31.99
Octopus vulgaris	OCTOVUL	10	50	127.97	25.59
Serranus hepatus	SERAHEP	10	50	1535.62	17.92
Citharus linguatula (macrolepidotus)	CITHMAC	10	50	1151.72	16.64
Trachurus mediterraneus	TRACMED	10	50	639.84	15.36
Psetta maxima	PSETMAX	10	50	25.59	14.59
Lepidopus caudatus	LEPICAU	10	50	767.81	12.80
Eledone moschata	ELEDMOS	10	50	127.97	11.52
Trigloporus lastoviza	TRIPLAS	10	50	255.94	11.52
Raja miraletus	RAJAMIR	10	50	25.59	10.49
Microchirus ocellatus	MICUOCE	10	50	255.94	8.96
Sepia elegans	SEPIELE	10	50	127.97	5.12
Arnoglossus laterna	ARNOLAT	10	50	383.91	3.84
Scorpaena notata	SCORNOT	10	50	255.94	3.84
Spicara smaris	SPICSMA	10	50	127.97	3.84
Boops boops	BOOPBOO	10	50	127.97	1.28
Deltentosteus (*Gobius*) *quadrimaculatus*	GOBIQUA	10	50	127.97	0.64
Total	**23 species**	**10**	**50**	**36726.96**	**1227.35**
Estimated biomass on the stratum 10-50m (in tons)					**343.66**

The percentage ratio in abundance and density between categories are follows:

- Fish species prevailed with 98.5% of abundance and 90.4% in density.
- Cephalopods, were represented 1.4% in abundance and 7% in density.
- Crustacea, made 0.1% in abundance and 2.6% in density.

In 2011 estimated biomass was 610.83 tons and total number of observed species was 35. The highest biomass (more than 100 kg/km²) had the Picarel, Red mullet, Common pandora, Brown skate and Bogue. This five species represent 82.1% of the total biomass in 2011. Smaller biomass, but also significant is made by following species: European squid, European pilchard, European anchovy, Musky octopus, Mediterranean horse mackerel, Common octopus and European hake.

This seven species represent 14.1% of the total biomass in 2011. Another 23 species take part of 3.8% regarding total biomass (Table 60).

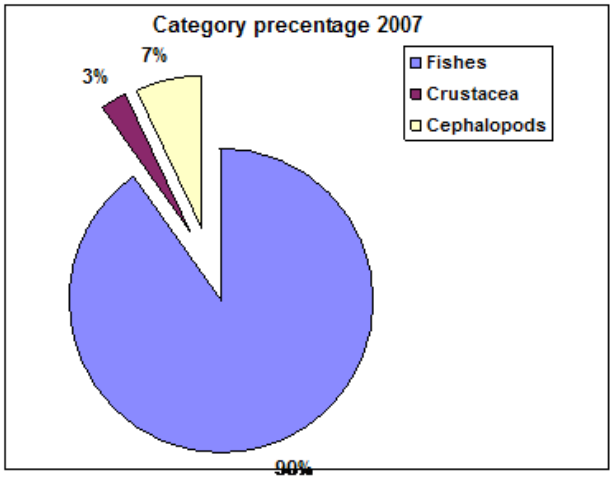

Figure 18. Percentage in density ratio between categories (Fishes, Crustacea and Cephalopods) in 2007

Table 60. Species composition, abundance index per species and density index per species on the Montenegrin coast up to 50 meters depth in 2011

SCIENTIFIC NAME	SPECIES CODE	MIN DEPTH(M)	MAX DEPTH(M)	N/Km²	Kg/Km²
Spicara flexuosa	SPICFLE	10	50	57099.44	553.56
Mullus barbatus	MULLBAR	10	50	19928.27	530.01
Pagellus erythrinus	PAGEERY	10	50	6666.31	369.83
Raja miraletus	RAJAMIR	10	50	141.34	230.85
Boops boops	BOOPBOO	10	50	3062.26	106.00
Loligo vulgaris	LOLIVUL	10	50	5747.63	80.09
Sardina pilchardus	SARDPIL	10	50	5888.97	68.31
Engraulis encrasicholus	ENGRENC	10	50	4145.83	47.11
Eledone moschata	ELEDMOS	10	50	282.67	40.52
Trachurus mediterraneus	TRACMED	10	50	918.68	28.27
Octopus vulgaris	OCTOVUL	10	50	94.22	23.08
Merluccius merluccius	MERLMER	10	50	777.34	20.02
Scyliorhinus canicula	SCYOCAN	10	50	47.11	14.13
Citharus linguatula (macrolepidotus)	CITHMAC	10	50	447.56	12.25
Lepidotrigla cavillone	LEPTCAV	10	50	471.12	9.42
Trigla lucerna	TRIGLUC	10	50	94.22	8.24
Serranus hepatus	SERAHEP	10	50	612.45	7.30
Arnoglossus laterna	ARNOLAT	10	50	824.46	6.36
Spicara smaris	SPICSMA	10	50	376.89	5.89
Scorpaena notata	SCORNOT	10	50	94.22	4.00
Diplodus annularis	DIPLANN	10	50	47.11	2.36
Trigloporus lastoviza	TRIPLAS	10	50	47.11	2.36
Scorpaena scrofa	SCORSCO	10	50	23.56	2.24
Gobius niger	GOBINIG	10	50	70.67	1.77
Trachurus trachurus	TRACTRA	10	50	141.34	1.18
Alloteuthis subulata	ALLOSUB	10	50	235.56	1.06
Blennius ocellaris	BLENOCE	10	50	23.56	0.94
Scomber scombrus	SCOMSCO	10	50	47.11	0.94
Sepia elegans	SEPIELE	10	50	117.78	0.94
Pagellus bogaraveo	PAGEBOG	10	50	23.56	0.82
Alloteuthis media	ALLOMED	10	50	212.00	0.59
Deltentosteus(Gobius)quadrimaculatus	GOBIQUA	10	50	70.67	0.47
Parapenaeus longirostris	PAPELON	10	50	23.56	0.35
Lissa chinagra	LISSCHI	10	50	23.56	0.24
Pagurus cuanensis	PAGUCUA	10	50	23.56	0.02
Total	**35 species**	**10**	**50**	**108851.70**	**2181.53**
Estimated biomass on the stratum 10-50m (in tons)					**610.83**

The percentage ratio in abundance and density between categories are follows (Fig. 19):

- Fish species prevailed with 93.79% of abundance and 93.27% in density.
- Cephalopods, were represented 6.15% in abundance and 6.71% in density.
- Crustacea, made 0.06% in abundance and 0.03% in density.

Total biomass of the demersal resources in the period 2004-2011 shows pronounced increasing trend from 128.38 tons in year 2004 to 610.83 tons in year 2011 (Figure 20). One of the possible reasons of the increase of the biomass is due to the decrease of active trawlers in Montenegro (pers. obs.). Also in this biomass there is a significant value of high proportion of Elasmobranchs such as *Scyliorhinus canicula* and *Raja miraletus*, which have been dramatically reduced toward the extinction in many other Mediterranean areas. This indicate a better condition of the Montenegrin fish community and a high biodiversity and at the same time the necessity to reverse the ongoing negative pattern and preserve the current richness of the Montenegrin sea.

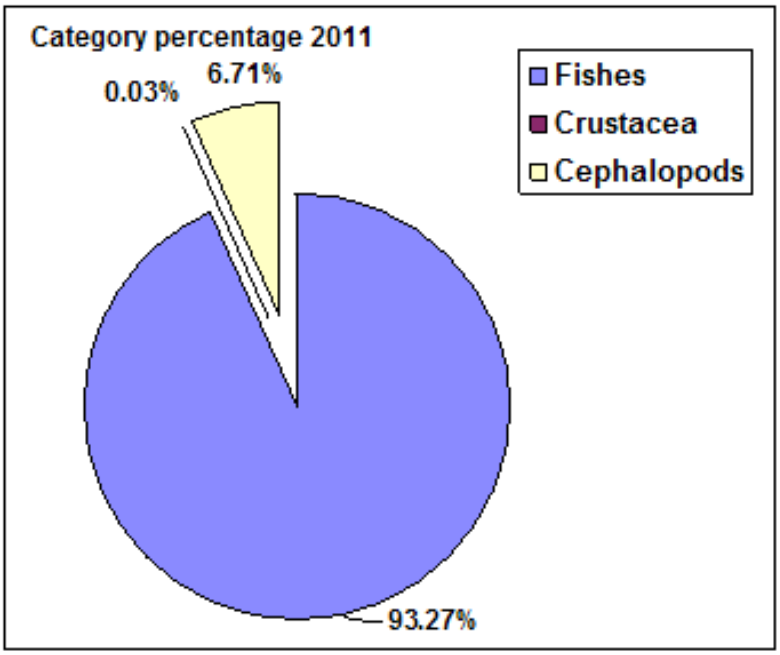

Figure 19. Percentage in density ratio between categories (Fishes, Crustacea and Cephalopods) in 2011

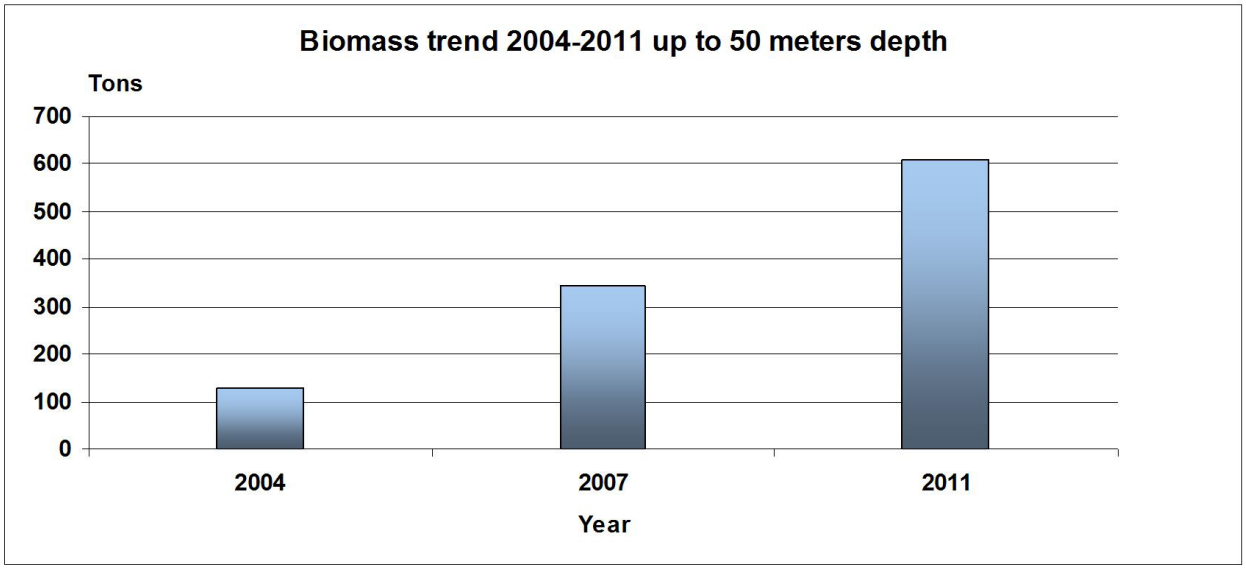

Figure 20. Trends of biomass estimation of demersal resources in the stratum from 10-50 meters on the Montenegrin coast in period 2004-2011

3. GENERAL CONCLUSIONS

During the study, 59 species are identified on all investigated areas. Fish species, mostly Teleosts prevailed with 47 species or 80%, 6 species belongs to group Elasmobranchs or 10%, Crustaceans are made of 4 species or 7 % and Cephalopoda group consists of 2 species or 3% (Table 61).

Table 61. List of common identified species

TELEOSTS	
Atherina hepsetus	*Trachinotus ovatus*
Auxis rochei	*Trachurus trachurus*
Boops boop	*Trigla lucerna*
Conger conger	*Umbrina cirrosa*
Coryphaena hippurus	*Uranoscopus scaber*
Dentex dentex	*Xiphias gladius*
Dentex gibbosus	*Zeus faber*
Diplodus annularis	*Lichia amia*
Diplodus puntazzo	*Lithognathus mormyrus*
Diplodus sargus	*Lophius budegassa*
Diplodus vulgaris	*Merluccius merluccius*
Engraulis encrasicolus	*Mugil cephalus*
Epinephelus marginatus	*Mullus barbatus*
Labrus merula	*Mullus surmuletus*
Labrus mixtus	*Oblada melanura*
Seriola demerili	*Pagellus erythrinus*
Serranus cabrilla	*Pagrus pagrus*
Solea impar	*Sarda sarda*
Sparus aurata	*Sardina pilchardus*
Sphyraena sphyraena	*Sarpa salpa*
Spondylosoma cantharus	*Scomber japonicus*
Symphodus tinca	*Scorpaena porcus*
Thunnus albacares	*Scorpaena scrofa*
Trachinius draco	
ELASMOBRANCHS	
Mustelus mustelus	*Raja asterias*
Prionace glauca	*Raja miraletus*
Psetta maxima	*Squalus acanthias*
CRUSTACEANS	
Homarus gammarus	*Palinurus elephas*
Melicerthus kerathurus	*Parapenaeus longirostris*
CEPHALOPODS	
Octopus vulgaris	*Sepia officinalis*

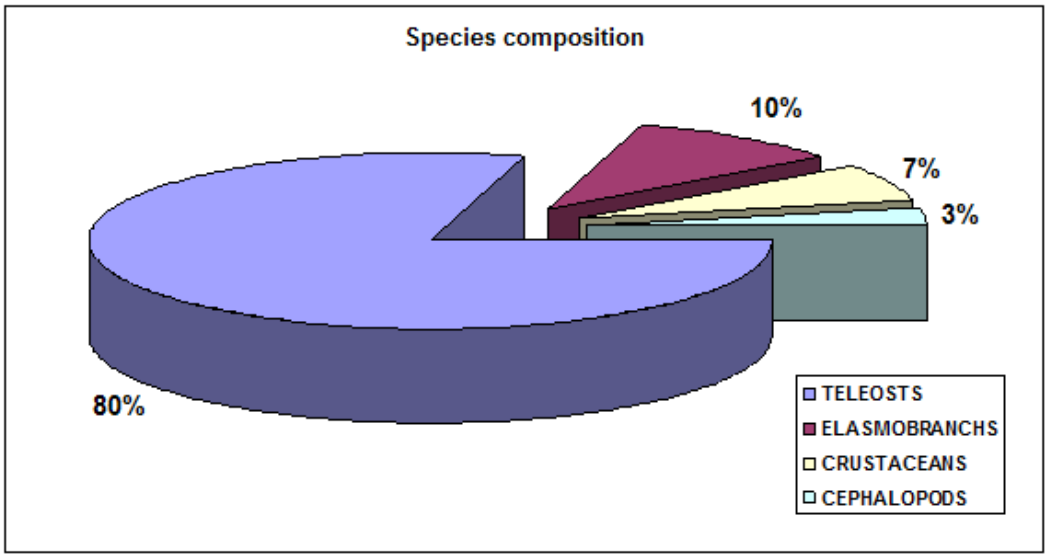

Figure 21. Percentage contribution of species.

The number of species by investigated areas are 29 species in Platamuni area, 34 species in area Old Ulcinj, 35 in island Mamula, while the biggest number was recorded in Petrovac area and the smallest with 9 species in Orahovac area.

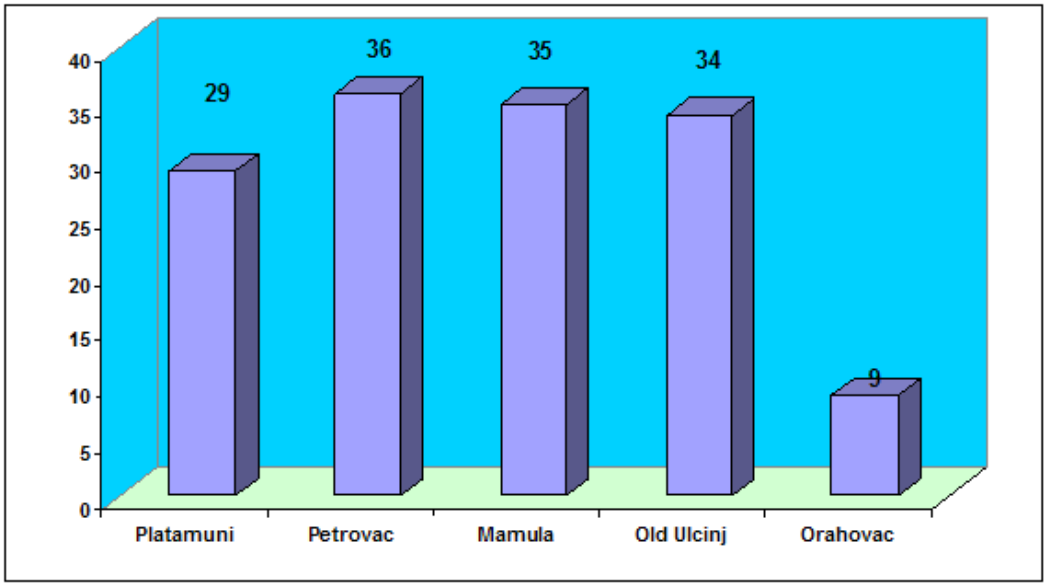

Figure 22. The number of species by investigated area.

According to the data, the investigated areas are still suitable for exploitation and characterized by high species diversity. However, it was observed that throwing dynamite, illegal fishing and night fishing with bottles and underwater lights are chronic problem in all locations of the open sea.

Furthermore, the impact of these negative effects are felt the rather last 5 years in terms of the reduction of the catch and the number of species, because most fishermen believed that the catches were reduced for 40-60% in the last 5 years depending on the location. Also, solving the problem of waste water that is flowing directly into the sea without any treatment must also be a priority in order to preserve existing resources in these areas. If the relevant institutions do not take measures to prevent any negative impact, in the near future we can expect even less catch, with the possibility of disappearance of certain species from certain areas.

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