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MARINE FISHERIES IN MONTENEGRO IN THE LAST DECADE (2000-2010)
STANJE MORSKOG RIBARSTVA U CRNOJ GORI U POSLEDNJOJ DECENIJI (2000-2010)

Abstract

Development of marine fisheries in Montenegro before the 1990s was very slow. However, since 1992/93 there has been a rapid increase in the number of ships, so in 1997/98 there were 196 registered vessels intended for use for professional or supplemental fishing. The last two decades or so were a period of intensive exploitation of trawling resources. There is no doubt that such activity has led to a disturbance in the natural state of the sea and a decrease in the number of individuals in fish populations. Catch per unit effort (CPUE) has decreased from 60 to 20 kg/h.

Key words: Marine fishery, Montenegro, demersal resources, pelagic resources, CPUE.

Izvod

Razvoj morskog ribarstva u Crnoj Gori do početka devedesetih godina bio je zanemarljiv. Nakon 1992/93. godine dolazi do naglog porasta broja brodova i čamaca, tako da je 1997/98. godine bilo 196 registrovanih plovila za obavljanje profesionalnog ili dopunskog ribolova na moru. Posljednje dvije decenije predstavljaju period intenzivne eksploatacije kočarskih resursa što je dovelo do narušavanja prirodnog stanja i smanjenja broja jedinki u ribljim populacijama u moru. Ulov po jedinici napora smanjio se sa 60 na 20 kg/h.

Ključne riječi: Morsko ribarstvo, Crna Gora, demerzalni resursi, pelagični resursi, CPUE.

INTRODUCTION

The length of the Montenegrin coastline is about 300 km, of which about two-thirds (200 km) faces the open sea, and one-third forms the Boka Kotorska Bay. There are only a few small islands in Montenegrin waters, with a total island coast length of about 26 km.

Interior waters of Montenegro cover about about 360 km^2, territorial waters (extending 12 nautical miles, or 22.22 km, from the coastline) are about 2000

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km^2, and the epicontinental zone is around 3,900 km^2. The total sea area of Montenegro comes to about 6,400 km^2.

The Montenegrin shelf area is relatively narrow, extending only a few nautical miles in the northern reaches, in front of Boka Kotorska Bay, but extending over 20 nautical miles from the Bojana River estuary (Fig. 1).

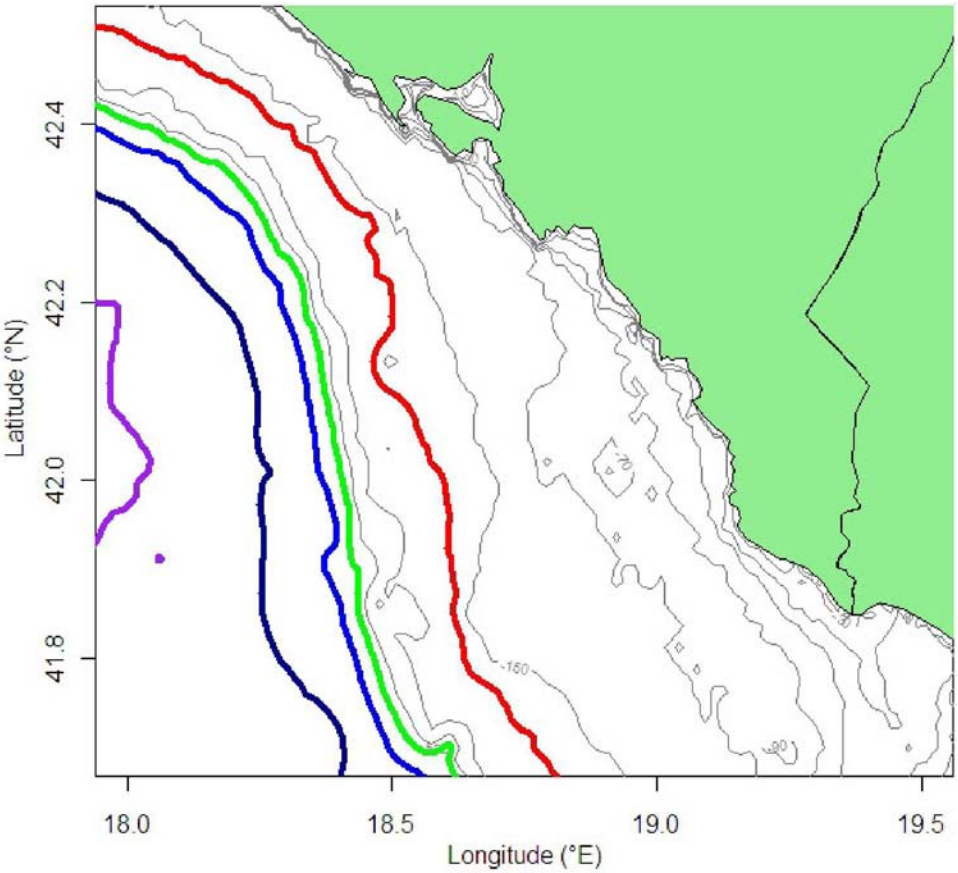

Figure 1: Isobaths of Montenegrin waters (red – 200 m, green – 500 m, blue – 700 m, dark blue – 1000 m, purple – 1200 m)

Slika 1: Izobate crnogorskih voda (crvena – 200 m, zelena – 500 m, plava – 700 m, tamnoplava – 1000 m, ljubičasta– 1200 m)

MATERIALS AND METHOD

Data collecting system in Montenegro is organized through different projects. Biological data collection for demersal species is organized through projects of National monitoring and MEDITS survey. Both surveys include the same methodology and same 10 sampling positions, the only difference is that National monitoring is conducted in avery season and MEDITS survey only in summer.

Biological data for species from trawl and small scale fishery are also collected through AdriaMed Project – Biological sampling. In the frame of this project data on catch are collected every month from all 3 fishery ports in Montenegro, and biological data of 18 economically important fish, crustacean and cephalopod species are collected every month from different port. Biological data collection and biomass estimation for pelagic species is organized through AdriaMed project, based on two methodologies, acoustic echosurvey and DEPM (Daily Egg Production Method).

RESULTS AND DISCUSSION

The three ports in Montenegro that are important for fisheries are Herceg Novi, Budva, and Bar (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. In all three ports bottom trawlers, small purse seiners, trammel netters and long-liners are present, while in Port Bar there are two purse seiners.

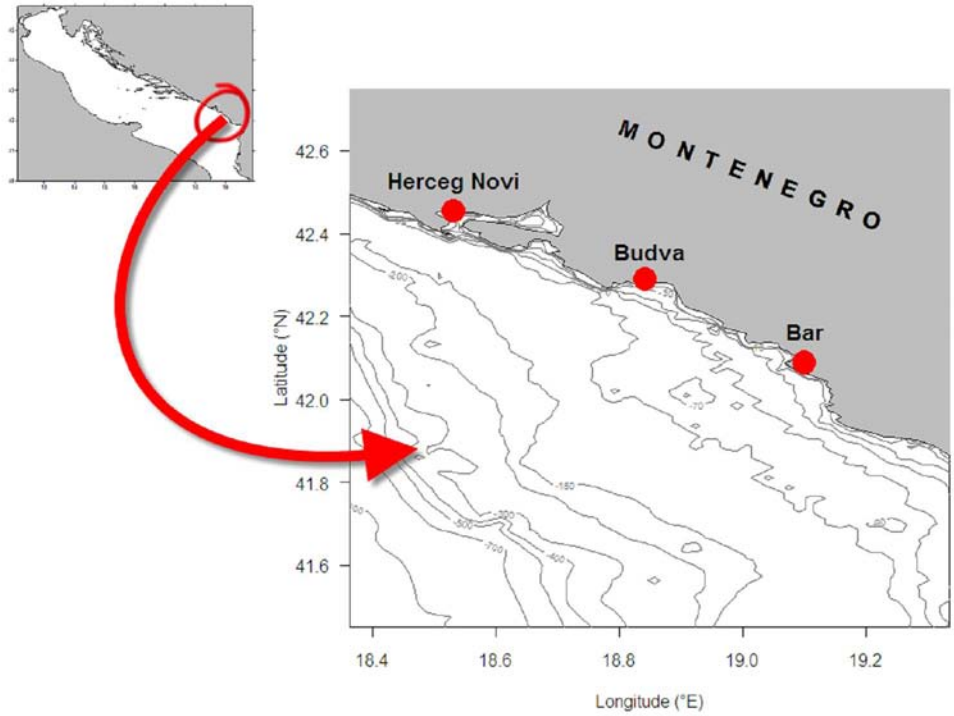

Figure 2: Main ports in Montenegro
Slika 2: Glavne crnogorske luke

Development of marine fisheries in Montenegro before the 1990s was insignificant. Except in Boka Kotorska Bay and the Ulcinj region, where the first documents related to fisheries date from the XIV Century, there was no fishing in other areas of the Montenegrin coast. In the 1970s and 1980s only one Montenegrin trawler fished in this area, while Italian vessels fished outside the

territorial waters, beyond 12 Nm. Owing to this situation, the state of fish stocks was good, and catch per unit effort was very high, about 60 kg/h.

Around 1992/93 the number of vessels started to increase rapidly, and in 1997/98 there were 196 licensed vessels for professional and supplemental fishery; 31 of these were vessels for demersal fishery (8.65 vessels/1000 km^2). In 2002, the number of vessels decreased to 17 trawlers (Figure 3). In the decade from 1990 to 2000, there was a period of intensive fishing of demersal resources without control and inspection, during which time forbidden nets and explosive devices were used. All of those activities led to a reduction of demersal stocks; catch per hour decreased to 20 kg; and CPUE decreased from 0.16 088 kg/h*ks before 1990 to 0.088 kg/h*ks in 2002 (Table 1) (**Regner and Joksimović**, 2002).

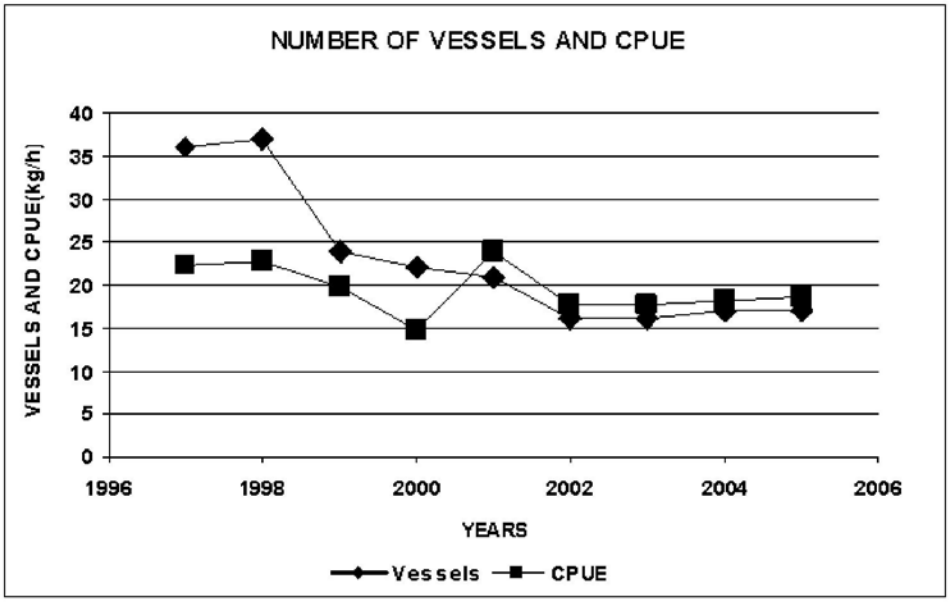

Figure 3: Relationship between number of vessels and CPUE
Slika 3: Zavisnost između broja plovila i CPUE

Table 1: CPUE of trawlers in Montenegrin waters during the last 50 years
Tabela 1: CPUE koča u crnogorskim vodama poslednjih 50 godina

Year	1948/49	1961	1973	1978/79	1986	1998-2006
CPUE (kg/h * kW)	0.120	0.103	0.214	0.131	0.118	0.088
No of active vessels	/	1	1	1	1	32

For these reasons, in 1997 the Institute for Marine Biology, Kotor, started with monitoring and biomass estimations of demersal resources on the Montenegrin shelf, using commercial trawlers. In 2004, in the context of the AdriaMed project, Montenegro joined the MEDITS group and started monitoring

demersal communities on 10 stations, based on the MEDITS protocol. Estimated biomass was 1,700 tons, half the biomass estimated in 1973 (3,400 tons, **Jukic**, 1973). Decrease of catch per unit effort from 60 kg to 20 kg also indicates a significant decrease of commercially important fish population densities in the sea. Based on the biomass of demersal resources, an MSY (Maximum Sustainable Yield) was estimated at 602 tons per year, and optimal fishing effort was placed at 190 days per year (**Regner and Joksimovic**, 2002).

The main commercial species in Montenegrin fisheries are European hake (*M. merlucciusi*), red mullet (*M. barbatus*), and deep–water pink shrimp (*P. longirostris*). Of all cephalopod species of commercial significance, squids (*Loligo vulgaris*, *Illex coindetii* and *Todaropsis eblanae*), octopuses (*Octopus vulgaris*, *Eledone* spp.) and cuttlefish (*Sepia officinalis*)), only squids are caught in significant quantities by bottom trawlers. Other species that have commercial value in the Mediterranean were present in catches occasionally, but they are either of lower than minimum catch size (e.g., *Lophius budegassa*), or they are not appreciated by local inhabitants (e.g., *Scyliorhinus canicula*).

A total of 160 demersal species were caught and examined during the 8 MEDITS surveys (**Djurovic and Regner**, 2009). The most abundant species in biomass (kg/km^2) were the following:

Merluccius merluccius (65.4 kg/km^2)
Scyliorhinus canicula (37.1 kg/km^2)
Mullus barbatus (30.3 kg/km^2)
Parapenaeus longirostris (25.7 kg/km^2)
Lophius budegassa (23.2 kg/km^2)
Illex coindetii (20.7 kg/km^2)
Trachurus trachurus (18.4 kg/km^2)
Aspitrigla cuculus (14.5 kg/km^2).

Comparing results from the MEDITS survey with those from the HVAR expedition (1948/49), a sharp decline of elasmobranches was found. Sharks and rays, which accounted for 36 - 42% of the total fish catch in the early 1970s, declined to 17 - 30% in 2000s. With the exception of *Scyliorhinus canicula* and *Squalus blanvillei,* a decrease or disappearance occurred for all the most common selachians species. Teleosteans fish did not show a clear pattern, in particularly hake and red mullet. Anglerfish (*Lopius budegassa*) and horse-mackerels (*Trachurus* spp.) seem to be more abundant in more recent surveys than in old expeditions. The opposite was observed for John Dory (*Zeus faber*).

It is also clear that the importance in the demersal community of cephalopods increased continuously over time. In general the pattern observed on the Montenegrin continental shelf is that of the classical fishing down the trophic web already described for the central-north Adriatic (**Coll et al.,** 2009; **Fortibuoni et al.,** 2010) where top predator (sharks) and K-strategy large fish (i.e. low growth-rate and reduced spawning potential) are progressively reduced and substituted by fast-growth small species, such as cephalopods.

However, it is also important to remark that Montenegrin waters are still characterized by the occurrence of quite a high proportion of demersal sharks, such as *Squalus* spp., and different species of rays, which have been dramatically reduced to near-extinction in many other Mediterranean areas. This indicates better conditions for the Montenegrin fish community and a high level of biodiversity. At the same time, it is necessary to reverse the ongoing negative pattern and preserve the current richness of the Montenegrin waters.

Analysis of biomass distribution in the area using the Kriging method showed that there are two important areas where the biomass is higher than in the other areas (**Regner and Joksimović**, 2002). Those areas are in front of Boka Kotorska Bay to the 150 meters isobath, and between Budva and Petrovac to the 100 meters isobath (Figure 4). Those higher biomass values are probably the result of specific hydrographic conditions in the area, i.e., an inflow of water with high concentrations of nutrients from Boka Kotorska Bay and the existence of a permanent frontal zone between Budva and Petrovac. On the other hand, biomass in the area in front of the Bojana River estuary is very low, while the number of juveniles in the catch is higher than in the other areas. This area is probably the nursery ground, and therefore it should be under a specific management regime.

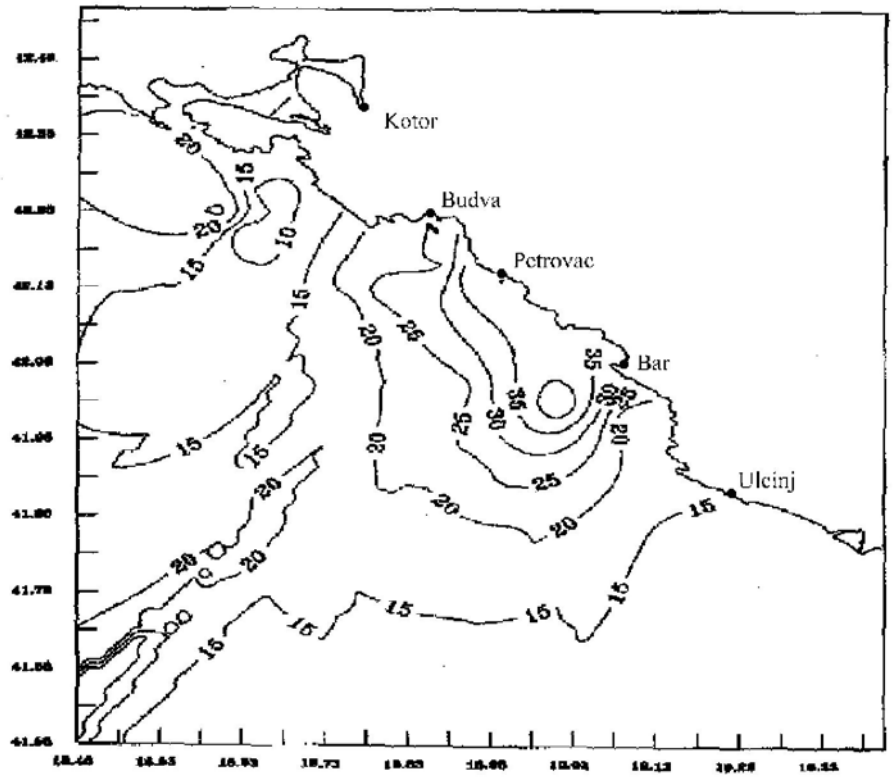

Figure 4: Biomass distribution of demersal resources in Montenegrin waters
Slika 4: Distribucija biomase of demerzalnih resursa crnogorskih voda

Data on the catch of small scale fisheries in Montenegro are still unknown. Almost all types of trammel nets and gillnets are used in the small scale fishery, which targets high quality fish, cephalopods and crustacean species. Based on interwievs of fishermen, a rough estimation is that the catch of small scale fisheries is approximately 1,200 tons (**Regner et al.,** 2004).

Montenegrin industrial fishing of sardine and anchovy is still undeveloped. Two existing purse seiners are not active due to a problem with unorganized fish markets and lack of trained crew. These two species are mainly caught through small-scale fishery, mostly using beach seines of small mesh size (5 - 6 mm) in the Boka Kotorska Bay, and targeting small, juvenile individuals in small amounts in coastal areas, using small purse seines. Since there were no organized catch and landing data, it was impossible to estimate biomass and MSY. For that reason, in 2002 the Institute for Marine Biology, Kotor, in cooperation with the ISMAR CNR Institute from Ancona, introduced direct methods for biomass estimation of anchovy, sardine and other pelagic species (OPS) based on echo-survey, and since 2005 DEPM (Daily Egg Production Method) has been used for anchovy biomass estimation. Estimates of biomass in this area were performed according to 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 experimental pelagic trawls.

Estimated biomasses of pelagic species with both methods are presented in Table 2.

Table 2: Estimated biomass of anchovy, sardine and OPS in Montenegrin waters (2002, 2004, 2005) and in Montenegrin and Albanian territorial and adjacent international waters (2008, 2010) during AdriaMed surveys

Tabela 2: Procjena biomase inćuna, sardina i OPS u crnogorskim vodama (2002, 2004, 2005), kao i u crnogorskim i albanskim teritorijalnim međunarodnim vodama (2008, 2010) tokom AdriaMed istraživanja

Year	Method	Anchovy	Sardine	OPS
2002	Echo-survey	90 383	30 763	14 973
2004	Echo-survey	3 454	31 638	4 161
2005	Echo-survey	23 220	7 479	18 185
2005	DEPM	3 842		
2008	Echo-survey	22 834	96 301	4 964
2008	DEPM	21 014		
2010	Echo-survey	8 875	14 693	3 244
2010	DEPM	10 691		

Based on the estimated biomass, calculated growth and mortality parameters, MSY was estimated on 30,910 tons of anchovy and 9,721 tons of sardine (**Azzali et al.,** 2002), and found that optimal fishing effort would be achieved with 33

purse seine vessels. There are currently only two vessels exploiting these resources in Montenegro, and their catches are very poor due to a problem with untrained crew and technical problems. Even when catches are good, there is a problem with an unorganized fish market in Montenegro.

Although tuna, sword fish and other large pelagic species pass along the Montenegrin coast on their migratory routes, this type of fishery still doesn't exist in Montenegro and recommendations are to form a fleet and exploit those natural resources.

Mariculture, i.e., artificial breeding of marine organisms, is one of the most rapidly developing economy units in the world, as well as in Montenegro. Boka Kotorska Bay represents an ideal habitat for mussel farming, so now there are about 20 farms with an annual production of about 200 tons of mussels. Estimates made by the Institute of Marine Biology, Kotor, are that annual production of high quality shellfish can be more than 600 tons. There are also two fish farms in Boka Kotorska Bay, and they produce about 180 tons of sea bass and sea bream per year. Fish farms have a very negative influence on the marine environment, so the recommendation is that in the future this type of farming should be located in suitable localities in the open areas of the Montenegrin Sea.

CONCLUSION

With the new low in marine fishery and mariculture (**Official Gazette of Montenegro**, 56/2009) and the strengthened Fishery Inspectorate, and through integration of fisheries, farming, fish markets and fish processing into a unique system, Montenegro has a chance to offer quality products and healthy protein-rich food to its population. In this system, one of the important areas is scientific investigation which, connected with economy, can make scientific results both usable and useful for society.

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by

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Summary

Development of marine fisheries in Montenegro before the 1990s was very slow. However, since 1992/93 there has been a rapid increase in the number of ships, so in 1997/98 there were 196 registered vessels intended for use for professional or supplemental fishing.

The last two decades represents a period of intensive exploitation of demersal resources in marine fisheries in Montenegro. This activity has led to a disturbance in the natural state of the sea and a decrease in the number of individuals in fish populations. On the other side, exploitation of pelagic resources is limited on the area of Boka Kotorska Bay, while pelagic resources at the open sea are completely unexploited and their explotation should be intesified. Further development of marine fishery in Montenegro must be based on the principles of sustainable development and ecosystem approach.