

## **GENERAL REVIEW OF BIOLOGICAL SAMPLING OF MOST IMPORTANT SPECIES AT MONTENEGRIN COAST (2007-2008)**

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### **OPŠTI PREGLED BIOLOŠKOG UZORKOVANJA NAJVAŽNIJIH VRSTA CRNOGORSKE OBALE (2007-2008)**

#### ***Abstract***

Pilot Studija prikupljanja bioloških i ekonomskih podataka ima za cilj da postavi bazu za jasan sistem monitoringa ribarstva u Crnoj Gori koji bi omogućio i olakšao sprovođenje politike odgovornog ribarstva na ovim prostorima, kao i lakše sprovođenje direktiva GFCM-a i EU. Tokom Pilot Studije prikupljeni su biološki, sociološki i ekonomski podaci vezani za celokupni ribarski sektor koji imaju za cilj precizniju procenu ribarstvenih resursa, njihovo upravljanje i konzervaciju.

***Ključne reči:*** pilot studija, ekonomski podaci, biološki podaci

#### **INTRODUCTION**

FAO-AdriaMed Project provides support to the Adriatic countries in developing the necessary expertise and tools for the appraisal of the fisheries resources and of the main socio economic aspects related to the fisheries, so as to provide the basis for implementing an Ecosystem Approach to Fisheries.

Montenegro joined AdriaMed in 2004 and since then the Project assisted the country in the establishment of a system for the fisheries resources evaluation and management. In this framework, during the 8<sup>th</sup> AdriaMed Coordination Committee (December 2006, Albania), the country asked the Project's assistance to develop a system which enables the national experts to monitor the biological, economic and social aspects related to the fisheries.

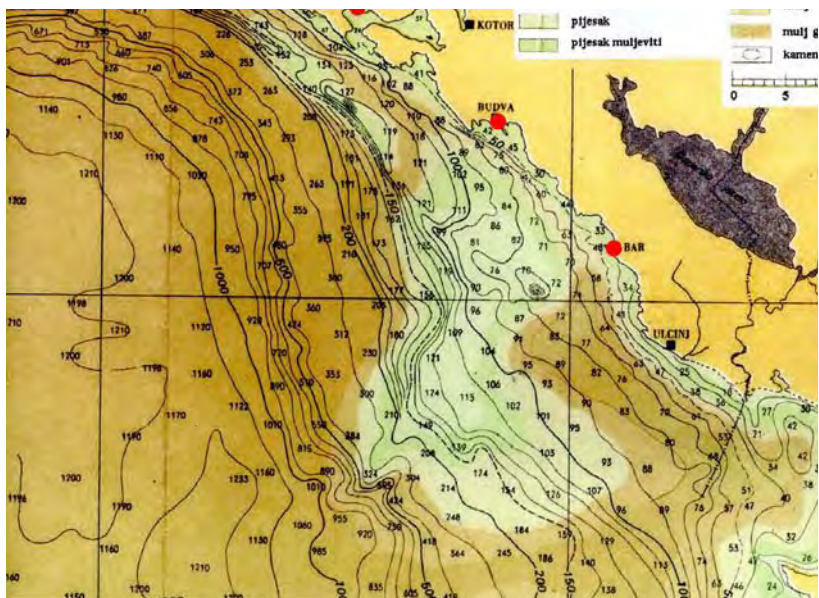
As follow up, a Pilot study on biological and socio-economic fishery data collection was scheduled and implemented in Montenegro by the Institute of Marine Biology

of Kotor (Montenegro) with the support of the FAO AdriaMed Project in the period September 2007-August 2008. The primary objective of the Pilot study was the establishment and implementation of a monitoring system for fisheries within a selected area, including biological, environmental, economic and social information applying the Operational Units concept.

Montenegrin fishing fleet comprises about 170 vessels most of which can be included in small scale fisheries, 20 are trawlers, one is a "polyvalent" vessel (bottom and pelagic trawler) and 8 are purse seiners; only 2 of these vessels exceed 24 m length overall (LOA), 1 trawler and 1 polyvalent vessel. All the fishing activities take place within the national territorial waters, including also a directed trawl fishery inside the 3 nautical mile limit

All fishing vessels have fishing licenses, which specify the types of fishing gear that they are allowed to use. About 70 licences were given to subsistence fishers ("subsistence fishing" is used to describe part time activity of fishers that have other jobs or are retired and can be generally included in small scale fisheries category) in 2005. Catches from this sector are taken using several types of gears and targeting different groups of species: small purse seiners generally target pelagic fish; trammel nettes, gill netters (small vessels < 6 m length overall which operate very close to the coastline also referred as beach seiners); bottom long-lines, gill nets, various gears with hooks catch the other species such as Hake, Red mullet and Rays; and traps and tangle nets catch Norway lobster.

Montenegro has a coastline of approximately 300 km along which there are 3 main fishing ports: Bar, Budva and Herceg Novi, and 2 minor landing sites: Kotor and Tivat. For the Pilot study the fishing activities of the 3 main fishing ports were monitored on a sampling basis: Herceg Novi, Budva and Bar (Figure 1).



**Figure 1.** The coastline of Montenegro and the three fishing port: Herceg Novi, Budva and Bar selected for the Pilot Study

These ports were selected for their position and for the contemporary presence in their fishing fleet of almost all the fleet segments (by fishing gear and vessel size) currently operating in the country: bottom trawlers, purse seiners, beach seiners, trammel netters, long liners. The main characteristics of the three ports selected for the Pilot Study are listed below.

- **Type of vessels existing:** bottom trawlers, purse seiners, small purse seiners, trammel netters, long liners
- **Type/s of fishing gear/s:** Surrounding Nets, Seine Nets, Trawls, Gillnets and Entangling Nets and Hooks and Lines
- **Type of data collected:** catch and effort, biological sampling

**Herceg Novi:**

- **Total number of vessels:** 73
- **Number of vessels per fleet segment:** Trawlers: 7, Purse seiners: 2, Trammel netters: 18 (10 of them also use hooks and lines), small purse seiners: 46

**Budva:**

- **Total number of vessels:** 42
- **Number of vessels per fleet segment:** Trawlers: 5, Purse seiners: 2, Trammel netters: 30 (10 of them also use hooks and lines), Hooks and lines: 5

**Bar:**

- **Total number of vessels:** 39
- **Number of vessels per fleet segment:** Trawlers: 8, Purse seiners: 4, Trammel netters: 12 and Hooks and lines: 15

During the Pilot Study information on catch and effort of all the active types of vessels (fleet segments) in the sampling ports were gathered by interviewing the responsible of the fishing operation at the end of the fishing trip: bottom trawlers, purse seiners, small purse seiners, gill netters, long liners. Due to the large number of active vessels, a sampling approach was followed and the sampled vessels were selected randomly.

### **Catch and effort**

The sampling took place in three fishing ports (landing sites) along the Montenegrin coast (Geographical Sub Area 18). To collect information on catch and effort, three stratification levels were considered: port (Herceg Novi, Budva and Bar), fleet segmentation (fishing gear bottom trawl, purse sein, gill net, long line), and number of vessels per fleet segment (total number). Catch and effort data on all the active fleet segments in the sampling ports was gathered by interviewing the responsible of the fishing operations at the end of the fishing trip. Sampling days per port and fishing vessels to be sampled were randomly selected.

During the interviews information on the main characteristics of the fishing gear and on the fishing operations were gathered. Information on gears comprised:

- Characteristics of towing cables, doors, chain, headrope, floats, footrope, mesh size for trawlers,
- Material, length, height, mesh size for gill netters,
- Hook type and saize, mainline length, mainline material and diameter, branch line length, branch line diameter, distance between branch lines, baits for long liners.

Information on fishing operations included:

- duration of the last fishing trip (days or hours),
- number and duration of the performed hauls (for trawlers), number of hooks and time of the hooks at sea (for long liners), net characteristics, length, height, mesh size (in gill and trammel netters), number of traps and time of the traps at sea (for traps netters),
- fishing area.

For each selected vessel at the end of the interview the following qualitative and quantitative data on the catch was recorded by direct observation:

- species landed,
- number of boxes landed per species and their approximate weight,
- length classes of the main target species (according to the commercial categories reported in the sampling data sheet format).

The catch and effort data by species and vessels recorded during each sampling day were used to estimate the catch (total and by species) of all the main fleet segments per day. Based on this data, an approximate estimation of total catch per fleet segment per month per port and tentatively per year were obtained. Moreover, the total catch per species per trawlers and purse seiners per month, as well as the yield per species ( $\text{kg h}^{-1}$ ) and the catch per unit of effort (CPUE,  $\text{kg vessel}^{-1}$ ) per day and per month for trawlers and purse seiners and per year, were estimated according to the following procedures:

- **Average catch of sampled vessels per day** = sum of the total catch per vessels during each sampling day / number of sampled vessels.
- **Total catch per day** = average catch of the sampled vessels per day \* total active number of vessels during that day.
- **Total catch per month** = total catch per day \* number of fishing days per month.
- **Total catch per year** = sum of the estimated total catch per month over the year.
- **Average catch by species per day** = sum of the total catch per vessels during each sampling day / number of sampled vessels.
- **Total catch per species day** = average catch of the species per day \* total active number of vessels during the sampling day.
- **Total catch by species per month** = total catch of the species per day \* number of fishing days per month.
- **Total catch by species per year** = sum of the total catch of a species per month over the year.

Moreover, for trawlers, the yield per vessel and per species was also estimated:

- **Yield ( $\text{kg h}^{-1}$ ) per vessel** = total catch (kg) per vessel / number of fishing hours (per trawlers)
- **Yield ( $\text{kg h}^{-1}$ ) per species** = total catch per species (kg) / total number of fishing hours (per trawlers)

### Biological data

The biological samples of the main fishery target species were taken to study their biological characteristics (biological sampling). Biological sampling started in September 2007 and since then samples were taken once a month (every month from a differ-

ent port), except in January when there were no catch due to a bad weather conditions. Samples were collected on the basis of a sampling scheme drawn considering both the total official landing statistics provided for the countries and the main requirements of regional bodies in terms of fishing monitoring (Tab. 1).

For each of the sampled species the following data was collected:

- total length for fishes (TL, 0.1 cm), carapace length for crustaceans (CL, 0.1 cm), dorsal mantle length for cephalopods (DML, 0.1 cm);
- total body weight (TW, 0.01 g);
- Sex and Sexual maturity according to the maturity scales proposed for the Adriatic Trawl Surveys in the Adriatic. For fishes a four maturity stages scale was considered (immature, maturing, mature and spent – resting; respectively, stages 1, 2, 3 and 4) and for crustaceans and cephalopods a three maturity stages scale was considered (immature, maturing, and mature; respectively, stages 1, 2, and 3).

These data allowed to estimate the size range and length frequency distribution of landings, the sex-ratio as proportion of males over the combined number of males and females (overall and by body length class), the size at first maturity (the classic logistic curve was used to fit the data) and the length-weight relationship parameters using a power function for most of the sampled species. The least square method was applied to estimate the curve parameters for both the maturity and the length weight curves. For some species the lack of small and immature individuals linked to the selectivity of the fishing gear prevented from the estimation of the size at first maturity.

Otoliths were collected from fish for age and growth estimation. Based on collected data, length frequency distribution, length at first maturity, length-weight relationship and sex ratio for all examined species was estimated.

**Table 1.** Proposed sampling scheme.

Species	Number of samples by size	Number of individual per sample	Number of samples by age	Number of individuals per sample
<i>Engraulis encrasicolus</i>	15	50	8	25
<i>Sardina pilchardus</i>	18	50	9	25
<i>Euthynnus alletteratus</i>	1	25	1	25
<i>Sarda sarda</i>	1	25	1	25
<i>Atherinidae</i> spp.	24	100		
<i>Boops boops</i>	24	50	12	25
<i>Eledone cirrhosa</i>	4	50		
<i>Illex coindetii</i>	10	50		
<i>Loligo vulgaris</i>	4	50		
<i>Lophius budegassa</i>	5	25	5	25
<i>Merluccius merluccius</i>	15	50	10	25
<i>Mugil cephalus</i>	15	50	8	25
<i>Mullus barbatus</i>	9	50	6	25
<i>Mullus surmuletus</i>	5	50	4	25
<i>Parpenaeus longirostris</i>	10	50		
<i>Sepia officinalis</i>	4	50		
<i>Spicara</i> spp.	24	100	12	25
<i>Trachurus mediterraneus</i>	9	50	6	25

## RESULTS

A total of 96 different vessels were sampled during the Pilot study, including all the trawlers and purse seiners (except purse seiners over 12m). Trawlers are the largest and best equipped vessels in Montenegro, with length overall (LOA), engine power and GRT ranging from 7.1 to 21.39 m, 35 to 285 KW and 2.75 to 49 m<sup>3</sup> respectively.

Considering the catch and effort data per fleet segment, during the study period trawlers were the most active vessels with an average of 13 fishing days per month, followed by gill netters and purse seiners (average = 12.5 days) and finally small purse seiners (average = 9 days). In terms of total catch, netters (gill and seine netters) landed the largest quantities per day (110 vessels landing > 5700 kg), with trawlers (20 vessels landing > 2900 kg day<sup>-1</sup>), long liners (35 vessels landing 868 kg day<sup>-1</sup>) and purse seiners (6 vessels landing 575 kg day<sup>-1</sup>) landing progressively lower quantities.

During the sampling period a total of 127 samples of 15 species or group of species were gathered to study the main biological characteristics of the catch. Samples were collected from the different types of fishing gears so to obtain a preliminary estimation of the size range and of the occurrence of juveniles in the population harvested using the different gears.

Data collected for all sampled species were analyzed to describe per each species: i) the length frequency distribution (LFD) by sex; ii) the sex-ratio, as the fraction of males over the total of males and females combined (overall and by size class); iii) the size at first maturity (size at 50 percent of maturity, Length<sub>50%</sub>) and size at 25 and 75 percent of maturity (Length<sub>25%</sub> and Length<sub>75%</sub> respectively) according to the classical logistic model; iv) the parameters of the length weight relationship according to a power model (Total Weight = a \* Body Length<sup>b</sup>). The parameters of the maturity curve (and the associated sizes at maturity), as well as of the length-weight relationship have been estimated according to the least square methods.

## CONCLUSIONS

Monitoring system for the identification of the main fishing activities in terms of number of vessels and vessels characteristics, as well as for the appraisal of the catch and effort characteristics of the main fishing segments operating in Montenegro was established with the support of the FAO-AdriaMed Project. The monitoring system also aimed at providing a description of the main resources exploited and landed by each fishing segment. Finally the data collected during the Pilot Study were used to complete the necessary information for the first identification and listing of Operational Units in Montenegro.

## REFERENCES

*AdriaMed Pilot study on biological and economic data collection and monitoring system in Montenegro (2007-2008)*, Scientific Cooperation to Support Responsible Fisheries in the Adriatic Sea. FAO Technical document, in press.