INTERNATIONAL COOPERATION PROJECTS IN THE RESEARCH OF THE ADRIATIC SEA

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PROJEKTI MEĐUNARODNE SARADNJE U ISTRAŽIVANJU JADRANSKOG MORA

Apstrakt

Prvi pisani dokumenti o naučnom istraživanju mora se pojavljuju u 16. vijeku i uglavnom se bave morskom dinamikom. Do 1950-ih godina, istraživanja su imala morfološke i sistematske karakteristike i bila su zasnovana na opisu i katalogizaciji vrsta. Moderna istraživanja sa širim implikacijama počinju u drugoj polovini 20. vijeka, nakon Drugog svjetskog rata, sa raznim ribolovnim ekspedicijama baziranim na istraživanju distribucije, biologije, ekologije vrsta, stanje pridnenih zajednica i mogućnosti za njihovu komercijalnu ali održivu eksploataciju. Prva ribarstveno-biološka ekspedicija u Jadranu je bila "HVAR" ekspedicija, organizovana 1948-1949 godine od strane Instituta za oceanografiju i ribarstvo u Splitu. Istraživanje je obuhvatilo većinu otvorenog Jadrana, a glavni cilj ekspedicije je bio da se stekne uvid u kvalitativni i kvantitativni sastav pridnenih zajednica na Jadranu, kao i procjena potencijala za komercijalno iskorištavanje takvih izvora. Od 2001. do 2007. istraživanja pridnenih zajednica su provedena u okviru projekta FAO ADRIAMED. Uz MEDITS program (Međunarodno straživanje pridnenih resursa Mediterana), Europska unija pokrenula je 1994 sveobuhvatno istraživanje pridnenih zajednica Mediterana i Jadrana na kontinentalnom šelfu i kontinentalnom slazu.

Ključne reči: Jadransko more, međunarodna saradnja, resursi ribarstva, odgovorno korišćenje

Keywords: Adriatic sea, international cooperation, fishery resources, responsible use of fisheries

INTRODUCTION

Evidence on use of natural resources from the Adriatic from prehistoric times clearly suggest the importance of this area for human population. Humans gathered their earliest experiences with the sea and related events upon their arrival on its shores following the great migrations. The first written records on scientific studies of the sea appear in the 16th century. Ichthyology (ancient Greek ichthys – fish, logos – science), a branch of zoology dedicated to the study of fish, their biology and ecology, developed during several periods. Human interest in fish begun the moment he became capable of research and understanding of terms and thoughts, as fish (like other animals) was a theme in human communication (images, symbols, and later the written text). Aristotle's "The History of Animals" represents the first written work in the study of fish.

The study of the ichthyofauna of the Adriatic has a long history. The first documents date back to the 16th century, from the time of the Republic of Dubrovnik. The 18th century is the period of Carl Linné's "Systema naturae" which brings the increased interest in categorisation and study of various species of the Adriatic. This interest continues into the 19th century with many scientists who worked in this field. The 20th century brought important works dealing with the cataloguing the Adriatic species. The most important check-list were compiled by Šoljan (1948, 1965, 1977), Jardas (1996) and Lipej and Dulčić (2010). Until 1950s, studies mostly dealt with morphological and systematic characteristics of the species, and were based on descriptions and check-lists. After the World War II modern, wide-encompassing studies begin with several scientific expeditions. These are based on studies of distribution, biology and ecology of the species, fish community conditions and the possibility for their commercial, but sustainable exploitation. FAO international scientific research projects in the Adriatic begin at the end of 1970s. Despite long tradition of research, the Adriatic ichthyofauna has still not been sufficiently researched, especially deep waters of the south Adriatic.

MATERIALS AND METHODS

The organised studies of the Adriatic for the advancement of fisheries begun in Trieste in the middle of the 19th century with the founding of the meteorological station and the City Natural History Museum. Several more station were founded afterwards. In 1891. a Zoological station of the Berlin Aquarium was established in Rovinj, which later became the station of the German–Italian Society. *Magyar Halyasati Biolocical Allomag* was established in 1904 in Rijeka. During the Kingdom of Yugoslavia, in 1930, the Biological–Oceanographic Institute is founded in Split (modern Institute of oceanography and fisheries), and in the Socialist Federal Republic of Yugoslavia, in 1961 Bureau od Marine Biology is founded in Kotor (modern Institute of Marine Biology).

Several scientific expeditions were organised at the beginning of the 20th century, "RUDOLF VIRCHOW", "ARGO", "ADRIA", "MONTEBELLO", "NAJADE" (Austria), "CICLOPE" (Italy), "THOR" (Denmark). Very important is the first expedition organised in Croatia, in the northern Adriatic in 1913 and 1914, "VILA VELEBITA". This expedition represents the most fruitful research in the Adriatic; a project which was spectacularly planned (for the period) and organised, with results that have (due to the multidisciplinary scientific approach) caused positive reactions of the scientific public. Unfortunately, this golden era came to an abrupt halt with the beginning of the Great War.

The first fishery–biological expedition conducted in the entire Adriatic was the "HVAR" expedition, organised by the Institute of oceanography and fisheries in Split in 1948/49. The expedition encompassed most of the open waters of the Adriatic, and the main goal was to provide a description of qualitative and quantitative composition of demersal benthic communities in the Adriatic, and the assessment of the possibility of commercial exploitation of those resources (Šoljan, 1977). Important data on hydrography and chemistry of the Adriatic were collected during the course of the expedition. This research was organised in the wake of the World War II, when the natural resources were preserved, without a significant influence from fishing activities. Fisheries were in their infancy in the Adriatic before the outbreak of WWII, and during the war, all commercial fishing activities were suspended. Such state of resources can be considered as intact, a "virgin state" of the populations, and as such can be used as a reference condition for the effect of fishing activities on the demersal resources of the Adriatic.

After the "HVAR" expedition, many other studies (temporally and spatially limited) were also organised (Crnković, 1959, 1965; Županović, 1961, Rijavec and Županović, 1965; Froglia, 1972; Jukić and Piccinetti, 1981; Županović and Jadrdas, 1989; Marano *et. al*., 1998; Vrgoč *et al.,* 2004; Regner and Joksimović, 2002).

Laboratory of marine biology in Fano (Italy) and the Institute of oceanography and fisheries in Split (Yugoslavia) started the "PIPETA" expedition in 1982, at that time the most detailed study of demersal communities of the Adriatic. Study area included the entire northern and central Adriatic, from the north to the Monte Gargano on the Italian coast, divided in 9 perpendicular transects. Sampling was done using the bottom trawl of the tartana type. After twenty years of research, the studies on the Italian (western) side of the Adriatic were continued until 2007 within the GRUND programme.

Figure 1. Scientific research expedition Deep Adriatic within the AdriaMed project, 2010

From 2001 to 2007, studies of the benthic communities in the eastern Adriatic were done within the framework of the FAO AdriaMed project (Scientific Cooperation to Support Responsible Fisheries in the Adriatic Sea) (Fig. 1). These research were organised annually, in the Autumn–Winter period with a standardised methodology in territorial

waters of Slovenia, Croatia, Montenegro and Albania. Most stations were in the areas of the Jabuka Pit, northern Adriatic and the channel area of Croatian Littoral (Vrgoč, 2004).

The European Union started an all–encompassing study of benthic communities of the Mediterranean (including the Adriatic) in 1994 with the MEDITS project (Mediterranean trawl Survey). This project encompasses all trawling areas (continental shelf and slope). Samples are collected according to the standardised protocol, annually in the Spring–Summer period (Bartnard, 1995). The studies of the resources of small pelagic fish, anchovy and pilchard, using echosurvey and DEPM (Daily Egg Production Model) methods within the framework of AdriaMed and MEDIAS projects should also be mentioned.

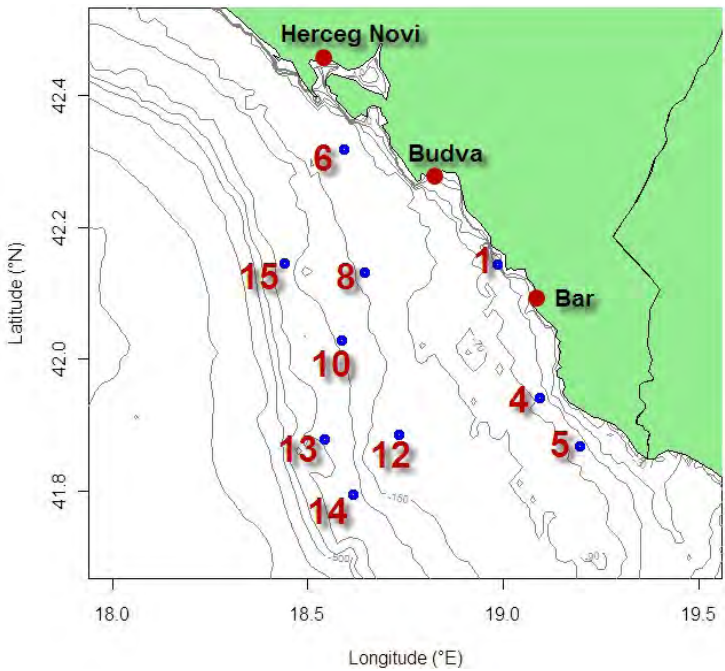

Figure 2. MEDITS stations in Montenegro

Recently, research using new methods have been conducted in the Adriatic, such as the research of the deepest areas of the South Adriatic Pit (1228 m; Deep Sea Survey), sole (*Solea solea*) community research (SOLEMON), research on Norway lobster in the Jabuka Pit using underwater TV (UWTV Survey) and genetic research of the exploited fish populations.

In addition to international research, national monitoring of commercial demersal, pelagic and artisanal fisheries are conducted in Croatia, Montenegro and Albania, while the EU member countries follow the Data Collection Framework (DCF).

All data collected in trawl fisheries are stored and processed in the ATrIS (AdriaMed Trawl Survey Information System) computer program (Gramolini, 2005), created within the AdriaMed project. Data on abundance, biomass and length frequencies are calculated using the swept area method, taking into account that the sampling was randomly stratified (Souplet, 1996), and the calculated values of abundance and biomass indexed are expressed as N/km^2 and kg/km^2, respectively.

RESULTS AND DISCUSSION

Results of the research are presented annually to the Resources Management Group of the GFCM (GFCM SubSAC Stock Assessment). Afterward, scientific recommendations are adopted by the Scientific Advisory Board (SAC) so the GFCM could send them to member countries to be implemented. The Mediterranean, including the Adriatic, is divided into sub–geographic areas (GSA), and all recommendations refer to specific GSAs. The Adriatic presents a special case, because its resources are shared among 5 countries, and is divided in two GSAa, 17 and 18. The data, especially those from AdriMed and MEDITS projects are then processed and published as annual reports, as has been previously mentioned.

An example of data and results obtained is presented using Montenegro as model. Research of demersal resources within the MEDITS project for 2012 have shown that an increase of the total biomass has occurred in the area compared to the results from 2011. In 2012, the total biomass of demersal resourceshas been estimated to 847.79 kg/km^2. A total of 123 species were registered during the survey. Abundance and biomass for the 25 most important commercial species are given in Table 1.

Table 1. The most abundant species in the survey area – MEDITS 2012.

VRSTA	MEDITS KOD	N/km^2
Spicara flexuosa	SPICFLE	14 872,52
Engraulis encrasicolus	ENGRENC	4075,35
Mullus barbatus	MULLBAR	3587,68
Spicara smaris	SPICSMA	3016,43
Merluccius merluccius	MERLMER	3010,36
Loligo vulgaris	LOLIVUL	1917,28
Trachurus trachurus	TRACTRA	1392,26
Illex coindetii	ILLECOI	1372,29
Parapenaeus longirostris	PAPELON	1349,25
Alloteuthis media	ALLOMED	1325,12
Lepidotrigla cavillone	LEPTCAV	1195,85
Sardina pilchardus	SARDPIL	1178,59
Scomber (Pneumatophorus) japonicus	SCOMPNE	917,74
Gadiculus argenteus	GADIARG	736,82
Serranus hepatus	SERAHEP	665,56
Sepia elegans	SEPIELE	522,27
Pagellus erythrinus	PAGEERY	454,71
Aspitrigla cuculus	ASPICUC	420,61
Macrorhamphosus scolopax	MACOSCO	403,58
Plesionika heterocarpus	PLESHET	401,36
Scyliorhinus canicula	SCYOCAN	394,37
Boops boops	BOOPBOO	341,95
Capros aper	CAPOAPE	310,57
Deltentosteus (Gobius) quadrimaculatus	GOBIQUA	290,67
Argentina sphyraena	ARGESPY	278,85

Analysis of the data presented in Tables 1 and 2 shows that the two picarel were most abnundant and had the highest biomass in demersal communities along the Montenegrin coast. In Montenegro, these two species are considered as discard, and usually returned to the sea, so their abundance is significant only from an ecological standpoint. Commercial species such as red mullet, hake, anchovy, common Pandora, black–bellied anglerfish, deep–water pink shrimp and bogue also show relatively high biomass indexes. The species mentioned are common in bottom trawl catches in Montenegro, and the increase in their biomass should have a positive financial effect with relevant subjects in Montenegrin fisheries sector. For comparison, the total estimated biomass increased from 616.08 kg/km^2 in 2011 to 847.79 kg/km^2 in 2012, which presents an increase of 37.6%. A parallel analysis of biomass indexes for commercial species in 2011 and 2012 is given in Fig. 3. The increase in biomass, sometimes as high as 400%, is obvious in most species.

Table 2. Species with the highest biomass in the survey area – MEDITS 2012.

VRSTA	MEDITS KOD	kg/km^2
Spicara flexuosa	SPICFLE	162,52
Mullus barbatus	MULLBAR	93,72
Engraulis encrasicholus	ENGRENC	60,10
Merluccius merluccius	MERLMER	59,19
Scyliorhinus canicula	SCYOCAN	51,63
Spicara smaris	SPICSMA	44,49
Illex coindetii	ILLECOI	35,48
Sardina pilchardus	SARDPIL	19,47
Pagellus erythrinus	PAGEERY	18,39
Todaropsis eblanae	TODIEBL	17,64
Helicolenus dactylopterus	HELIDAC	15,86
Aspitrigla cuculus	ASPICUC	15,85
Loligo vulgaris	LOLIVUL	14,63
Lophius piscatorius	LOPHPIS	14,50
Lepidotrigla cavillone	LEPTCAV	14,22
Trachurus trachurus	TRACTRA	13,53
Lophius budegassa	LOPHBUD	13,14
Scomber (Pneumatophorus) japonicus	SCOMPNE	13,03
Boops boops	BOOPBOO	10,79
Parapenaeus longirostris	PAPELON	9,73
Raja miraletus	RAJAMIR	8,56
Octopus vulgaris	OCTOVUL	8,31
Phycis blennoides	PHYIBLE	7,63
Trachurus mediterraneus	TRACMED	7,54
Zeus faber	ZEUSFAB	7,27

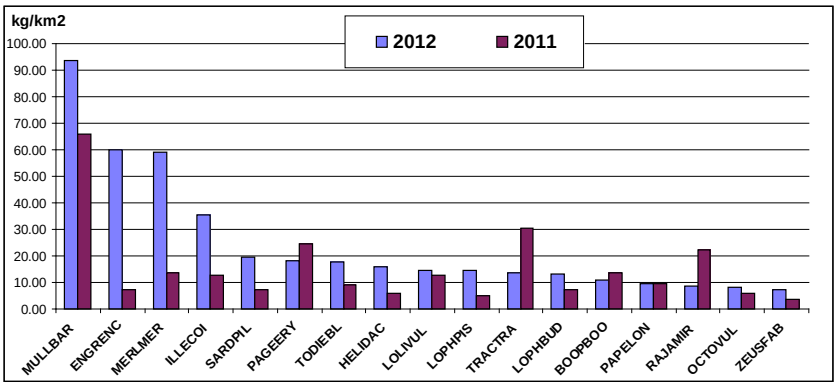

Figure 3. Parallel analysis of biomass indexes for commercial species in Montenegrin waters during the MEDITS survey in 2011 and 212

According to categories (fish, cephalopods, crustaceans), fish represent most of the biomass (87%), followed by cephalpods (12%) and crustraceans (1%). For comparison, the ratios were: fish 87%, cephalopods 8.4%, and crustaceans 3.6%.

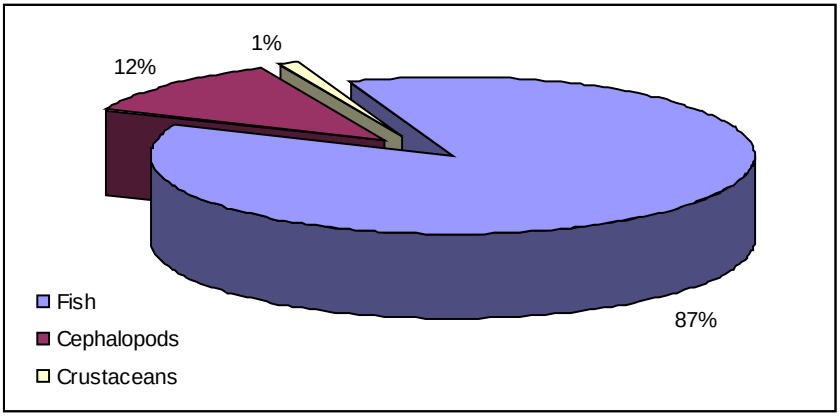

Figure 4. Percentage of biomass by category (fish, cephalopods, crustaceans) in Montenegrin waters, MEDITS 2012.

CONCLUSIONS

Adriatic and its living biological resources represent the shared resource of five Adriatic countries. This is the reason why international research and cooperation play an important role in the creation of fisheries activities, especially now when data indicate the disruption of balance between available resources and fishing effors, particularly on the west side. Biomass indexes and length frequency composition of commercial species can indicate certain (mostly negative) trends, which should lead to correct decisions on common conservation of resources. It is in that very segment that the importance of international cooperation can be seen in defining measures which will enable the renewal of resources (minimum mesh size increase, spatial and temporal fishing bans in

certain areas). Naturally, it is the task of science to provide expert and scientific opinions on the status of the biological resources as well as the suggested measures for their long–term sustainable exploitation and conservation, whereas the politics shoud take the obligation and responsibility of making such measures effective in practice within the legal framework.

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