# WORKSHOP ON DEMERSAL RESOURCES IN THE BLACK SEA & AZOV SEA

**15-17 April 2003**

**ŞİLE – TURKEY**

**Edited by**

**Bayram ÖZTÜRK**

**and**

**Saadet KARAKULAK**

**WORKSHOP ON**
**DEMERSAL RESOURCES IN THE**
**BLACK SEA & AZOV SEA**

**15-17 April 2003**
**ŞİLE – TURKEY**


ISBN – 92389 – 1 – 8

Citation: ÖZTÜRK, B. and KARAKULAK, S. ( Eds. ) 2003. Workshop on Demersal Resources in the Black Sea & Azov Sea. Published by Turkish Marine Research Foundation, Istanbul, TURKEY. Publication number: 14.

Available from: Türk Deniz Araştırmaları Vakfı ( TÜDAV )
Turkish Marine Research Foundation
ISBN – 92389 – 1 – 8

P. O Box 10 Beykoz / ISTANBUL, TURKEY
Tel: +90 0216 424 07 72
Fax: +90 0216 424 07 71
E-mail: tudav@superonline.com
Web site: www.tudav.org
TÜDAV yayınları satılamaz.

Printed by: Ofis Matbaa Tel: +90 0212 347 83 11

## CONTENTS

Page

**PREFACE** I-II

Cetacean Bycatch – Turbot Fisheries Interaction in the Western Black Sea 1-8
**Tonay, A. M., Öztürk, B.**

Variations on the Turbot ( *Scopthalmus maeoticus* ) Stocks in the Southeastern Black Sea during the Last Decade and Comments on Fisheries Management 9-26
**Zengin, M., Düzgüneş, E.**

The Whiting ( *Merlangius merlangus euxinus L.* ) in the Turkish Black Sea Coast 27-34
**İşmen, A.**

Possibilities for Applying the Jones Methods for Turbot Stocks Assesment and Catch Projection in the Black Sea 35-48
**Prodanov, K., Mikhailov, K.**

Status of Demersal Fish along the Bulgarian Black Sea Coasts 49-64
**Prodanov, K.**

The Status of the Demersal Fish Population along the Black Sea Coast of Ukraine 65-74
**Shlyakhov, V., Charova, I.**

On the Current State of Acipenseridae Stocks in the Ukrainian Sector of the Nortwestern Black Sea 75-77
**Shlyakhov, V.**

The Status of the Demersal Fish Populations in the Azov Sea 78-81
**Demyanenko, K. V., Diripasko, O. A.**

Composition, State and Stocks of the Demersal Fish Community of the Azov-Black Seas relating to the Development of Russian Sustainable Fisheries 82-92

**Volovik, S. P., Agapov, S. A.**

State of the Georgian Black Sea Demersal Ichthyoresources and Strategy for Their Rehabilition and Management 93-103
**Komakhidze, A., Diasamidze, R., Guchmanidze, A.**

Actual State of the Romanian Marina Demersal Fisheries 104-114
**Nicolaev, S., Maximov, V., Anton, E.**

Preliminary Data about the Impact of Fishing Gears on the Dolphins from the Black Sea Romanian Waters 115-129
**Radu, G., Nicolaev, S., Anton, E., Maximov, V., Radu, E.**

## PREFACE

The geographical position and morphometric features of the Black Sea have made it an ecologically vulnerable target that has been influenced by human activities over the centuries. Living conditions for different populations, species or bioceneoses have dramatically altered during the last decades. Fish stocks and other living marine resources have been declining as a result of pollution, over fishing, and physical destruction of habitats; the situation is particularly serious for demersal stocks. The decline in stocks is creating unfavorable conditions for the sustainable livelihood of coastal populations. This is why the Strategic Action Plan on the Protection and Rehabilitation of the Black Sea has called the 'ecosystem approach' that requires improvement of habitats for the management of fisheries and living marine resources.

The GEF is providing support to the Black Sea coastal countries for establishing a regionally coordinated approach for rational exploitation of marine living resources and conservation of the biodiversity of the Black Sea through promotion of responsible fisheries, integration of ecosystem considerations in fisheries management, and supporting the adoption of a regionally binding legal instrument among the coastal states. In line with this objective, a series of activities for studying the requirements of ecosystem-based fisheries in the Black Sea and for formulating technical measures, such as establishment of stock replenishment zones or Marine Protected Areas, improving fishing practices, backstopping inter-governmental negotiations for the adoption of a legal instrument, awareness raising and stakeholder participation for fisheries are being undertaken within the framework of the Black Sea Environmental Programme, a joint initiative of the Black Sea Commission and its partners to safeguard the Black Sea.

As part of the Black Sea Environmental Programme, the UNDP-GEF Black Sea Ecosystem Recovery Project and the Turkish Marine Research Foundation (TUDAV) have co-sponsored the 'Workshop on Responsible Fisheries and the Case of Demersal Fish Resources in the Black Sea & Azov Sea' that was held on 15-17 April 2003 in Sile, a beautiful Black Sea coastal town nearby Istanbul Turkey.

The Workshop brought together the representatives of governmental institutions responsible for fisheries management in each country, fisheries and environmental experts from the region and elsewhere, and representatives of specialized agencies such as FAO and others. The Workshop aimed to provide an update of fisheries management in the Black Sea since the last joint review made in 1997 and to suggest further measures that need to be taken at the national, regional, and international level for improved management of fisheries and conservation of populations, diversity and habitats of living marine resources, with a special focus on the demersal fish resources.

This publication consists of the papers submitted to the special session of the Workshop on the Demersal Fish Resources of the Black Sea and Azov Sea by scientists from all coastal countries. The papers highlight the situation of the stocks and their ecology, thus provide a useful insight for further research needed as well as for identification of priorities for their management in an ecologically and economically sustainable manner.

We thank Dr. Ayaka Amaha ÖZTÜRK and Ms. Elif ÖZGÜR for their help in editing this volume.

Sema ACAR
The GEF
Black Sea Ecosystem Recovery Project (BSERP)
Project Co-ordinator

Bayram ÖZTÜRK
Director, Turkish Marine Research Foundation (TÜDAV)

# CETACEAN BYCATCH - TURBOT FISHERIES INTERACTION IN THE WESTERN BLACK SEA

Arda M. TONAY and Bayram ÖZTÜRK
Faculty of Fisheries, Istanbul University, Turkey
Turkish Marine Research Foundation, Istanbul, Turkey

## ABSTRACT

The cetacean bycatch was studied in the bottom gillnet fishery for turbot on the western coast of the Turkish Black Sea. Information on incidental catches was compiled from two sources: 1. the interwievs with fishermen, 2. the field study. The bycaught animals were measured and photographed. The information on length, water depth and location of nets were collected. A total of 13 *Phocoena phocoena* (harbour porpoise) specimens were examined. Other two species *Tursiops truncatus* (bottlenose dolphin) and *Delphinus delphis* (common dolphin) inhabiting in the Black Sea were not recorded.

## INTRODUCTION

The Black Sea is a semi-closed basin with relatively great depths (max depth 2258m; over 2000m isobat is 156,604km$^2$ and 529,954km$^3$), with little connection to the world oceans, and high bioproductivity of the shelf zone (242t of phytoplankton per km$^2$). Here discharge some big rivers like the Danube, Dneister, Dneiper, which determines the lower salinity of the Black Sea water compared to those of the Marmara and Aegean Seas and Mediterranean. The occurrence of hydrogen sulphide at depths of more than 125-224m is another important peculiarity since the surface water saturated with oxygen represent only 12% of the total water volume (PRODANOV *et al.*, 1997).

Commercially the Black Sea turbot (*Psetta maxima* and *P. maxima maeotica*) is one of the most valuable species in the basin, and currently is fished with gillnets and bottom trawls (PRODANOV *et al.*, 1997).

There are three cetacean species in the Black Sea; *Phocoena phocoena* (LINNAEUS, 1758) (harbour porpoise), *Tursiops truncatus* (MONTAGU, 1821) (bottlenose dolphin) and *Delphinus delphis* Linnaeus, 1758 (common dolphin) (ÖZTÜRK, 1999).

The history of the Black Sea dolphin fisheries dates back more than one hundred years ago. Dolphins were caught mainly for oil and vitamin D extracted from blubber and for meal for poultry feed (ÖZTÜRK, 1999). The former Soviet Union countries initiated dolphin fishery in the Black Sea in 1870 and Turkey followed the course in the 1930s (YEL *et al.*, 1996). Due to the decline of the stocks, commercial killing has been banned in the former Soviet Union, Romania and Bulgaria since 1966 and in Turkey since 1983 (ÖZTÜRK, 1999). In Turkey, during the period between

1967 and 1983, 4534 tons of dolphins were processed so as to obtain 1277 tons of oil and 779 tons of meal (YEL *et al.*, 1996).

As the top predators of the Black Sea, marine mammals have been badly effected by ecological catastrophes such as water pollution, food shortage, microbial contamination, loss of habitats, incidental catch and changes in the population structures (ÖZTÜRK, 1999).

Every year several hunderds of dolphins are drowned in gill nets and stranded ashore between early April and June. Large numbers of *P. phocoena*, *T. truncatus* also die as a result of incidental catch during the sole, turbot and sturgeon fishing season. It is estimated at least 2000-3000 individuals of two species are bycaught in the Turkish Black Sea each year (ÖZTÜRK, 1996).

Bycatch has been studied in the Black Sea (ÖZTÜRK *et al.*, 1999; TONAY and ÖZ, 1999; BIRKUN, 2002), although more information is needed to elucidate this problem to design the conservation plan for the dolphins in the Black Sea. Therefore, this study is aimed to obtain information on the number of the cetacean bycatches so that conservation of these cetacean species is effectively managed.

## MATERIALS AND METHODS

The cetacean bycatch was studied in bottom gillnet turbot fisheries in 2002, between April to June, on the western coast of the Turkish Black Sea. The data were collected at the fishing ports of İğneada, Karaburun, Kıyıköy, Karaburun, Rumelifeneri, Şile and Ağva (Figure 1).


**Figure 1.** Fishing ports in the study area.

In these ports, the local fishermen were interviewed. Information on number of bottom gill nets, characteristics of nets and fishing areas were collected. Information on bycatch was compiled from two sources: 1. interviews with fishermen, 2. the field study. The bycaught animals were examined, measured and photographed immediately. Water depth and location of nets were recorded.

## RESULTS

### Bycatches

During the research period, a total of 13 specimens were examined from five boats (total 575nets=34500fathom~62km), at three fishing ports of Rumeli Feneri, Karaburun and Ağva. All specimens were *P. phocoena*, while *T. truncatus* and *D. delphis* bycatch was not observed. Table 1 shows date, port, sex and length of collected *P. phocoena* specimens.

Table 1. Landing port, sex and length data of caught specimens.

| No | Date | Port | Sex | Length(cm) |
|---|---|---|---|---|
| **001** | 17.05.2002 | R. Feneri | female | 120 |
| **002** | 20.05.2002 | Ağva | female | 107 |
| **003** | 26.05.2002 | Karaburun | female | 115 |
| **004** | 26.05.2002 | Karaburun | female | 124 |
| **005** | 01.06.2002 | R. Feneri | male | 119 |
| **006** | 05.06.2002 | R. Feneri | female | 113 |
| **007** | 05.06.2002 | R. Feneri | male | 105 |
| **008** | 05.06.2002 | R. Feneri | female | 124 |
| **009** | 05.06.2002 | R. Feneri | male | 101 |
| **010** | 05.06.2002 | R. Feneri | male | 103 |
| **011** | 16.06.2002 | R. Feneri | male | 121 |
| **012** | 16.06.2002 | R. Feneri | female | 118 |
| **013** | 16.06.2002 | R. Feneri | female | 113 |

There were 5 male and 8 female specimens and the most fequent length interval in bycaught was 111-120cm (Figure 2).

Figure 3 shows location, number of nets, and number of bycaught animals in the research area.

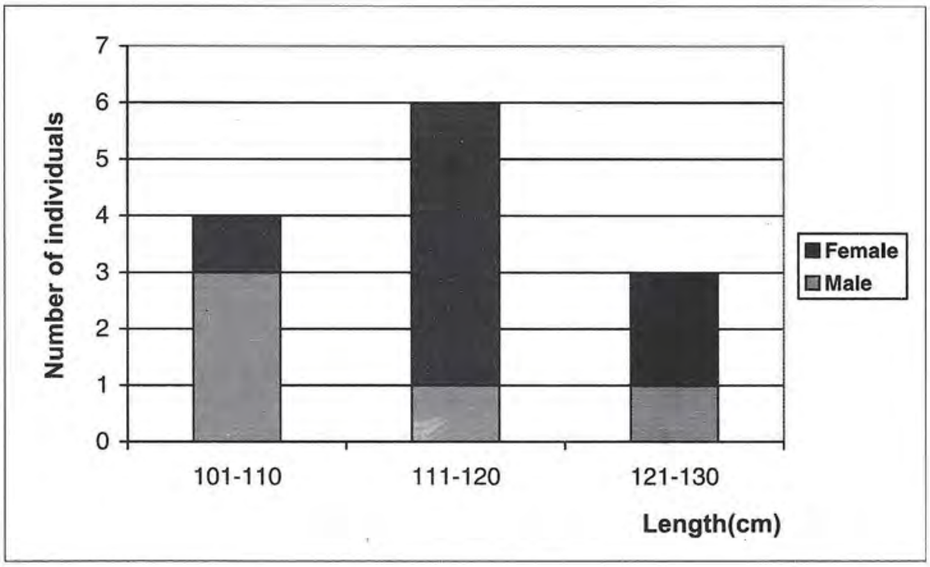
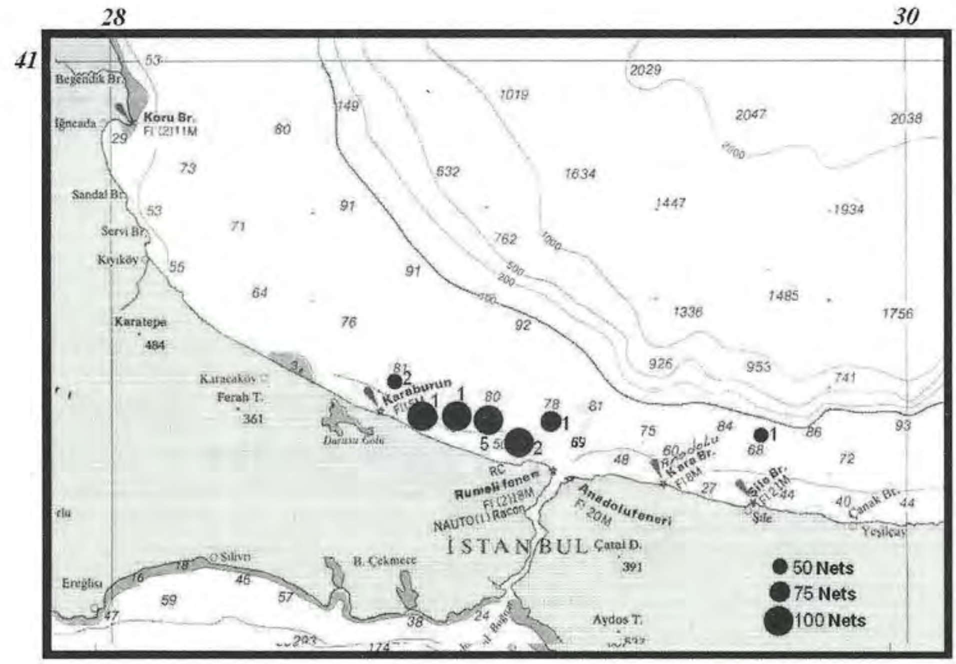



**Figure 2.** Relation between lenght, sex and number of specimens.




(1 Net=60fathom=108m)

**Figure 3.** Location, number of nets and number of bycaught animals. Figures next to the sign indicating the number of nets are the number of bycaught animals.

Turbot fishing area is within 100m isobat in the Turkish Western Black Sea. In general turbot fishery is operated in 15 miles from coast. In this study, 11 bycatches appeared in 5 nautical miles from coast.

Furthermore, according to the fishermen, 55 *P. phocoena* and 3 *T. truncatus* were bycaught in 1895 nets(=205km) during this season.

**Turbot Fishery**

Turbot fishery season begins particularly in April and ends in the last week of June. Table 2 summarizes the features of turbot fishery and bottom gill nets in the study area.

Table 2. The features of Turbot fishery and bottom gill nets.

| | |
|---|---|
| **Season** | April, May, June |
| **Fishing depth** | 20-60 fathom(36-108m) |
| **Soak time** | 10-30 days |
| **Mesh size** | 160-200mm |
| **Net twine** | 210d/9-18 no |
| **Net height** | 5-11 meshes |
| **Prohibitions** | Min. fish body length 40cm; banned 15 April-31 May |

For the turbot fishery, nets are set end to end. One net is 60 fathom length (=108m). One set of nets has 5-15 anchors. There are 12-30 nets between two anchors. For example, one set of 50 nets is approximately 5 km long.

The boats used for turbot fishery are between 7 to 30m in length. Table 3 shows number of boats, number of bottom gill nets and nautical miles of fishing area from coast.

Table 3. Number of boats, bottom gill nets and distance of fishing area from coast.

| **Fishing Ports** | **Number of bottom gill nets** | **Number of boats** | **Distance of fishing area from coast (nautical miles)** |
|---|---|---|---|
| Rumeli Feneri | 5,000 | 30 | 10-15 |
| İğneada | 4,000 | 80 | 15 |
| Kıyıköy | 5,000 | 27 | 15 |
| Karaburun | 2,000 | 8 | 3-5 |
| Şile | 1,000 | 10 | 1 |
| Ağva | 8,000 | 49 | 14 |
| **Total** | **25,000** | **204** | - |

In 6 fishing ports, 25000 pieces of bottom gill nets in total were found.

Figures 4 and 5 show turbot landings by countries during the period 1964-2000. During the years 1964-2000 Turkey had the landings. For recovering turbot stocks, other Black Sea countries banned turbot fishery between 1985 to 1995. These big landings of Turkey are due to the intensive fishery not only along its own coast but also off the coasts of other Black Sea countries (PRODANOV *et al.*, 1997).

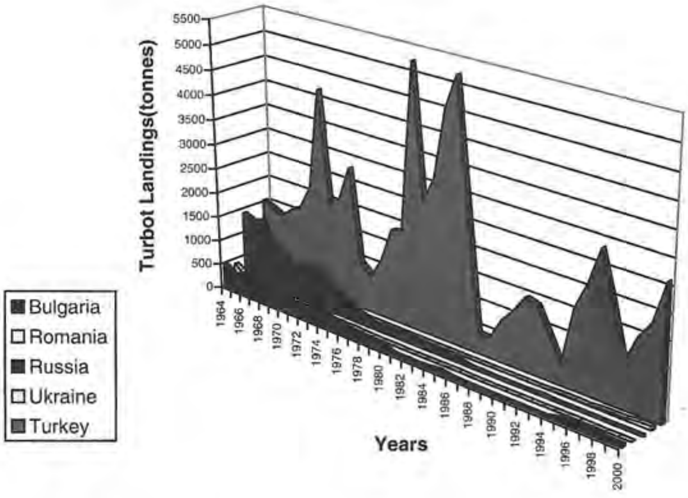



**Figure 4.** Turbot landings in the Black Sea (in tonnes) during the period 1964-2000 (PRODANOV *et al.*, 1997; FAO, 2002).

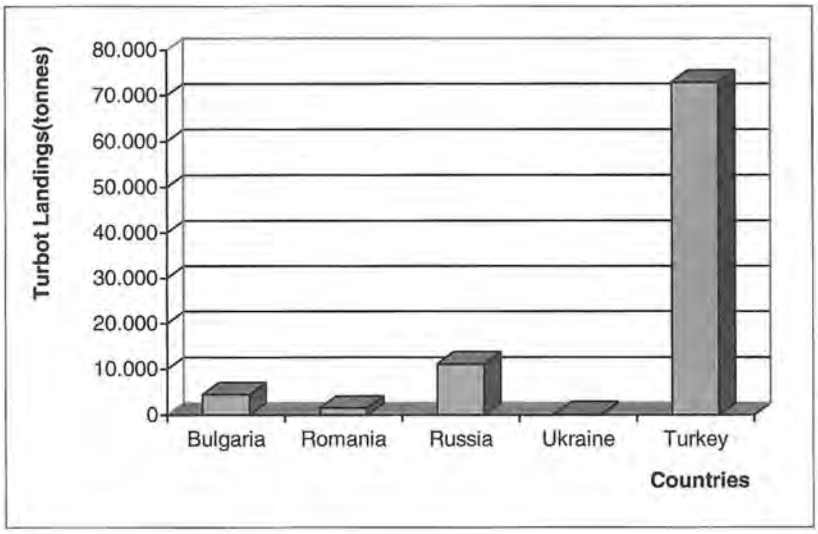



**Figure 5.** Total turbot landings of the Black Sea countries during the period 1964-2000 (PRODANOV *et al.*, 1997; FAO, 2002).

## DISCUSSION

Only *P.phocoena* bycatch was observed, while *T. truncatus* and *D. delphis* bycatch was not found. But according to the interviews with the fishermen, bycatch of *T. truncatus* in this area was known. *D. delphis* predominantly lives offshore, but visits coastal waters following the seasonal aggregations and mass migrations of small pelagic fish (DUMONT J.H., 1999). According to BIRKUN (2002) and ÖZTÜRK *et al.* (1999), the interaction of *D. delphis* with bottom gill nets has been rarely observed (Table 4.).

The bycatch of 13 *P. phocoena* occurred in 575 nets, which consist 2.3% of total bottom gillnets in the area. There were 25,000 nets have been used in the Turkish Western Black Sea in the area of approximately 3500 km$^2$.

Table 4. Result of bycatch studies in the Black Sea.

| Year | Countries | Species | | | Total | References |
|---|---|---|---|---|---|---|
| | | P.p. | D.d. | T.t. | | |
| 1990-1999 | Rom., Rus., Bulg., Geor., Ukr. | 363 | 10 | 12 | **385** | Birkun, 2002 |
| 1993-1997 | Turkey | 62 | - | 1 | **63** | Öztürk *et al.*, 1999 |
| 1999 | Turkey | 28 | - | - | **28** | Tonay and Öz, 1999 |

P.p.: *Phocoena phocoena,* D.d.: *Delphinus delphis,* T.t.: *Tursiops truncatus*

According to BIRKUN (2002), the Black Sea fisheries influence mainly on *P.phocoena* and the intensity of this impact is probably 30-40 times higher compared to the adverse influence of fisheries on the other two species.

Bycatch of pregnant females was not found in this study but according to BIRKUN (2002), turbot fishing operations in May-June could be defined not only as a significant anthropogenic factor of Black Sea harbour porpoises mortality, but also as a factor limiting their reproduction. The presence of near-term pregnant, postpartum and lactating females indicated that the turbot fishing season coincides with porpoise gestation and nursing period.

Furthermore, the pelagic and demersal fish stocks are over-exploited, which obviously has a direct impact on the cetacean populations. The lack of food may lead to increase conflicts between cetaceans and the fishing industry, thus icreasing the threat to these marine mammals as some fishermen view them as competitors for scarce resources of high commercial value (ÖZTÜRK, 1999).

Exact number of incidental catches is necessary before the impact on cetacean population in the western Black Sea can be assessed. More detailed studies are needed for certain bycatch data. Furthermore studies on abundance and population dynamics of cetaceans in the Black Sea are required. Already existing turbot fisheries and protection laws should be reviewed and revised. Relation between cetacean bycatch and demersal fishery should be investigated. Researches on reducing entanglement, dolphin-safe fishing methods, fishing gears and fisheries technology should be began. Demersal fishery causing bycatch should be monitored with a stranded and bycatch database for all the Black Sea riperian countries. A conservation action plan should be implemented in the entire Black Sea for the responsible fisheries and protection of the cetacean in the Black Sea.


## Acknowledgment

We thank Dr. Ayhan DEDE, Dr. Ayaka Amaha ÖZTÜRK, Assist. Prof. Bülent TOPALOĞLU who encouraged and helped us, Orçun AKIN for help in the field study and turbot fishermen for their help in collecting porpoise specimens.


## REFERENCES


BIRKUN, A. JR. 2002. Interactions between cetaceans and fisheries in the Black Sea.. In: G. Notarbartolo di Sciara (Ed.), Cetaceans of the Mediterranean and Black Seas: state of knowledge and conservation strategies. A report to the ACCOBAMS Secretariat, Monaco. Section 10, 11p.

DUMONT J.H. (ed.) 1999. Black Sea Red Data Book. UNO, GEF, UNDP. 413p

FAO, 2002. GFCM (Mediterranean and Black Sea) Capture production 1970-2000, www.fao.org/fi/stat/windows/fishplus/gfcm.zip

ÖZTÜRK, B. 1996. Balinalar ve Yunuslar, Setelojiye Giriş. Anahtar Kitapları Yayınevi, İstanbul. 136p.(in Turkish)

ÖZTÜRK, B. (Ed.) 1999. Black Sea Biological Diversity: Turkey. GEF Black Sea Environmental Programme, United National Publications, NewYork.27-35pp.

ÖZTÜRK, B., ÖZTÜRK, A.A., DEDE, A. 1999. Cetacean bycatch in the western coast of the Turkish Black Sea in 1993-1997. In: P.G.H. Evans, J. Cruz and J. A. Raga (Eds.), Proc. 13th Annual Conf. European Cetacean Society, Velencia, Spain. 134pp.

PRODANOV, K., MIKHAILOV, K., DASKALOV, G., MAXIM, C., CHASHCHIN, A., ARKHIPOV, A., SHLYAKHOV, V., ÖZDAMAR, E. 1997. Environmental Management of Fish Resources in the Black Sea and Their Rational Exploitation. General Fisheries Council for the Mediterranean, Studies and Reviews, No: 68. Food and Agriculture Organization of the United Nations, Rome. 185p.

TONAY, A.M., ÖZ, İ.M., 1999. Stomach contents of the Harbour Porpoise (*Phocoena phocoena*) bycatches in the Western Black Sea, Underwater Science and Technology Meeting, Istanbul.92-98pp(in Turkish)

YEL, M., ÖZDAMAR, E., AMAHA, A., MIYAZAKI, N. 1996. Some aspects of dolphin fishery on the Turkish coast of the Black Sea. In: Öztürk, B. (ed.), Proceedings of the First International Symposium on the Marine Mammals of the Black Sea, İstanbul..31-40pp

# VARIATIONS ON THE TURBOT (*SCOPTHALMUS MAEOTICUS*) STOCKS IN THE SOUTH-EASTERN BLACK SEA DURING THE LAST DECADE AND COMMENTS ON FISHERIES MANAGEMENT

Mustafa ZENGİN[1] and Ertuğ DÜZGÜNEŞ[2]

[1]Central Fisheries Research Institute of Ministry of Agriculture Rural Affairs, Trabzon, Turkey
[2]Karadeniz Technical University, Faculty of Marine Science, Department of Fisheries Technology, Trabzon, Turkey

## ABSTRACT

The state of the turbot stocks was determined by trawl surveys, population analyses and catch/landing statistics from 1990 to 2000. The results indicate that the stocks have been seriously overexploited through over-fishing. Analyses of the data have shown that recovery of the exploited stocks and establishing sustainable fisheries need some urgent provisions primarily through basic requirements of the fisheries management issues. Comments on urgent actions towards rehabilation of the Black Sea turbot stocks are presented.

## INTRODUCTION

Turbot has an important place within the Turkish commercial fishery resources, although the fisheries are generally intensified on pelagic stocks particularly anchovy, horse mackerel, sprat, bonito and bluefish. Turbot, whiting and red mullet are the major groundfish species of the Black Sea by means of production and market value. Although it has a great demand in the market, the supply is rather limited in comparison to the other marine species. The catch rate of turbot among the most popular and available species of the Black Sea such as anchovy, horse mackerel, whiting, bonito, mullets, shad and red mullet is around 1.7% (ZENGIN *et al.* 1998). But in terms of its value in the domestic market, it is considerably important. Its commercial value tends to increase due to limited production in recent years and imports of turbot as fresh and frozen fish have started and reached to 5000 tons per year (DIE, 1998).

Although turbot has great commercial value not only in Turkey but also in the other Black Sea countries, it is hard to say that stocks have been exploited rationally. Long-term catch data of the countries sharing the stocks in the Black Sea show that majority of the turbot (72%) had been caught by Turkey and followed by the Commonwealth of Independent States (19%), Bulgaria (7%) and Romania (3%) (PRADANOV *et al.*, 1997). Traditionally, main fishing grounds of the Turkish fishermen were the Kerch Strait and the area off Danube Delta until the beginning of the 1980's, particularly during the period of 1972-1983 and total annual catch reached up to

5250 tons. Generally, there was only a seasonal fishing in springtime in Turkish coasts in these years. Turkey had lost these traditional fishing areas after the enforcement of the Black Sea Exclusive Economic Zone Agreement in 1982 which permits the countries to increase their coastal water territorial rights up to 200 nautical miles. Turkey lost all the traditional fishing rights in the west, north and the north-east Black Sea for Russian Federation, Ukraine, Romania and Bulgaria. On the other hand, legal obligations forced the turbot fishermen and fishing effort to concentrate in the Turkish EEZ. Subsidies given by the Turkish Government to the fisheries sector encouraged fishermen to build up well-equipped and bigger vessels, larger nets, importation of high ranged fish finders and construction of fish meal and oil plants. After this period of rapid expansion, fishing fleet growing in an unplanned and uncontrolled manner caused a dramatic decline of the both overall fisheries and turbot stocks, of which the catch declined from 2800 tons in 1985-2000 to 400 tons (Table 1) (ZENGIN, 1998).

Bottom trawl is the main fishing gear used in turbot fisheries in the coastal waters of Turkey. It is more common in the western part of the Black Sea where the continental shelf is considerably wide mainly around Samsun, Sinop Bay and near west and areas near the Bulgarian border. Gill nets are widely used generally in all neritic waters along the coastal line. In some areas in the north-western part of Turkey trawling can also be performed in international waters.

*Scopthalmus maeoticus* (Palas, 1811) is the endemic species of the Black Sea and distributed all over the Black Sea and the Azov Sea. Vertical distribution of the species may extend down to 180 m depth, which is the maximum depth for the anoxic layer, which limits the life of macro-fauna. The species has no significant long distance horizontal migration but only local replacement is possible for feeding and reproduction.

Mature turbot is typical bottom dwelling flatfish and prefers particularly sandy or muddy bottoms. Depth preferences increase as the fish gets older. Juveniles and young turbots at ages of $0^{+}$ and $1^{+}$ prefer coastal waters up to 30 m depths while mature fish are found in the whole littoral zone depending on the season and life and/or reproductive cycles. Mature fish migrate towards to the coast up to 20-30 m depths for spawning in the South-Eeast coasts of the Black Sea in spring. Spawning takes place in the same area from April to June, when the water temperature reaches around 9.5-15.5°C (SLASTENENKO, 1956; KARPETKOVA, 1980; IVANOV and BEVERTON, 1985; ZENGIN, 2000).

Although there was no remarkable threat to flatfish stocks in the Black Sea until 1980s, increased fishing effort have caused overfishing especially in the coastal waters of Russia, Ukraine and Turkey. On the other hand, pollutants carried by the major rivers from Central Europe and surrounding countries have affected seriously the north-east region covering Bulgarian and Romanian coasts. So, eutrofication and overfishing have been co-acted to diminish turbot stocks (AVŞAR, 1998). This has resulted in declining landings, for example total turbot catches of 334 tons during the 1960s dropped to 172 tons in the 1970s, and 12 tons in the 1980s. Finally it almost disappeared during the 1990s and there was no official catch data in the early years of the decade. Similar trend was also followed in Romania. Turbot production decreased from 354 tons (1950-1954) to 70 tons (1971-1974) in twenty years and almost collapsed in the 1980s. Ukraine completely banned turbot fishing since the 1980s (ZAITSEV and MAMAEV, 1997).

Table 1. Turbot catches by Turkish fishermen in the Turkish coasts during 1985-2000 (tons) (DİE, 1982/2001).

| YEARS | EASTERN BLACK SEA | WESTERN BLACK SEA | TOTAL |
|---|---|---|---|
| 1982 | 903 | 3638 | 4541 |
| 1983 | 1365 | 3851 | 5216 |
| 1984 | 1202 | 1575 | 2777 |
| 1985 | 263 | 142 | 405 |
| 1986 | 228 | 171 | 3999 |
| 1987 | 477 | 358 | 835 |
| 1988 | 610 | 500 | 1110 |
| 1989 | 1001 | 448 | 1449 |
| 1990 | 475 | 908 | 1383 |
| 1991 | 315 | 600 | 915 |
| 1992 | 110 | 308 | 418 |
| 1993 | 1185 | 400 | 1585 |
| 1994 | 821 | 1293 | 2114 |
| 1995 | 844 | 2006 | 2850 |
| 1996 | 510 | 1414 | 1924 |
| 1997 | 134 | 772 | 906 |
| 1998 | 412 | 1056 | 1468 |
| 1999 | 318 | 1875 | 2193 |
| 2000 | 225 | 232 | 457 |

There are a few scientific studies at the stock abundance of turbot in the Black Sea littoral zone. The first research was carried on by KUTAYGIL and BILECIK (1979) between Sinop-Marmara Ereğlisi-Kefken regions from 1969 to 1973 and biomass abundance was tried to be estimated by seasons and depths as for kg per unit area during the summer time. There was no realistic research on the estimation of the abundance of the turbot stocks on the Turkish coasts until the 1990s when BINGEL *et al.* (1995) initiated a comprehensive study to estimate the total biomass using swept area method employing the bottom trawls in 1990-1992. The most detailed study carried out for the whole coast line was realized by ACARA (1985) and PRADANOV *et al.* (1997) which were depending upon the evaluation of the commercial data by VPA based stock estimation method. According to the results of this study, size of the stock was estimated as 25,800 tons in the 1900s and decreased to 6,100 tons in 1988 (Table 2). It is difficult to accept the presence of a reliable and serious estimate of turbot population till the early 1990s. Lack of qualitative and quantitative long-term data, both from national and other countries territorial waters, had limited serious efforts towards the estimation of stock abundance using historical catch data. On the other hand the analysis of the commercial catch data have still been one of the important sources for quantitative stock analyses for the past. Fisheries data have shown that fishing pressure has gradually increased after the 1980s, the catch reached to 5,000 tons in 1983 and decreased sharply to 400 tons in 1992, according to the DIE[1] .

This study aimed to investigate the latest situation of turbot stocks, and distribution and basic fisheries parameters were described for the last decade. It also aimed to evaluate options for recovering the turbot stocks and develop strategies for stock conservation, control and surveillance measures to better resource management.

Table 2. Some studies carried out in the Black Sea countries on turbot stocks.

| Researcher | Years | Location | Quantity (tons) |
|---|---|---|---|
| | 1950- | | (ave) 12 |
| Popova (1967) | 1960 | North-west Black Sea coasts | 300 |
| | 1970 | " | 10 000 |
| | 1975 | " | 6 000 |
| | 1980 | " | 800 |
| | 1975- | | |
| Effimov *et al.* (1989) | 1979 | | |
| | 1980- | Former SSCB coasts | 19 100 |
| | 1984 | " | 14 200 |
| Ivanov and Beverton (1985) | 1963 | Bulgarian coasts | 1 710 |
| | 1978 | " | 450 |
| Karpetkova (1980) | 1980 | Bulgarian coasts | 80 |
| Kutaygil and Bilecik (1979) | 1969-1973 | Western Black Sea coasts, Turkey(Samsun-Kefken) | (ave) 180.4 |
| | | Eastern Black Sea coasts, Turkey | |
| | | " | |
| Bingel *et al.* (1995) | 1990 | " | 124 |
| | 1991 | Western Black Sea coasts | 410 |
| | 1992 | Eastern and Western Black | 766 |
| | 1990 | Sea coasts | 130.5 |
| Acara (1985) | | Eastern and | 11 225 |
| | 1983 | Western Black Sea coasts | 14 137 |
| Pradanov *et al.* (1997) | 1979 | | 25 800 |
| | 1988 | Black Sea coasts | 6 100 |

[1] State Statistical Institute

## MATERIALS AND METHODS

Field studies were carried out in three stages in order to determine general background of the turbot fishery and its biomass in the Turkish Black Sea coasts from 1990 to 2000.

### 1-Biological Surveys

In this phase of study, monthly surveys were conducted to gather basic fishery data in three stations up to 100 m depth by a research vessel (RV-1 Central Fisheries Research Institute) between 1990 and 1996 (Figure 1). Samlples were taken by bottom trawl nets with mesh sized 14 mm using 30 min standart hauls. Sub-sampling strategy (HOLDEN and RAITT, 1974) could not be applied due to insufficient amount of catch, so all the turbot caught treated as sample. All fish were measured and aged using the otholits (CHUGONOVA, 1963). In order to determine a common hatching day and to prevent confusion age readings were given full cohort (WILLIAMS and BEFORD, 1974).

Using these vital data as an input, some basic fishery parameters such as length and age distribution according to depths up to 100 m and years, mortality and survival rates and exploitation rate were estimated. Two different methods were used for estimating the mortality rates (RICKER 1975; SPARRE and VENEMA, 1992). Exploitation rate (E) was calculated by the ampirical equation derived by PAULY (1980).

### 2-Biomass Estimations

"Sub Area Biomass Estimation" method was employed to assess the turbot stocks in the south-eastern Black Sea (SPARRE *et al.*, 1989). Trawl surveys had been conducted at eight sub regions and two sub layers as 0-50 and 50-100 m depths in the area between Cape Sinop and Georgian border from 1990 to 1993 (Figure 1). It was intended to include both juvenile and adult stock to the samples, thus operations mainly are carried out in autumn season. Catchability co-efficient (q) of the trawl net used for the sub layers assumed as one in the method of "swept area" (BINGEL, 1985). Opening rate of the buoy line was taken as 0.5 (PAULY, 1980). Trawl operation (hauling) time was limited by 30 minutes with the fixed speed of 1.5 (1.4-2.2) knots. Maximum sustainable yield (MSY) or the potential yield (PAULY, 1980; SPARRE *et al.*, 1989) was estimated by the equation proposed by GULLAND (1975), which consists of natural mortality and total biomass parameters (GULLAND, 1975).

### 3- Landing Data

Data for the landings in markets and major fishing ports were collected monthly from along the Black Sea coast from the Bulgarian to Georgian border. Turbot samples were also taken during the data transfer for ageing and body measurements including weighing.

As a basic fishery data, daily catch, fishing effort, date of operation, frequency and fishing method were recorded on turbot landing sheets. Part of the landing data for 1998/2000 was taken from the research carried out in the same area (GENÇ *et al.*, 2002).

## RESULTS AND DISCUSSION

### Estimation of Exploitable Turbot Biomass

Exploitable turbot biomasses during autumn seasons were estimated as 686 tons in 1980, 250 tons in 1991, 222 tons in 1993 and 134 tons in 1993 (Table 3, Figure 2). Highest biomass was observed in 0-50 m depth contour with the combined data for all years. Mean turbot biomass was 128.3 kg per square km for 0-50 m and 44.1 kg per square km for 50-100 m. These results showed that both recruited juveniles and adult stocks were found together at the shallow waters in the littoral zone in autumn (ZENGIN and DÜZGÜNEŞ, 2000).


Figure 1. Study area along the southeastern Black Sea coast.

The average stock size as 323.3 tons in this area from 1990 to 1993 was very close to the estimation of 433 tons obtained from the study carried out by BINGEL *et al.* (1995) (Table 2). On the other hand, comparing the estimates of two previous surveys, which were 180 tons (for 1969/1973; KUTAYGIL and BILECIK, 1979) and 130 tons (in 1990; BINGEL *et al.*, 1995) less than current estimations, it is very clear that Eastern sublittoral zone appears to be more productive than the Western Black Sea areas.

Table 3. Turbot catches by trawl, in the south-eastern Black Sea during the autumn 1990-1993 (M: instantaneous natural mortality rate, Py: potential yield, n: operation number).

| Years | Layer (m) | Mean Yield ($kg/km^2$) | [1]Biomass (kg) | M | [2]Py (kg) |
|---|---|---|---|---|---|
| 1990 | 0-50<br>50-100<br>0-100 | 269.6±56.4 (n=25)<br>54.8±15.6 (n=13)<br>179.4±34.9 (n=38) | 484558.7<br>100094.8<br>686293.4 | 0.28 | 96081.1 |
| 1991 | 0-50<br>50-100<br>0-100 | 118.2±50.9 (n=29)<br>57.6±21.8 (n=24)<br>95.4±41.9 (n=53) | 152153.8<br>75841.6<br>250419.6 | 0.21 | 26294.1 |
| 1992 | 0-50<br>50-100<br>0-100 | 68.5±13.2 (n=26)<br>60.8±18.2 (n=21)<br>59.9±9.5 (n=47) | 132110.4<br>101913.3<br>222436.0 | 0.22 | 24467.9 |
| 1993 | 0-50<br>50-100<br>0-100 | 56.7±23.2 (n=26)<br>3.1±3.6 (n=22)<br>37.5±13.6 (n=48) | 94970.9<br>2622.5<br>134044.5 | 0.23 | 15415.1 |

1: Biomass estimation model in stratified sampling commented by SPARRE *et al.* (1989)
($B = \sum B_i = \sum_{i=1} (cwi / ai * qi) * Ai$; B: Biomass of total area (kg), Bi: Biomass of layer i (kg), cwi: mean biomass of sub layer i, ai: swept area in sub layer i ($m^2$), qi: catchability coefficient of the trawl net in layer i, Ai: area of sublayer i ($m^2$))
2: (Py=0.5.M.Bv, M: instantaneous natural mortality rate, Bv: less or never exploited stock) as commented by Gulland (1975)

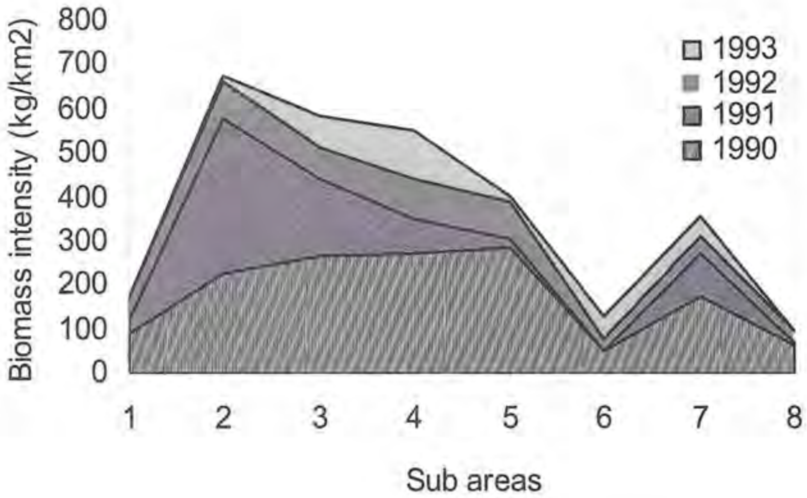



Figure 2. Biomass intensity of turbot in the subareas in the South-eastern Black Sea in 1990/1992

Mean biomass abundance was 323 tons and calculated optimum potential yield (Py) was 40.8 tons for 1990/1993 but the actual catch was realized more than 8 fold of the expected amount. Another useful approach is the exploitation rate (E=F/Z) and all the rates calculated for the periyod from 1990 to 2000 are given in Table 4, which was minimum in 1995 (0.61) and maximum in 2000 (0.77). Values are higher than optimum level ($E_{opt}$=0.5) for all years and it is another evidence of overfishing due to high fishing intensity on turbot stocks during these years in the southeastern Black Sea. These results were also reflected in the landing statistics (Table 1). In this area the turbot catch was 1300 tons in the 1980s it decreased almost half of this level in the 1990s (with the exceptions 1993, 1994 and 1995.

Age of the oldest turbots in the samples was $9^+$, while the age of recruitment (Tr) was estimated as 2 using the survival rate equation of Ricker (1975) (Table 4). Instanstaneous total mortality rate was Z = 0.61-1.13 for *Scopthalmus maeoticus* which are well known as long lived species. Survival rate was very low, $S_{mean}$=0.47 (ranged between S= 0.35 - 0.55) (46 % of turbot population can survive). It is also another indication of the negative effect of the high fishing (F) and natural mortality (M).

Table 4. Some population parameters of the turbot stock in 1990-2000 (Tr: age of recruitment S: survival rate, M: instantaneous natural mortality rate, F: instantaneous fishing mortality rate, Z: instantaneous total mortality rate, E: exploitation rate)

| Years | [1]Age Interval | [1]Tr | [2]S | M | [3]F | [3]Z | [4]E |
|---|---|---|---|---|---|---|---|
| 1990 | 1-8 | 3 | 0.44 | 0.28 | 0.57 | 0.85 | 0.67 |
| 1991 | 0-8 | 3 | 0.50 | 0.21 | 0.55 | 0.76 | 0.72 |
| 1992 | 0-7 | 2 | 0.49 | 0.22 | 0.55 | 0.77 | 0.71 |
| 1993 | 0-9 | 2 | 0.38 | 0.23 | 0.71 | 0.93 | 0.76 |
| 1994 | 2-6 | 3 | 0.53 | 0.30 | 0.49 | 0.79 | 0.62 |
| 1995 | 1-7 | 2 | 0.35 | 0.25 | 0.69 | 1.13 | 0.61 |
| 1996 | 0-8 | 1 | 0.55 | 0.20 | 0.41 | 0.61 | 0.67 |
| 2000 | 0-9 | - | 0.54 | 0.14 | 0.47 | 0.61 | 0.77 |
| Overall | 0-9 | 2 | 0.47 | 0.23 | 0.56 | 0.81 | 0.69 |

1: Smaller fish at lengths which are not available for commercial fish nets
2: Relationship between the survival rate and total mortality; Ricker (1975); $S=e^{-Z}$
3: Two different method used for to estimate M; Ricker (1975), and Sparre and Venema (1992) then average is taken,
4: According to Pauly (1983); if $E=F/Z < 0.5$ stock is under exploited, if $E=F/Z=0.5$ it is exploited on optimum level and if $E=F/Z > 0.5$ stock is over exploited.

**Indications of Diminishing in Stocks**

It is quite possible to follow the last ten year's profile in the turbot stocks from the basic population parameters. Length - frequency distribution of the samples for the time series analyses of the population, mean length, and weight and age data can reflect the variations in the population very briefly. Length - frequency distributions of the turbot stock from 1990 to 2000 are given in Figure 3.

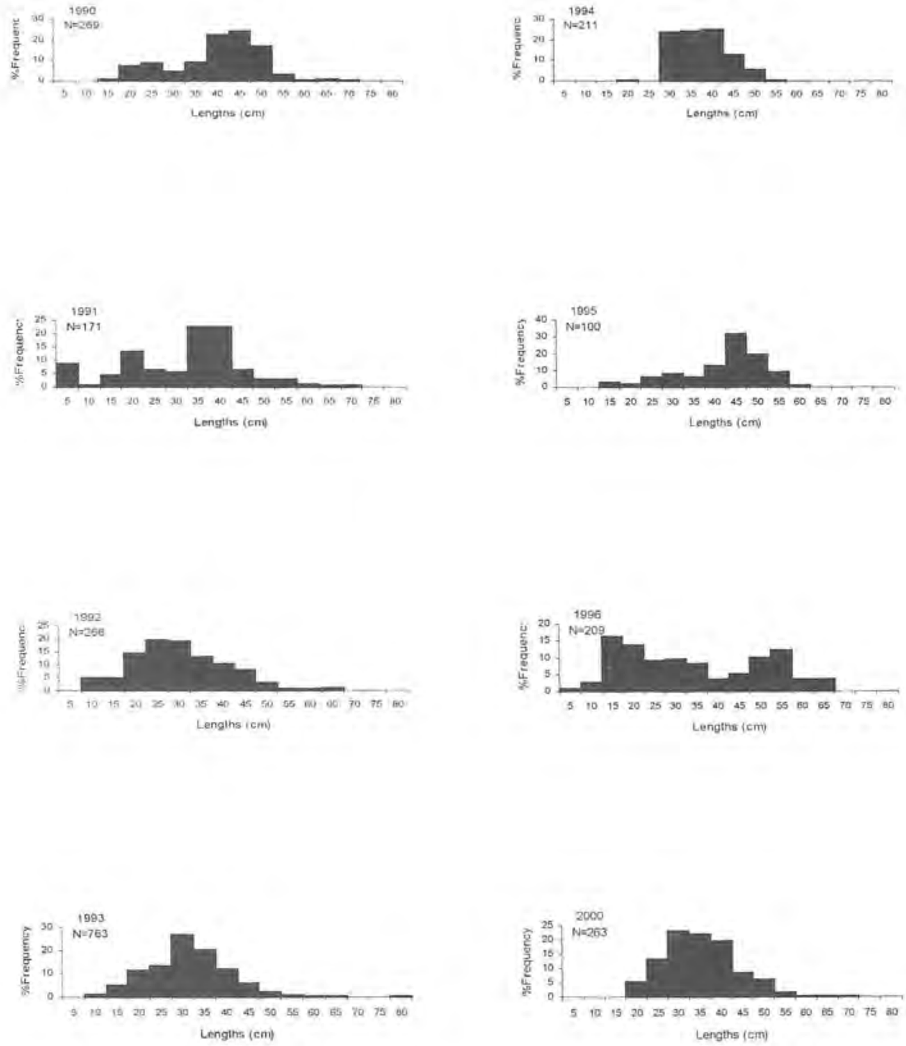



Figure 3. Length frequency distribution of *Scopthalmus maeoticus* population in the southeastern Black Sea in 1990-2000.

When the year series are taken into consideration mean length of the fish caught by trawl net was 41.9 cm in 1990, decreased to 36.5 cm in 1996 and 37.6 cm in 2000 (Table 5). Cumulative length distribution for these years reflected the state of the stocks. For instance, mean lengths corresponding 50% cumulative lengths were 39.2 cm in 1996, 28.6 cm in 1996 and 32.0 cm in 2000, while overall mean length was 32.3 cm (Table 5). On the other hand, in case of age composition, total fish at ages of $0^+$, $1^+$, $2^+$ and $3^+$ were found as high as 62.5 % average for all the years combined data. These turbots are at the immature stage (ZENGIN, 2000). When the majority of the population were under age of first sexual maturation, in other words if they are composed by the young turbots the stocks are subject to over fishing and exploited not to letting them to grow for the best size to sustain maximum yield. These are all the indications of increasing overfishing.

Table 5. Some parameters of the turbot population in the south-eastern Black Sea in1990-2000.

| Years | 50% cumulative lengths (cm) | Mean lengths (cm) | Mean body weight (g) | [1]Rate of immature turbots (%) |
|---|---|---|---|---|
| 1990 | 39.2 | 41.9 | 1534.1 | 42.8 |
| 1991 | 32.2 | 34.1 | 949.6 | 78.9 |
| 1992 | 26.7 | 32.7 | 810.3 | 78.6 |
| 1993 | 28.5 | 33.6 | 793.4 | 86.4 |
| 1994 | 33.9 | 38.9 | 1100.3 | 51.2 |
| 1995 | 37.6 | 44.2 | 1807.1 | 38.0 |
| 1996 | 28.6 | 36.5 | 1463.4 | 61.2 |
| 2000 | 32.0 | 37.6 | 1089.1 | 62.7 |
| Overall | 32.3 | 37.4 | 1193.4 | 62.5 |

1: Distribution of immature fish and small turbots aged $0^+$, $1^+$, $2^+$ and $3^+$

**Evaluation about the landings**

Landing data has shown that turbot fishery generally intensified on the period of March to June when the water temperature increased. This means the reproduction period is overlapping with the main fishing season. It is estimated that 70% of the spawning fish which tend to move towards the shallow waters for spawning are caught in this period. The rest 30% of the stock are utilized during the following 9 months (Figure 4). Turbot fishing in the Black Sea has mainly been carried out by 72% bottom gill nets, 26% trawls net and limited amount as 2% is the bycatch from purse seines.

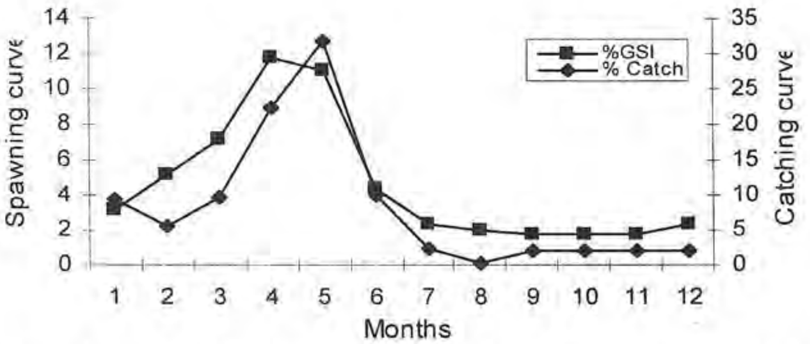



Figure 4. Reproduction and catch curves of *Scopthalmus maeoticus* caught in the eastern Black Sea.

Gill nets are the main gear used in the eastern Black Sea, while in the Central and Western Black Sea bottom trawls are also used. Presumably, one of the main reasons for declining of the turbot stocks is the bottom trawl nets which are used for whiting and red mullet fishery and having no selectivity for turbots due to small mesh size, likely 20 mm at the codend. This impact has been reflected to the productivity of open and closed areas for trawling (Figure 2). Biomass abundance in sub stations between Ordu and Sinop ($6^{th}$, $7^{th}$ and $8^{th}$), which are accessible for trawling, is significantly less than the sub stations between Ordu and Georgian border ($1^{st}$, $2^{nd}$, $3^{rd}$, $4^{th}$ and $5^{th}$), which are for to trawl fishing. Biomass level in the sub stations for combined data for all year is 119.6 kg per square km in the East and 70.6 kg per square km in the West of the region.

As it has been mentioned that the fishing season of the turbot coincides with the spawning period and commercial fishing activities have significant undesirable effect on the spawning stock which is essential for the future. According to the results of the study, since the fishing of the targeted catch is mainly caught in this period, it is also the first step of overfishing and known as recruitment overfishing. It is literally known that the first catch is usually formed by the larger size fish and it causes the decrease in the number of the recruits and when the fishing pressure on larger fish continues, overfishing has an increasing effect (DAHM, 1998).

Condition factor (K) is rather low in pre/post spawning months than the other months. K has a steady state during the whole year in contrary with the females which they spend most of their metabolic energy for the development of the eggs. This affects the meat yield negatively and there is less meat edible (ZENGIN, 2000). Therefore males are more popular than females in the reproduction period and have a better price (up to double) in the market. Heavy fishing activities on females during spawning season will lead loss not only in the sustainable proudcution but also in the fishermen's income.

**Regulations Related Fisheries Management**

MARA (Ministry of Agriculture and Rural Affairs) is the main authority regulating fishery activities in Turkey by endorsing the main Fisheries Law 1380, amending Law

3288 and fishery circulars for technical measures implemented by Conservation and Control Department. There are rules for trawling and turbot itself by means of conservation, control and surveliance issues. Regulations contain size (length) limitations, closed area/season restrictions and fishing gear specifications (Table 6). However, it is hard to say that these regulations are effective and successful in practice, because turbot stocks have not been successfully managed, monitored and protected when it is necessary. On the other hand, one of the major handicaps is the lack of stability in the measures taken by the fisheries administration which are under the strong influence of the political pressures.

Table 6. Management measures for turbot fisheries implemented by Turkish Governments in 1985-2000[1].

| Years | Measures | | |
|---|---|---|---|
| | Size limitations(cm) | Time restrictions | Fishing gear restrictions |
| 1985 | 36 | - | - |
| 1986 | 36 | - | - |
| 1987 | 36 | - | - |
| 1988 | 36 | 1st April-1st June | - |
| 1989 | 36 | 20th April-20th June | all type of fishing gear along the fishing season |
| 1990 | 36 | 1st May-1st July | all type of fishing gear along the fishing season |
| 1991 | 36 | 1st May-1st July | all type of fishing gear along the fishing season |
| 1992 | 40 | 1st May -1st July | all type of fishing gear along the fishing season |
| 1993 | 40 | - | with longline in the whole year |
| 1994 | 40 | - | with longline in the whole year |
| 1995 | 40 | 1st May-1st June | with longline in the whole year |
| 1996 | 40 | 1st April-1st June | with longline in the whole year |
| 1997 | 44 | - | with longline in the whole year |
| 1998 | 44 | - | with longline in the whole year |
| 1999 | 44 | - | with longline in the whole year |
| 2000 | 40 | 15th April-15th May | longline and trammel nets along the fishing season |

1:Fisheries Circulars No:18,20,21,22,23,24,25,26,27,28,29,30/1,31/1,32/1,33/1 and 34/1

Minimum legal catch size was 36 cm until 1991, and then it was raised to 40 cm in the early 1992 and 44 cm in 1997. A measure such as increasing only the minimum size, has not been sufficient and effective; at the same time there is a strong need for additional measures such as fishing gear specifications, mesh size, fishing season and time restrictions. Due to failures on the implementation stage, these measures have not been successful to prevent declining in the stocks.

According to the data on the reproductive biology; size for sexual maturity is 38.8 cm for females and 34.6 cm for males (ZENGIN, 2000). When the universal conservation law is considered, a right to reproduce at least once must be given to each living organisms to grant the future of the generations, minimum catch size for the turbot should be taken as 40 cm. On the other hand, trawl nets used for other fish species can not be selective for the turbots as well as the gill nets meshed 16 to 36 mm, so turbot of all sizes are removed from the sea as an unregulated fishery.

## RESULTS and RECOMMENDATIONS

Comparing the landings and biomass estimations, and reviewing the biological the population data, it is very difficult to advise any management measures to remove the negative impacts of the past in the South-Eastern part of the Black Sea. At this moment it is very urgent to decrease fishing mortality to under the determined level in order to recruit the stocks and establish an optimum level of fishing intensity. In order to establish sustainable exploitation the stocks;

- provide enough recruitment and increase the catch size,
- fishing fleet and effort must be limited, controls and conservation measures should be carried out both in the natural environment and in markets,
- administrative problems needs to be solved,
- market and sales controls must be increased,
- administrative restructuring should be started,
- turbot sites must be closed to all kinds of fishery as a short-term regulation.

Main target should not be sustaining the current state of the stock, but rehabilitation of the stocks at least to the state of the early 1980s is a better target as a first step. Stocks should be restored applying universal fisheries management principles. It is hard to say that the stocks have been diminished solely as as result of fishing (ZENGIN, 2001a). There may be other reasons related with the changes in the ecosystem (IVANOV and BEVERTON, 1985). After the mid 1980s, in addition to the increased fishing pressure, chemical and biological pollution (invaders), eutrification, food competition had caused collapse of some commercial fish species (KIDEYŞ, 1993; BINGEL *et al.*, 1995; GÜCÜ, 1995; ZAITSEV and MAMAEV, 1997). According to ACARA (1985), turbot biomass was 13 thousand tons in the neritic waters of the former Soviet Union in the period of 1950-1960; it decreased to 10 thousand tons in 1970 and 0.8 tons in 1975.

Turkey did not agree with other Black Sea countries to stop turbot fishery for the entire Black Sea for ten years between 1985-1995 (ZUEV, 1991). On the contrary Turkish fishermen have continued fishing in the EEZ of the Black Sea. In recent years, some Turkish fishermen were arrested, wounded or killed by Bulgarian, Romanian, Ukrainian, Russian and Georgian authorities, claim of illegal turbot fishing in the beyond exclusive economic zone in the Black Sea. This fact also shows how important common fishery policies and urgent actions are in the region. Acceptance of the legal and technical measures technical measures by the Turkish fishermen both in Turkey and in fishing grounds of the other Black Sea countries is very important for the recovery and sustainability of the turbot stocks.

Countries, mainly Turkey, should implement and support the policies and legal enforcements established by the national governments, local and international organisations to restore the damaged turbot stocks as soon as possible. Black Sea Environmental Programme (BSEP) has listed the urgent requirements to recover the turbot stocks by international coorperation as follows (ZAITSEV and MAMAEV).

- Turbot fishery should be limited to rehabilate the stocks especially living under severe environmental conditions, production losts,
- Radical administrative decisions are urgently needed for the better management of the turbot stocks in the national waters, primaryly to stop fishing turbot with gill net and trawl nets completely in the national fishing grounds,
- Implementing and supporting of the common agreements signed by the Black Sea Countries to manage the turbot stocks effectively, a special care should be given to support the local fishermen in the areas fully closed to fishing especially to protect young turbots.

On the other hand, General Fisheries Council for the Mediterranean (GFCM) had reported that both environmental impacts and all the demersal fishery resources including turbot stocks, mainly spawning and the nursery grounds are under the great threat and need urgent conservation meausures (FAO, 1999). It may be good for Turkey to implement general rules to protect fishery resources when waiting in the front door of European Union as a candidate of accession membership without losing time anymore.

A number of attemps done on local or regional scales should be encouraged. For instance, studies carried out on "Turbot Stock Development Programme" had been started in 1999 are the first positive steps by the MARA Central Fisheries Research Institute. Results of this study will play a vital role to enhance and support turbot stocks in future. More information is needed for the transplantation. First results have shown that outputs of the first step studies need to be supported with the parameters related with the turbot fishery management issues and will be meaningful after creating the essential norms. It can only be decided on the specific management rules as extent of increment in natural stocks, the time needed to reach this level, the quantity of maximum sustainable yield, etc.

Developed countries as Norway and Japan would be the model for the basis of turbot fishery management strategies. Fishermen should be enforced to understand that they are the owners of the main resource and sustainability and the application of responsible fishing principles are the most essentials of the modern fisheries concept (HANNESSON, 1996; KNUDSEN, 1977). This strategy needs regional administrative planning and each of the regions should have the authority to take specific decisions. In the regional fishereies model, each of the licensed fishermen operates in his own area which is allocated for the use of fishery associations, and an autocontrol system has been applied by the fishermen and the union of fishermen (INADA, 1993).

On the other hand there is a strong need to design a specific fishing method and gear as for the population specifications of the species. Turbots live at the bottom embedding into the sand layer out of the reproduction period mainly in fall and winter seasons. Feeding activities are very limited and low at this stage (ZENGIN, 2000). Therefore, it is quite difficult to catch turbots during the late fall and winter period using passive (trammel nets) and active (trawl) nets. On the other hand, mature turbots swimming together towards the shallow waters are more exposed to the gill nets set parallel to the coastline during the spawning migration in the period from April to June. Management strategies implemented to the similar species, which are caught only during the spawning period, might be applied also for the Black Sea turbot population. In this system, quotas are determined based on stock assessment studies on the spawning stock swimming towards the coast and total allowable catch. The typical example is the *Arctoscopus japonicus* living in the Japan Sea, on the North-East of Japan, which only migrates to the coastal waters for spawning and harvested also in this period. There is a regular monitoring and stock assessment research on this fish by the collaboration of fisheries cooperatives and a research institute. A monitoring group which the members are composed of these two institutions permits to catch maximum 25% of the stock with the minimum catch size of 13 cm in the reproduction period for only fifteen days (November-December) (MASUDA *et al.*, 1984; ZENGIN, 2001b).

Turbots are very important fish among the other groundfish species for the commercial fishery of Turkey in terms of both economic value and meat quality. Conservation of the stocks and a good management strategy will raise the outputs provided from the turbot fishery to the national economy and food quality of the society. It is also very important for protecting the biodiversity for the sustainability of the nature.

## REFFERENCES

ACARA, A. 1985. The Black Sea Turbot, State Planning Organisation, Ankara, Turkey, 19 p.

AVŞAR, D. 1998. Balıkçılık Biyolojsi ve Populasyon Dinamiği, Çukurova Ün. Su Ürünleri Fak., Adana, No: 5/20, 303 s.

BINGEL, F. 1985. Balık Populasyonlarının İncelenmesi, İstanbul Ün. Su Ürünleri Yüksek Okulu, Sapanca Balık Üretme ve Islah Merkezi, N: 10, 133 s.

BINGEL, F., GÜCÜ, A.C., STEPNOWSKI, A., NIERMANN, U., MUTLU, E., AVŞAR, D., KIDEYŞ, A.E., UYSAL, Z., İŞMEN, A, GENÇ, Y., OKUR, H., ZENGIN, M. 1995. Stock Assessment Studies for the Turkish Black Sea Coast, METU Institute of Marine Sciences Erdemli and Fisheries Research Institute Trabzon, TÜBİTAK, Final Report, 159 p.

CHUGUNOVA, N.I. 1963. Age and Growth Studies in Fish. National Science Foundation, Washington D.C., 132 p.

DAHM, E. 1988. Ekolojik Balıkçılığı Geliştirme Projesi, Eğitim Semineri, 9-10 Aralık 1998, Ege Ün. Su Ürünleri Fak., Avcılık Bölümü, Bornova, İzmir.

DİE. 1999. tc Başbakanlık Devlat İstatistik Enstitüsü 1998 Yılı Su Ürünleri İstatistikleri, No. 2154, 4-7.

EFIMOV, Y.N., REVINA, N.I., SHLYAKHOV, V.A., VINARIK, T.V. 1989. The State of the Black Sea Turbot Stock, Zemskaya, K.A. ed. Monlova, USSR Uniro, 163-174 (İn Russian).

FAO. 1999. General Fisheries Conmmision for Mediterranean, ScientificAdvisory Committee, Draft Report, FAO, 7-10 June 1999, Rome, Italy, 22 p.

GENÇ, Y., MUTLU, C., ZENGIN, M., AYDIN, İ., ZENGIN, B., TABAK, İ. 2002. Doğu Karadeniz'deki Av Gücünün Demersal Balık Stokları Üzerine Etkisinin Tesbiti, Tarım Köyişleri Bakanlığı, TAGEM, Trabzon Su Ürünleri Merkez Araştırma Enstitüsü, Sonuç Raporu, Proje No: TAGEM/IY/97/17/03/006, ss: 114.

GULLAND, J.A. 1975. Manuel of Methods for Fisheries Resource Survey and Appraisal, FAO Fish. Tech. Pap., 145, 1-29.

GÜCÜ., A.C. 1995. Role Played by Fishing on theBlack Sea Ecosystem, Sensitive to Change; Black Sea, Baltic Sea and North Sea, Ed. By Emin Özsoy and Alexander Mikaelyen, NATO ASI Series 2, Ebviromental Vol. 27, 149-162.

HANNESSON, R. 1996. Fisheries Mismanagament: The Case of the North Atlantic cod, Fishing News Books, The Norwegian School of Economics and Business Adminstration, 155 p., Bergen.

HOLDEN, M. J., RAITT, D.F.S. 1974. Manuel of Fisheries Science, Part 2, Methods of Resource Investigation and their Application, FAO Tech. Pap. 115, Rev. 1, 214 p.

INADA, T. 1993. Final Report of Fisheries Resources Survey in Republic of Turkey, JICA Draft, İzmir.

IVANOV, L., BEVERTON, R.J.H. 1985. The Fisheries Resources of the Mediterranen, Part II, Black Sea Etud. Rev., GFCM, 60, 135 p.

KARPETKOVA, M. 1980. Distribution and Migration of Turbot Along the Bulgarian Coast of Black Sea, Bulletin de L'Institut de Zoologie et Musee, Tome XVI (İn Bulgarian).

KIDEYŞ, A.E. 1994. Recent Dramatic Changes in the Black Sea Ecosystem; The Reason for the Sharp Decline in Turkish Anchovy Fisheries, Journal of Marine System, (5), 171-181.

KNUDSEN, S. 1997. A Comparative Study of Fishing Communities and Public Awareness in Turkey and Ukrainian, Fnal Report, BSEP GEF, Istanbul.

KUTAYGIL, N., BILECIK, N. 1979. Observations Sur Le Turbot qui est Peche Sur Le Littoral Anatolien de La Mer Noire, Rapp. Comm. Int. Mer Medit. Monaco, Vol. 25/26, Fas. 10.

MASUDA, H., AMAOIKA, K., ARAGA, C., UYENO, T., YASHINO, T. 1984. The Fisheries oj Japanese Archipalago, 437p.

PAULY, D., A. Selection of Simple Methods for Assessment of Tropical Fish Stocks, FAO Fish. Circ. No. 729, 54 p.

POPOVA, V.P. 1967. Methods of Evaluation of the State of the Turbot Stocks in the Black Sea, Tr. Uses. Naucho, Issled Inst. Morzk. Rybn. Khoz. Okeanogr., 62, 197-204 (İn Russian).

PRADANOV, K., MIKHAILOV, K., DASKALOV, G., MAXIM, C., CHASHCHIN, A., Arkhipov, A., SHLYAKHOV, V., ÖZDAMAR, E. 1997. Environmental Management of Fish Resources in the Black Sea and Their Rational Exploitation, Studies and Reviews, GFCM, FAO, Rome, No: 68, 178 p.

RICKER, W.E. 1975. Computation and Interpretation of Biological Statistics of Fish Populations, Bull. Fish. Res., Board. Can., 191, 382 p.

SLASTENENKO, E. 1956. Karadeniz Havzası Balıkları, Rusça'dan çeviren; Atlan, H.E., EBK Umum Müdürlüğü, İstanbul, 711 s.
SPARRE, P., URSIN, E., VENEMA, S.C. 1989. Introduction to Tropical Fish Stock Assessment, Part I Manual, FAO Fish. Tech. Pap. No. 306/1, Rev.Rome, 376 p.
SPARRE, P., VENEMA, S.C. 1992. Introduction to Tropical Fish Stocks Assessment, Part I, FAO Fish. Tech. Pap. No: 306/1, Rev. 1, Rome, 376 pp.
WILLIAMS, T., BEDFORD, B.C. 1974. The Use of the Otholits for Age Determination, In Ageing of Fish Proceedings of on International Symposium Organised by the European Inland Fisheries Advisory Commission of FAO, Fisheries Society of the British Ises and the Freshwater Biological Association at the University of Reading (Ed. T.B. Bagenal), 114-123.
ZAITSEV, Y., MAMAEV, U. 1997. Biological Diversity in the Black Sea, A Study of Changead Decline. GEF Black Sea Enviromental Programme, Istanbul, VOL. 3, 208 p.
ZENGIN, M. 1998. Coastal Fisheries in Black Sea; Present State, Problems and Suggestions, Ege Ün. Su Ürünleri Fak., Su Ürünleri Dergisi, V. 15, No. 1-2, 33-47.
ZENGIN, M., DÜZGÜNEŞ, E., GENÇ, Y. 1988. Evaluation of Data From Market Samples on the Commercial Fish Species in the Black Sea During 1990-1995, Proceedings. First International Symposium on Fisheries and Ecology, 2-4 Sept. 1998, Trabzon, Turkey (Editors; Çelikkale, M.S., Düzgüneş, E., Okumuş, İ., Mutlu, C.), 91-99 pp.
ZENGIN, M., DÜZGÜNEŞ, E. 2000. Distribution and Abundance of Flatfish on the Suthern Eastern (Trabzon) Black Sea, Bildiriler, 1. Ulusal Deniz Bilimleri Konferansı, 30 Mayıs-2 Haziran 2000, TÜBİTAK-ODTÜ Erdemli Deniz Bilimleri Enstitüsü, Ankara165-170.
ZENGIN, M. 2000. Türkiye'nin Doğu Karadeniz Kıyılarındaki Kalkan (*Scopthalmus maeoticus*) Balığının Biyoekolojik Özellikleri ve Populasyon Parametreleri, Doktora Tezi, KTÜ Fen Bilimleri Enstitüsü, Balıkçılık Teknolojisi Mühendisliği Anabilim Dalı, 225 s.
ZENGIN, M. 2001a. Doğu Karadeniz'deki Balıkçılık Kaynaklarının Son Durumu ve Balık Stoklarının Yönetimine İlişkin Öneriler, IV. Ulusal Ekoloji ve Çevre Kongresi, 5-8 Ekim 2001, (Ed., Gündüz. C., Buhan, E., Şenol, T.) Bodrum, 249-264 s.
ZENGIN, M. 2001b. Japonya'daki Balıkçılık Yönetim Modeli ve Bu Modeli Oluşturan Değerler, Yunus Dergisi, SMAE Yayını, Trabzon, Yay. No.1,11-12 s.
ZUEV, G.V. 1991. On the Question for Investigations of Black Sea Turbot, The Black Sea Symposium, 16-18 Sept., İstanbul, Published by the Black Sea Foundation, 183-188.

# THE WHITING ( *Merlangius merlangus euxinus L.* ) IN THE TURKISH BLACK SEA COAST

Ali İŞMEN
Faculty of Fisheries, Çanakkale Onsekiz Mart University
P.O. Box:56, 17100 Çanakkale - Turkey.

## ABSTRACT

In this study, the state of whiting fisheries in the Turkish Black Sea Coast is evaluated. The study provides information concerning length composition and age, growth, length-weight relationship, reproduction and biomass in the Turkish Black Sea Coast as a contribution to the management of fishery exploiting those stocks in the Black Sea.

## INTRODUCTION

Turkey has access to fish resources of both the Black Sea and Mediterranean Sea because of its favourable geographic position. The report of FAO fishery statistic indicated that fisheries production of Turkey in the year 2000 was about 582,376 tons, which is among the first 32 countries of the world (GFCM, 2003). The State Institute of Statistics Republic of Turkey states that the production of the marine capture fisheries was about 465,180 tons in the year 2001. The Black Sea dominates the marine capture fisheries and has accounted for 74 percent of the total.

Total fish production of Turkey was about 120,000 tons in the years between the 1950s - 1960s. It fluctuated around the same level until 1975 (DÜZGÜNEŞ and KARAÇAM, 1989). In the 1980s, considerable development was observed in the fisheries industry of Turkey. The production increased 676,004 tons in 1988. The introduction of more efficient and advanced techniques of captures fisheries led to increase in total fish production (Fig. 1).

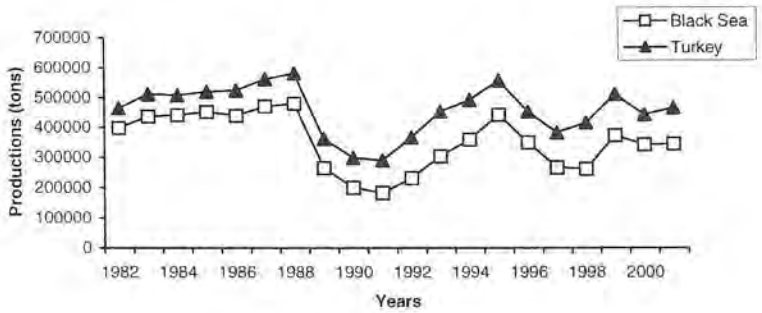



Fig.1. Total fish productions of Turkey and the Turkish Black Sea, 1982-2000.

Capture fisheries of Turkey can be categorized to two main groups as inshore fishery and coastal fishery (ÜNAL and ÖZEKİNCİ, 1999). Inshore fishery is a small-scale fishery, which provides about 10%, or less of the total catch in Turkey. However, fishing boats operating in inshore fishery are usually between 5-10 meters in length and 10-70 horsepower and make up over 80 % of total boats. The large capacity fishing boats are 18-32 meters purse seiners and 15-27 meters trawlers. Engine power in purse seiners and trawlers varies from 250 to 850 and 150 to 500 horsepower, respectively. According to 2001 statistics, there are a total of 12989 fishing boats in Turkey, 37% of them in the Black Sea (Fig. 2).

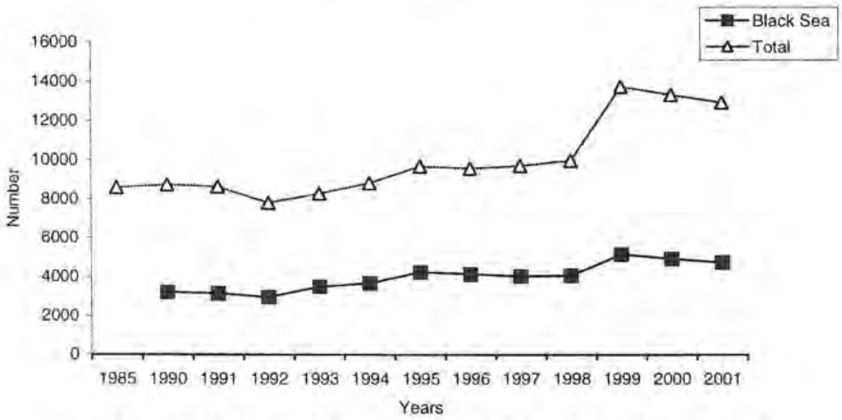



Fig.2. Number of fishery vessels of Turkey and the Turkish Black Sea in the years between 1985-2001.

The main fish species caught by the inshore and coastal fishing vessels in the Black Sea are European anchovy (*Engraulis encrasicholus*), horse mackerel (*Trachurus mediterraean*), whiting (*Merlangius merlangus euxinus*), red mullet (*Mullus barbatus*), Turbot (*Psetta maxima*), Atlantic bonito (*Sarda sarda*), grey mullet ( *Mugil caplatus*), Blue fish (*Pomatomus saltator*) (Table 1).

Table 1. Top ten species of fish according to their catch (tons) (DIE, 2001).

| Species | Total | Eastern Black Sea | Western Black Sea |
|---|---|---|---|
| Anchovy | 288613 | 201946 | 86667 |
| Horse mackerel | 16750 | 5067 | 11683 |
| Atlantic bonito | 8237 | 2905 | 5332 |
| Whiting | 7781 | 4849 | 2932 |
| Blue fish | 7307 | 541 | 6766 |
| Grey mullet | 6705 | 4202 | 2503 |
| Turbot | 2323 | 154 | 2169 |
| Red mullet | 1110 | 708 | 402 |
| Picarel | 540 | 102 | 438 |
| Striped red mullet | 388 | 11 | 377 |

Small pelagic fish make up the bulk of the catch with anchovy and horse mackerel. Whiting is the major commercial demersal species caught in the Black Sea. This species followed by red mullet and turbot (Table 1). Whiting is mainly caught with trawl and gillnets during autumn and winter. The whiting annual catch exceeded 31000 tons in 1988 in the Black Sea. After 1988, the annual nominal catches of whiting have been reduced considerably, and in 2001, the whiting landings were only 7781 tons (Fig. 3).

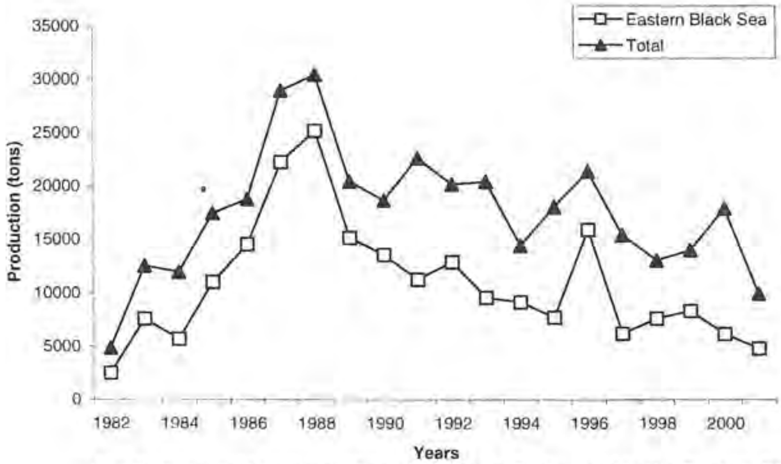


Fig. 3. Total capture production of whiting in Turkey and in the Eastern Black Sea, 1982-2001.

## Length distribution

The length distribution of the whiting caught from trawl survey during 1990-1993 are illustrated in Figure 4. The range was smaller for males, from 5 to 29 cm than that of females. Overall mean total length of females (13,9 cm) was bigger than males (12,3 cm) (İŞMEN, 1995). The length composition are available of the whiting landings between Sinop and Hopa (Eastern Black Sea) for 1998-2000 (GENÇ *et al.*, 2002). Length distributions of the fish caught using different nets exhibited significant differences. Length of specimen taken from gillnets with mesh sizes of 18, 20, 22 mm were greater (8,5-28,5 cm) those sampled from trawl with legal mesh size of 20 mm (7,0-22,5 cm). Mean length of whiting was 17,4 and 14,4 cm for gillnet and trawl samples, respectively.

## Sex composition

The studies made in the Black Sea between 1990 and 2000 show that females are dominant in the samples, and male to female ratio in the population is about (1) 40% : (1,2) 60%. Sex ratio is around 1:1 during early ages of whiting, but female ratio increaes in older ages (İŞMEN, 1995; GENÇ *et al.*, 2002).

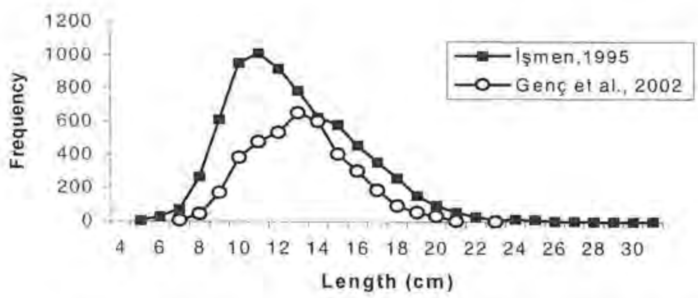



Fig. 4. Length frequency distribution of whiting for research vessel data-1990-1993 (İŞMEN, 1995) and landing data-2000 (GENÇ *et al.*, 2002)

**Age composition**

The age composition of the population is characterized by a predominance of age groups I-IV (IVANOV and BEVERTON, 1985; DPT-DEU, 1986; UYSAL 1994; İŞMEN, 1995). IVANOV and BEVERTON (1985) reported that six or seven age groups were observed in the catches made in the west and northwest Black Sea where I-IV year old fish were predominant. DPT-DEU (1986) stated that the catches made between Sinop-Ünye (eastern Black Sea) consisted of four age groups and that age group II was predominant. UYSAL (1994) mentioned that the samples taken between Sinop and Sarp comprised VIII age gropus with a predominance of age groups I-IV. İŞMEN (1995) reported that the maximum age group determined was IX for females and VI for males. The greater portion of the sample is composed by the age groups I-III. The decrease in the percentage occurrence of older ages may be due to fishing pressure.The young individuals of age group 0 were absent in the samples because of mesh selection by the nets used, as well as the habitat selection by fish of different ages. The larger and older individuals live at greater depths (IVANOV and BEVERTON, 1985). The whiting revert to bottom-dwelling in their first summer months when they change their habits from pelagic to demersal (İŞMEN, 1995).

Length-weight relationship

The length-weight relationships have been calculated using the commercial catch sampling and research vessel data. The functional regression *b* values were found to be greater than 3. the Black Sea whiting shows a positive allometric growth (Table 2).

Table 2. The length-weight relationship constants given by different studies

| | Prodanov (1980) | Bingel *et al.* (1995) | İşmen (1995) | Çiloğlu (1997) | Genç *et al.* (1998) | Genç *et al.* (2002) |
|---|---|---|---|---|---|---|
| a | 0.0054 | 0,0056 | 0,0042 | 0,0038 | 0,0052 | 0,0058 |
| B | 3.07 | 3,10 | | 3,24 | 3,14 | 3,24 |

Certain seasonal changes in the condition of whiting occurred in the montly seasonal samples. İŞMEN (2002) stated that the smallest condition for both sexes coincides with the intensive spawning period in January and February, during their least feeding period. According to İŞMEN and BİNGEL (2000), their empty stomach ratio ranged from 18% to 44% througout the year. In the winter months (especially February), the empty stomach rate increased to a maximum (44%). Therefore, it is clear that the feeding intensity was at its lowest level and the condition of fish reached the lowest value in this intensive spawning period. In fact, these authors showed that in November and December, when the significant differences were found compared to March, the stomachs were mostly full in November and December and the gonad development increased sharply to a maximum in January. GENÇ *et al.* (1998, 2002) reported that the condition of the whiting was smallest in winter.

**Growth in the length**

The parameters of von Bertalanffy growth equation calculated for the Black Sea whiting using all data are given in Table 3. No differences were observed between the growth curves.

Table 3. Von Bertalanffy growth constants of the Black Sea whiting (m:male, f: female).

| Author | Region | $L_\infty$ | K | $t_0$ (year) | Ø' | Year |
|---|---|---|---|---|---|---|
| Prodanov (1980) | Bulgarian coast | 31,8 | 0,13 | -2,82 | 4,88 | 1976-78 |
| Uysal (1994) | Sinop-Giresun(m) | 41,8 | 0,14 | -2,16 | 5,50 | 1988-89 |
| | Sinop-Giresun(f) | 49,1 | 0,11 | -1,24 | 5,57 | |
| Bingel *et al.* (1995) | Turkish coast | 33,6 | 0,30 | -0,54 | 5,83 | 1991-92 |
| İşmen (1995) | Turkish coast | 39,1 | 0,15 | -1,05 | 5,44 | 1992-93 |
| Çiloğlu (1997) | Eastern T. Black Sea | 38,4 | 0,14 | -1,83 | 5,30 | 1996 |
| Genç *et al.* (1998) | Eastern T. Black Sea | 43,7 | 0,10 | -1,96 | 5,28 | 1998 |
| Genç *et al.* (2002) | Eastern T. Black Sea | 39,5 | 0,12 | -2,21 | 5,27 | 2000 |

Table 4. Mean lengths of the Black Sea whiting (total length in cm) for each age group.

| Age groups (years) Length(cm) | I | II | III | IV | V | VI | VII | VIII | IX |
|---|---|---|---|---|---|---|---|---|---|
| **Soviet coast** | | | | | | | | | |
| Burdak (1964) | 11,2 | 14,9 | 17,2 | 19,3 | 21,0 | 22,0 | - | - | - |
| female- male | 10,6 | 13,2 | 15,4 | 17,0 | - | - | - | - | - |
| **Bulgarian coast** | | | | | | | | | |
| Prodanov (1980) | 12,8 | 15,2 | 17,2 | 19,0 | 20,8 | 22,0 | - | - | - |
| **Turkish Coast** | | | | | | | | | |
| DBT-DBTE (1986) | 14,2 | 19,2 | 23,0 | 28,7 | - | - | - | - | - |
| Uysal (1994) | 12,0 | 15,2 | 18,1 | 21,1 | 24,3 | 26,5 | 28,5 | 31,6 | |
| Işmen (1995) | 10,4 | 14,4 | 17,8 | 20,8 | 23,3 | 25,5 | 27,4 | 29,1 | 30,4 |
| Genç *et al.* (2002) | 12,2 | 15,1 | 17,8 | 20,2 | 22,3 | 24,1 | 25,8 | 27,3 | 28,6 |

The available data suggest that growth is rapid during the first year of life, and the mean length at the end of the year is between 10 and 14 cm (Table 4). Growth rate over subsequent years becomes less rapid. The male fish grow less than that of the females after the second year, and the disparity in the mean length of the male and female fish at each age group increases with increasing age (İŞMEN, 1995). The differences between the mean length of males and females after the second year may possibly be due to difference in the age of sexual maturity. İŞMEN and BİNGEL (1994) showed that the whiting generally attains sexual maturity at age II, and there is a difference between sexes for length at first maturity (males at 12,5 cm length or at the end of their first year; females at 14,5 cm length or at the end of their second year).

### Mortality

The total (Z), natural (M) and fishing mortality rates (F) on an annual basis for the whiting were calculated by PRADANOV (1980), İŞMEN (2002), GENÇ *et al.* (2002). PRADANOV (1980) showed that natural mortality rate was about 0,4-0,5. İŞMEN (2002) stated that the total mortality coefficients fluctuated between 1,29 and 2,18 with a mean value of 1,63 for all years. The values of natural mortality in 1990, 1991 and 1992 were 0,43, 0,38 and 0,36, respectively while fishing rates were found as 1,74, 1,05 and 0,93, respectively. GENÇ *et al.* (2002) reported that total mortality were 0,86, while the estimated values of natural mortality were 0,25. Fishing rate was found as 0,71.

The exploitation rates (E) calculated as 0,71-0,86 in 1990-2000 indicated that the whiting stock is highly over-exploited. The over-exploitation of the whiting stock can be explained by an increase in fishing effort concentrated on demersal fishes after the decrease in pelagic stocks(especially the collapse of the anchovy in 1988).

While the number of the trawl fleets in the Black Sea increased considerably (from 94 in 1988 to 273 in 1992), the whiting catches decreased from 30,000 tons to 18,000 tons (more evident in catch per unit of effort). The fishing pressure also continued with an increasing trend between 1992 and 2001. The number of the trawl attained 286 in 2001 and the whiting catch decreased to 7781 tons.

**Biomass**

The total trawlable biomass in each depth range and local areas during four successive periods were estimated by İŞMEN (1995). The highest trawlable biomass was found in the region between Çaltı Cape and Sarp (eastern Black Sea) which is an area closed to trawl fishing. The trawlable biomass between İğneada and Sinop (western Black Sea) in April 1990 and September 1990 were found to be 1117 and 1764 tones. In September 1991 and October 1992, the trawlable biomass between Sinop and Sarp were found as 19233 and 30188 tones.

**Yield analysis**

Application of yield per recruit analysis implied that the minimum allowable length of whiting with in the existing fishing intensity (F=1,24) should be over 17,5 cm (İŞMEN, 1995). However, females attained sexual maturity at age 2, 14,5 cm length. A decrease in fishing intensity or the enforcement of a minimum allowable total length is necessary to allow optimum exploitation of the whiting stock at present. Fishing intensity may be reduced either by increasing the mesh size or by decreasing fishing operations in the region. Commercial fishing selectivity parameters of trawl and gillnet were estimated for whiting (GENÇ *et al.*, 2002). Selectivity of gillnet for whiting was calculated using 18, 20 and 22 mm mesh sizes and $L_{50}$ values found as 15,1, 16,8 and 18,5 cm, respectively. $L_{50}$ for trawl with legal mesh size of 20 mm was calculated as 13,5 cm for whiting. The sexual maturity length of whiting (14,5 cm) is over 13,5 cm. GENÇ *et al.* (2002) evaluated the effects of whiting fishing on stock using length based cohort analysis and Thompson and Bell analysis during 2000 and found that catch effort at present is over maximum sustainable yield (MSY). Therefore, trawl nets with 22 mm mesh size should be used for optimum exploitation. It is also necessary to modernize trawl equipment, close the fishing grounds periodically and limit for the licenses small fishing boats.

**REFERENCES**

BİNGEL, F., GÜCÜ, A.C., STEPNOWSKI, A., BEKİROĞLU,Y., NIERMANN, U., KIDEYŞ, A.E., MUTLU, E., DOĞAN, M, KAYIKÇI, Y., AVŞAR, D., UYSAL, Z., İŞMEN, A., GENÇ, Y., OKUR, H., ZENGİN, M. 1995. Stock Assessment Studies for the Turkish Black Sea Coast.NATO-TU FISHERIES FINAL REPORT.METU-D.B.E., Erdemli.108 p.,

BURDAK, V. D. 1964.Biology of the whiting (*Odontogadus merlangus euxinus*) of the Black Sea. Tr. Sevastop. Biol. Stn., 15:196-278 p.

ÇİLOĞLU, E. 1997. Trabzon'un doğu sahillerinde mezgit (*Merlangius merlangus euxinus*) balığının vertikal dağılımı ve populasyon parametreleri. İ.Ü. fen Bilimleri Ens. Yük.Lisans Tezi.İstanbul.

DIE. 1982-2001. 1982-2001 yılı su ürünleri İstatistikleri, Başbakanlık Devlet İstatistik Enstitüsü, Ankara.

DBT-DBE. 1986.Orta Karadeniz (Sinop-Ünye) Trol Sahalarının Hidrografisi ve Verimliliği. Birinci Dönem Araştırmaları, Dokuz Eylül Üni., Deniz Bil. Tekno. Enst., İzmir, 50 p.

DÜZGÜNEŞ, E., KARAÇAM, H. 1989. Doğu Karadenizdeki mezgit (*Merlangius merlangus euxinus*) balıklarında bazı populasyon parametreleri, et verimi ve biyokimyasal kompozisyon.TÜBİTAK , Doğa Zoology Dergisi. No:14, 345-352 s.

GENÇ,Y., ZENGİN, M., BAŞAR, S., TABAK, İ., CEYLAN, B., ÇİFTÇİ, Y., ÜSTÜNDAĞ, C., AKBULUT, B., ŞAHİN, T. 2002. Ekonomik deniz ürünleri araştırma projesi. Proje no: TAGEM/IY/96/17/3/001. S.Ü. Merkez Araştırma Ensititisü, Trabzon.

GENÇ,Y., MUTLU, C., ZENGİN, M., AYDIN, İ., ZENGİN, B., TABAK, İ. 2002. Doğu Karardenizdeki av gücünün demersal balık stokları üzerine etkisinin tespiti. Sonuç Raporu. S.Ü. Merkez Araştırma Ensititisü, Trabzon, 114 s.

GFCM. 2003. Statistical Bulletin, Nominal catches 2000. FAO Bull. of Fishery Statistics, Rome.

IVANOV, L., BEVERTON, R. J. H. 1985. The fisheries resources of the Mediterranean. Part two:Black Sea. Etud. Rev. CGPM/Stud. Rev. CFCM. 60 : 1-135.

İŞMEN, A., BİNGEL, F. 1994. A preliminary study on reproductive biology of whiting, *Merlangius merlangus euxinus*, in the eastern Black Sea coast of Turkey. National Biology Congress, Edirne, 71-78pp.

İŞMEN, A. 1995. The biology and population parameters of the whiting (*merlangius merlangus euxinus*) in thw Turkish coast of the Black Sea. Ph. D. Thesis. METU.Institute of Marine Sciences, İçel.

İŞMEN, A., BİNGEL, F. 2000. Stomach contents of whiting, *Merlangius merlangus euxinus*, and estimation of food consumption. I. National Marine Science Conference. METU, Institute of Marine Sciences, Ankara. 177-182p.

İŞMEN, A. 2002. A preliminary study on the population dynamics parameters of whiting (*Merlangius merlangus euxinus*) in the Turkish Black Sea coastal waters. Turk.J.Zool. 26: 157-166 p.

PRODANOV, K. 1980. Preliminary data on the growth and age of the whiting (*Odontogadus merlangus euxinus* ) along the Bulgarian coast of the Black Sea. Izv. Inst. Rybn. Resur., Varna, 18:35-44p.

UYSAL, A. 1994. Doğu Karadeniz (Sinop-Hopa) Bölgesi Mezgit Balıklarının, *Merlangius merlangus euxinus* Biyolojisi ve Populasyon Dinamiği. Bülten. 9:145-173p.

ÜNAL, V., ÖZEKİNCİ, U. 1999. The State of Turkish Fisheries Towards 2000 Years. Su Ürünleri Dergisi. İzmir. No:16,sayı1-2, 219-227 p.

While the number of the trawl fleets in the Black Sea increased considerably (from 94 in 1988 to 273 in 1992), the whiting catches decreased from 30,000 tons to 18,000 tons (more evident in catch per unit of effort). The fishing pressure also continued with an increasing trend between 1992 and 2001. The number of the trawl attained 286 in 2001 and the whiting catch decreased to 7781 tons.

**Biomass**

The total trawlable biomass in each depth range and local areas during four successive periods were estimated by İŞMEN (1995). The highest trawlable biomass was found in the region between Çaltı Cape and Sarp (eastern Black Sea) which is an area closed to trawl fishing. The trawlable biomass between İğneada and Sinop (western Black Sea) in April 1990 and September 1990 were found to be 1117 and 1764 tones. In September 1991 and October 1992, the trawlable biomass between Sinop and Sarp were found as 19233 and 30188 tones.

**Yield analysis**

Application of yield per recruit analysis implied that the minimum allowable length of whiting with in the existing fishing intensity (F=1,24) should be over 17,5 cm (İŞMEN, 1995). However, females attained sexual maturity at age 2, 14,5 cm length. A decrease in fishing intensity or the enforcement of a minimum allowable total length is necessary to allow optimum exploitation of the whiting stock at present. Fishing intensity may be reduced either by increasing the mesh size or by decreasing fishing operations in the region. Commercial fishing selectivity parameters of trawl and gillnet were estimated for whiting (GENÇ *et al.*, 2002). Selectivity of gillnet for whiting was calculated using 18, 20 and 22 mm mesh sizes and $L_{50}$ values found as 15,1, 16,8 and 18,5 cm, respectively. $L_{50}$ for trawl with legal mesh size of 20 mm was calculated as 13,5 cm for whiting. The sexual maturity length of whiting (14,5 cm) is over 13,5 cm. GENÇ *et al.* (2002) evaluated the effects of whiting fishing on stock using length based cohort analysis and Thompson and Bell analysis during 2000 and found that catch effort at present is over maximum sustainable yield (MSY). Therefore, trawl nets with 22 mm mesh size should be used for optimum exploitation. It is also necessary to modernize trawl equipment, close the fishing grounds periodically and limit for the licenses small fishing boats.

## REFERENCES

BİNGEL, F., GÜCÜ, A.C., STEPNOWSKI, A., BEKİROĞLU,Y., NIERMANN, U., KIDEYŞ, A.E., MUTLU, E., DOĞAN, M, KAYIKÇI, Y., AVŞAR, D., UYSAL, Z., İŞMEN, A., GENÇ, Y., OKUR, H., ZENGİN, M. 1995. Stock Assessment Studies for the Turkish Black Sea Coast.NATO-TU FISHERIES FINAL REPORT.METU-D.B.E., Erdemli.108 p.,

BURDAK, V. D. 1964.Biology of the whiting (*Odontogadus merlangus euxinus*) of the Black Sea. Tr. Sevastop. Biol. Stn., 15:196-278 p.

ÇİLOĞLU, E. 1997. Trabzon'un doğu sahillerinde mezgit (*Merlangius merlangus euxinus*) balığının vertikal dağılımı ve populasyon parametreleri. İ.Ü. fen Bilimleri Ens. Yük.Lisans Tezi.İstanbul.

DIE. 1982-2001. 1982-2001 yılı su ürünleri İstatistikleri, Başbakanlık Devlet İstatistik Enstitüsü, Ankara.

DBT-DBE. 1986.Orta Karadeniz (Sinop-Ünye) Trol Sahalarının Hidrografisi ve Verimliliği. Birinci Dönem Araştırmaları, Dokuz Eylül Üni., Deniz Bil. Tekno. Enst., İzmir, 50 p.

DÜZGÜNEŞ, E., KARAÇAM, H. 1989. Doğu Karadenizdeki mezgit (*Merlangius merlangus euxinus*) balıklarında bazı populasyon parametreleri, et verimi ve biyokimyasal kompozisyon.TÜBİTAK , Doğa Zoology Dergisi. No:14, 345-352 s.

GENÇ,Y., ZENGİN, M., BAŞAR, S., TABAK, İ., CEYLAN, B., ÇİFTÇİ, Y., ÜSTÜNDAĞ, C., AKBULUT, B., ŞAHİN, T. 2002. Ekonomik deniz ürünleri araştırma projesi. Proje no: TAGEM/IY/96/17/3/001. S.Ü. Merkez Araştırma Ensititisü, Trabzon.

GENÇ,Y., MUTLU, C., ZENGİN, M., AYDIN, İ., ZENGİN, B., TABAK, İ. 2002. Doğu Karardenizdeki av gücünün demersal balık stokları üzerine etkisinin tespiti. Sonuç Raporu. S.Ü. Merkez Araştırma Ensititisü, Trabzon. 114 s.

GFCM. 2003. Statistical Bulletin, Nominal catches 2000. FAO Bull. of Fishery Statistics, Rome.

IVANOV, L., BEVERTON, R. J. H. 1985. The fisheries resources of the Mediterranean. Part two:Black Sea. Etud. Rev. CGPM/Stud. Rev. CFCM. 60 : 1-135.

İŞMEN, A., BİNGEL, F. 1994. A preliminary study on reproductive biology of whiting, *Merlangius merlangus euxinus*, in the eastern Black Sea coast of Turkey. National Biology Congress, Edirne, 71-78pp.

İŞMEN, A. 1995. The biology and population parameters of the whiting (*merlangius merlangus euxinus*) in thw Turkish coast of the Black Sea. Ph. D. Thesis. METU.Institute of Marine Sciences, İçel.

İŞMEN, A., BİNGEL, F. 2000. Stomach contents of whiting, *Merlangius merlangus euxinus*, and estimation of food consumption. I. National Marine Science Conference. METU, Institute of Marine Sciences, Ankara. 177-182p.

İŞMEN, A. 2002. A preliminary study on the population dynamics parameters of whiting (*Merlangius merlangus euxinus*) in the Turkish Black Sea coastal waters. Turk.J.Zool. 26: 157-166 p.

PRODANOV, K. 1980. Preliminary data on the growth and age of the whiting (*Odontogadus merlangus euxinus* ) along the Bulgarian coast of the Black Sea. Izv. Inst. Rybn. Resur., Varna, 18:35-44p.

UYSAL, A. 1994. Doğu Karadeniz (Sinop-Hopa) Bölgesi Mezgit Balıklarının, *Merlangius merlangus euxinus* Biyolojisi ve Populasyon Dinamiği. Bülten. 9:145-173p.

ÜNAL, V., ÖZEKİNCİ, U. 1999. The State of Turkish Fisheries Towards 2000 Years. Su Ürünleri Dergisi. İzmir. No:16,sayı1-2, 219-227 p.

# POSSIBILITIES FOR APPLYING JONES' METHODS FOR TURBOT STOCK ASSESSMENT AND CATCH PROJECTION IN THE BLACK SEA

K. PRODANOV, K. MIKHAILOV
Institute of Fisheries and Aquaculture
P.O.Box 72, 9000 Varna, Bulgaria

## ABSTRACT

Determining the state of turbot stocks annually is of prime significance for their sustainable utilization. In the past they have been assessed by different methods: swept area method (MARTİNO and KARAPETKOVA, 1957; POPOVA, 1967), VPA based on the age composition of commercial catches (IVANOV and BEVERTON, 1985; EFFİMOV *et al.*, 1986; PRODANOV *et al.*, 1997), Fox' production model (ACARA, 1985) and LSFA (PRODANOV *et al.*, 1997). The first two methods require appreciable funds for carrying out trawl hauls or for aging contain number of samples, as in the second case they have to be bought from the market. Besides, precise determination of turbot age composition bears rather high subjectivity. The last shortcoming applies to some extent to Jones' method, too, since the established growth by ages defines the parameters in Bertalanffy's equation, respectively the value of the interrelation M/2k, the last underlying Jones' method. Nevertheless, this method has the advantage that the risk of making mistakes when defining the size composition of the catches is rather low. Furthermore, the collecting of the necessary information for the size and weight structure of the catches doesn't affect the turbot commercial appearance as ageing by otoliths is not necessary.

The production models are most easily applicable but they need precise statistic data for the magnitude of the catches yielded and the fishing efforts applied.

In the present paper are given the results obtained by Jones' method used to analyze the size composition of turbot catches off the Bulgarian coast in 2002. According to the calculations, the exploited stock in the beginning of the year has been 866.7 tons. In the same year, the annual catch was 135.5 tons, which represents 15.63% of the initial stock. Having in mind that the optimum exploitation level of the turbot is 17.79% ($F = 0.2$) a conclusion can be drawn that the catch obtained is consistent with the criteria of sustainable utilization of turbot stocks.

## INTRODUCTION

The first assessment of turbot biomass off the Bulgarian Black Sea coast was performed by MARTINO and KARAPETKOVA (1957). These authors, on the basis of 47 trawl hauls carried out in the period 23.02 – 17.03,1955, calculated that it was 850 tons. The most compact turbot concentrations were recorded at depths of 90-110 m. KOLAROV and KARAPETKOVA using the same method in 1993 found out that the turbot biomass along the Bulgarian coast has been reduced to about 100 tons. On this account the turbot catch in Bulgaria was banned during 1990-1994.

Similar assessments off the coast of the former Soviet Union were reported by POPOVA (after IVANOV and BEVERTON, 1985). According to them the turbot biomass during 1950-1963 had ranged from 10 300 tons (1958) to 15 800 tons (1954).

Following IVANOV and BEVERTON the turbot biomass (B2+) in the whole Black Sea have varied among 2 800 tons (1979) and 17 100 tons (1963). EFFIMOV *et al.* (1986) believed that during 1974-1984 it has been at the average of 17 000 tons. The biomass had the highest value of about 26 000 tons (11 000 tons in the eastern and 15 000 tons in the western part of the Black Sea) according to ACARA (1985). PRODANOV *et al.* (1997) calculated that during 1970-1988 the turbot biomass varied from 6 100 (1988) to 25 800 (1979) tons. In 1989-1990 and 1991-1992 the mean exploited biomass had been 19 126 and 6 171 tons, respectively. In these same years, the catches have averaged 1 416.5 and 680.6 tons, i.e. in 1991-1992 it was 2.08 fold lower than that in 1989-1990.

Since 1993 estimates of the turbot stocks have not been carried out. For this reason the turbot catches during the period 1995-2002 have not been an objective for quoting. The regulation measures in the exploitation of its stocks came down only to prohibition of its fishery in the spawning season – April, 15th – May, 31th. However, in order to protect the turbot stocks from over fishing, annual estimates of the biomass and respectively the values of TAC (total allowable catch) are indispensable.

## MATERIALS AND METHODS

In 2002 the Bulgarian turbot catch was 135.5 tons. In Table 1 is presented its distribution by age groups. The mean value of M = 0.25 is calculated on the basis of the data of IVANOV and BEVERTON (1985) for the values of M by ages with the exception of those for 10-, 11-, and 12-year old fish which in our calculation are slightly overestimated. The values of the parameters in the equation of von Bertalanffy are after IVANOV and KARAPETKOVA (1979).

Table 1. Age distribution of turbots caught in Bulgaria (2002).

| **Age** | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mt** | 0,25 | 0,20 | 0,15 | 0,20 | 0,25 | 0,30 | 0,35 | 0,40 | 0,45 | 0,55 | 0,70 |

The optimum level of exploitation is defined in conformity with $F_{0.1}$ standard proposed by GULLAND and BOEREMA (1993). The catch per unit recruitment is estimated by the method described in RICKER (1975) at exponential growth of the biomass by age groups.

The Bulgarian turbot catches for the period 1925-2002 are presented in Table 2 and the size composition of these catches is shown in Table 3.

The catch per unit recruitment (Y/R in kg) is calculated by equation (1):

$C_b = F * B$

where: $C_b$- catch in kilograms; F – fishing mortality; B' – mean biomass in kilograms (the sum of the mean biomasses by ages - $B_t$').

(2) $C_b = F \times \sum B_t\{(e^{Gt-Z} - 1)/G_t - Z\}$

where: $B_t$ - initial biomass by age groups; $G_t$ - instantaneous coefficient of growth by ages; Z – coefficient of total mortality.

$Z = F + M$

where M – mean value of the coefficient of natural mortality

Table 2. Bulgarian turbot catches during 1925-2002.

| Year | Tons | Year | Tons | Year | Tons | Year | Tons |
|---|---|---|---|---|---|---|---|
| 1925 | 56.0 | 1945 | 9,6 | 1965 | 324,9 | 1985 | 50,9 |
| 1926 | 57,8 | 1946 | 22,9 | 1966 | 425,6 | 1986 | 12,4 |
| 1927 | 66,6 | 1947 | 79,1 | 1967 | 312,3 | 1987 | 3,4 |
| 1928 | 41,2 | 1948 | 135,4 | 1968 | 304,3 | 1988 | 3,6 |
| 1929 | 23,0 | 1949 | 185,6 | 1969 | 200,2 | 1989 | 0,9 |
| 1930 | 6,9 | 1950 | 195,3 | 1970 | 267,9 | 1990 | ........ |
| 1931 | 15,8 | 1951 | 160,0 | 1971 | 222,1 | 1991 | ........ |
| 1932 | 12,0 | 1952 | 95,9 | 1972 | 175,1 | 1992 | ........ |
| 1933 | 61,3 | 1953 | 103,0 | 1973 | 248,5 | 1993 | ........ |
| 1934 | 91,4 | 1954 | 255,1 | 1974 | 311,5 | 1994 | ........ |
| 1935 | 77,5 | 1955 | 198,9 | 1975 | 203,3 | 1995 | 60,0 |
| 1936 | 30,7 | 1956 | 234,0 | 1976 | 217,2 | 1996 | 62,0 |
| 1937 | 23,0 | 1957 | 458,4 | 1977 | 63,1 | 1997 | 60,0 |
| 1938 | 32,2 | 1958 | 368,6 | 1978 | 121,3 | 1998 | 64,0 |
| 1939 | 56,7 | 1959 | 247,5 | 1979 | 69,9 | 1999 | 54,0 |
| 1940 | 69,7 | 1960 | 215,8 | 1980 | 88,8 | 2000 | 55,1 |
| 1941 | 46,3 | 1961 | 174,3 | 1981 | 9,5 | 2001 | 56,5 |
| 1942 | 10,2 | 1962 | 431,7 | 1982 | 9,4 | 2002 | 135,5 |
| 1943 | 4,8 | 1963 | 435,3 | 1983 | 7,5 | Mean | 121,5 |
| 1944 | 2,4 | 1964 | 460,2 | 1984 | 20,8 | Mean* | 129,8 |

Mean* - without the period 1990-1994, when turbot catches were stopped.

Table 3. Lengths (in cm), weights (in kg) and values of the instantaneus growth coefficient (Gt) of turbot in front of the Bulgarian coast of Black Sea (by age groups).

| Age | Lt, cm | Wt, kg | Gt | Age | Lt, cm | Wt,kg | Gt |
|---|---|---|---|---|---|---|---|
| 1 | 32,5 | 0,614 | 0,56749532 | 8 | 64,4 | 5,170 | 0,12800357 |
| 2 | 39,0 | 1,083 | 0,41861313 | 9 | 67,1 | 5,876 | 0,10950440 |
| 3 | 44,6 | 1,646 | 0,33107670 | 10 | 69,5 | 6,556 | 0,09272767 |
| 4 | 49,6 | 2,292 | 0,27051994 | 11 | 71,6 | 7,193 | 0,07741920 |
| 5 | 54,1 | 3,004 | 0,21673156 | 12 | 73,4 | 7,772 | 0,06717272 |
| 6 | 58,0 | 3,731 | 0,17757521 | 13 | 75,0 | 8,312 | |
| 7 | 61,4 | 4,456 | 0,14862119 | | | | |

(4) $Z = F+M$

where M – mean value of the coefficient of natural mortality

(5) $Gt = \ln(W_{t+1}/W_t)$

The mean weights by ages are estimated by equation (5), the parameters in which are established by IVANOV and KARAPETKOVA (1979):

(6) $W = 0.01194 \times L^{3.116}$

The value of the parameter "k" in the von Bertalanffy's equation is according to IVANOV and KARAPETKOVA (1979) and is equal to 0.125. Consequently the interrelation M/2κ is equal to 0.25/0.25 = 1.00.

The mean size of the turbot stocks is assessed by means of cohort analysis of the size composition of the catches (JONES, 1981). This method is based on the basic equation in the cohort analysis (POPE, 1972):

(7) $N_t = N_{t+1}.e^{M/2} + C_t.e^{M/2}$

On the basis of this equation Jones performed the following transformations:

(8) $N_t = N_t + \Delta t.e^{M.t} + C_t^{M.\Delta t/2}$

where: t is the time needed for fish growth in particular size interval.

There are different equations for expressing fish growth but the most frequently used one is the von Bertalanffy's equation. The transformation of this equation gives expression for the age as a dependence on fish length i. e.

(9) $$t = t_0 - \frac{1}{k.\ln(1 - L_t/L_\infty)}$$

Therefore, if $t_1$ is the age corresponding to $L_1$:

(10) $$t_1 = t_0 - \frac{1}{k.\ln(1 - L_1/L_\infty)}$$

Similarly, if $t_2$ is the age corresponding to $L_2$:

(11) $$t_2 = t_0 - \frac{1}{k.\ln(1 - L_2/L_\infty)}$$

From the equations (10) and (11) follows that the time needed for growth from $L_1$ to $L_2$ would be the difference between them:

(12) $$\Delta t = t_2 - t_1 = \frac{1}{k.\ln(\frac{L_\infty - L_1}{L_\infty - L_2})}$$

Substituting t in equation (8) we receive:

(13) $N_1 = (N_2.X_1 + C_1).X_1$

where: $C_1$ are the numbers of fish caught in the course of the year with lengths between $L_1$ and $L_2$; $N_1$ and $N_2$ represent the numbers of fish in the sea with lengths $L_1$ and $L_2$, respectively

(14) $$.\ X_L = (\frac{L_\infty - L_1}{L_\infty - L_2}$$

Using equation (13) it is possible to proceed to the performance of the cohort analysis by the data for catch size composition.

The values of the coefficients Z, F and the interrelation F/Z for each size class are defined as follows:

- the interrelation F/Z is calculated according to the expression:

(15) $F/Z = C_L/N_L - N_{L+1}$

- from the interrelation F/Z we define the value of Z by the equation:

(16) $$Z = \frac{M}{1 - F/Z}$$

- the value of F we find by the equation:

$$(17) \qquad F = Z - M$$

where Z – coefficient of total mortality.

The numbers of the most abundant size group is estimated through the expression:

$$(18) \qquad N_{L_\lambda} = \frac{C_{L_\lambda}}{F_{st}/Z}$$

The numbers of the remaining size groups are estimated in succession towards the smallest size classes according to equations (13) and (14).

The mean abundance of the fishes in the sea of particular size class is found through equation:

$$(19) \qquad \overline{N}_L = N_L - \frac{N_{L+1}}{Z}$$

The mean biomass of the corresponding size classes is equal to:

$$(20) \qquad \overline{B}_L = N_L.\overline{W}_L$$

## RESULTS AND DISCUSSION

The results from the calculations through equations (1) – (5) are presented in Table 5 and Figures 1 and 2. The estimations are done on the basis of the data for length frequencies given in Table 4 and the following biological characteristics:

- the exploited stock comprises the fish at 2 to 12 years of age with the following shares: 2-year olds – 10%; 3-year olds - 50%; 4-year olds and older - 100%, i.e., fully recruited to the exploited stock are the fish older than 3 years of age.

- the age at sexual maturity is as follows: 3-year olds - 50%, 4-year olds - 100%, i.e., a portion of 3-year old fish is yet immature.

These biological characteristics underlie the defined minimum catch length of turbot – 45 cm which corresponds to an age of 3 years.

Table 4. Size and weigth structure of turbot catches off the Bulgarian coast in 2002.

| L, cm | W, kg | N | % | n*W |
|---|---|---|---|---|
| 41,5 (40,0 – 42,9) | 1,17 | 7 | 2,24 | 8,19 |
| 44,5 (43,0 – 45,9) | 1,64 | 23 | 7,35 | 37,72 |
| 47,5 (46,0 – 48,9) | 2,05 | 48 | 15,33 | 98,40 |
| 50,5 (49,0 – 51,9) | 2,31 | 53 | 16,93 | 122,43 |
| 53,5 (52,0 – 54,9) | 2,85 | 56 | 17,89 | 159,60 |
| 56,5 (55,0 – 57,9) | 3,50 | 41 | 13,10 | 143,5 |
| 59,5 (58,0 – 60,9) | 4,13 | 32 | 10,22 | 132,16 |
| 62,5 (61,0 – 63,9) | 4,80 | 20 | 6,39 | 96,00 |
| 65,5 (64,0 – 66,9) | 5,50 | 14 | 4,47 | 77,00 |
| 68,5 (67,0 – 69,9) | 6,30 | 9 | 2,88 | 56,70 |
| 71,5 (70,0 – 72,9) | 7,20 | 6 | 1,92 | 43,20 |
| 74,5 (73,0 – 75,9) | 8,10 | 3 | 0,96 | 24,30 |
| 77,5 (76,0 – 79,9) | 9,10 | 1 | 0,32 | 9,10 |
| Total | | 313 | 100,00 | 1008,3 |
| $M_L$ | 54,31 | | | |
| $M_W$ | 3,22 | | | |

Table 5. Initial ($B_{2-12}$) and mean biomass ($B'_{2-12}$) of total exploited stock and yield per recruit (Y/R, in kg) of the turbot inhabiting the Bulgarian aquatory of Black Sea.

| F | ($B_{2-12}$) 1 | ($B'_{2-12}$) 2 | ($B_{2-12}$)ex 3 | ($B'_{2-12}$)ex 4 | (Y/R) 5 | 5/1 (%) | 5/3 % |
|---|---|---|---|---|---|---|---|
| 0.0 | 12,838 | 11,542 | 11,222 | 10,598 | 0,000 | 0,00 | 0,00 |
| 0.1 | 9,813 | 8,509 | 9,339 | 7,526 | 0,753 | 7,67 | 8,06 |
| 0.2 | 7,912 | 6,628 | 6,308 | 5,608 | 1,122 | 14,18 | 17,79 |
| 0.3 | 6,666 | 5,406 | 5,067 | 4,352 | 1,306 | 19,59 | 25,77 |
| 0.4 | 5,818 | 4,585 | 4,223 | 3,501 | 1,400 | 24,06 | 33,15 |
| 0.5 | 5,216 | 4,009 | 3,625 | 2,896 | 1,448 | 27,76 | 39,94 |
| 0.6 | 4,775 | 3,591 | 3,118 | 2,451 | 1,471 | 30,81 | 47,18 |
| 0.7 | 4,446 | 3,282 | 2,862 | 2,117 | 1,482 | 33,33 | 51,78 |
| 0.8 | 4,187 | 3,038 | 2,607 | 1,852 | 1,482 | 35,40 | 56,85 |
| 0.9 | 3,986 | 2,852 | 2,408 | 1,644 | 1,480 | 37,13 | 61,46 |
| 1.0 | 3,826 | 2,705 | 2,250 | 1,476 | 1,476 | 38,58 | 65,60 |

It is evident from Table 3 that length of 45 cm corresponds basically 3-year olds, out of which 50 % attain sex maturity for the first time. The rest 50 % will reach sex maturity at the age of 4 and only then they will spawn for the first time. The younger fish (1- and 2- year olds) are still immature and thus they are protected by the new Bulgarian fishery legislation with a view to ensure them reaching sex maturity and spawning.

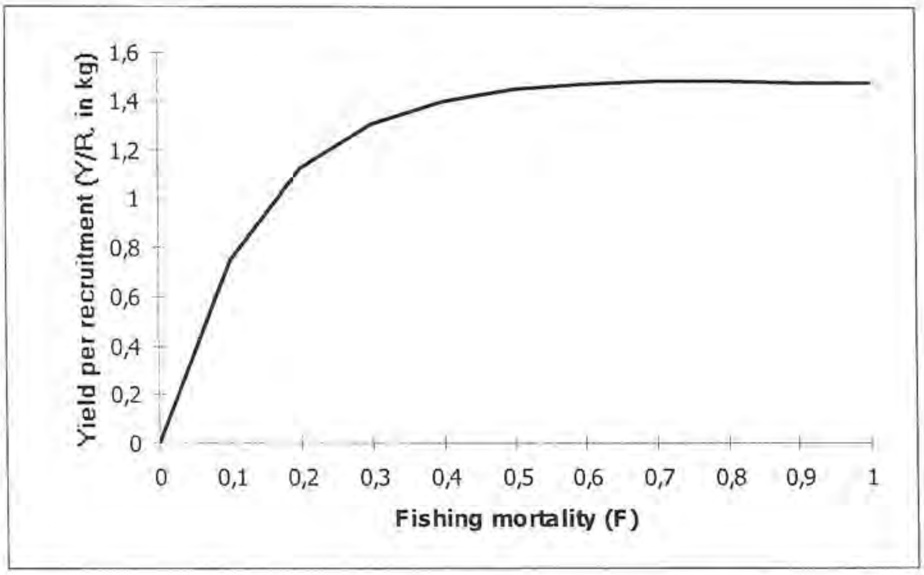



**Figure 1.** Yield per recruit (Y/R, in kg) of the turbot inhabiting the Bulgarian aquatory of Black Sea.

It is clear from Table 5 that $F_{opt}$ according to $F_{0.1}$ criterion equals to 0.4. At that level of fishing mortality the catch will be 33.15% of the biomass of the initial exploited stock in state of balance. Consequently, if we knew the value of the stock under consideration in early April 2002 we could appraise whether the fish species is exploited rationally or not. Now we are aware only, and even with relative precision, that in 2002 135.5 tons of turbot were caught. If this catch is correct, the exploited stock in early April had to be at minimum 408.7 tons (135.5*100/33.15). The criterion $F_{0.1}$ have been criticized time and again as according to it the lowering of the biomass and the shifts of size and age structure do not affect the abundance of the recruitment adopted conditionally to be unity. In our case with the turbot at F=0.4 the initial exploited stock will account for 37.63% from that in virgin state, i.e. before any fishery on this fish species (F=0) to be carried out, when the environmental conditions have not been the same, as well. According to the calculations when reaching F=0.4 the initial exploited turbot stock would have reduced 2.66 times in relation to the virgin one if the abundance of the recruitment have remained constant, conditionally adopted for unity. The size-age composition of this stock will differ radically from this at F=0. In the first case the share of 2- and 3-year old fish (in biomass) in the initial exploited stock would increase from 6.67% to 17.24%. Conversely, the fully mature fish will drop from 93.23% to 82.76%. From theoretical point of view, if F would come at unity the percent of the indicated age groups (in biomass) would grow up to 31.47%, i.e. the reduction of the turbot mean size is one of the indirect indices for the increase of the fishing mortality level.

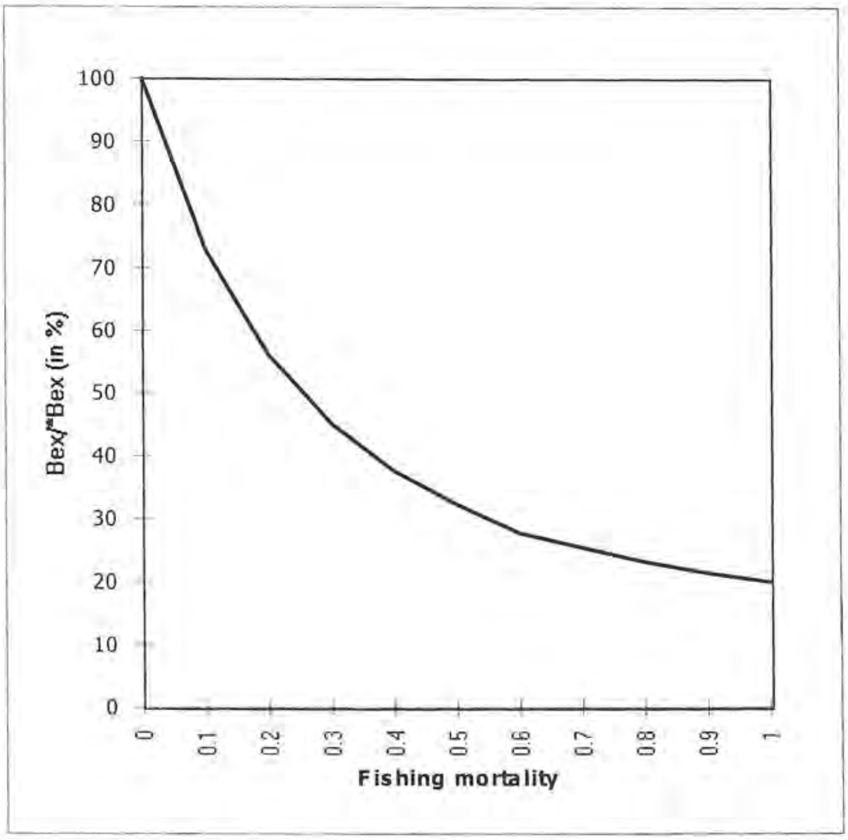



**Figure 2.** Decreasing of the initial exploited biomass (in %) with the increasing of the fishing mortality rate of the turbot inhabiting the Bulgarian aquatory of Black Sea. (*Bex – biomass of the turbot stock in virgin state at F=0).

As it was indicated the mentioned criterion for defining the optimum fishing mortality value might be risky in view of depleting the stock of heavily exploited fish populations. For this reason many authors have suggested different criteria which need, however, the additional data. After one of them the optimum value of F is approximately two fold lower than the one estimated by $F_{0.1}$ standard, i.e. the value of $F_{opt}$ would have to be around 0.2 in the turbot. For this value of F, the optimum allowable annual catch would account for 17.79% from the initial exploited stock. Therefore, the achieved catch of 135.5 tons in 2002 is consistent with the principles for sustainable utilization of marine living resources only when the exploited stock in the beginning of April 2002 had been at least 761.7 tons. That is why the real amount of the obtained catch in particular year is of primary importance for the reliability of the calculations made. Otherwise, the theory of fish population dynamics, no matter how good it is, would not give the expected results for protecting the fish populations against overfishing.

It is evident that, for determining correctly the annual allowable catch for 2003, the estimate of the size of the turbot exploited and spawning biomass at the end of March 2003 must be available. Unfortunately, due to the lack of fund, the Institute of Fisheries and Aquaculture cannot carry out necessary studies for that purpose on trawl hauls to assess the turbot stock by the swept area method. That is why it is necessary to use statistic data for the catch size in 2002 and its size composition as in Tables 2 and 3. On the basis of these data using equations (7) to (20) we defined the mean turbot biomass off the Bulgarian coast in 2002 (Tables 6 and 7).

Table 6. Mean abundance ($*N_l$) in numbers and biomass ($*B_L$) in tons of the turbot off the Bulgarian coast ($F_{st}$ = 0.20).

| L, cm | $X_L$ | $C_L$ | $N_L$ | F/Z | Z | F | $*N_L$ | $*B_L$ |
|---|---|---|---|---|---|---|---|---|
| 41,5 | 1,0701919 | 942,6 | 118546,86 | 0,0592 | 0,2657 | 0,0157 | 59922,2 | 70,1 |
| 44,5 | 1,0754907 | 3092,9 | 102625,52 | 0,1844 | 0,3065 | 0,0565 | 54737,8 | 89,8 |
| 47,5 | 1,0816549 | 6451,0 | 85848,39 | 0,3499 | 0,3846 | 0,1346 | 47936,2 | 98,3 |
| 50,5 | 1,0889152 | 7124,3 | 67412,11 | 0,4166 | 0,4285 | 0,1785 | 39911,7 | 92,2 |
| 53,5 | 1,0975927 | 7528,2 | 50309,96 | 0,4886 | 0,4889 | 0,2389 | 31515,1 | 89,8 |
| 56,5 | 1,1081471 | 5512,6 | 34902,23 | 0,4813 | 0,4820 | 0,2320 | 23764,7 | 83,2 |
| 59,5 | 1,1212611 | 4300,6 | 23447,64 | 0,4982 | 0,4982 | 0,2482 | 17328,1 | 71,6 |
| 62,5 | 1,1379945 | 2689,0 | 14814,79 | 0,4686 | 0,4705 | 0,2205 | 12195,5 | 58,5 |
| 65,5 | 1,1600854 | 1881,0 | 9076,78 | 0,4758 | 0,4769 | 0,2269 | 8290,4 | 45,6 |
| 68,5 | 1,1905972 | 1211,9 | 5123,10 | 0,4796 | 0,4804 | 0,2304 | 5259,9 | 33,1 |
| 71,5 | 1,2354788 | 807,9 | 2596,23 | 0,5215 | 0,5225 | 0,2725 | 2965,1 | 21,3 |
| 74,5 | 1,3080082 | 404,0 | 1046,96 | 0,5431 | 0,5472 | 0,2972 | 1359,4 | 11,0 |
| 77,5 | | 134,7 | 303,08 | 0,4444 | 0,4500 | 0,2000 | | |
| Total | | 42080,7 | | | | | | 764,5 |

Table 7. Mean abundance ($*N_l$) in numbers and biomass ($*B_L$) in tons of the turbot off the Bulgarian coast ($F_{st}$ = 0.40).

| L, cm | $X_L$ | $C_L$ | $N_L$ | F/Z | Z | F | $*N_L$ | $*B_L$ |
|---|---|---|---|---|---|---|---|---|
| 41,5 | 1,0701919 | 942,6 | 116690,13 | 0,0601 | 0,2660 | 0,0160 | 58969,1 | 69,0 |
| 44,5 | 1,0754907 | 3092,9 | 101004,36 | 0,1868 | 0,3074 | 0,0574 | 53863,2 | 88,3 |
| 47,5 | 1,0816549 | 6451,0 | 84446,83 | 0,3538 | 0,3869 | 0,1369 | 47125,0 | 96,6 |
| 50,5 | 1,0889152 | 7124,3 | 66214,17 | 0,4212 | 0,4319 | 0,1819 | 39163,0 | 90,5 |
| 53,5 | 1,0975927 | 7528,2 | 49299,67 | 0,4941 | 0,4942 | 0,2442 | 30829,7 | 87,9 |
| 56,5 | 1,1081471 | 5512,6 | 34063,61 | 0,4879 | 0,4882 | 0,2382 | 23144,0 | 81,0 |
| 59,5 | 1,1212611 | 4300,6 | 22764,72 | 0,5064 | 0,5065 | 0,2565 | 16768,3 | 69,3 |
| 62,5 | 1,1379945 | 2689,0 | 14271,59 | 0,4790 | 0,4798 | 0,2298 | 11701,2 | 56,2 |
| 65,5 | 1,1600854 | 1881,0 | 8657,34 | 0,4891 | 0,4893 | 0,2393 | 7860,0 | 43,2 |
| 68,5 | 1,1905972 | 1211,9 | 4811,43 | 0,4977 | 0,4977 | 0,2477 | 4892,6 | 30,8 |
| 71,5 | 1,2354788 | 807,9 | 2376,36 | 0,5483 | 0,5535 | 0,3035 | 2662,1 | 19,2 |
| 74,5 | 1,3080082 | 404,0 | 902,92 | 0,5906 | 0,6106 | 0,3606 | 1120,3 | 9,1 |
| 77,5 | | 134,7 | 218,88 | 0,6154 | 0,6500 | 0,4000 | | |
| Total | | 42080,7 | | | | | | 741,1 |

It is evident from Table 6 that at $F_{st} = 0.20$ the mean exploited biomass ($B'_{ex}$) is 764.5 tons and the mean abundance – 305 186.1 fish, i.e. the mean fish weight is 2.51 kg. From the same table, the mean weighed value of F is computed which is equal to 0.1375. For this F value the interrelation between the mean and initial biomass is 85.61% (Table 5). Therefore, the latter is approximately 893.0 tons. In this case the total allowable catch has to be 158.9 tons (17.79%).

In Table 7 are presented the results from the computations at $F_{st} = 0.40$. It is evident that, when applying twice higher value of $F_{st}$, the assessment remains almost the same. The difference in abundance is 2.32% and in biomass 3.06%. All these indicate that possible bias when defining $F_{st}$ has almost no effect on the final result as it fades away rapidly in direction to smaller sized individuals (younger fish classes) which are much more abundant compared to older fish classes (larger sized specimens). In the second case the mean weighed value of F is with 2.33% higher than at $F_{st} = 0.20$. That is why the interrelation between the mean and initial exploited biomasses remains almost unchanged (85.51%). In the second case its value is 866.7 tons and the total allowable catch 154.2 tons. Therefore, if the size composition of the catches was corresponding to that shown in Table 3 the catch of 135.5 tons obtained in 2002 has agreed with the turbot stock size.

In Table 8 is presented another size composition of the turbot catch in 2002.

Table 8. Size and weigth structure of turbot catches off the Bulgarian coast in 2002.

| L, cm | W, kg | n | % | n*W |
|---|---|---|---|---|
| 41,5 (40,0 – 42,9) | 1,17 | 14 | 4,47 | 16,38 |
| 44,5 (43,0 – 45,9) | 1,64 | 41 | 13,10 | 67,24 |
| 47,5 (46,0 – 48,9) | 2,05 | 68 | 21,73 | 139,40 |
| 50,5 (49,0 – 51,9) | 2,31 | 79 | 25,24 | 182,49 |
| 53,5 (52,0 – 54,9) | 2,85 | 53 | 16,93 | 151,05 |
| 56,5 (55,0 – 57,9) | 3,50 | 34 | 10,86 | 119,00 |
| 59,5 (58,0 – 60,9) | 4,13 | 17 | 5,43 | 70,21 |
| 62,5 (61,0 – 63,9) | 4,80 | 5 | 1,60 | 24,00 |
| 65,5 (64,0 – 66,9) | 5,50 | 2 | 0,64 | 11,00 |
| Total | | 313 | 100,00 | 780,77 |
| $M_L$ | 50,60 | | | |
| $M_W$ | 2,49 | | | |

In this case the assessment of the stock size is radically different as in Table 9. When Fst is 0.20 the mean weighed (by biomass) F value is 0.2964, which means that the mean exploited biomass will represent about 83% of the initial exploited biomass. On this occasion the latter is 352.3/0.83 = 424.5 tons. Consequently, the total allowable catch in 2002 might have to be 75.5 tons. In reality, a catch of 135.5 tons is made which means that the turbot population has been overfished and especially its mature part – the fish bigger than 45 cm. For this part of the population the mean weighed value in F is 0.5070. That is just the reason to make us propose a quota of 60 tons of the Bulgarian coast as the length size of the fish in January catches are very low - from 42 to 47 cm. This is an indication that the turbot have been subjected to intense fishing that do not respond to the state of its stocks. More reliable assessments of the turbot stock size are possible only on the basis of accurate data for the magnitude of the catches and their size and weight structure. Carrying out VPA by the catch age composition is quite difficult and expensive as it needs to buy a stock of samples for ageing of the fish, which cause the commercial appearance of the turbot worsen when extracting the otoliths. Besides, there is a problem in correctly defining the fish age because there is not uniform view-point among the scientists on this matter. On the other hand, the clarifying of this problem is an important task as it has an effect in estimating the value of k and therefore on the interrelation M/2k. This affects also the precision of the cohort analysis done by the size composition of the catches.

Table 9. Mean turbot abundance (* $N_L$, in numbers) and biomass (* $B_L$ in tons) off the Bulgarian coast (Fst = 0.20).

| L, cm | $X_L$ | $C_L$ | $N_L$ | F/Z | Z | F | * $N_L$ | * $B_L$ |
|---|---|---|---|---|---|---|---|---|
| 41,5 | 1,0701919 | 2432,5 | 100456,70 | 0,1620 | 0,2983 | 0,0483 | 50346,4 | 58,9 |
| 44,5 | 1,0754907 | 7128,7 | 85438,36 | 0,3917 | 0,4110 | 0,1610 | 44286,0 | 72,6 |
| 47,5 | 1,0816549 | 11825,0 | 67236,83 | 0,5712 | 0,5830 | 0,3330 | 35507,1 | 72,8 |
| 50,5 | 1,0889152 | 13735,0 | 46536,17 | 0,6901 | 0,8067 | 0,5567 | 39163,0 | 57,0 |
| 53,5 | 1,0975927 | 9212,9 | 26633,17 | 0,7131 | 0,8714 | 0,6214 | 14826,0 | 42,3 |
| 56,5 | 1,1081471 | 5909,8 | 13713,81 | 0,7501 | 1,0004 | 0,7504 | 7876,0 | 27,6 |
| 59,5 | 1,1212611 | 2954,9 | 5834,64 | 0,7717 | 1,0951 | 0,8451 | 3496,6 | 14,4 |
| 62,5 | 1,1379945 | 870,7 | 2005,55 | 0,7125 | 0,8696 | 0,6196 | 1405,3 | 6,7 |
| 65,5 | | 348,2 | 783,53 | 0,4444 | 0,4500 | 0,2000 | | |
| Total | | 54417,7 | | | | | | 352,3 |

First attempt for quantitative determination of the turbot stocks off the Bulgarian coasts trough carrying trawl hauls has made by MARTİNO and KARAPETKOVA (1957) who established that the turbot biomass off the Bulgarian coast in March 1955 had been around 850 tons. However, they considered this biomass was underestimated as at the same time Romanian and Soviet scientists reported for much larger stocks off the coasts of Romania and former USSR.

The turbot biomass assessments performed so far in the Black Sea cover different periods of time thus they can be compared only for relatively short time interval: IVANOV and BEVERTON (1985) gave data for turbot biomass during the period 1956 – 1979 and EFFİMOV *et al.* (1986) for the period 1970 –1984. For 1950 – 1963 such assessment have been carried out by POPOVA (after IVANOV and BEVERTON, 1985). These three estimates agree quite well, although, in some years they differ substantially in their absolute values as well as in the trends of the turbot stock dynamics. According to POPOVA, the total biomass during 1950 – 1963 varied from 10 300.0 (958) to 15 800.0 tons (1954). After IVANOV and BEVERTON the turbot biomass (B2+) during 1956 – 1979 had ranged from 2 800.0 (1979) to 17 000.0 tons (1963) and, according to EFFİMOV *et al.* (1986), the same had been on the average 17 000.0 tons during 1974 – 1984. The biomass is largest according to ACARA (1985) who applied the Fox's production model and estimated the biomass to be about 26 000 tons – 11 000 tons in the eastern part and 15 000 tons in the western part of the Black Sea. The last turbot biomass assessment in the Black Sea was performed by PRODANOV *et al.* (1997) by the method of VPA for the period 1971 – 1994. However, all these estimates refer to the entire Black Sea and thus could be used only as a reference point for the fluctuation level in the periods discussed.

There are two estimates carried out along the Bulgarian coast in 1955 and 1993. According to the second research, the turbot biomass was 100 tons, i.e. it has decreased 8.5 fold in relation to the one in 1955. It is evident from Table 1 that in 1955 our catch was 198.9 tons and in 1993, the official catch stastics is lacking as in 1990 – 1994 the turbot catch off the Bulgarian coast was halted. Based on the above conclusions for sustainable utilization of turbot stocks for having made a catch of 198.9 tons, it is necessary that the initial exploited stock to be at minimum 1,118 tons. In fact it has been around 850 tons which means that as far back as 1955 the turbot has probably been overfished. In the same way it could be judged that the turbot biomass along the Bulgarian coast during the period 1960 – 1980 might have been in the range from 2,586.8 (1964) to 354.7 (1977). Otherwise, it means that the turbot has been overfished as in the above years when the catches had been 460.2 and 63.1 tons, respectively. In our opinion, the exploited turbot stock along the Bulgarian coast has never been over 2,500 tons which means that the turbot stocks reduction off our coast was due primarily to overfishing and to a less considerable degree due to the deteriorating environment itself. Without going into details about the impact of the so called bottom-up/top-down control in the Black Sea ecosystem, it will only be marked that the processes are interrelated. This further extends the scientists' and the authorized state institutions' responsibility for adopting specific measures that would guarantee the preservation of the biodiversity and the sustainable utilization of the marine living resources. In this connection and taking into account the lack of precise assessments of the stock biomass in late March 2003, we consider that the total allowable turbot catch off the Bulgarian coast in 2003 has to be around 60 tons. This catch would be justified in case the initial exploited biomass is at least 337.3 tons. To have the quota of 80 or 100 tons, the stock must be at least 450 or 562 tons, respectively. In our opinion the first figure is more probable and so we propose the quota not to exceed 60 tons. The scarce information available gives us a reason to decide so and it is shown by the worsened size structure of the fish species – at present the catches are composed by fish with size 42 –47 cm. This means that the 3-year olds and to some extent 2- and 4-year olds are prevailing. This is an indirect evidence that highly intense fishery is exerting upon this fish species disturbing the size structure of the population and especially its mature part.

## CONCLUSION

The correct catch quoting of the turbot needs defining its stocks in the beginning of each year, till the middle of March. For this purpose precise statistic data for the magnitude of the catch and its size and weight structure have to be collected annually. It is indispensable the elucidation of the question about the turbot length and weight growth by ages because it affects the value of k in the von Bertalanffy's equation and consequently the interrelation M/2k. All this has a decisive significance for the precision of Jones' method.

For this reason we hope when funds are available, the turbot biomass in particular year will be defined directly by carrying out trawl-hauls. Then it is likely to determine the limits of the possible differences between the two methods in consideration, as well.

## REFERENCES


ACARA, A. 1985. The Black Sea turbot. T.S. Basbakanlic. Devlet planlama teskilati, 1-19.

IVANOV, L., KARAPETKOVA, M. 1979. Dynamics of the Reserves of Turbot (Scophthalmus maeoticus, Pallas) in the Bulgarian Shelf of the Black Sea and measures for their utilization. I. Growth and Mortality rate. Hydrobiology, Sofia, v.9, 3-14 (in Bulgarian).

IVANOV, L., KARAPETKOVA, M. 1979. Dynamics of the Reserves of Turbot (Scophthalmus maeoticus, Pallas) in the Bulgarian Shelf of the Black Sea and measures for their utilization. II.Reserves and Reproduction. Hydrobiology, Sofia, v.9, 15-28 (in Bulgarian).

IVANOV, L.., BEVERTON, R.J.H. 1985. The fisheries resources of the Mediterranean. Part two: Black Sea. FAO Studies and Reviews, 60: 135 pp.

MARTINO, K., KARAPETKOVA, M. 1957. The distribution of turbot dduring the first months of the year 1955. Proceeddings of the Institute of Fisheries and Fish Industry-Varna, v. I, 45-52 (in Bulgarian).

POPOVA, V. P. 1967. Stock assessment methods and catch projection of the Black Sea turbot. Proceedings of the AzCherNIRO, v. 24, 87-95 (in Russian )

PRODANOV, K., MIKHAILOV, K., DASKALOV, G., MAXIM, C., CHASHCHIN, A., ARKHIPOV, A., SHLYAKHOV, V., OZDAMAR, E. 1997. Environmental management of fish resources in the Black Sea and their rational exploitation. FAO Studies and Reviews, v. 68, pp 178.

# STATUS OF DEMERSAL FISH ALONG THE BULGARIAN BLACK SEA COSTS

Konstantin MIKHAILOV and Kamen PRODANOV
Institute of Fisheries and Aquaculture
P.O.Box 72, 9000 Varna, Bulgaria

## Fam. SCOPTHALMIDAE (BOTHIDAE). Turbots
## PSETTA MAEOTICA (MAXIMA) (PALLAS). Black Sea turbot.

Commercially the Black Sea turbot is one of the most valuable fish species in the basin. Currently it has been fished by gillnets and bottom trawl hauls. At present the latter are prohibited. In Bulgaria a minimum mesh size (180 mm) of the gillnets has been established. The turbot fishery was closed during 1990 – 1994 with the aim of recovering its stocks off the Bulgarian coast. Now the ban is in force only during the spawning season (15 April – 31 May).

In Tables 1 and 2, the turbot landings by years during the period 1925–2002 are presented. The turbot catches had been largest during 1955–1969, at the average 319.5 tons.

According to IVANOV and KARAPETKOVA (1979) and IVANOV and BEVERTON (1985) the fishing mortality of the exploited stock in the Bulgarian aquatory was around 0,57.

Table 1. Bulgarian landings of Black Sea turbot (in tons) during the period 1925-2002.

| Years | Tons | Years | tons | Years | Tons | Years | Tons |
|---|---|---|---|---|---|---|---|
| 1925 | 56.0 | 1945 | 9.6 | 1965 | 324.9 | 1985 | 50.9 |
| 1926 | 57.8 | 1946 | 22.9 | 1966 | 425.6 | 1986 | 12.4 |
| 1927 | 66.6 | 1947 | 79.1 | 1967 | 312.3 | 1987 | 3.4 |
| 1928 | 41.2 | 1948 | 135.4 | 1968 | 304.3 | 1988 | 3.6 |
| 1929 | 23.0 | 1949 | 185.6 | 1969 | 200.2 | 1989 | 0.9 |
| 1930 | 6.9 | 1950 | 195.3 | 1970 | 267.9 | 1990 | ........ |
| 1931 | 15.8 | 1951 | 160.0 | 1971 | 222.1 | 1991 | ........ |
| 1932 | 12.0 | 1952 | 95.9 | 1972 | 175.1 | 1992 | ........ |
| 1933 | 61.3 | 1953 | 103.0 | 1973 | 248.5 | 1993 | ........ |
| 1934 | 91.4 | 1954 | 255.1 | 1974 | 311.5 | 1994 | ........ |
| 1935 | 77.5 | 1955 | 198.9 | 1975 | 203.3 | 1995 | 60.0 |
| 1936 | 30.7 | 1956 | 234.0 | 1976 | 217.2 | 1996 | 62.0 |
| 1937 | 23.0 | 1957 | 458.4 | 1977 | 63.1 | 1997 | 60.0 |
| 1938 | 32.2 | 1958 | 368.6 | 1978 | 121.3 | 1998 | 64.0 |
| 1939 | 56.7 | 1959 | 247.5 | 1979 | 69.9 | 1999 | 54.0 |
| 1940 | 69.7 | 1960 | 215.8 | 1980 | 88.8 | 2000 | 55.1 |
| 1941 | 46.3 | 1961 | 174.3 | 1981 | 9.5 | 2001 | 56.5 |
| 1942 | 10.2 | 1962 | 431.7 | 1982 | 9.4 | 2002 | 135.5 |
| 1943 | 4.8 | 1963 | 435.3 | 1983 | 7.5 | Mean | 121.5 |
| 1944 | 2.4 | 1964 | 460.2 | 1984 | 20.8 | Mean* | 129.8 |

Mean* - excluding the period (1990-1994) when turbot catches were forbidden in front of the Bulgarian Black Sea coast.

Table 2. Mean catches of Black Sea Turbots ( in tons ) by 5 years periods during 1925-2002.

| Periods | Mean catch | Periods | Mean catch | Periods | Mean catch |
|---|---|---|---|---|---|
| 1925-1929 | 48,9 | 1955-1959 | 301,5 | 1985-1989 | 14,2 |
| 1930-1934 | 37,5 | 1960-1964 | 343,5 | 1990-1994 | 0,0 |
| 1935-1939 | 44,0 | 1965-1969 | 313,5 | 1995-1999 | 60,0 |
| 1940-1944 | 26,7 | 1970-1974 | 245,0 | 2000-2002 | 82,4 |
| 1945-1949 | 86,5 | 1975-1979 | 135,0 | Mean | 121,3 |
| 1950-1954 | 161,9 | 1980-1984 | 27,2 | Mean* | 129,7 |

In Table 3 and Figure 1 are shown the Bulgarian turbot landings by months during the period 1960–1990.

Table 3. Bulgarian turbot landings by months during the period 1960-1990 (in tons).

| Month | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 |
|---|---|---|---|---|---|---|---|---|---|---|
| January | 45,1 | 11,8 | 79,3 | 30,1 | 37,9 | 35,5 | 19,0 | 29,9 | 11,9 | 4,0 |
| February | 36,6 | 16,1 | 11,2 | 45,7 | 100,7 | 21,5 | 71,5 | 44,4 | 51,2 | 20,4 |
| March | 8,0 | 13,1 | 68,6 | 57,0 | 69,6 | 29,0 | 38,1 | 40,9 | 41,4 | 13,2 |
| April | 12,8 | 22,2 | 61,3 | 79,0 | 61,1 | 29,5 | 84,4 | 36,1 | 77,3 | 49,5 |
| May | 70,3 | 43,8 | 69,6 | 79,6 | 86,6 | 81,1 | 67,5 | 70,2 | 77,0 | 76,9 |
| June | 17,6 | 15,3 | 25,1 | 44,7 | 35,3 | 37,2 | 38,0 | 14,3 | 13,1 | 19,6 |
| July | 9,8 | 5,2 | 16,4 | 8,5 | 11,3 | 18,2 | 21,2 | 14,7 | 1,8 | 4,5 |
| August | 7,0 | 4,7 | 37,1 | 10,0 | 13,7 | 21,7 | 15,5 | 3,9 | 10,4 | 0,9 |
| September | 1,4 | 10,5 | 32,3 | 15,4 | 30,6 | 22,9 | 30,1 | 1,6 | 5,9 | 1,5 |
| October | 3,7 | 4,9 | 1,2 | 30,4 | 2,4 | 18,3 | 13,7 | 3,6 | 6,0 | 2,0 |
| November | 2,5 | 9,0 | 7,6 | 18,5 | 0,0 | 3,4 | 2,0 | 1,2 | 1,7 | 2,9 |
| December | 1,0 | 17,7 | 8,0 | 16,4 | 11,0 | 6,6 | 24,6 | 1,5 | 6,6 | 4,9 |
| Total | 215,8 | 174,3 | 431,7 | 435,3 | 460,2 | 324,9 | 425,6 | 312,3 | 304,3 | 200,2 |

Table 3 – continued.

| Month | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 |
|---|---|---|---|---|---|---|---|---|---|---|
| January | 34,4 | 25,3 | 4,1 | 10,3 | 17,1 | 43,1 | 0,3 | 0,195 | 1,111 | 0,004 |
| February | 21,6 | 23,3 | 30,7 | 51,9 | 20,9 | 9,1 | 0,1 | 0,340 | 0,702 | 0,123 |
| March | 12,5 | 1,8 | 9,0 | 2,0 | 3,4 | 0,6 | 4,1 | 0,066 | 0,811 | 13,707 |
| April | 65,5 | 46,6 | 49,4 | 78,9 | 121,5 | 92,5 | 110,0 | 34,432 | 56,647 | 26,018 |
| May | 51,7 | 60,4 | 59,3 | 77,3 | 124,3 | 45,9 | 90,6 | 24,912 | 37,756 | 10,791 |
| June | 13,3 | 5,8 | 11,4 | 13,2 | 11,7 | 11,6 | 11,4 | 1,596 | 7,030 | 1,065 |
| July | 4,8 | 1,0 | 1,9 | 0,0 | 0,0 | 0,2 | 0,3 | 0,334 | 1,713 | 1,055 |
| August | 8,1 | 8,8 | 2,3 | 0,2 | 0,0 | 0,0 | 0,0 | 0,428 | 2,471 | 0,408 |
| September | 23,5 | 21,3 | 0,2 | 2,3 | 1,6 | 0,2 | 0,0 | 0,013 | 1,213 | 0,119 |
| October | 17,2 | 22,9 | 0,7 | 3,2 | 4,9 | 0,1 | 0,1 | 0,319 | 0,194 | 0,068 |
| November | 10,9 | 1,5 | 2,9 | 6,6 | 0,3 | 0,0 | 0,0 | 0,299 | 0,0 | 0,051 |
| December | 4,4 | 3,4 | 3,2 | 2,6 | 5,8 | 0,5 | 0,3 | 0,144 | 11,625 | 16,678 |
| Total | 267,9 | 222,1 | 175,1 | 248,5 | 311,5 | 203,8 | 217,2 | 63,078 | 121,273 | 69,887 |

Table 3 – continued.

| Month | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 |
|---|---|---|---|---|---|---|---|---|---|---|
| January | 0,728 | 0,108 | 0,036 | 0,057 | 0,085 | 0,053 | 0,365 | 0,005 | 0,085 | 0,0 |
| February | 0,830 | 2,054 | 0,015 | 0,421 | 0,211 | 0,0 | 0,012 | 0,007 | 0,123 | 0,060 |
| March | 0,228 | 0,018 | 0,099 | 0,236 | 0,046 | 0,115 | 0,019 | 0,0 | 0,024 | 0,018 |
| April | 51,645 | 2,616 | 0,680 | 1,372 | 4,350 | 6,968 | 5,317 | 0,123 | 0,137 | 0,767 |
| May | 29,822 | 4,036 | 5,304 | 3,484 | 14,707 | 39,317 | 5,177 | 0,566 | 0,609 | 0,002 |
| June | 2,513 | 0,272 | 1,608 | 0,090 | 0,455 | 4,335 | 1,391 | 2,128 | 1,865 | 0,0 |
| July | 0,204 | 0,016 | 0,057 | 0,018 | 0,002 | 0,036 | 0,033 | 0,507 | 0,706 | 0,003 |
| August | 0,021 | 0,030 | 0,014 | 0,006 | 0,670 | 0,0 | 0,0 | 0,061 | 0,071 | 0,003 |
| September | 0,039 | 0,0 | 1,010 | 0,0 | 0,184 | 0,0 | 0,002 | 0,001 | 0,003 | 0,0 |
| October | 0,0 | 0,0 | 0,0 | 0,010 | 0,014 | 0,0 | 0,0 | 0,0 | 0,0 | 0,010 |
| November | 0,037 | 0,0 | 0,004 | 0,0 | 0,007 | 0,021 | 0,002 | 0,0 | 0,0 | 0,009 |
| December | 2,713 | 0,362 | 0,618 | 1,831 | 0,036 | 0,062 | 0,032 | 0,012 | 0,015 | 0,0 |
| Total | 88,780 | 9,512 | 9,445 | 7,525 | 20,767 | 50,907 | 12,350 | 3,410 | 3,638 | 0,872 |

Table 3 – continued.

| Month | 1990* | Range** | Mean** | % |
|---|---|---|---|---|
| January | 0,0 | 0,0 – 79,3 | 14,751 | 8,28 |
| February | 0,0 | 0,0 – 100,7 | 19,393 | 10,89 |
| March | 0,0 | 0,0 – 69,6 | 14,256 | 8,00 |
| April | 0,0 | 0,123 – 121,5 | 42,289 | 23,74 |
| May | 0,0 | 0,002 – 124,3 | 46,953 | 26,36 |
| June | 0,029 | 0,0 - 44,7 | 12,098 | 6,79 |
| July | 0,0 | 0,0 – 21,2 | 4,149 | 2,33 |
| August | 0,0 | 0,0 – 37,1 | 4,949 | 2,78 |
| September | 0,026 | 0,0 – 32,3 | 6,796 | 3,82 |
| October | 0,0 | 0,0 – 30,4 | 4,997 | 2,81 |
| November | 0,0 | 0,0 – 18,5 | 2,381 | 1,34 |
| December | 0,0 | 0,0 – 17,7 | 5,088 | 2,86 |
| Mean | 0,055 | 0,0 – 124,3 | 178,100 | 100,00 |

* - the turbot catches were forbidden during the period 1990-1994

** - during the period 1960 - 1989

As it is evident from Table 3 and Figure 1, the largest turbot catches had been obtained during spring (April and May) – 50,1% from the mean total catch during the period 1960 – 1989. As it is well known, the turbot spawns in these two months. In March it migrates from the depths of 70 – 110 m, where it is wintering, to the depths of 20 – 40 m to spawn. Thus it is apparent that till the closure of the turbot fishery (1990 – 994) the fish species had been caught most intensively during its spawning season. After the ban for the spawning period (since 1994) was started and due to the restriction of the catches, the turbot stocks may have probably begun recovering with the mean catch of 68,4 tons (during the period 1995 – 2002).

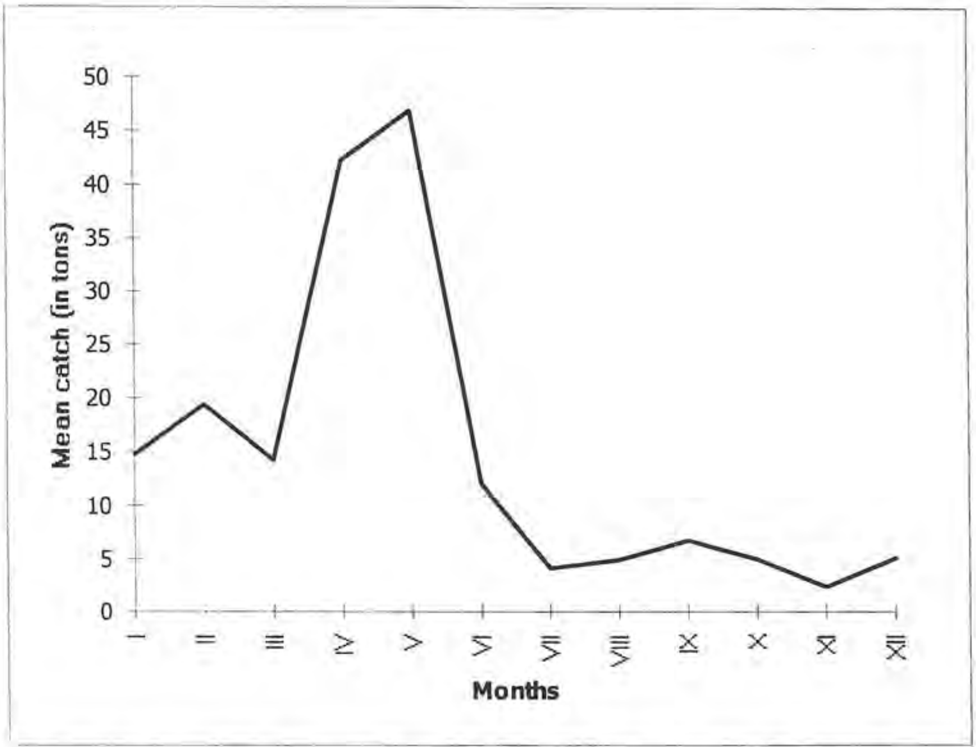



Figure 1. Mean turboth catches by months (in tons) during the period 1960 – 1989.

**Fam. PLEURONECTIDAE Rafinesque. Flatfishes. (Right-eyed flounders)**
**PLATICHTHIS FLESUS LUSCUS (PALLAS). European flounder.**

The flounder landings during the period 1925 – 2002 are shown in Table 4. The fish as it is evident has always been of inconsiderable significance for the Bulgarian fishery.

**Fam. SOLEIDAE Bonaparte. Soles**
**SOLEA NASUTA (PALLAS). Snouted sole.**

The sole catches have been incidentally reported for the Bulgarian zone. In 2002 the catch was 9,5 tons.

Table 4. Bulgarian landings of the European flounder (in tons) during the period 1925 – 2002.

| Years | Tons | Years | Tons | Years | Tons | Years | Tons |
|---|---|---|---|---|---|---|---|
| 1925 | 1,7 | 1945 | + | 1965 | 0,0 | 1985 | 0,0 |
| 1926 | 1,0 | 1946 | + | 1966 | 0,0 | 1986 | 0,0 |
| 1927 | 0,2 | 1947 | + | 1967 | 0,0 | 1987 | 0,0 |
| 1928 | 0,2 | 1948 | 0,9 | 1968 | 0,0 | 1988 | 0,0 |
| 1929 | 0,4 | 1949 | ·0,0 | 1969 | 0,0 | 1989 | 0,0 |
| 1930 | + | 1950 | + | 1970 | 0,0 | 1990 | 0,0 |
| 1931 | + | 1951 | 0,1 | 1971 | 0,0 | 1991 | 0,0 |
| 1932 | 0,1 | 1952 | + | 1972 | 0,0 | 1992 | 0,0 |
| 1933 | + | 1953 | 0,2 | 1973 | 0,0 | 1993 | 0,0 |
| 1934 | 0,1 | 1954 | 0,1 | 1974 | 0,0 | 1994 | 0,0 |
| 1935 | 0,1 | 1955 | 0,0 | 1975 | 0,0 | 1995 | 0,0 |
| 1936 | + | 1956 | 0,2 | 1976 | 0,0 | 1996 | 0,0 |
| 1937 | 0,0 | 1957 | 0,0 | 1977 | 0,0 | 1997 | 0,0 |
| 1938 | 0,1 | 1958 | + | 1978 | 0,0 | 1998 | 0,0 |
| 1939 | 0,2 | 1959 | + | 1979 | 0,0 | 1999 | 0,0 |
| 1940 | 0,8 | 1960 | 0,0 | 1980 | 0,0 | 2000 | 0,0 |
| 1941 | 0,8 | 1961 | 0,0 | 1981 | 0,0 | 2001 | 0,0 |
| 1942 | 0,2 | 1962 | 0,0 | 1982 | 0,0 | 2002 | 9,0 |
| 1943 | 0,9 | 1963 | 0,0 | 1983 | 0,0 | Mean | 0,22 |
| 1944 | + | 1964 | 0,0 | 1984 | 0,0 | | |

## Fam GOBIIDDAE Bonaparte. Gobies.

Twenty two goby fish occur off the Bulgarian coast, however, only few are of commercial importance (Table 5). The catches of gobies during 1925 – 2002 are presented in Table 6. The mean catch is 81 tons. The largest catches have been made during 1955 –1999, on the average of 459,8 tons. In 2000 – 2002 the catches were comparatively stable and have varied hardly from 141,5 to 144,8 tons.

Table 5. Species composition of the representatives of Fam. Gobiidae along the Bulgarian Black Sea coast (after PRODANOV *et al.*, 1993).

| No | Species name | * | ** | *** |
|---|---|---|---|---|
| 1 | *Aphya minuta* (Risso) | - | - | + |
| 2 | *Bentophiloides brauneri* (Beling et Iljin) | + | - | - |
| 3 | *Chromogobius quadrivittatus* (Steindachner) = *Relictogobius kryzhanobski* (Ptchelina) | - | - | + |
| 4 | *Gobius bucchichi* (Steindachner) | - | - | + |
| 5 | *Gobius cobitis* (Pallas) | - | - | + |
| 6 | *Gobius niger* (Lineaneus) | - | - | + |
| 7 | *Gobius ophiocefalus* (Pallas) | - | - | + |
| 8 | *Gobius paganelus* (Lineaneus) | - | - | + |
| 9 | *Knipowitschia georghievi* (Pinchuk) = *K. longicaudata* (Kessler) | + | - | - |
| 10 | *Mesogobius batrachocephalus* (Pallas) | + | - | - |
| 11 | *Neogobius cephalarges* (Pallas) | + | - | - |
| 12 | *Neogobius fluviatilis* (Pallas) | + | - | - |
| 13 | *Neogobius gymnotrachelus* (Kessler) = *Mesogobius gymnotrachelus* (Kessler) | + | - | - |
| 14 | *Neogobius melanostomus* (Pallas) | + | - | - |
| 15 | *Neogobius platyrostris* (Pallas) | + | - | - |
| 16 | *Neogobius ratan* (Nordmann) | + | - | - |
| 17 | *Neogobius cephalargoides* (Pinchuk) | + | - | - |
| 18 | *Neogobius syrman* (Nordmann) | + | - | - |
| 19 | *Pomatoschistus caucasicus* (Kawrajski) = *Knipowitschia kawrajski* (Berg) | + | - | - |
| 20 | *Pomatoschistus marmoratus* (Pallas) = *P. microps* (Kroyer) | - | - | + |
| 21 | *Pomatoschistus elongatus* (Canestrini) = *P. minutus* (Pallas) | - | - | + |
| 22 | *Proterorhinus marmoratus* (Pallas) | + | - | - |

* - Pontic relicts; ** - Borealo-Atlantic relicts; *** Mediterranean immigrants.

Table 6. Bulgarian landings of Black Sea gobies (in tons) during the period 1925-2002.

| Years | tons | Years | Tons | Years | tons | Years | Tons |
|---|---|---|---|---|---|---|---|
| 1925 | 60,0 | 1945 | 70,2 | 1965 | 31,4 | 1985 | 80,7 |
| 1926 | 68,7 | 1946 | 49,2 | 1966 | 23,8 | 1986 | 62,3 |
| 1927 | 46,8 | 1947 | 61,4 | 1967 | 12,7 | 1987 | 23,1 |
| 1928 | 65,8 | 1948 | 133,3 | 1968 | 12,9 | 1988 | 10,0 |
| 1929 | 60,1 | 1949 | 139,1 | 1969 | 16,5 | 1989 | 23,0 |
| 1930 | 39,4 | 1950 | 115,3 | 1970 | 18,3 | 1990 | 14,0 |
| 1931 | 75,0 | 1951 | 96,3 | 1971 | 35,4 | 1991 | 24,0 |
| 1932 | 63,0 | 1952 | 50,4 | 1972 | 32,9 | 1992 | 20,0 |
| 1933 | 106,8 | 1953 | 33,4 | 1973 | 32,1 | 1993 | 10,0 |
| 1934 | 135,7 | 1954 | 10,2 | 1974 | 24,4 | 1994 | 10,9 |
| 1935 | 107,5 | 1955 | 4,5 | 1975 | 36,0 | 1995 | 580,0 |
| 1936 | 118,3 | 1956 | 42,0 | 1976 | 36,5 | 1996 | 477,0 |
| 1937 | 98,5 | 1957 | 31,5 | 1977 | 10,9 | 1997 | 423,9 |
| 1938 | 90,0 | 1958 | 29,7 | 1978 | 7,4 | 1998 | 381,1 |
| 1939 | 115,3 | 1959 | 21,9 | 1979 | 6,7 | 1999 | 437,0 |
| 1940 | 139,1 | 1960 | 94,4 | 1980 | 8,6 | 2000 | 144,8 |
| 1941 | 141,3 | 1961 | 40,1 | 1981 | 8,9 | 2001 | 142,0 |
| 1942 | 124,3 | 1962 | 31,5 | 1982 | 4,0 | 2002 | 141,5 |
| 1943 | 81,9 | 1963 | 30,6 | 1983 | 5,1 | Mean | 81,0 |
| 1944 | 62,8 | 1964 | 27,5 | 1984 | 38,9 | | |

**Fam. RAJIDAE Bonaparte. Rays (Skates)**
**RAJA CLAVATA LINNAEUS. Thornback ray.**

The thornback ray has no commercial importance due to its low market demands (Table 7).

Table 7 Bulgarian landings of thornback ray (in tons) during the period 1925-2002.

| Years | Tons | Years | Tons | Years | Tons | Years | Tons |
|---|---|---|---|---|---|---|---|
| 1925 | 0,0 | 1945 | 0,4 | 1965 | 0,0 | 1985 | 0,0 |
| 1926 | 0,0 | 1946 | 0,6 | 1966 | 0,0 | 1986 | 0,1 |
| 1927 | 0,0 | 1947 | 0,6 | 1967 | 0,0 | 1987 | 0,0 |
| 1928 | 0,0 | 1948 | 1,1 | 1968 | 0,0 | 1988 | 0,0 |
| 1929 | 0,0 | 1949 | 1,8 | 1969 | 0,0 | 1989 | 0,0 |
| 1930 | 0,0 | 1950 | 1,7 | 1970 | 0,0 | 1990 | 0,0 |
| 1931 | 0,0 | 1951 | 2,6 | 1971 | 0,0 | 1991 | 0,0 |
| 1932 | 0,0 | 1952 | 2,6 | 1972 | 0,0 | 1992 | 0,0 |
| 1933 | 0,0 | 1953 | 5,0 | 1973 | 0,0 | 1993 | 0,0 |
| 1934 | 1,7 | 1954 | 2,2 | 1974 | 0,0 | 1994 | 0,0 |
| 1935 | 0,0 | 1955 | 13,3 | 1975 | 0,0 | 1995 | 0,0 |
| 1936 | 0,8 | 1956 | 2,3 | 1976 | 0,0 | 1996 | 0,0 |
| 1937 | 1,5 | 1957 | 20,2 | 1977 | 0,0 | 1997 | 0,0 |
| 1938 | 1,6 | 1958 | 9,7 | 1978 | 0,0 | 1998 | 0,0 |
| 1939 | 1,2 | 1959 | 8,6 | 1979 | 0,0 | 1999 | 0,0 |
| 1940 | 3,5 | 1960 | 0,0 | 1980 | 0,0 | 2000 | 0,0 |
| 1941 | 4,7 | 1961 | 0,0 | 1981 | 5,2 | 2001 | 0,0 |
| 1942 | 0,7 | 1962 | 0,0 | 1982 | 0,1 | 2002 | 0,0 |
| 1943 | 0,0 | 1963 | 0,0 | 1983 | 0,7 | Mean | 1,2 |
| 1944 | 0,0 | 1964 | 0,0 | 1984 | 0,1 | | |

**Fam. DASYATIDAE (TRIGONIDAE). Stingrays.**
**DASYATIS PASTINACA (LINNAEUS) = TRIGON PASTINACA (LINNAEUS). Atlantic (common) stingray.**

The common stingray has no commercial importance due its low market demands.

**Fam. SQUALIDAE Blanville. Dogfishes.**
**SQUALUS ACANTHIAS LINNAEUS. Picked (=spiny) dogfish.**

The landings of spiny dogfish are presented in Table 8.

Table 8. Bulgarian landings of Black Sea spiny dogfish (in tons) during the period 1925-2002.

| Years | Tons | Years | Tons | Years | tons | Years | Tons |
|---|---|---|---|---|---|---|---|
| 1925 | 0,0 | 1945 | + | 1965 | 0,0 | 1985 | 67,5 |
| 1926 | 1,7 | 1946 | 0,1 | 1966 | 0,0 | 1986 | 152,6 |
| 1927 | 0,0 | 1947 | 0,1 | 1967 | 0,0 | 1987 | 90,3 |
| 1928 | 1,1 | 1948 | 0,1 | 1968 | 0,0 | 1988 | 51,0 |
| 1929 | 0,4 | 1949 | 0,8 | 1969 | 0,0 | 1989 | 27,7 |
| 1930 | 0,2 | 1950 | 0,1 | 1970 | 0,0 | 1990 | 16,4 |
| 1931 | 0,1 | 1951 | 0,1 | 1971 | 0,0 | 1991 | 21,0 |
| 1932 | 0,0 | 1952 | 0,1 | 1972 | 0,0 | 1992 | 14,0 |
| 1933 | 0,0 | 1953 | 0,5 | 1973 | 0,0 | 1993 | 12,0 |
| 1934 | 3,5 | 1954 | 0,1 | 1974 | 0,0 | 1994 | 12,0 |
| 1935 | 2,3 | 1955 | 5,0 | 1975 | 0,0 | 1995 | 80,0 |
| 1936 | 0,4 | 1956 | 2,0 | 1976 | 0,0 | 1996 | 64,0 |
| 1937 | 0,4 | 1957 | 2,4 | 1977 | 0,0 | 1997 | 40,0 |
| 1938 | + | 1958 | 6,8 | 1978 | 0,0 | 1998 | 28,0 |
| 1939 | 0,1 | 1959 | 1,9 | 1979 | 0,0 | 1999 | 25,0 |
| 1940 | 0,0 | 1960 | 0,0 | 1980 | 0,0 | 2000 | 102,3 |
| 1941 | 0,1 | 1961 | 0,0 | 1981 | 27,4 | 2001 | 126,0 |
| 1942 | 0,0 | 1962 | 0,0 | 1982 | 16,1 | 2002 | 100,0 |
| 1943 | 0,0 | 1963 | 0,0 | 1983 | 53,2 | Mean | 15,3 |
| 1944 | 0,0 | 1964 | 0,0 | 1984 | 36,0 | | |

## Fam. ACIPENCERIDAE. Sturgeons.

Six species of Fam. Acipenceridae occur in the Black Sea. Five of them are anadromous and one inhabiting only fresh waters (Danube River) – the sterlet sturgeon, *Acipencer ruthenus* (Linnaeus). One species is considered almost extinct - the bastard (spiny) sturgeon *Acipencer nudiventris* Lovetzky. Among the rest four species the beluga (great sturgeon), *Huso huso* (Linnaeus), and the Russian (Danube) sturgeon, *Acipencer guldenstaedti* Brandt, are of greatest importance for the Bulgarian fishery. The first fish is caught in the Danube and the Black Sea and the second only in the Danube. Out of the remaining two fish – the common (Atlantic sea), *Acipencer sturio* Linnaeus, and the starry (stelate) sturgeon , *Acipencer stellatus* Pallas, - The second is mainly caught.

In Table 9 the catch of the sturgeons in Bulgaria (the Danube and the Black Sea) are presented.

Table 9. Bulgarian landings of sturgeons (in tons) during the period 1925-2002.

| Years | Tons | Years | Tons | Years | Tons | Years | Tons |
|---|---|---|---|---|---|---|---|
| 1925 | 0,3 | 1945 | 0,5 | 1965 | 73,2 | 1985 | 3,4 |
| 1926 | 0,7 | 1946 | 0,6 | 1966 | 53,9 | 1986 | 21,6 |
| 1927 | 0,8 | 1947 | 1,2 | 1967 | 29,9 | 1987 | 13,7 |
| 1928 | 1,5 | 1948 | 0,6 | 1968 | 39,2 | 1988 | 1,0 |
| 1929 | 0,7 | 1949 | 0,6 | 1969 | 45,1 | 1989 | 28,0 |
| 1930 | 0,3 | 1950 | 1,0 | 1970 | 30,2 | 1990 | 14,6 |
| 1931 | 0,5 | 1951 | 0,8 | 1971 | 13,4 | 1991 | 8,0 |
| 1932 | 0,6 | 1952 | 0,2 | 1972 | 17,3 | 1992 | 12,0 |
| 1933 | 0,5 | 1953 | 0,6 | 1973 | 29,9 | 1993 | 10,0 |
| 1934 | 1,5 | 1954 | 1,9 | 1974 | 23,0 | 1994 | 5,0 |
| 1935 | 2,2 | 1955 | 5,9 | 1975 | 34,5 | 1995 | 30,0 |
| 1936 | 1,1 | 1956 | 6,1 | 1976 | 41,5 | 1996 | 32,0 |
| 1937 | 1,0 | 1957 | 14,6 | 1977 | 51,1 | 1997 | 49,0 |
| 1938 | 0.9 | 1958 | 39,3 | 1978 | 97,0 | 1998 | 55,0 |
| 1939 | 1,4 | 1959 | 21,2 | 1979 | 50,1 | 1999 | ..... |
| 1940 | 2,0 | 1960 | 11,8 | 1980 | 37,3 | 2000 | ..... |
| 1941 | 1,1 | 1961 | 5,9 | 1981 | 28,4 | 2001 | ..... |
| 1942 | 3,2 | 1962 | 23,6 | 1982 | 26,9 | 2002 | 24,1 |
| 1943 | 0,8 | 1963 | 61,7 | 1983 | 3,0 | Mean | 17,1 |
| 1944 | 0,4 | 1964 | 67,3 | 1984 | 11,2 | | |

## Fam. MUGILIDAE Cuvier. Mullets.

Five mugilid fish, including the new fish species the harder, it Mugil soiuy Basilewsky introduced in the Black Sea basin about 20 years ago, occur along the Bulgarian coast and the adjacent lakes. The largest catches are made for the flathead grey mullet (*Mugil cephalus*, Linnaeus), followed by that of the leaping grey mullet, *Liza saliens* (Risso) and the golden (long-finned) grey mullet, *Liza aurata* (Risso). The Black Sea (thin lipped) mullet, *Liza ramada* (Risso) falls incidentally in the catches as single specimens.

In Table 10 and Figure 2, the landings of Mugilidae during the period 1925 – 2002 are presented.

Table 10. Bulgarian landings of Mugilidae (in tons) during the period 1925-2002.

| Years | Tons | Years | Tons | Years | Tons | Years | Tons |
|---|---|---|---|---|---|---|---|
| 1925 | 12,9 | 1945 | 16,7 | 1965 | 34,8 | 1985 | 1,5 |
| 1926 | 27,1 | 1946 | 9,1 | 1966 | 37,2 | 1986 | 4,9 |
| 1927 | 28,3 | 1947 | 15,4 | 1967 | 48,2 | 1987 | 9,3 |
| 1928 | 27,3 | 1948 | 79,8 | 1968 | 27,8 | 1988 | 12,0 |
| 1929 | 1,8 | 1949 | 26,1 | 1969 | 12,7 | 1989 | 3,1 |
| 1930 | 14,5 | 1950 | 10,4 | 1970 | 18,3 | 1990 | 0,5 |
| 1931 | 31,9 | 1951 | 52,1 | 1971 | 8,9 | 1991 | 7,0 |
| 1932 | 32,3 | 1952 | 247,9 | 1972 | 18,7 | 1992 | 5,0 |
| 1933 | 21,7 | 1953 | 81,2 | 1973 | 5,3 | 1993 | 6,0 |
| 1934 | 11,5 | 1954 | 42,6 | 1974 | 12,1 | 1994 | 6,0 |
| 1935 | 12,9 | 1955 | 59,6 | 1975 | 10,0 | 1995 | 24,0 |
| 1936 | 76,8 | 1956 | 75,8 | 1976 | 14,7 | 1996 | 29,0 |
| 1937 | 139,6 | 1957 | 11,1 | 1977 | 5,7 | 1997 | 30,0 |
| 1938 | 93,2 | 1958 | 34,3 | 1978 | 7,8 | 1998 | 13,0 |
| 1939 | 200,2 | 1959 | 57,6 | 1979 | 19,5 | 1999 | 16,0 |
| 1940 | 145,7 | 1960 | 18,1 | 1980 | 6,3 | 2000 | 15,4 |
| 1941 | 83,8 | 1961 | 34,9 | 1981 | 10,1 | 2001 | 57,4 |
| 1942 | 33,0 | 1962 | 31,5 | 1982 | 26,9 | 2002 | 96,3 |
| 1943 | 9,7 | 1963 | 20,6 | 1983 | 5,6 | Mean | 174,3 |
| 1944 | 48,3 | 1964 | 27,4 | 1984 | 26,1 | | |

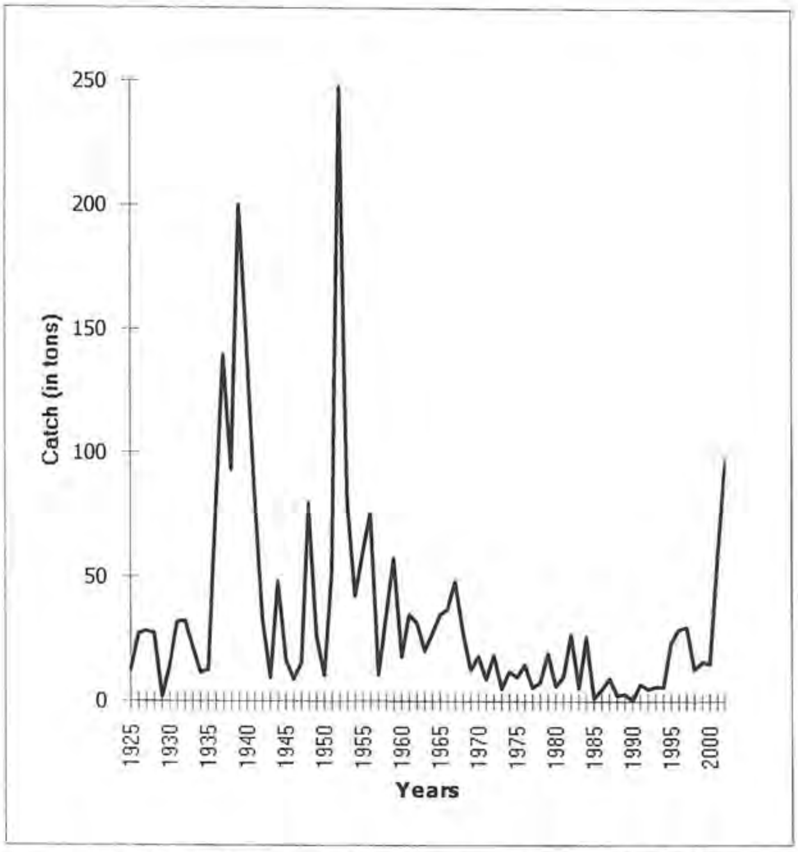



Figure 2. Bulgarian catches of mullets during 1925-2002.

The percentage of *M. cephalus*, *L. saliens* and *L. aurata* in the Bulgarian catches from the sea and adjacent lakes are given in Tables 11 and 12.

Table 11. Proportion (%) of the three mugilid species in the catches from the sea along the Bulgarian coast (ALEXANDROVA, 1973)

| Year | *M. cephalus* | *L. saliens* | *L. aurata* |
|---|---|---|---|
| 1966 | 8,76 | 9,37 | 81,87 |
| 1967 | 3,93 | 34,40 | 61,67 |
| 1968 | 4,49 | 10,15 | 85,36 |
| 1969 | 6,09 | 9,07 | 84,84 |
| 1970 | 7,63 | 44,03 | 48,34 |
| Average | 6,18 | 21,40 | 72,42 |

Table 12. Proportion of the three mugilid species in the Bulgarian catches from the shore lakes (ALEXANDROVA, 1973).

| Year | *M. cephalus* | *L. saliens* | *L. aurata* |
|---|---|---|---|
| 1956/1957 | 67,57 | 32,43 | 0,00 |
| 1957/1958 | 100,00 | 0,00 | 0,00 |
| 1958/1959 | 100,00 | 0,00 | 0,00 |
| 1959/1960 | 97,32 | 2,68 | 0,00 |
| 1960/1961 | 100,00 | 0,00 | 0,00 |
| 1961/1962 | 100,00 | 0,00 | 0,00 |
| 1962/1963 | 83,33 | 16,67 | 0,00 |
| 1963/1964 | 45,11 | 54,89 | 0,00 |
| 1964/1965 | 100,00 | 0,00 | 0,00 |
| 1965/1966 | 96,15 | 3,85 | 0,00 |
| 1966/1967 | 97,94 | 2,06 | 0,00 |
| 1967/1968 | 79,20 | 20,80 | 0,00 |
| 1968/1969 | 100,00 | 0,00 | 0,00 |
| 1969/1970 | 100,00 | 0,00 | 0,00 |
| Average | 90,47 | 9,53 | 0,00 |

It is evident that the flathhead grey mullet predominates in the shore lakes catches while the golden grey mullet occurs only in the sea catches.

## Fam. MULLIDAE. Goatfishes.
## MULLUS BARBATUS PONTICUS ESSIPOV. Striped (red) mullet.

The red mullet is caught incidentally off the Bulgarian coast. In some years there have been catches of the order of tens of tons, while in others just a few specimens.

The red mullet landings in the period 1925 – 2002 are presented in Table 13.

Table 13. Bulgarian landings of *Mullus barbatus* (in tons) during the period 1925-2002.

| Years | Tons | Years | Tons | Years | Tons | Years | Tons |
|---|---|---|---|---|---|---|---|
| 1925 | 5,7 | 1945 | 28,5 | 1965 | 0,0 | 1985 | 0,1 |
| 1926 | 7,8 | 1946 | 5,9 | 1966 | 0,0 | 1986 | 0,0 |
| 1927 | 10,8 | 1947 | 3,1 | 1967 | 0,0 | 1987 | 0,1 |
| 1928 | 4,9 | 1948 | 24,2 | 1968 | 0,0 | 1988 | 0,0 |
| 1929 | 0,2 | 1949 | 19,2 | 1969 | 0,0 | 1989 | 0,0 |
| 1930 | 1,7 | 1950 | 37,0 | 1970 | 0,0 | 1990 | 0,0 |
| 1931 | 9,2 | 1951 | 46,7 | 1971 | 0,0 | 1991 | 0,0 |
| 1932 | 0,8 | 1952 | 19,1 | 1972 | 0,0 | 1992 | 0,0 |
| 1933 | 4,6 | 1953 | 16,0 | 1973 | 0,0 | 1993 | 0,0 |
| 1934 | + | 1954 | 0,0 | 1974 | 0,0 | 1994 | 0,0 |
| 1935 | 7,3 | 1955 | 1,1 | 1975 | 0,0 | 1995 | 0,0 |
| 1936 | 42,0 | 1956 | 0,0 | 1976 | 0,0 | 1996 | 0,0 |
| 1937 | 16,2 | 1957 | + | 1977 | 0,0 | 1997 | 0,0 |
| 1938 | 16,0 | 1958 | 0,3 | 1978 | 0,0 | 1998 | 0,0 |
| 1939 | 50,1 | 1959 | 8,2 | 1979 | 0,0 | 1999 | 0,0 |
| 1940 | 34,4 | 1960 | 0,0 | 1980 | 0,0 | 2000 | 0,0 |
| 1941 | 9,0 | 1961 | 0,0 | 1981 | 0,0 | 2001 | 0,0 |
| 1942 | 0,4 | 1962 | 0,0 | 1982 | 0,0 | 2002 | 33,0 |
| 1943 | 1,5 | 1963 | 0,0 | 1983 | 0,0 | Mean | 6,1 |
| 1944 | 8,0 | 1964 | 0,0 | 1984 | 0,0 | | |

## CONCLUSION

It may be concluded from the overview of the demersal fish made herein that only a few of them are targets of intense commercial fishery – turbot, spiny dogfish, gobies, and to some extent fish of Fam. Mugilidae and sturgeons. The landings are comparatively small as bottom trawl hauls and dragging are prohibited by the Bulgarian legislation (April, 2001). Besides, during the spawning seasons of the turbot and gobies, their fishing is closed. All these fish are caught by nets the, the spiny dogfish are also fished by pelagic trawl hauls carried out near the bottom as the bycatch in the sprat fishery. The same manner is applied for the whiting and this is the reason why its catches are not statistically reported independently.

## REFERENCES

ALEXANDROVA, K. 1973. The catch of mullets along the Bulgarian coast and its impact on their stocks. Proceedings of the Institute of Oceanography and Fisheries, v. V, 133-143. (in Bulgarian).

FAO Yearbook Fishery statistics. 1998. Vol. 86/1.

IVANOV, L., KARAPETKOVA, M. 1979. Dynamics of the Reserves of Turbot (Scophthalmus maeoticus, Pallas) in the Bulgarian Shelf of the Black Sea and measures for their utilization. I. Growth and Mortality rate. Hydrobiology, Sofia, v.9, 3-14 (in Bulgarian).

IVANOV, L., BEVERTON, R.J.H. 1985. The fisheries resources of the Mediterranean. Part two: Black Sea. FAO Studies and Reviews, 60: 135 pp.

PRODANOV, K., DENCHEVA, K., IVANOV, L. 1993. Biodiversity of the ichthiofauna in the Bulgarian Black Sea waters. National Biological Diversity Conservation Strategy, Sofia, 547-566 (in Bulgarian).

# THE STATUS OF THE DEMERSAL FISH POPULATIONS ALONG THE BLACK SEA COAST OF UKRAINE

V. SHLYAKHOV, I. CHAROVA,
YugNIRO, Ukraine
Head of Division of Marine Living Resources of Black – Azov Seas Basin

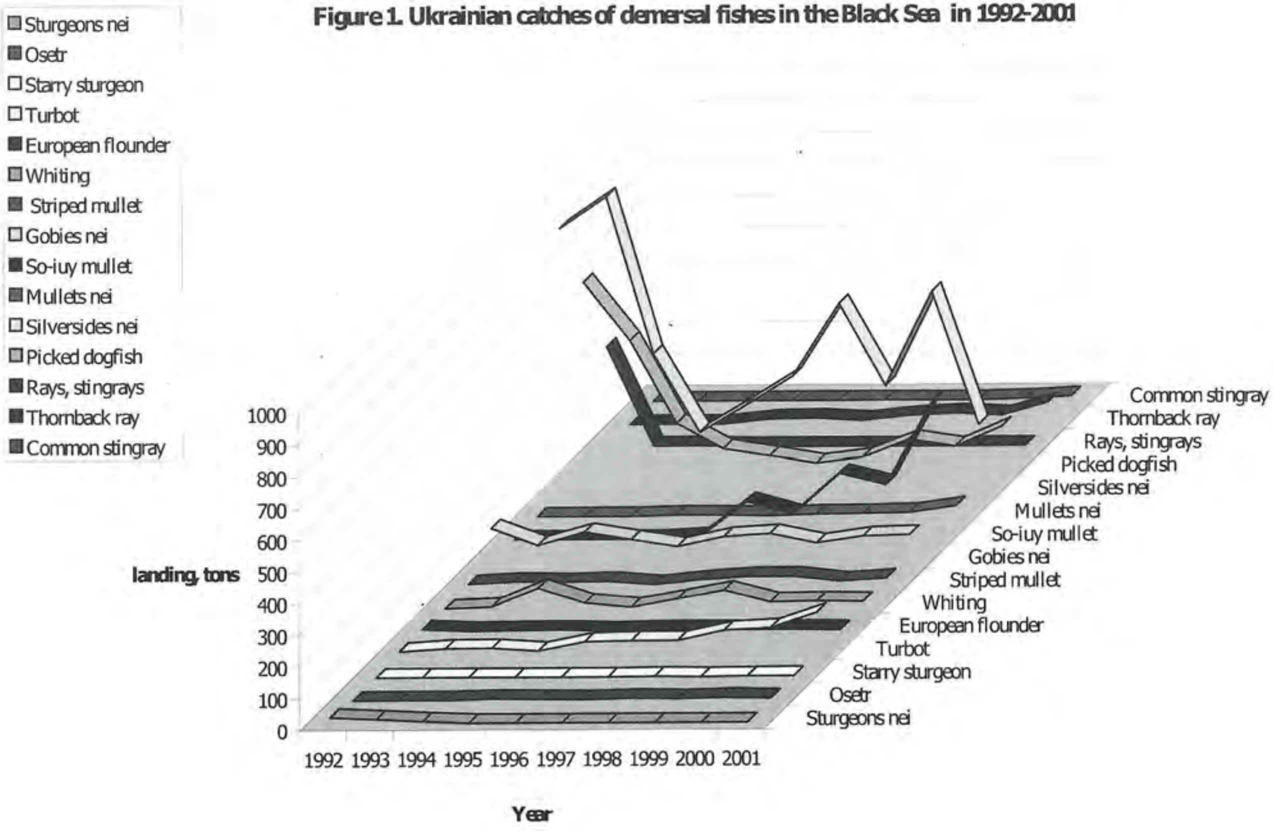
If one has to conventionally divide the commercial fish resources of the Black Sea into two major groups, they are namely resources of pelagic and demersal communities. The former group represented by highly abundant populations of fishes such as European anchovy, Azov Sea sprat (tyulka), European sprat and Mediterranean horse mackerel, is dominating undoubtedly. However, the group of the bottom community incorporates species being the most valuable in food and marketing respect, i.e. sturgeons, turbots, striped mullet, mullets, etc.

This paper provides the review of the status of the populations of most important commercial species inhabiting mainly bottom areas of the Black Sea along the Ukrainian coast, extracted as a result of YugNIRO fisheries research for recent 10 years. Dynamics of Ukrainian catches for demersal fishes (Figure 1) were distinguished by the initial slump from 1.5-1.9 thousand tons (1992 – 1993) down to 0.4 thousand tons (1995 – 1996) and the subsequent increase up to 1.1 thousand tons (2000 – 2001). Variations in amount and structure of the annual catches roughly reflect the processes, taking place in the Ukrainian economy during its transition from the planned model toward the market one. For the first two years of the period under review, non-valuable silversides (44-64%) had the greatest share in catches and the percentage of species with traditional high commercial demand in Ukraine (sturgeons, mullets, gobies, and striped mullet) made up only 7-8%. In 2000-2001 silversides percentage reduced down to 19-54%, and that of the most valuable fish species increased up to 32-61%. Yet the statistics of catches alone cannot always fairly describe the status of the fish populations. The distribution, stock assessments and measures being taken in Ukraine in order to regulate fisheries in respect of whiting, turbot, mullets, striped mullet, picked dogfish, thornback ray and common stingray.

Whiting. In the Ukrainian Black Sea, it is one of the most abundant species among the demersal fishes. The adult whiting is cold-living, preferring temperatures not higher than 9-10° C. It occurs all along the shelf, dense commercial concentrations are formed by 2-3 year old fishes most often in depth 60-120 m. Such concentrations off the Ukrainian coast are not formed every year, appearing with the periods of 5-6 years. In the period under review, along the coasts of the Crimea the densest concentrations of whiting were observed in 1992, 1996 and 2002. It does not undertake long migration, and spawns mainly in the cold season within the whole habitat area.

Since 1976 the area coverage technique incorporating the data of bottom trawl surveys has been applied. Since 1982, in the years between surveys, the abundance and biomass of fishes have been calculated by the mathematical modeling. The mathematical modeling

**Figure 1. Ukrainian catches of demersal fishes in the Black Sea in 1992-2001**



has integrated several techniques, developed in YugNIRO. These are Ricker's modified model for the isolated whiting population and multi-species model for the populations of whiting and picked dogfish (SHLYAKHOV, 1983 ; SHLYAKHOV, 1997). The stock assessments for whiting are given in Table 1.

In Ukrainian waters, whiting and sprat fisheries with midwater trawls are permitted approximately in 60% of the shelf zone. For the whole year four grounds are closed for fisheries, the most spacious of them being located north to the line connecting Tarkhankut Cape and Belgorod-Dnestrovsky Liman (estuary). As sprat trawl fisheries are more profitable for economic reasons, fishermen try to conduct fisheries on the grounds with its densest concentrations, occurring usually in depth 30-60 m. On such relatively shallow grounds, fine-sized whiting less than 2 years old occurs. Sprat catches with bycatch of small whiting are almost not graded to size and they are recorded in statistics as sprat. Grading is made in case of increased bycatch (more than 10-20%), graded whiting are either landed under its name during discharging, or merely discarded (although it is prohibited by the Regulations of Fisheries). In the latter case they do not sink due to the inflated belly and almost totally they become the bait for the fish-eating birds.

Table 1. Stock (thousand tons) of Black Sea whiting in zone of YugNIRO registration in 1992 - 2002.

| **Years** | **Trawl surveys** | | **Ricker's modified model** | |
|---|---|---|---|---|
| | Waters of Ukraine, the Russian Federation and Georgia | Waters of Ukraine | Waters of Ukraine, the Russian Federation and Georgia | Waters of Ukraine |
| 1992 | 108 | 75 | 98 | 65 |
| 1993 | - | - | 90 | 60 |
| 1994 | - | - | 70 | 47 |
| 1995 | - | - | 64 | 43 |
| 1996 | - | - | 77 | 51 |
| 1997 | - | - | 72 | 48 |
| 1998 | - | 34 | 68 | 45 |
| 1999 | - | - | - | 33 |
| 2000 | - | - | - | 33 |
| 2001 | - | - | - | 40 |
| 2002 | - | - | - | 68 |

Every year YugNIRO undertakes the expert estimates of whiting actually harvested with trawl as a bycatch. These estimates are based on the monitoring data extracted in the process of sprat fisheries on board fishing vessels. In 2002 the factual by-catch of whiting with midwater trawls made up 4% on average, and in terms of weight it was the largest in the period of 1992 – 2002 (Table 2). Like in the previous years, the catch statistics included only its small part.

Table 2. Black Sea whiting catches in 1992 – 2002.

| Year | Sprat catch according to the official statistics* (thousand tons) | Mean by-catch of whiting, (%) | Whiting catch, (thousand tons) | |
|---|---|---|---|---|
| | | | Official statistics | Expert estimate |
| 1992 | 11,5 | 8,0 | - | 0,9 |
| 1993 | 9,5 | 5,0 | 0,0 | 0,5 |
| 1994 | 12,6 | 3,0 | 0,1 | 0,4 |
| 1995 | 15,2 | 4,0 | 0,0 | 0,6 |
| 1996 | 20,7 | 5,0 | 0,0 | 1,1 |
| 1997 | 20,2 | 5,0 | 0,0 | 1,0 |
| 1998 | 30,3 | 3,0 | 0,1 | 1,0 |
| 1999 | 29,2 | 2,0 | 0,0 | 0,65 |
| 2000 | 32,6 | 3,0 | 0,0 | 0,95 |
| 2001 | 49,0 | 2,0 | 0,0 | 1,0 |
| 2002 | 45,5 | 4,0 | 0,0 | 1,8 |

* – provisional data

"Regulations of the Commercial Fisheries in the Black Sea Basin" currently in force in Ukraine have determined the following requirements: minimum commercial size of whiting – 12 cm (SL); the allowable by-catch of its juveniles – not more than 20% of total biomass of catch during non-target trawl fisheries and not more than 30% by counting during the target fisheries with trawls (with mesh size not less than 12 mm). The annual regulation of whiting fisheries includes determination of the limits for whiting's harvesting on the basis of its stock value and TAC. It should be noted that, even taking into account the by-catch in sprat fisheries, total yield of whiting in the Ukrainian waters does not exceed 30% of TAC. Therefore whiting resources are the reserve for the fisheries in our country.

Turbot. It occurs all over the shelf of Ukraine. Like whiting, it does not undertake distant transboundary migrations. Local migrations (spawning, feeding and wintering) have a general direction from the open sea towards the coast or from the coasts towards offshore.

It spawns in spring, since late March till mid and late June at the water temperature 8-12°C. The peak of the spawning falls on the late April – May in depths down from 20-40 to 60 m. The grounds of the most abundant reproduction are rather compact, in the northwestern Black Sea. They are located in the area of Tarkhankut Peninsula, and in the northeastern Black Sea – in front of the Kerch Strait and in the Feodosia Strait. In some years the turbot forms major spawning concentrations along the northwestern coasts of Tarkhankut Peninsula and in Karkinitsky Bay, but more often – along the southern coasts of Tarkhankut Peninsula and sometimes in Kalamitsky Bay. In the northwestern Black Sea more than 60% of brood stock inhabiting the Ukrainian waters spawn. After the spawning turbot move downwards to the depth 50-90 m and till the early autumn it leads a low-activity life, feeding poorly.

In autumn, the turbot reaches the coasts again, where it feeds intensively. For wintering it migrates to the depths more than 60 m. During the wintering period in the northwestern Black Sea it distributes on the grounds from Uret Cape to Tarkhankut Cape within the depth range of 70-90 m. In the northeastern Black Sea the major grounds of the wintering concentrations are located in the waters of the Russian Federation.

Target trawl fisheries for the Black Sea turbot in the waters of Ukraine are prohibited. Net target fisheries for the turbot are permitted since 1 February till 31 October. Net fishing is more efficient during spawning on spawning grounds (usually since late April till mid May) as well as in the periods of local spawning and post-spawning migrations (March-April, June-early July), and wintering migrations (October – November). During migrations, net are mostly set in depth from 40 down to 60 m on the migration routes of turbot.

To assess the turbot stock we have applied a wide set of techniques (trawl surveys, tagging, VPA, etc.), but for the last 10 years the area coverage technique based on the trawl surveys data and mathematical modeling based on Baranov's modified equation (SHLYAKHOV, 1997 ; KOKOZ *et al.*,1995) are mostly used for the sake of practical reasons. Results of the turbot stock assessments are given in Table 3.

Table 3. Fisheries stock (thousand tons) of the Black Sea turbot in YugNIRO survey zone in 1992 – 2002.

| Years | Trawl surveys | | Baranov's modified model | |
|---|---|---|---|---|
| | Waters of Ukraine and the Russian Federation | Waters of Ukraine | Waters of Ukraine and the Russian Federation | Waters of Ukraine |
| 1992 | 12,2 | 10,4 | 14,6 | 8,7 |
| 1993 | - | 8,2 | 12,5 | 7,9 |
| 1994 | - | 8,2 | 13,0 | 8,2 |
| 1995 | - | - | - | 10,2 |
| 1996 | - | - | - | 13,7 |
| 1997 | - | - | - | 13,5 |
| 1998 | - | 8,4 | - | 13,3 |
| 1999 | - | - | - | 12,6 |
| 2000 | - | - | - | 9,0 |
| 2001 | - | 9,9 | - | 10,5 |
| 2002 | - | 10,0 | - | 8,9 |

Like for many demersal fish species, at justifying of the efficient measures as for turbot fisheries regulation the serious problem is the considerable exceeding of the recorded statistics by factual yields. We produce expert estimates of turbot actual by-catch during sprat trawl fisheries on a regular basis. However, unlike the above-mentioned estimates of whiting by-catch, these estimates cannot be equal to factual yields of turbot in the Ukrainian waters, as this fish does not perish after the returning to the sea. It is even more complicated to produce unbiased estimates of turbot yields at the poaching fisheries conducted by both Ukrainian and Turkish fishermen. With these reservations our estimates of the non-registered annual yield of turbot in the Ukrainian waters were in the range 0.2 – 0.8 thousand tons in 1992 – 2002.

Without detailed and more reliable estimates of the non-recorded catches (for instance under RRA techniques) we have to understate the value of the annually determined limit in order to avoid over fishing. For the last five years by our recommendations limit for turbot fishing has been set as 10 – 20% of TAC.

The Regulations of Fisheries determine the following standards regulating the fisheries of the Black Sea turbot:

- minimum commercial fishing size – 35 cm (SL);

- allowable by-catch of its juveniles – during the non-target fisheries not more than 2% of total catch weight, during the target fisheries with nets (with mesh size 180 mm) not more 5% in numbers;

- during target long-lining of picked dogfish and *Rajiformes* by-catch of turbots is allowed, at the amount of not more than 20% of its juveniles in numbers;

- turbot by-catch is allowed in trawl catches of sprat not more than 4 individuals of commercial fishing length per one ton of catch;

- in the period of abundant spawning of turbot in the coastal 12-mile zone a temporal prohibition for 15 – 30 days is implemented for harvesting of fish with trawls, net and long-lines (such prohibition may be imposed gradually).

In addition to the above-mentioned items, the annual regulation of turbot fisheries includes determination of limits for harvesting (proceeding from its stock and TAC) as well as a restriction in a number of nets. For the last two years number of nets (not more 100 m long each) is restricted to 8 – 8.5 thousands of nets.

In conclusion we should note that measures taken by Ukraine in order to protect the Black Sea turbot are not strict enough. They were able to stabilize the turbot stock only at the level of 10 thousand tons, while before over-fishing in the mid 1970s its stock was 1.5-2 times higher.

<u>Mullets</u>. In the waters of Ukraine they are represented by six species, three of which are flathead gray mullet, golden gray mullet and acclimatized so-iuy mullet being of the greatest commercial value. Mullets are distributed all over the coastal waters and in the estuaries adjacent to the sea. Their migration routes run along the whole coast side and via the Kerch Strait (to the Sea of Azov and back). Wintering migrations of mullets are the most intensive in November. Wintering of warm-loving aboriginal mullets takes place in the narrow coastal band in depth less than 25 m in the restricted area near the southern coast of Crimea and in bays in the vicinity of Sevastopol. The wintering grounds of so-iuy mullet are studied not well enough. It is known, that so-iuy mullet spend winter in the vicinity of the Crimean coast, in the Dneprovsky estuary and in other estuaries connected to the sea (Donuzlav, Berezansky, etc.). Often it spends winter under the ice.

Spring migrations of mullets to the feeding grounds are the most intensive in early May till mid May. Golden gray mullet before the first maturation feeds mainly in the Karkinitsky Bay and in the Sea of Azov. All the repeatedly maturating individuals proceed for feeding only to the Karkinitsky Bay. Spawning migrations from feeding grounds to the Black Sea take place in late August - September.

To assess the stocks of the aboriginal mullets, visual air surveys were used occasionally till the early 1970s, from 1981 till 1990 Pope's cohort analysis was used

(SHLYAKHOV,1997). Then the period of deep depression for mullets set in and their fisheries were prohibited. Only in the late1990s populations of mullets became restored, however, their renewed fisheries are not intensive. This factor makes impossible to apply, as earlier, methods based on the analysis of the fishing and biological statistics.

Nowadays fishing of mullets in the Black Sea is carried out with passive fishing gears (with traps of different design). Non-recorded harvesting of mullets in the waters of Ukraine is likely to be large, yet nobody estimates it, even at the expert level.

To regulate the fishing of mullets in the Black Sea, the following standards were established:

- minimum commercial fishing size of aboriginal mullets - 20 cm, for Pacific mullet – 38 cm (SL);
- allowable by-catch of juvenile mullets in target fisheries is not more than 20% in numbers;
- in the period of abundant spawning of aboriginal mullets the temporal prohibition for their fishing is imposed since 20 August till 10 September all over the area.

Besides the above-mentioned items, the Regulations of Fisheries establish fishing periods, mesh size in the fishing gears of various types; limits for harvesting are established every year.

<u>Striped mullet</u>. Striped mullet is distributed all over the Ukrainian Black Sea. It prefers waters with the temperature higher 8° C and salinity more than 17 ‰. Striped mullet is most abundant in the vicinity of the Crimean coasts, where it is customary to distinguish two forms – settled and migrating ones. The latter has higher rate of growth. Migrating form has the greater commercial value, moving to the Kerch Strait and the Sea of Azov for feeding and spawning in spring, and coming back to the coasts of the Crimea for wintering. Target fishing of the striped mullet is permitted only with beach seines and scrapers; however, the greater part of its catches falls on non-target fishing with bottom traps. The major share of striped mullet is harvested in autumn in Balaklava, near Sebastopol. The amount of the non-registered catch of striped mullet is not defined.

The regulations of fisheries establish the minimum commercial fishing size for striped mullet as 8.5 cm (SL); the allowable by-catch of juveniles (in non-target fishing) – not more than 8% of the total weight of haul, in target fishing – not more than 20% in numbers; the mesh size in beach seines and in scrapers – 10 mm. The annual determination of limits for striped mullet harvesting is made without TAC, but taking into account the monitoring of the whole status of the population (size and age composition of catches, proportion between the rest and recruitment, etc.).

<u>Picked dogfish</u>. It inhabits the whole Black Sea shelf at the water temperatures 6 – 15° C. It undertakes regular migrations in the waters of Ukraine. In autumn feeding migrations are aimed at the grounds of the formation of the wintering concentrations of anchovy and horse mackerel in the vicinity of the Crimean coasts. With their disintegration picked dogfish disperses all over the shelf. Reproductive migrations of viviparous picked dogfish take place towards the coastal shallow

water with two peaks of intensity – in spring and autumn. The autumn migration for reproduction covers more individuals usually. The major grounds for reproduction of picked dogfish in the Ukrainian waters are located in Karkinitsky Bay, in front of the Kerch Strait and in Feodosia Bay.

Most of picked dogfish is harvested in spring and autumn months by target fishing with nets of the mesh size100 mm and with long-lines and during sprat trawl fisheries as by-catch. The target fishing is permitted on the grounds southwards the line connecting Tarkhankut Cape and Belgorod-Dnestrovsky Liman.

To assess the picked dogfish stock, the area coverage technique incorporating the data of trawl surveys, as well as dynamic model of an isolated population, being a combination of Baranov's analytical model and the reproduction model (SHLYAKHOV, 1997 ; KIRNOSOVA and SHLYAKHOV, 1988) were applied. The results of the picked dogfish stock assessments are given in Table 4. Picked dogfish in the waters of Ukraine tend to be reduced slowly, although its population is harvested slightly. This is connected with progressive deterioration of reproductive ability of the females, which we have observed since the early 1990s. If in 1970-80s the mean number of yolk ovocytes for one female made up 22, and embryos – 14, so by the late 1990s these figures made up, respectively, 19.5 and 12.4. As a result, the abundance of recruits reduces year by year.

Table 4. Commercial stock of picked dogfish in the Black Sea and along the coast of the former USSR and in the water of Ukraine in 1992 - 2002 (thousand tons).

| Years | Waters of Ukraine, the Russian Federation and Georgia | | Waters of Ukraine | |
|---|---|---|---|---|
| | Trawl survey | Modeling | Trawl survey | Modeling |
| 1992 | 62,9 | 60,3 | 56,9 | - |
| 1993 | - | 57,1 | 30,2 | - |
| 1994 | - | 52,9 | 36,0 | 42,1 |
| 1995 | - | - | - | 37,6 |
| 1996 | - | - | - | 32,1 |
| 1997 | - | - | - | 31,0 |
| 1998 | - | - | 32,0 | 30,8 |
| 1999 | - | - | - | 28,0 |
| 2000 | - | - | - | 24,3 |
| 2001 | - | - | - | 22,3 |
| 2002 | - | - | - | 21,0 |

Monitoring of non-reported catches of picked dogfish in the waters of Ukraine in 1992 – 2003 was not carried out, but, according to the data available, their major amount fell on by-catch in sprat trawl fishing. In the late 1980s YugNIRO undertook expert estimates concerning picked dogfish by-catch in trawls for separate years. Thus, in 1998 its value in the waters of Ukraine was estimated as 0.8 thousand tons, while the official landing of picked dogfish in by-catch made up about 0.2 thousand tons, and total annual catch – 1.7 thousand tons. Intensity of trawl fishing of sprat in the waters of Ukraine in the first decade of the 21$^{st}$ century and in the late 1980s was related as 1/1.5, and the stocks of picked dogfish as 1/2. Proceeding from this, the rough assessment of the modern level of picked dogfish by-catch in trawls in our waters is equal to product $0.8*1/1.5*1/2 = 0.27$ thousand tons. Officially reported picked dogfish catch in 2001 (0.13 thousand tons) was half as much as this assessment. As in the case of turbot, a part of the picked dogfish as by-catch in trawls is released to the sea, not losing viability at this time.

To regulate picked dogfish fishing in the Black Sea the following norms were established:

- minimum commercial fishing size – 85 cm (SL);
- allowable by-catch of its juveniles in target fisheries not more than 15% in numbers.

The annual regulation of picked dogfish fishing includes determination of the limits for picked dogfish harvesting on the basis of its stock value and TAC.

Thornback ray and common stingray. Over the shelf of Ukraine two representatives of *Rajiformes* family – thornback ray and stingray occur. Thornback ray does not undertake distant migrations. Its local migrations are spring approaches to the coast in depth 10 – 40 m and autumn escapes to the open sea in depth more than 40 m. In summer, in the period of reproduction, and in the early autumn thornback ray is forming commercial concentrations mainly in the coastal waters of Crimea. In the rest periods of a year it distributes by segregations over a large area of the shelf zone.

Stingray is a warm-loving fish, therefore distant wintering migrations are typical in autumn, in the waters of Ukraine – towards the southern coast of Crimea. With water warming in spring, common stingray comes back to the coastal shallow water for reproduction and feeding. It belongs to viviparous fish; fingerlings are born at temperature more than 15°C. It distributes with maximum density in Kalamitsky and Karkinitsky Bays in depth of 5 – 30 m.

Grounds and fishing gears for target fishing of *Rajiformes* are the same as for picked dogfish. By-catch of *Rajiformes* in trawls is inconsiderable and usually it releases to sea completely as these fishes are of little demand at the domestic market. Till the early 1990s totally the whole yield of *Rajiformes* were processed into the minced meat for feeding of poultry and other domestic animals. After 1992 sales of minced flesh as feeds for animals slumped and fishermen lost their interest for harvesting of *Rajiformes*. For recent years in Ukraine there has been observed people's demand for *Rajiformes* as human food. In this connection their fishing becomes to revive.

Till 1993, when the intensity of *Rajiformes* fisheries was high in the waters of Ukraine and catches of thornback ray varied within the range 0.3 – 0.6 thousand tons, the stock of this species was assessed by VPA method applying the software ANACO produced by FAO (SHLYAKHOV, 1997 ; SHLYAKHOV and LUSHNIKOVA, 1995). For the subsequent years the intensity of the coastal fisheries became so low that application of this method was incorrect. For some years the stock of thornback ray was assessed by the trawl surveys data, however, due to the under-recording of fishes in small depths these assessments were underestimated (Table 5). The stock of common stingray in the waters of Ukraine is not assessed.

Regulations of Fisheries do not envisage the commercial fishing length and allowable by-catch for *Rajiformes* juveniles. Annual regulation of fisheries includes determination of limits for the harvesting.

Table 5. Commercial stock (thousand tons) of thornback ray in the Ukrainian Black Sea in 1992 – 1998.

| Years | Stock | |
|---|---|---|
| | VPA | Trawl survey |
| 1992 | 2,6 | 1,1 |
| 1993 | - | - |
| 1994 | - | 0,9 |
| 1995 | - | - |
| 1996 | - | - |
| 1997 | - | - |
| 1998 | - | 1,0 |

## REFERENCES


EFIMOV, YU.N., REVINA, N.I., SHLYAKHOV, V.A., VINARIK, T.V. 1989. The state of turbot stocks in the Black Sea. In: Biological basis of abundance dynamics and catch prediction.- Moscow : VNIRO, 179-199. (in Russian).

KIRNOSOVA, I.P., SHLYAKHOV, V.A. 1988. Abundance and biomass of the spiny dogfish *Squalus acanthias* L., in the Black Sea. Journal of Ichthyology, USSR, v.28(1), 38-43. (in Russian).

KOKOZ, L.M., SHLYAKHOV, V.A., PRONENKO, S.M. 1995. Models of "stock-recruitment" type and the fisheries regulation. In: The main results of YugNIRO complex researches in the Azov-Black Sea Basin and the World Ocean in 1995. Kerch: YugNIRO, v.42, 51-56.

SHLYAKHOV, V.A. 1983. About Black Sea whiting rational fishery. Fish Industry, 12 : 32-34. (in Russian).

SHLYAKHOV, V.A. 1997. Results of YugNIRO studies on stock assessment and parameters of fish population in the near-bottom complex in the Black and Azov Seas. In: The main results of YugNIRO complex researches in the Azov-Black Sea Region and the World Ocean (Jubilee issue). Kerch:YugNIRO, v.43, 48-59. (in Russian).

SHLYAKHOV, V.A., KIRNOSOVA, I.P., PRONENKO, S.M. 1995. Two-species model of stocks of the Black Sea whiting and spiny dogfish. In: The main results of YugNIRO complex researches in the Azov-Black Sea Basin and the World Ocean in 1994. Kerch:YugNIRO, v.41, 51-56. (in Russian).

SHLYAKHOV, V.A., LUSHNIKOVA, V.P. 1995. Parameters of the population and stock assessments for the thornback ray (*Raja clavata* L.) in the Black Sea and in the shelf waters of Ukraine. In: The main results of YugNIRO complex researches in the Azov-Black Sea Basin and the World Ocean in 1995. Kerch:YugNIRO, v.42, 152 – 158.

# ON THE CURRENT STATE OF *ACIPENSERIDAE* STOCKS IN THE UKRAINIAN SECTOR OF THE NORTHWESTERN BLACK SEA

V. SHLYAKHOV
YugNIRO, Ukraine
Head of Division of Marine Living Resources of Black – Azov Seas Basin

Among the other commercial fishes of Ukraine, it is the sturgeons that arouse the greatest anxiety for deterioration of their populations. Three species of sturgeons: osetr (*Acipenser gueldenstaedtii*), starry sturgeon (*Acipenser stellatus*) and beluga (*Huso huso*) are most common species in the marine area of Ukraine. The other species – sturgeon (*Acipenser sturio*) and fringebarbel sturgeon (*Acipenser nudiventris*) are so rare, that no captures have been recorded in Ukraine for recent 30 years. Natural spawning of sturgeons from the northwestern Black Sea takes place in the Danube and Dnieper Rivers. Artificial rearing of sturgeons and releasing their fingerling into the wild is carried out at the Dnieper Sturgeons' Rearing Plant. Starting from 1985 this farm has released into the sea about 2-2.5 million juveniles of sturgeons (generally, osetr) per year. In 2001 a total of 2.37 million of osetr juveniles of average weight 3.8 g and 0.14 million juveniles of starry sturgeon of average weight 3.6 g were released into the mouth zone of the Dnieper River and into the Dneprovsky Liman (estuary).

The main foraging and wintering grounds of the Danube and Dnieper populations of the osetr and starry sturgeons as well as juveniles of beluga are located along the coasts of Ukraine. Abundance of sturgeons in 1981-2002 was estimated based on the results of bottom trawl surveys (1981, 1984, 1987, 1991, 1992, 1993, 1994, 1998, and 2002) and by mathematical modelling. Methodology of abundance estimates was described earlier in more details (SHLYAKHOV and AKSELEV, 1993; SHLYAKHOV, 1994). In the period under review the sturgeons' abundance was characterized by stable growth till 1993, and then by a sharp decline (Figure 1). The increase of total abundance of sturgeons was recorded generally due to growth of osetr biomass, which was related with highly efficient fish protection measures and restocking the wild population by juveniles from the Dnieper Sturgeons' Rearing Plant. In 1966-1974 the abundance of sturgeons was assessed as 0.2 millions of individuals (AMBROZ and KIRILLUK, 1979), in 1992-93 it increased up to 4 millions of individuals. However, in the following year, 1994, sturgeons abundance decreased to 2 millions of individuals, and in 1998 reduced to 1 millions of individuals. The only species of sturgeons which abundance not decreased during recent 10 years is beluga. Its population number was steady low: since the early 1990s Ukraine took extremely strict measures concerning the protection of this species. Beluga of the Black Sea was entered into the Red Book of Ukraine.

We assume that the main cause of sturgeons stocks decreasing in the northwestern Black Sea since the mid 1990s is a sharp increase of the poaching. The same trend was recorded in the Azov Sea. According to expert estimates published by FAO (PRODANOV *et al.*, 1997) the average poaching of sturgeons in the northwestern

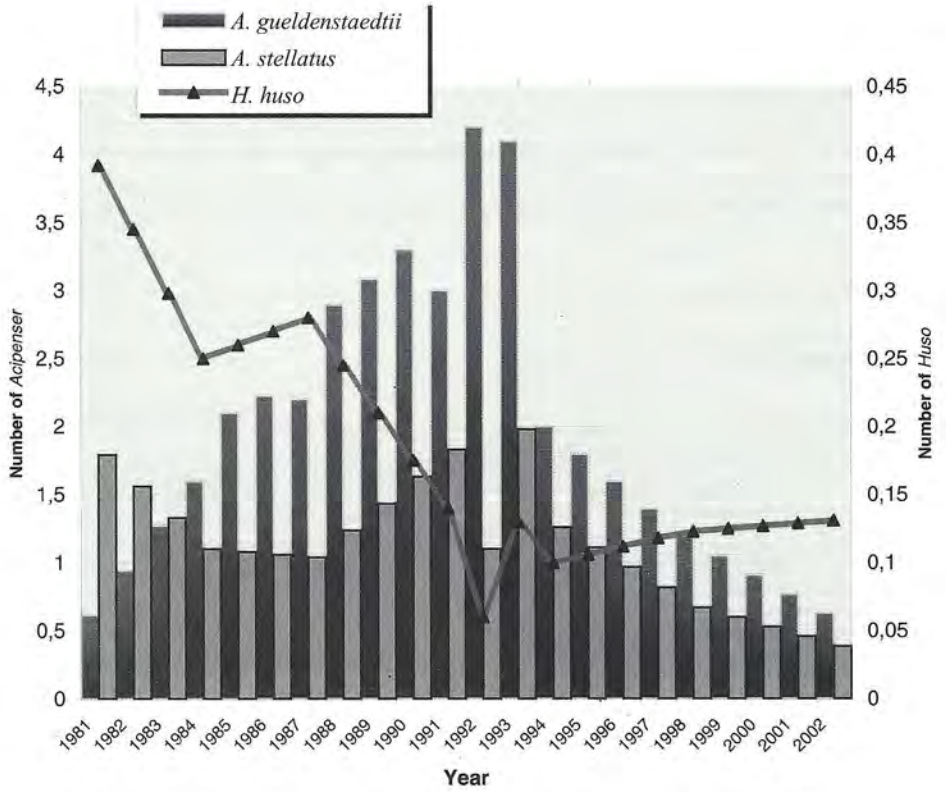



Fig. 1. Number of Acipenseridae in the Ukrainian sector of the Black Sea (million of individuals)

Black Sea (not to take into account poaching in the waters of Romania) was equal to 25 t in 1970-1979 and 27 t in 1980-1989, i.e. at the same level. In 1990 poaching increased twice as much compared with the previous period and was estimated as 55 t; in 1991 it reached 78 t, and in 1992 – 281 t. In 1997 – 1998 the annual catch of sturgeons by Romania, Ukraine, Bulgaria and Yugoslavia in the lower Danube only was 300-400 t according to estimates made by (NAVODARU *et al,* 1999) while the official total catch of sturgeons by these countries in the Danube for the mentioned years did not exceed 45 t. Such excessive catch resulted in overfishing and consequently in decrease of sturgeon populations abundance.

According to YugNIRO accounting surveys, till 1993 a trend was observed towards increase not only in the total abundance of sturgeons, but also in the total number of sturgeons reached commercial size. Between accounting surveys of 1992 and 1993, the increase of abundance of sturgeons' juveniles almost stopped, the number of adults began to decrease. In the consequent years number of both juveniles and adults (of commercial size) was decreasing sharply. It was related with the fact that the significant damages to the populations of osetr and starry sturgeons at sea and in the spawning rivers has been caused by non-selective poaching both with trawls and with relatively small-meshed gill nets. Sturgeons of 50-70 cm (TL) long become common illegal commodity at Ukrainian fish markets.

Protective measures taken by Ukraine since the early 1990 (entry of beluga into the Red Book, prohibition to take as bycatch onboard, and prohibition for sturgeons fisheries in the Black Sea, etc.), unfortunately, turned to be efficient to some extent for conservation of the beluga only. The current situation with the Black Sea populations of sturgeons require, in our opinion, international coordination of efforts of the Black Sea countries in regulation of their fisheries, prevention of illegal fishing and trade, as well as increasing of restocking of wild population, in the Danube area, in particular.

## REFERENCES


AMBROZ, A. M., KIRILLUK, M. M. 1979. Sturgeons. In monogr.: Tkacheva K. S. and Yu. K. Benko (eds) "Fisheries resources of the Black Sea". Moscow: Pishchevaja Promyshlennost, 242-247. (in Russian).

NAVODARU I., STARAŞ, M., BANKS, R. 1999. Management of sturgeon stocks of the lower Danube River system. In: Romulus Stiuca and Iulian Nuchersu (eds) "The Delta's: State-of-the-art protection and management". Conference Proceedings, Tulcea, Romania 26-31 July 1999: 229-237.

PRODANOV, K., MIKHAILOV, K., MAXIM, K., CHASHCHIN, A., ARKHIPOV, A., SHLYAKHOV, V., OZDAMAR, E. 1997. Environmental management of fish resources in the Black Sea and their rational exploitation. Studies and Reviews. GFCM. 68, FAO, Rome, 178.

SHLYAKHOV, V. A., AKSELEV, O. I. 1993. Stock's state and reproduction efficiency of Russian sturgeon in the Black Sea North-Western part. In: The main results of YugNIRO complex researches in the Azov-Black Sea Basin and the World Ocean in 1992. Kerch: YugNIRO, 78-84. (in Russian).

SHLYAKHOV, V. A. 1994. Estimation of Dnieper sturgeon population abundance in the North-Western Black Sea. In: The main results of YugNIRO complex researches in the Azov-Black Sea Basin and the World Ocean in 1993. Kerch: YugNIRO, v. 40, 50-55. (in Russian).

# THE STATUS OF THE DEMERSAL FISH POPULATIONS IN THE AZOV SEA

. K.V. DEMYANENKO, O. A. DIRIPASKO
The Azov centre YugNIRO, Berdyansk, Ukraine

In the present period, the most common commercial demersal fish in the Azov Sea are gobied species (Gobiidae), sander (*Stizostedion lucioperca*), haarder (*Mugil soiuy*) and Azov turbot (*Psetta maeotica torosa*).

Frequently in the Azov Sea it is possible to find sturgeon species (Acipenseridae) – **Russian sturgeon** (*Acipenser gueldenstaedtii*) and **starred sturgeon** (*Acipenser stellatus*). However, recently the species have lost commercial importance and have got the special protection status (as objects of the national Red Books of Ukraine and Russian Federation, and also as CITES objects). Let's stop more in detail on the listed species.

Sturgeons long since are the most valuable fish of the Azov Sea basin. In the first 90 years of the XX century, annual catch of sturgeons in the Azov Sea basin exceeded 1000 tons (the largest part of the catch was made over two species – Russian sturgeon and starred sturgeon).

The size of their populations at present, by our estimation, is for Russian sturgeon - 1 820 000 specimens, and for starred sturgeon - 340 000 specimens. These numbers and also the number of other demersal Azov fish are determined by our specialized sea trawl expeditions.

Such expeditions have been made in the Azov Sea for several decades - earlier by Institute AZNIIRKH (Rostov-on-Don, Russia), which in USSR was engaged in study of biological resources of the Azov Sea. Since 1992 these works were carried out in common with Ukrainian (YUGNIRO, Kerch; AZYUGNIRO, Berdyansk) and Russian (AZNIIRKH) scientific organizations.

Unfortunately, with the dissolution of USSR, there has been an increase of poaching in the Azov Sea. Although the states ore steadfast attention to this problem, the stocks of sturgeons were already heavily exploited (Table 1).

Table 1. Dynamics of the number of Russian sturgeon and starred sturgeon in the Azov Sea basin (from the results of the research expeditions in the Azov Sea per 1992-2002 years).

| Years | Russian sturgeon | Starred sturgeon | TOTAL |
|---|---|---|---|
| 1992 | 12,525,000 | 3,572,000 | 16,097,000 |
| 1993 | 7,476,000 | 1,759,000 | 9,235,000 |
| 1994 | The data are not present | The data are not present | The data are not present |
| 1995 | 4,963,000 | 1,358,000 | 6,321,000 |
| 1996 | 4,831,000 | 1,262,000 | 6,093,000 |
| 1997 | 3,480,000 | 938,000 | 4,418,000 |
| 1998 | 3,425,000 | 839,000 | 4,264,000 |
| 1999 | 3,410,000 | 1,049,000 | 4,459,000 |
| 2000 | 1,520,000 | 166,000 | 1,686,000 |
| 2001 | 1,123,000 | 252,000 | 1,375,000 |
| 2002 | 1,820,000 | 340,000 | 2,160,000 |

Since 2000, the commercial catching of sturgeons in the the Azov Sea basin is not conducted. Ukraine and Russia in common have decided to continue such ban until the commercial recovery of these species. As an exception, the catching amounts of the Russian sturgeon and starred sturgeon are necessary for the realization of works on artificial fingerlings-reproduction at specialized fish-breeding enterprises and also for the realization of scientific researches to be stipulated.

The doubtless leader in artificial restocking of sturgeons in the Azov Sea basin is Russia. It is necessary to note that in terrain of Russia, there are very large rivers of the Azov Sea basin -the Don and Kuban. Before creation of water reservoirs, these rivers were the main spawning areas for the sturgeons in the Azov Sea. After the construction of numerous dams on the Don and Kuban, the system of fish-breeding enterprises for artificial reproduction of sturgeon fingerlings was built.

In Ukraine the artificial reproduction of the Azov sturgeons is realized only at small sturgeon-breeding stations which were built by some fishing enterprises. The largest quantity of sturgeon fingerlings was produced by Ukraine in 1996, when almost 3 millions fingerlings of Russian sturgeon were released to the Azov Sea.

However, in the last few years restocking volume of the Azov sturgeons by Ukraine was no more than 1,5 millions. In 2002, Ukraine produced 1,3 millions of the Azov sturgeon fingerlings (average mass - 3,1 g).

The measures, undertaken by Russia and Ukraine, on conservation and artificial reproduction of the Azov sturgeons, most likely, will give A positive result. Taking into account all factors, however, restocking the populations of Russian sturgeon and starred sturgeon in the Azov Sea even up to a level of the beginning of the last century is expected to take at least 10 years.

**Great sturgeon** (*Huso huso*) is a seldom found species, which is noted in the Red Book of Ukraine. The natural reproduction of great sturgeon in the Azov Sea basin is not marked for many years. Once, in some years, were produced artificially great sturgeon fingerlings by sturgeon-breeding enterprises of Russian Federation.

**Bastard sturgeon** (*Acipenser nudiventris*). In the last decades, there was no record of bastard sturgeon in the Azov Sea basin. Most likely, this species completely disappeared from the Azov Sea. Bastard sturgeon is in the Red Book of Ukraine.

**Sterlet** (*Acipenser ruthenus*). It is another species in the Red Book of Ukraine. Sterlet is seldom found in the Azov Sea.

**Azov turbot** is not numerous in the Azov Sea. Until recently, it was marked that, despite of small number, the state of a population of this species in the Azov Sea was rather stable. However, in the last years we notice a decrease in the number of Azov turbot population: in 1999 its number was about 2,9 million specimens, by 2002 it was reduced to 1,6 million specimens.

The main reason of such a decrease in the number of Azov turbot population is the reduction of the salinity in the Azov Sea. It is necessary to note that high salinity is important for normal development of the pelagic caviar of this species.

**The family of Gobies** in the Azov Sea is represented by 20 species. However in commercial catches there are generally, 4 - 5 species: round goby (*Gobius melanostomus*), syrman goby (*G. syrman*), monkey goby (*G. fluviatilis*), toad goby (*Mesogobius batrachocephalus*) and grass goby (*Zosterisessor ophiocephalus*). Round goby dominates, therefore, playing a leading role in the formation of ichthyomass of Azov gobies.

The state of the populations of Azov gobies has been depressing in the last two decades and they practically were not targets for commercial fisheries (though 50-60 years before the annual catch of Azov gobies reached 40-80 thousand tons). Only since 1999, when the conditions of life of these species were improved (reproduction-conditions, feeding-conditions), the number of gobies began to grow, and they again became the object of commercial catching. The growth of these fish was improved and their average sizes had also increased.

Now in commercial catches it is usual to find specimens of 15-17 cm. in length and sometimes can be found specimens whose body length comes near to the maximal length known for this species (25 cm.). The commercial catch of Azov gobies, recently, makes about 35 thousand tons.

**Sander** in the last few years, when the salinity of the Azov Sea has rather decreased, sander dwelt practically in all areas of the Azov Sea. The conditions for pasturing of sander are very good, because last years because the number of gobies has increased in the sea, which are favorite food of sander. Therefore, the growth of fish was improved. Average weight of sander in commercial catches is 1,7 kg, and prevailing age groups are fish in the age of 4-5 years (about 40 %).

The basic limiting factor for the further increase of sander number in the Azov Sea basin is the suitable spawning areas for this species (freshwater areas).

In 2002, ichthyomass of a commercial sander population in the Azov Sea makes 23,5 thousand tons.

**Haarder.** About 20 years ago in the Azov Sea this fish species was acclimatized from the Japanese Sea.

The high ecological plasticity of this species, in a combination with the congenial factors of environment, caused successful result of the acclimatization. In conditions of the Azov Sea were realized high production of this species. In comparison with the initial natural habitat, the rate of growth and sizes of fish have increased and the level of the contents of fat in muscles has grown.

The reduction of older fish is a characteristic for the age structure of a haarder population in the last few years, which explained by the influence of intensive commercial catching.

The effectiveness of natural reproduction of this fish directly is connected to presence of places and conditions for breeding (areas of the Azov Sea basin with optimum salinity; water rotation between reservoirs of the basin, where spawning of the species takes places). Therefore in perennial dynamics of recruitment of haarder population are observed significant fluctuations. The recent commercial stock of this species in the Azov Sea is estimated asabout 18 thousand tons.

## REFERENCE

DIRIPASKO, O.A., IZERGIN, L.V., YANOVSKY, E.G., DEMYANENKO, K.V. 2001. The Qualifier of the Azov Sea Fish – Berdyansk : AzYugNIRO, 109 p. (in Russian).

# COMPOSITION, STATE AND STOCKS OF THE DEMERSAL FISH COMMUNITY OF THE AZOV-BLACK SEAS RELATING TO THE DEVELOPMENT OF RUSSIAN SUSTAINABLE FISHERIES

S. VOLOVIK, S. AGAPOV
Research institute of the Azov Sea fishery problems (AzNIIRKH), Russia
2/2 Beregovaya St., Rostov – on – Don 344007

Intensive processes of nature transformation, reduction of biological and landscape diversity, exhaustion of natural resources characterize the present-day period of human society's development. All these processes are becoming apparent in the Azov and Black Seas. Therefore, all efforts that are realized in the framework of the Bucharest Convention, the Black Sea Environment Recovery Project, TACIS, other initiatives should be greeted and supported.

Here we would like to discuss the problem of real state of diversity and stocks of demersal complex of the Azov and Black Sea fish, to define our common estimations of the present situation and the steps for improving the state of the Black Sea ecosystem and conservation of biodiversity.

The Azov Sea (including Taganrog Bay) and the Black Sea in its northeastern part wash the southern shores of Russia. These water bodies are characterized by different parameters of their regimes that bring great variability in their biota.

The Azov Sea is a shallow (depth is less than 15 m), brackish (average salinity nowadays is 10.5-11.5‰), small (area is 38.6 th. $km^2$, volume is 320 $km^3$) water body. In winter its surface is frozen partially or full and in summer the temperature of water is 25-30°C , with not definite water flows, containing dissolved gases, with high turbidity. The sea is highly eutrophic and not so long ago the biggest quantity of commercial fish (85 kg) among seas of the world was caught from each hectare of its area. Taganrog Bay is a northeastern part of the Azov Sea detached from the sea proper by two sand peninsula. Its depths are 4-8 m, salinity is from 0.5 (near delta of the River Don) to 6-9‰ (in the bay mouth).

Bottom sediments of the Azov Sea are silts, sands and cockle-shells. Only for a short distance there is a rocky shore near Crimea. High productivity of the water body and its small depth make a basis for the development of intensive and multiformitive biota both in demersal and in pelagic communities.

The northeastern part of the Black Sea (region under Russian jurisdiction) is principally different from the Azov Sea. The salinity is higher (16-17‰) here. It is a small and narrow shelf with great (up to 2.2 km) depth near the shore, and 100-150 m level of water with normal life here. These and other local peculiarities of the Black Sea make for common more intensive development of biota in pelagic system in comparison with demersal community. Let us to look though these features of biota organization in detail.

Ichthyofauna of the Azov Sea includes 108 species and subspecies of fish that belong to 37 families and 70 genera. Ichthyofauna of the Azov Sea proper (without the Taganrog Bay) is represented by 99 species from 36 families, 68 genera; 73 species from 21 families and 48 genera exist in the Taganrog Bay. Both in demersal and pelagic communities of the Azov Sea there are fish with common, rare, vulnerable, uncertain status and, unfortunately, disappeared species (Table 1). Species composition in the fish communities in the Azov Sea proper and in the Taganrog Bay are almost equal (for example, demersal fish are 66.6 and 68.5% respectively). There are three facts here that require attention to: 1) Most of the fish with uncertain status, to this category, as some investigators pointed, are those rarely met, or we have only remarks on catching of these fish without any description or other material for their classification; 2) great transformations of the Ichthyofauna, including the fact that some species disappeared or lost their importance as commercial species. Among demersal fish in the Azov Sea proper 17 species lost their commercial importance and the main reasons are drastic changes in the conditions of reproductive sites in the rivers for anadromous fish and on the sea bottom, for sea fish with bottom eggs; 3) Pelagic fish community have not been under such great anthropogenic stress in comparison with demersal community. But this changing is more essential in quantity. For example, data from Tables 2 and 3 show that during the last decades commercial catches of pelagic fish decreased and the main reason for these events is the intrusion of ctenophore *Mnemiopsis leidyi*.

Earlier it was pointed that demersal community has a greater amount of fish species, but its productivity is not so great as that of the pelagic community and the catches of demersal fish amounted to 5-40% of total catches made in the sea (Table 4).

During the last 3 years, we continue to monitor the aggravation of the situation in the Azov Sea, the state of its fish stocks continues to be unstable, fish catches decrease, especially of demersal fish from anadromous complex. The main reason of decreased stocks during the last decade is illegal fishing.

Table 1. Composition of ichthyofauna in the Azov and Black (Russian part) Seas.

| Commnity, complex of fish | Unit of measure | Status, number of species | The Azov Sea proper | Taganrog Bay | The Black Sea |
|---|---|---|---|---|---|
| Demersal | % | common | 45,5 | 40,0 | 38,2 |
| | | Rare +vulnerable | 40,9 | 50,0 | 42,2 |
| | | disappeared | 4,5 | 4,0 | 0,8 |
| | | uncertain | 7,6 | 6,0 | 18,8 |
| | n | Total species, include: | 66 | 50 | 123 |
| | | commercial | 10 | 7 | 9 |
| | | loss their commercial importance | 17 | 2 | - |
| Pelagic | % | common | 39,4 | 26,1 | 42,5 |
| | | Rare +vulnerable | 48,5 | 52,2 | 37,5 |
| | | disappeared | - | 4,3 | - |
| | | uncertain | 12,1 | 17,4 | 20,0 |
| | n | Total species, include: | 33 | 23 | 40 |
| | | commercial | 4 | 1 | 5 |
| | | loss their commercial importance | 4 | - | 3 |
| Total species, include: | n | | 99 | 73 | 163 |
| demersal | % | | 66,6 | 68,5 | 75,5 |
| pelagic | | | 33,4 | 31,5 | 24,5 |

Table 2. Commercial fish catches in the Azov Sea basin (tons).

| Subjects of catches | Years | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 |
| **Anadromous fish** | | | | | | | | |
| Sturgeons* include: | 1302 | 1384 | 1355 | 679 | 624 | 1012 | 1021 | 1006 |
| russian sturgeon* | 827 | 903 | 895 | 399 | 495 | 677 | 759 | 756 |
| starred sturgeon* | 459 | 479 | 457 | 278 | 126 | 334 | 262 | 246 |
| great sturgeon* | 16 | 17 | 3 | 2 | 3 | 1 | - | 4 |
| Herring | 66 | 106 | 133 | 273 | 351 | 81 | 88 | 147 |
| Vimba* | 3 | 5 | 8 | 5 | 13 | 9 | 12 | 7 |
| Total | 1371 | 1495 | 1496 | 957 | 988 | 1102 | 1131 | 1160 |
| **Semi- anadromous fish** | | | | | | | | |
| Perch-pike* | 1556 | 2403 | 2604 | 1215 | 2151 | 1446 | 1266 | 975 |
| Bream* | 3133 | 2616 | 2629 | 2872 | 1740 | 1715 | 1663 | 1554 |
| Roach* | 2194 | 1581 | 1606 | 1389 | 666 | 182 | 101 | 129 |
| Carp* | 582 | 572 | 417 | 427 | 308 | 270 | 257 | 92 |
| Sabrefish | 325 | 680 | 475 | 485 | 446 | 307 | 447 | 154 |
| European wells* | 36 | 33 | 14 | 14 | 21 | 10 | 14 | 1 |
| Pike | 113 | 171 | 115 | 185 | 260 | 161 | 69 | 37 |
| Others | 3615 | 3636 | 2755 | 2948 | 1526 | 1213 | 2227 | 1146 |
| Total | 11554 | 11692 | 10615 | 9535 | 7118 | 5304 | 6044 | 4098 |
| **Sea fish** | | | | | | | | |
| Azov anchovy | 14237 | 58739 | 5968 | 9755 | 176 | 36 | 46 | 9517 |
| Azov kilka | 124779 | 89632 | 84575 | 36771 | 38102 | 1370 | 27055 | 3018 |
| Gobies* | 547 | 727 | 303 | 1046 | 542 | 208 | 432 | 106 |
| Flatfish* | 1402 | 1841 | 499 | 370 | 585 | 530 | 403 | 365 |
| Haarder* | - | - | - | - | - | - | - | 52 |
| Others | 6317 | 7261 | 6395 | 4900 | 3041 | 977 | 596 | 260 |
| Total | 147282 | 158200 | 97740 | 52842 | 42446 | 3121 | 28532 | 13318 |
| Total fish | 160207 | 171387 | 109851 | 63334 | 50552 | 9527 | 35697 | 18576 |
| **Others** | | | | | | | | |
| Crustaceans | 93 | 66 | 25 | 3 | - | 33 | 36 | 14 |
| Molluscs | - | - | 16 | - | - | - | - | 19 |
| Total | 93 | 66 | 41 | 3 | - | 33 | 36 | 33 |
| Total in sum | 160300 | 171453 | 109892 | 63337 | 50552 | 9560 | 35733 | 18609 |
| Sea weed (zostera) | 5879 | 7134 | 6511 | 7175 | 6039 | 5352 | 4733 | 1161 |

* - demersal fish

Table 2 continued.

| Subjects of catches | Years | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **1993** | **1994** | **1995** | **1996** | **1997** | **1998** | **1999** | **2000** |
| **Anadromous fish** | | | | | | | | |
| Sturgeons,* include: | 1202 | 1224 | 790 | 586 | 621 | 398 | 217 | 71 |
| russian sturgeon* | 893 | 874 | 476 | 410 | 391 | 263 | 142 | 49 |
| starred sturgeon* | 307 | 348 | 312 | 175 | 230 | 134 | 74 | 22 |
| great sturgeon* | 2 | 2 | 2 | 1 | 0.3 | 1 | - | - |
| Herring | 63 | 13 | 1 | 4 | 2 | 0.1 | 0.1 | 0.2 |
| Vimba* | 6 | 6 | 12 | - | - | - | - | - |
| Total | 1271 | 1243 | 803 | 590 | 623 | 398 | 217 | 71 |
| **Semi- anadromous fish** | | | | | | | | |
| Perch-pike* | 699 | 1092 | 1367 | 2833 | 2828 | 3009 | 2380 | 2955 |
| Bream* | 1387 | 1025 | 887 | 350 | 658 | 533 | 401 | 337 |
| Roach* | 140 | 476 | 244 | 81 | 107 | 15 | 30 | 75 |
| Carp* | 65 | 143 | 22 | - | 3 | 9 | - | - |
| Sabrefish | 124 | 103 | 83 | 47 | 113 | 101 | 201 | 275 |
| European wells* | 2 | 5 | 1 | - | - | - | - | - |
| Pike | 27 | 24 | 23 | - | - | 2 | - | - |
| Others | 1157 | 1208 | 1738 | 81 | 50 | 59 | 130 | 350 |
| Total | 3601 | 4076 | 4365 | 3392 | 3759 | 3728 | 3142 | 3992 |
| **Sea fish** | | | | | | | | |
| Azov anchovy | 3123 | 17950 | 15049 | 4659 | 3333 | 727 | 396 | 5506 |
| Azov kilka | 281 | 4500 | 6969 | 1445 | 1520 | 3464 | 10789 | 12007 |
| Gobies* | 249 | 305 | 130 | 23 | 16 | 259 | 557 | 748 |
| Flatfish* | 273 | 263 | 126 | 174 | 130 | 67 | 67 | 71 |
| Haarder* | 74 | 365 | 981 | 1214 | 3282 | 4929 | 7475 | 7815 |
| Others | 84 | 67 | 45 | 64 | 38 | 532 | 83 | 94 |
| Total | 4084 | 23450 | 23300 | 7549 | 8291 | 9965 | 19367 | 26241 |
| Total fish | 8956 | 28769 | 28468 | 11531 | 12673 | 14091 | 22725 | 30304 |
| **Others** | | | | | | | | |
| Crustaceans | 8 | 1 | 1 | 1.3 | - | 0.3 | - | - |
| Mollusks | - | 2 | - | - | 37 | - | - | - |
| Total | 8 | 3 | - | 1.3 | 37 | 0.3 | - | - |
| Total in sum | 8964 | 28772 | 28469 | 11532 | 12710 | 14091 | 22725 | 30304 |
| Sea weed (zostera) | 424 | 264 | 242 | 369 | 331 | 310 | 157 | 6 |

* - demersal fish

Table 3. Commercial catch of the main fish species in the Azov Sea (th. t/year).

| Species | 1930-1951 Period of nature regime of fresh water flow | Period of the transformation of nature fresh water flow | | | |
|---|---|---|---|---|---|
| | | 1952-1971 Years of the forming of the new regime of the sea | 1972-1977 Years of increasing of the salinity of the sea | 1978-1988 Years of the new dissolvation of the sea water | 1989-2000 Years of the containing dissolvation and intrusion of Mnemiopsis leidyi |
| Anadromous fish, include: | 75,0 | 24,2 | 10,6 | 10,0 | 6,0 |
| herring | 3,5 | 1,2 | 0,5 | 0,3 | <0,1 |
| sturgeons* | 3.0 | 0,8 | 1,0 | 1,1 | 0,7 |
| perch-pike* | 30,7 | 8,8 | 2,8 | 1,4 | 2,1 |
| bream* | 23,5 | 4,1 | 2,1 | 1,8 | <0,1 |
| roach* | 6.1 | 4,9 | 2,2 | 1,2 | <0,1 |
| carp* | 2.0 | 0,4 | 0,3 | 0,4 | <0,01 |
| sabrefish | 3.3 | 1,8 | 0,3 | 0,4 | 0,2 |
| european wells* | 0.9 | <0,1 | <0,01 | ... | ... |
| others | 5,2 | 2,1 | 1,3 | 3,4 | 1,5 |
| Sea fish, include: | 133,8 | 160,6 | 141,3 | 137,5 | 17,3 |
| azov anchovy | 51,5 | 51,6 | 74,6 | 47,7 | 5,0 |
| azov kilka | 63,2 | 61,3 | 58,7 | 80,6 | 9,2 |
| gobies* | 15,1 | 45,8 | 4,6 | 0,6 | 0,1 |
| haarder* | - | - | - | - | 2,4 |
| turbot* | 0,4 | 0,4 | 0,5 | 1,3 | 0,2 |
| others | 3,6 | 1,5 | 2,8 | 7,3 | 0,4 |
| Total | 208,6 | 184,8 | 151,8 | 147,5 | 23,3 |

* - demersal fish

Table 4. Catches of demersal and pelagic fish complexes in the Azov Sea.

| Complex | | 1930-1951 | 1952-1971 | 1972-1977 | 1978-1988 | 1989-2000 |
|---|---|---|---|---|---|---|
| Demersal | th. t | 81,7 | 65,3 | 13,5 | 7,8 | 5,7 |
| | % | 39,2 | 35,3 | 8,9 | 5,3 | 24,5 |
| Pelagic | th. t | 126,9 | 119,4 | 138,3 | 139,7 | 17,6 |
| | % | 60,8 | 64,7 | 91,1 | 94,7 | 75,5 |
| Total | th. t | 208,6 | 184,8 | 151,8 | 147,5 | 23,3 |

Table 5. Commercial catches of fish in the Black Sea by Russian fishery organizations (tons).

| Subjects of catches | Years | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **1985** | **1986** | **1987** | **1988** | **1989** | **1990** | **1991** | **1992** |
| **Anadromous fish** | | | | | | | | |
| Herring | 3 | 5 | 2 | - | 8 | - | 4 | - |
| Salmo, trout | - | - | 5 | - | - | 37 | 6 | - |
| Total | 3 | 5 | 7 | - | 8 | 37 | 10 | - |
| **Sea fish** | | | | | | | | |
| Azov anchovy | 8360 | 5316 | 13354 | 16043 | 74 | 7 | - | - |
| Black Sea anchovy | 18910 | 28782 | 5491 | 45392 | 16086 | 11335 | 35 | 5173 |
| Sprat | 4079 | 8693 | 10910 | 13122 | 23058 | 11519 | 2675 | 3221 |
| Whiting* | 1580 | 662 | 2121 | 736 | 7 | 235 | - | - |
| Mullet* | 82 | 379 | 258 | 129 | 324 | 131 | 210 | 37 |
| Mugil,* | 63 | 122 | 39 | 45 | 12 | 4 | 2 | - |
| include: haarder | - | - | - | - | - | - | - | - |
| Flatfish* | 27 | - | - | - | - | - | - | 1 |
| Scads | 11147 | 429 | 91 | 91 | 30 | 4 | 2 | - |
| Sharks* | 348 | 287 | | 200 | 204 | | | 15 |
| | | | }455 | | | }462 | }147 | |
| Stingrays* | 423 | 214 | - | 161 | 183 | - | - | 54 |
| Others | 428 | 559 | 150 | 191 | 2 | 36 | - | 7 |
| Total | 45447 | 45443 | 32869 | 76110 | 39980 | 23733 | 3071 | 8508 |
| **Others** | | | | | | | | |
| Crustaceans | - | - | - | - | - | - | - | - |
| Molluscs | 8 | 22 | 60 | 36 | 4 | 40 | 29 | 197 |
| Dolphins | - | 1 | 1 | - | - | - | - | - |
| Total | 8 | 23 | 62 | 36 | 4 | 40 | 29 | 197 |
| Total in sum | 45458 | 45471 | 32938 | 76146 | 39992 | 23810 | 3110 | 8705 |

* - demersal fish

Table 5 continued.

| Subjects of catches | Years | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **1993** | **1994** | **1995** | **1996** | **1997** | **1998** | **1999** | **2000** |
| **Anadromous fish** | | | | | | | | |
| Herring | - | 2 | - | 6 | 1 | - | - | - |
| Salmo trout | - | - | - | - | - | - | - | - |
| Total | - | 2 | - | 6 | 1 | - | - | - |
| **Sea fish** | | | | | | | | |
| Azov anchovy | 949 | 2390 | 4184 | 16676 | 1812 | 2266 | 2226 | 3386 |
| Black Sea anchovy | 40 | - | 11 | 4 | 11 | - | 0.3 | - |
| Sprat | 694 | 893 | 1384 | 1324 | 706 | 1243 | 4341 | 5543 |
| Whiting* | 14 | 125 | 77 | 11 | - | 118 | 123 | 341 |
| Mullet* | - | 21 | 87 | 67 | - | 118 | 86 | 126 |
| Mugil,* | 54 | 307 | 65 | 1 | - | - | 35 | 22 |
| include: haarder | 53 | 70 | 43 | 382 | 480 | 401 | - | 63 |
| Flatfish* | 2 | 5 | 10 | 17 | 11 | 14 | 15 | 4 |
| Scads | - | - | - | - | - | 2 | 2 | 2 |
| Sharks* | 5 | 15 | 13 | 15 | | 4 | 8 | 12 |
| | | | | | }25 | | | |
| Stingrays* | 12 | 28 | 26 | 21 | | 17 | 26 | 13 |
| Others | - | 1 | 1 | 2 | 71 | 50 | 8 | 2 |
| Total | 1770 | 3785 | 5858 | 3520 | 3116 | 4233 | 7170.3 | 9514 |
| **Others** | | | | | | | | |
| Crustaceans | - | 1 | - | - | 2 | - | - | 1 |
| Mollusks | 29 | 2 | 54 | 3 | - | 46 | 47 | 182 |
| Dolphins | - | - | - | - | - | - | - | - |
| Total | 29 | 3 | 54 | 3 | 2 | 46 | 47 | 183 |
| Total in sum | 1799 | 3789 | 9561 | 3523 | 3118 | 4279 | 7217.3 | 9697 |

* - demersal fish

In spite of the large quantity of fish that form up demersal community in the northeastern part of the Black Sea, the abundance of commercial species is not so great there as in the Azov Sea (see Table 1), their commercial catches are also smaller (Table 5). We can explain it by the fact of predominance of small, not abundant fish species, which cannot make accumulations large enough for fishing efforts. Nevertheless, in the Black Sea as well as in the Azov Sea, the fish species (though not numerous) from pelagic communities are more productive and have greater commercial importance than demersal fish.

Nowadays we can take into account only some species that have commercial importance in the Azov and Black Seas. We try to give short characteristics of these species.

The Azov Sea. At present only the following fish species are of any commercial importance here: Mugilidae, pike-perch, roach, flounders and gobies. The other species, including sturgeons, bream, vimba and all the rest, have lost their commercial importance or their annual catches are so little that they cannot "make weather" in fishing statistics.

The commercial stocks of the Azov Sea pike perch *Stizostedion lucioperca* Linnaeus, 1758 amount to 11.7 mln. specimens. Despite the three fold decrease in the amount of mature pike perch (generations of 1966-1995) the productive broods of 1997-1998, which are now being caught, compensate the loss of the biomass. The promising generations of 1999-2000 are expected to sustain the pike perch catches at the level of 4 th. t.

The abundance of the Azov Sea roach *Rutilus rutilus heckeli* Nordmann, 1840 has been fixed lately on 25 mln. specimens, which allows one to catch annually 500 t of this species and in future to increase its catches up to 800 t.

Mullet (*Mugil so-iuy* Basilewsky, 1855) fishery in the nearest future will be based on productive broods of 1996, 1997 and 2000. Its stocks are expected to be steady and kept at the level of 25-30 th. t. Such amounts promise catches up to 5 th.t per year.

The goby stocks are restoring now. Thus, the available biomass of such a representative of *Gobiidae* family as the round goby *Gobius melanostomus* Pallas, 1814 approaches the value of 30 th.t, which allows one to catch 6 th. t of this species per year.

The stock of the Azov Sea flounder *Psetta maeotica torosa* Rathke, 1837 is preserved at a stable, though not very high level – 1 th. t.

Commercial stocks of such anadromous fish species as *Vimba vimba carinata* Pallas, 1814, the great sturgeon *Huso huso* Linnaeus, 1758, the stellate sturgeon *Acipenser stellatus* Pallas, 1771 and the Russian sturgeon *Acipenser gueldenstaedti* Brandt, 1833 are extremely low. The abundance of the stellate sturgeon (without fingerlings) is evaluated to be 356 th. specimens, that of the Russian sturgeon amounts to 1877 th. specimens, while great sturgeon is occurred only in single specimens. Great sturgeon is a particularly protected species and is placed into the Red Books of Russia and Ukraine. Since the year of 2000 the catches of vimba, stellate sturgeon and sturgeon are limited, they can be caught only for reproduction and research purposes.

Due to the fact that after 1994 the conditions for the natural reproduction of bream were unfavorable in the Don, the abundance of mature fish in its population decreased to 250 th. specimens that caused to limit sharply its fishery. To preserve the Don semi-migratory bream as a commercial species, it is necessary to create proper conditions for its natural spawning in the river Don and to intensify its artificial reproduction.

Preservation of stable stocks and catches of the Azov commercial fish species representing demersal community is possible in the present-day period only if the fishery rules are kept strictly and scientific recommendations are fulfilled on how to catch and what amounts can be used. It is also necessary to intensify industrial reproduction. Special attention should be given to keep the schedule of water discharges from the Tsymlyansk Reservoir, with taking into account the fishery interests. Then the breeders of migratory and semi-migratory species will be able to use the most productive spawning grounds of the Azov Sea basin, which are found in the flood zones of the lower Don.

The Black Sea. We present the brief data on the biology of dogfish, stingrays, whiting, flounders, mugilidae and mullets and the assessment of their stocks. All these fish have secondary commercial importance because their annual catches are not big.

The dogfish *Squalus acanthias* Linnaeus, 1758 is a small shark (it is up to 2 m long, weight is up to 18 kg), inhabits the whole water column but prefers lower layers. Predator. Its main food items are anchovy, kilka and other small fish, especially those which form accumulations. Its annual catch have decreased during last decades (see Table 5), but they do not reflect the state of the stock. The scientific trawl surveys undertaken every year show that the biomass of the dogfish in the north-eastern part of the Black Sea is near 20 th.t and the total admissible catch (TAC) can be estimated as 700 tons.

Rays. There are two species (the thornback ray/bucler skate *Raja clavata* Linnaeus, 1758 and the stingray *Dasyatis pactinaka* Linnaeus, 1758) in the Russian part of the Black Sea. They occupy different ecological niches. Their stocks are about 800 t,. Rays are usually caught together with dogfish and flounders. TAC for ray cannot be more than 100 t.

The Black Sea whiting *Merlangus merlanguseuxinus* Nordmann, 1810. Nowadays the stocks of this species, as well as those of the other *Gadidae*, such as the three-spined stickleback *Gaidropsarus mediterraneus* Linnaeus, 1758, are used poorly. Our trawl surveys show that stocks of these species are great enough and they are estimated about 7.6-8 th. t including commercial stocks which amount to 4.3 th. t. The annual TAC for whiting averages 2 th. t.

The Black Sea turbot *Psetta maxima maeotica* Pallas, 1811). During a long period (from the middle of the 1970s to the middle of the 1990s) commercial catching of this species was forbidden. As a result of such an interdiction the state of the population, its biomass and stocks have become much better than earlier. The TAC for the northeastern part of the Black Sea was assessed to be 200 t per year (the Russian and the Ukrainian quotas were equal). The next period of observation shows that the state of turbot stock is not stable, however, changes are not great. Presently AzNIIRKH proposes some protection measures for the conservation of the turbot population. The turbot TAC in Russia does not exceed 100 t, while its stocks are estimated about 1000-1700 t. Annually they caught not more than 100 t of turbot including 8-35 t from special commercial catches and 50-80 t caught together with anchovy, Black Sea kilka and dogfish.

The Azov-Black Sea mugils. There are five species seen in commercial catches in the northeastern part of the Black Sea. But only three species (such as the haarder *Mugil so-iuy* Basilewsky, 1855, the striped/grey mullet *Mugil cephalus* Linnaeus, 1758 and the golden mullet *Liza aurata* Risso, 1810) are abundant enough for making commercial catches. Up to present we have not had sufficient data for assessing their stocks. Only in 2002 we could calculate TAC for mugils as 150 t/year in the Russian part of the Black Sea and in the Kerch Strait.

The Black Sea mullet *Mullet barbatus ponticus* Essipov, 1927. During the last five years the stocks of the mullet have become greater, which is the result of reduction of *Mnemiopsis leidyi* population. The present-day abundance of the mullet has increased to 60 mln. specimens, their biomass is 1200 t, stock amounts to 960 t and TAC is 200 t.

As a result of studies conducted by AzNIIRKH on the biology and state of the Azov-Black Sea demersal fish species, the following can be specified:

1. There are great differences between the state of demersal fish populations in the Azov and Black Seas.

2. Demersal fish populations in the Azov Sea have been exploited very intensively, thus overfished.

3. Demersal fish populations in the Black Sea are in much better state than in the Azov Sea, but they are smaller compared with the earlier times.

4. Commercial catches of the demersal fish in the Black Sea do not reflect the state of these populations and small annual catches are the result of deficiency in fishing efforts.

5. Nowadays we cannot make sustainable fishing of demersal fish in the Azov and Black Seas without implementation of effective protected measures.

# STATE OF THE GEORGIAN BLACK SEA DEMERSAL ICHTHYORESOURCES AND STRATEGY FOR THEIR REHABILITATION AND MANAGEMENT

A. KOMAKHIDZE, R. DIASAMIDZE, A.GUCHMANIDZE
Georgian Marine Ecology and Fisheries Research Institute
Black Sea Regional Activity Center for Biodiversity Conservation.
51 Rustaveli str. B.O. Box 58, 384500 Batumi, Georgia

## ABSTRACT

The Black Sea coastal zone stretches 315km from Sarpi up to the River Psou. Its northern part from Psou to Sokhumi and southern part from Kobuleti to Sarpi are mountainous; the coastline is rocky in some places, but the central part is lowland, which is a wetland to a great extent. The coastline of Georgia is not sharply parted: here are only the low capes (Bichvinta, Gudauta, Sokhumi, Kodori, Anaklia, Poti and Batumi) created by the river discharges. About 150 rivers flow into the Black Sea; their annual discharge is 50km$^3$, which is 16 % from the annual continental inflow of the Black Sea. The watershed of the river occupies the territory of 32,650km$^2$ or the entire western Georgia, the length of the majority of the rivers is less than 25km, and only 6 of them have a length more than 100km. These rivers are: Rioni, Enguri, Khobi, Kodori, Bzipi and Supsa. The Black Sea coastline is characterized by a narrow shelf zone. The width of shelf zone here is mainly 2-4 miles and only in Ochamchire and Gudauta areas it widens up to 10-15 miles.

The water of the coastal zone is comparatively warm, the sea doesn't freeze here. The average water temperature near the coast is 17-20°C, maximal – 30°C (August), minimal – 9°C (Sokhumi) and 11°C (Batumi) (February). The salinity on the surface offshore varies from 17,8 (in spring) to 18,3 ‰ (in winter). The rivers of Georgia significantly freshen the surface of the sea at the coast, especially in spring and in the first half of summer, although, this freshening does not extend to 2-4 miles away from the coast. Only during great floods, the freshening takes place on a larger territories, and the salinity drops for a while to 8-12‰.

Of 167 fish species and subspecies captured in the coastal zone of Georgia, over 100 are identified. This zone is peculiar with the favourable conditions for breeding of both marine and anadromous fish.

### Squalidae

*Squalus acanthias* Linnae- Found in the Black Sea coastal zone of Georgia, in 10-90m depth in small groups length about 120-140cm. It is a bottom-pelagic species. Its favourable temperature is 6-18°C. Females acquire reproductive abilities at the age of 17, and males at the age of 13-14.It is a viviparous species. The copulation period is spring. The period of pregnancy is 18-22 months. It lays eggs in October-November and December in 10-35m depth, mostly 20-30cm long, 10-32 fish. It feeds on fish and bottom invertebrates.

### Rajidae

*Raja calvata* Linne- Found in the Black Sea coastal zone of Georgia in small quantities, generally in Poti-Ochamchire district and Gudauta region, in silt and stony ground, in 10-90m depth. Length up to 90cm. It is a bottom fish. Avoids the temperature higher than 18-19°C. It is egg laying. After copulating in March-April on the bottom of 10-40m depth, it lays eggs in installments several tens of eggs. The eggs are in a black flat sack, the angles of which have 4 whip-like sprouts. The length of the sack with sprouts is 10-15cm. The development of the laid eggs takes 5 months. The length of the appeared fish is about 12-13cm, its width 8 cm. It feeds on fish and bottom invertebrates. It is captured in small amounts.

### Dasyatidae

*Dasyatis pastinaca* (Linne)- Found in the Black Sea coastal zone of Georgia in medium quantities, in silty and sandy ground, in 10-80m depth. Length 100cm. It enters Paloestomi. It is a bottom fish. It avoids the temperature lower than 11-12°C. It is ovoviviparous. In summer, in the depth of 10-30m depth, about 4-12 fish of 30-33cm hatch. In December, to the local stock, the newcomers from the north-eastern part of the Black Sea are added, which return back in March. It feeds on fish and bottom invertebrates. Here it is caught in medium amounts.

### Congridae

*Conger conger* (Linne)- Found in the Black Sea coast of Georgia, it is quite rare in Batumi area, on a stony-sandy ground. Length 100cm. It does not reproduce here. It feeds on fish and decapods. It is a bottom-pelagic fish.

### Gadidae

*Merlangius merlangus euxinus* (Nordmann) –It is abundant in the Black Sea coast of Georgia, on a silty ground in 10-85m depth, in a 5-16°C temperature. Length 25-30cm, rarely 35cm. It enters Paleostomi. A bottom-pelagic fish. It starts spawning from 2-3 years. It spawns in portions, almost during the whole year, mainly in December-March. The productivity is from 100000 to 600000 eggs. It is fed by generally by fish and sometimes by bottom crustaceans and worms. It is captured in great quantities.

*Gaigropsarus mediterraneus* (Linne)- is met on the Black Sea coastal zone of Georgia in small quantities, generally from Sarpi to Kobuleti and from Sokhumi to Psou. It prefers areas with gross of algae and stony areas covered by algae, in about 50m depth. Its length is 30-35cm. It is a bottom-pelagic fish, the optimal temperature is 6-16°C. It spawns in portions in November-March. It lays about 450 000 pelagic eggs. It feeds on small fish and bottom invertebrates. It is captured in small quantities.

### Merlucciidae

*Merluccius merluccius* (Linne)- Found in the Black Sea coast of Georgia, it is quite rare in Batumi area in June –November, generally on a silty ground in a depth of 30-80m. Length about 40cm. A bottom-pelagic fish. It does not reproduce here, it generally feeds on small fish.

### Ophidiidae

*Ophidion rochei* Muller- Found all over the Black Sea coastal zone of Georgia in small quantities, on a sandy ground. Length 25-30cm. A bottom-pelagic fish. In May-October it is in 20 m depth. During the cold season of the year, it is in 40-60m depth. Its spawning period is June-September. It lays about 900 000 of pelagic eggs. It feeds on bottom invertebrates and small fish. It is caught in a very small amounts.

### Lophiidae

*Lophius piscatorius* Linne – Two cases of its capture are recorded on the Black Sea coast of Georgia. In 1956 near Ochamchire on 30m depth, with the length of 67cm and in 1956 near Ajara coast, between Gonio and Chorokhi river mouth, with the length 76cm. It's a bottom fish. In the recent years it has not been recorded.

### Scorpaenidae

Bottom fish. It is recorded in the stony-bouldery areas covered by algae and epifauna, on a sandy and shelly ground in the depth of 30-40m. The spawning abilities are revealed from 2-3 years. They spawn in portions in April- September. Up to 200 000 of pelagic eggs are laid. They are fed by small fish and decapods.
*Scorpaena porcus* Linne- Found in small quantities along the Georgian Black Sea coastline. Length 25cm, rarely 30cm. Sometimes it enters the mouths of the rivers. It is captured in small amounts.
*Scorpaena notata* (Slasteneko) –Its length is up to 20cm, and it is a rare species.

### Triglidae

Bottom fish. Found generally on sandy and silty ground in 60m depth. Spawning ability is observed from 3-4 years, they spawn in portions in May-September.

They lay 100 000-300 000 pelagic eggs. They feed on bottom invertebrates and fish. They are found in a rather small quantities on the Black Sea coast of Georgia, especially in Poti-Ochamchire and Gudauta areas.
*Trigla lucerna* Linne- Length up to 70cm. This is the most frequently caught member of this family here.
*Eutrigla gurnardus* (Linne)- Length up to 50cm. As compared to the above species it is recorded in less quantities.
*Aspitrigla cuculus* (Bloch)-There are several records of its catch in Batumi area. Length up to 50cm.

### Serranidae

*Serranus scriba* (Linne)- Found in a rather small quantities on the Black Sea coastal zone of Georgia, especially in Sarpi-Kobuleti and Sokhumi-Psou. It prefers stony areas overgrown with algae. Length 25cm, rarely 30cm. It's a bottom-pelagic fish, hermaphrodite, spawns in portions in June-September, lays about 120 000 pelagic eggs. It feeds on small fish and decapods. It lives alone.

### Sparidae

Bottom-pelagic fish, found in areas covered by algae on stony-bouldery and rocky areas, on a stony and sandy ground. Generally it forms small groups. During the cold season of the year they go deeper, far from the coast. They spawn in portions, in June-September. Eggs are pelagic. Gonads include masculine and feminine sexual elements. But masculine sexual elements develop and function first, and then feminine ones (protandry) or vice versa (protogony), or they change sex.
*Diplodus annularis* (Linne) - Found in rather small quantities in the Black Sea coastal zone of Georgia. It rarely enters the river mouths. Length up to 25cm. It feeds on fixed algae, overgrowths, bottom invertebrates, small fish. It is captured in small quantities.

*Diplodus sargus* (Linne)- Rarely found from Sarpi to Kobulti. Length up to 30cm. It feeds on fixed algae, overgrowths, bottom invertebrates, small fish.
*Diplodus puntazzo* (Cetti)- Rarely found from Sarpi to Kobuleti and from Sokhumi to Psou. Length 40-50cm. It feeds on fixed algae, overgrowths, bottom invertebrates, small fish.
*Sparus auratus* Linne- Seldom found in Batumi and Sokhumi areas. Length up to 35cm. It feeds on bottom invertebrates and small fish.
*Pagellus erithrynus* Linne- Seldom found anywhere. Length up to 35cm, sometimes more. It feeds on bottom invertebrates and small fish.
*Boops boops* (Linne)- Rarely found in Batumi area. Length up to 35cm, it feeds on plankton, fixed algae, bottom invertebrates and small fish.

**Sciaenidae**

Bottom-pelagic fish, found in a coastal stony-bouldery areas, on a stony-sandy and silty ground. They enter Paleostomi. They often enter and gather in the mouths of comparatively large rivers, especially if the water is turbid. Most of the fish is caught here in September-December and March-April. During the cold seasons of the year they go relatively deeper. They spawn in portions in Spring-Summer. The eggs are pelagic. They feed on fish and bottom invertebrates. One of the most valuable fish.
*Sciena umbra* Linne- Found in small quantities on the Black Sea coast of Georgia. Length up to 50cm, generally 25-30cm. It lays 520 000 eggs.
*Umbrina cirrosa* (Linne)- Found in small quantities on the Black Sea coast of Georgia. Usually it weighs up to 5-6kg, and its length is 1m. Its productivity is up to 3 million eggs, it is captured on small amounts.

**Pomacentridae**

*Chromis chromis* (Linne) –It is rare in the Black Sea coastal zone. Length 10-15cm. A bottom-pelagic fish. In April-November it is found in small groups in the stony - bouldery and rocky areas covered by algae and overgrowths in 10m depth. During the cold time of the year it goes relatively deeper, away from the coast. It spawns in summer, the eggs are demersal and protected by a male. The juveniles are pelagic. It feeds on bottom invertebrates.

**Mullidae**

Bottom fish, generally found in 10-40m depth. Sometimes they enter Paleostomi and river mouth. They prefer temperature up to 8-24°C, according to which, they change depth. They start spawning at the age of 2 years. They spawn in portions in May-August, lay 3000-90 000 pelagic eggs. The juveniles 1,5 -2 months have pelagic way of life. As they reach 3,5-6cm in length, they come to the coast, go down to the bottom and continue living in the bottom. The longevity of life is up to 10-12 years. They generally feed on bottom invertebrates, sometimes small fish. It is a valuable species and captured in great amount.

*Mullus barbatus ponticus* Essipov-it is recorded in great quantities on the Black Sea coast of Georgia on soft silty and sandy ground. Length up to 20 cm, rarely up to 25cm.

*Mullus surmuletus* Linne- Found everywhere on a hard stony and stony-sandy and shell grounds. Length up to 30cm, sometimes bigger.

**Labridae**

Bottom-pelagic fish. They are found in the stony - bouldery and rocky areas covered by algae and overgrowths in 15m depth, and deeper during the cold season of the year. They seldom enter the river mouths, they feed generally on molluscs and other bottom invertebrates. It becomes sexually mature at the age of 1 to 3 years. They spawn in portions from April to August, the eggs are demersal, laid in a quiet nest prepared by male, at the depth of 3,5m, which is a hole laid with plants. Several females lay eggs in one nest. It is hid by a male after fertilization under the plants, and protected until hatching out. Juveniles are pelagic, they generally live alone.

*Crenilabrus tinca* (Linne)- Length up to 20cm, sometimes 25-30cm, lays up to 60 000 eggs.

*Crenilabrus roissali* Risso- Length 15cm, rarely 20cm, lays up to 40 000 eggs.

*Crenilabrus ocellatus* Forskal- Length up to 12cm, rarely 15cm, lays up to 10 000 eggs.

*Crenilabrus cinereus staitii* (Nordmann)- Length up to 15cm, sometimes 20cm, lays 8000 eggs.

In the Black Sea coastal zone of Georgia, the representatives of the above family are found in small quantities, generally from Sarpi to Kobuleti and from Kodori to Psou. Most frequently caught one is *Crenilabrus tinca* (Linne). *Crenilabrus roissali* Risso and *Crenilabrus ocellatus* Forskal are caught less frequently and the rarest is *Crenilabrus cinereus staitii* (Nordmann).

**Trachinidae**

*Trachinus draco* Linne- Found in small quantities on the Black Sea coast of Georgia. Length up to 35cm, usually 20-25cm. A bottom fish, living on a silty and sandy ground, generally in the depth of 20-30m. Sexually matures at the age of 2 or 3 years. It spawns in portions in June-August, lays up to 90 000 pelagic eggs. It feeds on fish and bottom invertebrates. A prickle on the opercle and the sharp rays of the first dorsal fine are very poisonous. That's why the predators avoid it. After removal of the poisonous parts, it can be eaten. It is captured in small amounts.

## Uranoscopidae

*Uranoscopus scaber* Linne- Found in the Black Sea coastal zone of Georgia in small quantities. Length up to 30cm. A bottom fish, living on a silty and sandy ground, in 20-30m depth, and going deeper during the cold season of the year. It spawns in portions in June-August, laying about 120 000 pelagic eggs. It feeds on small fish and bottom invertebrates. The thorns on its head and sharp rays of the first dorsal fine are very poisonous. That's why the predators avoid it. After removal of the poisonous parts, it can be eaten. It is captured in small amounts.

## Blenniidae

Bottom fish, found in stony and bouldery areas covered by overgrowths and algae in the depth of 15m. They spawn in portions from April till September. The eggs are laid on the stone surface, among the stones and in the empty shells of molluscs. It lays up to 15 000 eggs. It takes 15-20 days to hatch. During that time, the eggs are protected by male. Juveniles are pelagic. It feeds on fixed algae and bottom invertebrates. The representatives of the family are found in small quantities in the Black Sea coastal zone of Georgia.

*Aidablennius sphinx* (Valenciennes)- Found everywhere. Length up to 8cm, usually 5cm.

*Lipophrys pavo* (Risso)- Caught in Batumi area. Length up to 14cm, usually 10cm.

*Parablennius tentacularis* (Brunnich)- Found everywhere. Length up to 13cm, usually 10cm.

*Parablennius sanguinolentus* (Pallas)- Found everywhere. Length up to 25cm, usually 20 cm. It rarely enters the mouths of rivers.

*Parablennius zvonimiri* (Kolombatovic)- Caught in Batumi area. Length up to 7cm, usually 6cm.

*Caryphoblennius galerita* (Linne)- Found everywhere. Length 7-8cm. It rarely enters the river mouths.

Among the above species, *Parablennius sanguinolentus* (Pallas) is found most frequently. *Aidablennius sphinx* (Valenciennes) is found less frequently. The others are captured in small quantities.

## Ammodytidae

*Ginnammodytes cicerellus* (Rafinesque) – Rarely captured in the Black Sea Georgian coastal zone near Gagra. Length 15-17cm. It lives on a sandy ground, in the depth of 20m. It is a bottom pelagic fish, spawns in portions from September to January, laying up to 7000 demersal eggs. Juveniles are pelagic. It feeds on zooplankton.

### Gobiidae

Bottom fish, feeding on bottom invertebrates and small-sized fish. They start spawning from the age of 2 or 3. They spawn in portions in spring-summer. The eggs are laid under the stones, among them, in empty shells. It lays about several thousands of eggs. The eggs are protected by a male during the development.
*Gobius cobitis* Pallas- Found in Sokhumi area. Length up to 27 cm, usually 24cm. Found in stony and bouldery areas in 10-15m depth.
*Gobius niger* Linne- Found in Gudauta area. Length up to 15cm. Its habitat is covered with mussels, oysters , silt and sand, among the water plants, in the depth of 40m. It rarely enters fresh water.
*Mesogobius batrachocephalus* (Pallas)- Found in the area with silt, sand, and shells, mainly in 40m depth. Length 37cm,. It rarely enters the fresh water.
*Neogobius melanostomus* (Pallas)- Found in the area with silt, sand, and shells, mainly in 20m depth. Length 26cm. It enters the fresh water (Paleostomi, Inkiti, Nurie, Kakhaberi).
*Neogobius ratan* (Nordmann)- Captured in Batumi area. Length reaches 20cm. Its habitats are covered with stones, boulders and rocks in the depth of 10-15m. It seldom enters river mouths.
*Neogobius cephalarges* (Pallas)- Found in the Black Sea coastal zone of Georgia, and in the lakes (Paleostomi, Nurie, Bebesiri) and rivers flowing into the sea. Length up to 25cm. Its habitats are covered with stones, boulders and rocks in the depth of 10-15m.
*Neogobius platyrostris* (Pallas)- Found in the Black Sea coastal zone of Georgia from Sarpi to Kobuleti and from Kodori to Psou. Length 23cm. Its habitats are covered with stones, boulders and rocks in the depth of 10-15m. It enters river mouths.

From the representatives of the family, in the Black Sea coastal zone of Georgia,the most abundant are *Neogobius melanostomus* (Pallas) and *Neogobius melanostomus* (Pallas), which are captured in medium quantiy. Other representatives are caught in small amounts.

### Callionymidae

Bottom fish, found generally on a sandy ground and also in areas with stones and rocks in 20m depth. They spawn in portions from April to October. Eggs and juveniles are pelagic. They feed on bottom invertebrates. In the Black Sea coastal zone of Georgia, they are found in small quantiy. They rarely enter river mouths.
*Callionymus lyra* Linne- Captured in Batumi area. Length up to 25-30cm, usually 15cm.
*Callionymus pusillus* Delaroche- Found everywhere. Length up to 14cm, usually 10cm.
*Callionymus risso* Risso- Found everywhere. Length 8cm.
*Callionymus fasciatus* Val.- Captured in Batumi area. Length 8-12cm.

## Gobiesocidae

Bottom fish, living among stones, boulders and rocks, covered by algae and overgrowths. They spend a lot of time under the stones and stone holes. They avoid freshwater areas. They spawn in portions in May-August. Over 200-270 eggs are laid in stones, on the lower surface of the stones, between them, or in the empty shells of molluscs. They are protected during the development 2-4 weeks . The juveniles are pelagic. They feed on bottom invertebrates. In the Black Sea coastal zone of Georgia, they are found in a very small quantiy.
*Diplecogaster bimaculatus euxinica* (Bonnaterre)- Length 5-7cm. Most abundant of this family.
*Lepadogaster lepadogaster lepadogaster* (Bonnaterre)- Length 7-8cm. Its abundance is comparatively less in this family.
*Lepadogaster candollei* Risso – Length up to 10cm. The rarest from the family.

## Bothidae

*Arnoglossus kessleri* Schmidt- Rarely captured in the Black Sea coastal zone of Georgia near Batumi, Sokhumi and Akhali Athoni. Length 10cm. A bottom fish, found generally on a sandy ground, in 20m depth. It goes deeper during the cold seasons. It spawns in portions in June-August. Eggs and larvae are pelagic .It feeds on bottom invertebrates.
*Scophthalmus rhombus* (Linne)- Rarely captured on the Black Sea coastal zone of Georgia near Batumi. Length up to 50cm. A bottom fish. It spawns in portions in June-August. Eggs and larvae are pelagic .It feeds on bottom invertebrates and fish.
*Psetta maxima maeotica* (Pallas)- Found everywhere in the Black Sea coastal zone in small quantities. Length up to 85cm, weight up to 9kg. Sometimes, however, it reaches 100cm and 15kg. It enters Paleostomi and river mouths. A bottom fish, found on a silty, sandy and shelly ground in the depth of 100m. It becomes sexually mature late, females at the age of 9-11 years, and males at the age of 7-8 years. It spawns in portions in March-May, and most intensively in April, at the depth of 10-40m. Sometimes, it spawns not every year, but with an interval of several years. It lays 2,5-13 millions pelagic eggs. After spawning, in summer, it shifts to the depth of 40-80m. In October-November and December, it comes closely to the coast for feeding in the depth of 10-30m. In January-February it goes on a 60-100m depth. It feeds on fish and bottom invertebrates. One of the most valuable species. It is captured in small quantity.

## Pleuronectidae

*Platichthys flesus luscus* (pallas)- Found everywhere in the Black Sea coastal zone in small quantities. Length 25cm, sometimes up to 30cm. It enters rivers (mainly in summer) and Paleostomi. A bottom fish, found on a silty and sandy ground in the depth of 50m. It becomes sexually mature at the age of 2-3 years. It spawns in portions, generally in January-March. It lays from100 000 to 1 million pelagic eggs. It feeds on fish and bottom invertebrates. It is captured in small quantity.

### Soleidae

*Solea nasuta* (Pallas) - Found everywhere in the Black Sea coastal zone in small quantities. Length 20cm, sometimes 30cm. It enters Paleostomi. A bottom fish on a silty and sandy ground in the depth of 60m. It spawns in portions, generally in June-September. It lays from 5 000 to 150 000 pelagic eggs. It feeds on fish and bottom invertebrates. It is captured in small quantity.

### Balistidae

*Balistes capriscus* Gmelin- Only two cases of its capture on the Black Sea coast of Georgia have been recorded. In 1934, one with the length of 47cm, and in 1952 another one with the length of 38cm, near Sokhumi. A bottom-pelagic fish.

Poti-Ochamchire shelf zone is characterized by wide diversity and quantity of fish species. This area is known to be a reserve. This is an area for breeding, feeding and wintering for almost all the Black Sea species. Moreover, it is feeding area of sturgeons on Caucasus coast. An icthyofauna of sea contact zone and coastal lakes (especially Paleostomi and Inkiti) is rather peculiar. It includes over 60 species and sub species. Here we meet marine, brackish and freshwater forms, which are not present in the coastal zone.

The species of commercial value on the Georgian coastline of the Black Sea are anchovy, sprat, Black Sea red mullet, Black Sea scad, spiny dog fish, and mullet.

The Black Sea coastal zone, therefore, due to its peculiarities may be distinguished as an independent region for ichthyofauna studies. While the Black Sea freshwater fish species are actually well studied, we cannot say much about the sea fish species. We know almost all species composition of the ichthyofauna, but there still is something unclear. As for biology and morphology, a big part of marine fish from this view point are less or unstudied in our area.

The article represents 60 bottom and bottom-pelagic fish forms of the Black Sea coast of Georgia. Their existence is proved by literature, as well as by studies undertaken by the authors in 2000-2002. Among the above fish species the most abundant are red mullet, whiting and spiny dog fish. Gobies and sea cat are less in quantity. The above mentioned fish play a significant role in local fishing. The red mullet is a valuable commercial object, which is very popular in Georgia. It should be noted that during the last 10 years, because of economic stagnation and decline of number of the fishing objects, the following fish species became commercial: *Raja calvata, Dasyatis pastinaca, Gaidropsarus mediterraneus, Ophidion rochei, Scorpaena porcns, Trachinius draco, Uranoscopius scaber, Gobiidae* and *Solena nasuta*. The most valuable species *Psetta maxima maeotica* and *Umbrina cirrosa* belong to the bottom and bottom-pelagic fish. They are captured in very small numbers, as they are very rare in the Black Sea. Many of bottom and bottom-pelagic fish are the objects of amateur and sports fishing.

Bottom and bottom-pelagic fish serve as food for predators as sturgeons, dolphins, waterfowls. In order to insure rational use of the Black Sea fish, in order to avoid excessive fishing and destruction of the stocks, first of all, basic study of fish species of the region is required, with the purpose of creating rational fishing bases. Trawling and fixed nets must be prohibited in a very narrow shelf zone. Regional Red Book must be prepared, and the fishing must be prohibited for rare species. Besides, the fishing must be prohibited during spawning period in April-May-June.

By the late 1990s, after pollution of marine and wetlands water, the biodiversity of the Black Sea coastline fish species has decreased. For example, commercial species such as bluefish, common bass, mackerel, bonitos, large race horse-mackerel, gurnard, garfish, wrasse, painted comber, sharp- snouted sea bream and brown meagre were not captured any more by them.

Number of the following species has sharply reduced: thornback ray, common stingray, sturgeons, picarel, shore rockling, annular gilthead, greater weever, stargazer, blennies, cusk-eel, gobies, flatfish.

However, in the 1990s, due to the economic stagnation in Georgia, nearly all factories, representing main polluters of the Black Sea coastal zone, were closed. Also, after the decay of the agriculture pesticides and fertilizer usage has decreased. Number of fishing vessels has also diminished. Therefore, it resulted in the revival of the coastal ecosystem. In a few years, disappeared fish species appeared again, these are: mackerel, bonito, painted comber, gurnard, sharp-snouted sea bream and wrasse.

Today, we have information concerning capture of large race horse-mackerel and bass. Quantity of common stingray, thornback ray, whiting, small race horse-mackerel, red mullets, mullets and corb has obviously increased. Biodiversity of fish in the Black Sea coast of Georgia has considerably increased.

## REFERENCES


BURCHULADZE, O.G., MESKHIDZE, D.K. 1982. Fishes of Georgia, p.113.

SVETOVIDOV, A.I. 1964. The Black Sea Fishes, USSR, Acad. of Sciences, Moscow, p.550.

BLACK SEA BIOLOGICAL DIVERSITY. 1998. Georgian national report. United Nations Publications. New York.

MILLER, P.J., LOATES, M.J. 1997. Fish of Britain and Europe. Harpers Collins Publishers.

# ACTUAL STATE OF THE ROMANIAN MARINE DEMERSAL FISHERIES

Simion NICOLAEV, Volodea MAXIMOV, Eugen ANTON, Gheorghe RADU
National Institute for Marine Research and Development
"Grigore Antipa", Constantza, Romania

**ABSTRACT**

This paper presents the state of the bottom fishery at the Romanian Black Sea littoral.

It includes data on the development of the Romanian fisheries, methods and fishing gears used, as well as the temporal variations of the bottom catches (1970-2002) and their structure by species.

This paper also makes a brief note about the legislative framework for the fishery activity in the Romanian territorial waters and Exclusive Economic Zone and mentions the main fishing regulations.

## INTRODUCTION

Over the last 50 years, the Black Sea ichthyofauna has undergone major changes concerning either its qualitative and quantitative structure and the behaviour of various species. These changes are consequences of human activities, directly through the fishing pressure and indirectly through the deterioration of the environmental conditions, especially in the western part of the Black Sea.

A specific feature of the Pontic Basin is that most of the fish species cover large areas located within the exclusive zones of the riparian countries. In this connection the Romanian littoral is an important place for feeding and spawning of the main fish species, although the catches made in this area do not exceed 2% of the total Black Sea catch.

The bottom fish species inhabiting the Romanian Black Sea shelf represent the most important part of the regional fishery potential considering the commercial interest, the demand in the domestic and foreign market. Among the bottom fish species, the turbot *(Psetta maeotica)*, flounder *(Platichthys flesus luscus)*, beluga *(Huso huso)*, Danube sturgeon *(Acipenser gueldensteadi)*, starry sturgeon *(Acipenser stellatus)* and picked dogfish *(Squalus acanthias)* are suitable for a commercial fishing, and a good exploitation management and a good utilization of their catches could ensure the economic recovery of our national marine fisheries which could launch on the market valuable fishery products whose demand is poorly satisfied at present.

There is an old tradition of the marine bottom fishing in Romania, as this was the main occupation in the Dobrudja fishery settlements in the 18th and 19th centuries, followed by the Romanian marine fishing in the 20th century. Nowadays the bottom species are caught only as by-catches, either in the stationary fishery using pound nets or turbot gillnets installed along the seaside, or in the coastal trawlers catch mainly interested in the exploitation of the small gregarious pelagic fishes gathering in compact agglomerations easy to be caught.

A research team of the National Institute for Marine Research and Development "Grigore Antipa" – Constantza is conducting a prioritary project entitled "Solutions for the Recovery of the Black Sea Bottom Fishery". The main aim of this project is to know the state of the exploitable bottom fish stocks in the Romanian marine waters and their evolution tendencies given the conditions of the Black Sea ecosystem modifications, as well as to get data and information enabling to mitigate the human impact, to rehabilitate the marine ecosystem and to ensure a rational exploitation of the bottom resources. All these would result in viable solutions for the recovery of the fishery of these species in the Romanian marine sector.

## STATE OF FISHERIES AT THE ROMANIAN BLACK SEA LITTORAL

There are two kinds of marine fishing in the Romanian Black Sea sector, namely :

- active fishery, using coastal trawlers and operating offshore, at depth exceeding 20 m;
- stationary fishing, using passive gears in 30 fishery locations along the littoral between Sulina and Vama Veche, in the shallow coastal waters.

### The Active Fishery

The industrialization of the national marine fishery began with a first stage between 1948 and 1964 – the "offshore fleet" was established and the bottom fishing was invigorated; the gillnets and longlines used on board the Swedish and Finish cutters and seiners enabled a first modernization of the commercial fishery. As an indirect result of the fleet dissolution caused by the collapse of *Scombridae* fishery, the bottom species fishing was given up. Another important factor causing the lack of interest for the bottom species were the low prices in the domestic market imposed by the centralized economy, which totally ignored the exploitation costs. That is why in 1960-1980 the bottom fishery was declared unprofitable and practically abandoned.

Since 1980, a new commercial fishing fleet has been organized in Romania and it included coastal trawlers type B410 (132GRT/570HP) built in Poland, type Baltica (98GRT/300HP) built in the Soviet Union and TCMN (95GRT/365HP) built in Romania. Twenty trawlers were purchased (Table 1).

Table. 1. Romanian coastal fishing fleet evolution.

| Year | Number | Trawler type | | |
|---|---|---|---|---|
| | | B-410 | Baltica | TCMN |
| 1981 | 2 | 2 | | |
| 1982 | 3 | 3 | | |
| 1983 | 11 | 7 | 4 | |
| 1984 | 11 | 7 | 4 | |
| 1985 | 15 | 7 | 4 | 4 |
| 1986 | 14 | 7 | 4 | 3 |
| 1987 | 14 | 7 | 4 | 3 |
| 1988 | 14 | 7 | 4 | 3 |
| 1989 | 20 | 6 | 4 | 10 |
| 1990 | 13 | 6 | 4 | 3 |
| 0 | 1 | 2 | 3 | 4 |
| 1991 | 7 | 2 | 4 | 1 |
| 1992 | 8 | 3 | 4 | 1 |
| 1993 | 8 | 3 | 4 | 1 |
| 1994 | 8 | 3 | 4 | |
| 1995 | 9 | 3 | 4 | 2 |
| 1996 | 11 | 3 | 4 | 4 |
| 1997 | 13 | 3 | 4 | 6 |
| 1998 | 14 | 3 | 4 | 7 |
| 1999 | 14 | 3 | 4 | 7 |
| 2000 | 12 | 2 | 4 | 6 |
| 2001 | 7 | 2 | 1 | 4 |
| 2002 | 9 | 2 | 1 | 4 |

The trawlers mainly operated in fishing small gregarious pelagic species (sprat, Black Sea horse mackerel, European anchovy) and the main object of their activity was the high production, taking no care of the catch diversity and commercial value. The intensive fishing has resulted in a slight increase of the dogfish catch, but it did not exceed the value of a by-catch. Since 1990, the new conditions of fishing (no state subvention, economical competition and privatization) radically changed the national marine fishery. In 2002 there were nine trawlers operating in the Romanian Black Sea sector (two B410 type, two Baltica type, three TCMN type and two – other types) and only two of them carried out a specialized bottom fishery with turbot gillnets and longlines, namely "Pelican 1"/S.C."TRIPELICANS" and "Hendem Mustafa"/S.C." BALENA TRADING".

**The Stationary Fishery**

The stationary (passive) fishery is carried out along the Romanian Black Sea littoral between Sulina and Vama Veche, in shallow waters, in 30 fishery locations.

There are two kinds of passive fishing:

- commercial fishing, carried out by private companies or persons authorized by the National Company for the Management of the Fishery Resources – Bucharest or the Danube Delta Biosphere Reserve Administration- Tulcea, in 16 fishery locations in the sector Sulina-Vama Veche, using pound nets, turbot gillnets,trammel nets, longlines, beach seines, gobies gillnets;
- angling, carried out by persons, which are or are not members of the General Associations of Game Hunters and Anglers, in 14 fishery locations between Cap Midia and Mangalia, with rodlines.

In 1960-1989 the stationary fishing was carried out by three state companies, in 18 fishing locations along the Romanian littoral between Sulina and Mangalia, with about 70-150 pound nets yearly, and catches (3120-7900 t) mainly consisting of pelagic species, while the bottom species were to be found only as by-catches.

Since 1990, similarly to the situation in the coastal fishing fleet, the stationary fishing at the Romanian littoral has declined. The number of pound nets have been gradually reduced (from 150 to 29), the number of the employees in that activity has diminished and the number of fishing days has decreased from 9945 to 571. The total catch has been gradually reduced from 2490 t in 1993 to 423 t in 2001 and 641 t in 2002. An illegal fishery has developed along the entire littoral.

In 2002, 21 private companies and more than 50 persons were authorized to carry out commercial fishery. Most companies (having 3-5 turbot gillnets) and all persons practised a turbot bottom fishing with trammel nets, turbot gillnets and longlines. There were also 4050 game anglers, members of the General Association of Game Hunters and Anglers-Constantza (3900 anglers) and Tulcea (150 anglers), who used about 9034 rodlines and obtained a productivity of 3.99 kg/rodline (Table 2). In 2002, a number of 4662 fishermen operated in the marine stationary fishery and used 882 boats (579 motor boats), 41 pound nets, 1267 turbot gillnets/trammel nets, 11 beach seines and 9034 rodlines (Table 2).

Table 2. Numbers of boats, fishing gears and authorised personell for demersal marine fishing activity, year 2002.

| Nr | Fishing point | Boats | | | Fishing Gears | | | | Authorised personell | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total | withs motor | with out | Trap net | Gill net | Beach seine | Hand line | Total | ARB DD | CNA FP | AG VPS |
| 1 | Sulina | 181 | 99 | 82 | 1 | 750 | - | - | 220 | 120 | - | 100 |
| 2 | Sf. Gheorghe | 114 | 100 | 14 | 1 | 50 | - | 50 | 184 | 114 | 20 | 50 |
| 3 | Perilor | 5 | - | 5 | | 10 | 1 | - | 8 | 8 | - | - |
| 4 | Porti\a | 6 | - | 6 | 8 | 10 | - | - | 100 | 100 | - | - |
| 5 | Periboina | 8 | - | 8 | 4 | 15 | - | - | 48 | 48 | - | - |
| 6 | Edighiol | 4 | - | 4 | 3 | 10 | 1 | - | 20 | 20 | - | - |
| 7 | Chituc | 4 | - | 4 | 2 | 6 | - | - | 14 | 14 | - | - |
| 8 | Chituc cherhana | 3 | - | 3 | 2 | 6 | - | - | 14 | 14 | - | - |
| 9 | Vadu | 4 | - | 4 | 2 | 10 | - | - | 10 | 10 | - | - |
| 10 | Corbu | 7 | - | 7 | 1 | 10 | 1 | - | 7 | 7 | - | - |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11 | Cap Midia | 2 | - | 2 | 2 | 10 | 1 | - | 110 | - | 10 | 100 |
| 12 | Cap Midia cherhana | 2 | - | 2 | 2 | 10 | - | 900 | 10 | - | 10 | - |
| 13 | Tab[r[ N[vodari | 15 | 10 | 5 | - | 25 | 3 | 850 | 515 | - | 15 | 500 |
| 14 | Mamaia sat | 3 | - | 3 | 2 | 10 | 1 | - | 12 | - | 12 | - |
| 15 | Mamaia | 4 | - | 4 | 2 | 5 | - | - | 10 | - | 10 | - |
| 16 | Mamaia pesc[rie | 83 | 70 | 13 | - | 30 | - | 1240 | 257 | - | 5 | 252 |
| 17 | Constan\a Tomis | 130 | 120 | 10 | - | 50 | - | 1750 | 992 | - | 3 | 989 |
| 18 | Agigea | 11 | - | 11 | 2 | 5 | - | | 8 | - | 8 | - |
| 19 | Eforie Nord | 5 | 2 | 3 | - | 15 | - | 425 | 245 | - | 5 | 240 |
| 20 | Eforie Sud | 78 | 70 | 8 | - | 25 | 2 | 948 | 319 | - | 3 | 316 |
| 21 | Tuzla | 31 | 25 | 6 | - | 50 | 1 | 1067 | 359 | - | 3 | 356 |
| 22 | Tuzla sud | 10 | 5 | 5 | - | 10 | - | - | 28 | - | - | 28 |
| 23 | Costine]ti | 4 | - | 4 | - | 10 | - | 444 | 146 | - | - | 146 |
| 24 | Golful Francezului | 8 | - | 8 | - | 10 | - | 25 | 18 | - | - | 18 |
| 25 | Halta Pesc[ru] | 16 | - | 16 | - | 10 | - | 30 | 10 | - | - | 10 |
| 26 | Tatlageac | 23 | 3 | 20 | 2 | 15 | - | 500 | 170 | - | 10 | 160 |
| 27 | Jupiter Cap Aurora | 8 | 5 | 3 | - | 10 | - | 25 | 18 | - | - | 18 |
| 28 | Saturn | 7 | - | 7 | - | 10 | - | 20 | 16 | - | - | 16 |
| 29 | Mangalia | 80 | 60 | 20 | - | 50 | - | 600 | 694 | - | 8 | 686 |
| 30 | 2 Mai | 30 | 10 | 20 | 2 | 20 | - | 150 | 65 | - | 15 | 50 |
| 31 | Vama Veche | 3 | - | 3 | 3 | 10 | - | 10 | 35 | - | 20 | 15 |
| T O T A L | | 889 | 579 | 310 | 41 | 1267 | 11 | 9034 | 4.662 | 455 | 157 | 4.050 |

## Methods and Techniques in the Bottom Fishery

In catching the fish species living on the sea bottom (turbot, flounder, etc.) or very near to it (dogfish, sturgeons, etc.), the Romanian Black Sea littoral fisheries have used traditional passive fishing gears, such as : pound nets, beach seines, turbot and gobies gillnets, trammel nets for sturgeons, longlines for dogfish and gobies, bottom lines for sturgeons.

In order to solve the problems issued by the project, an active fishing gear is also to be used: a bottom trawl with a suitable rigging system. The trawl and its rigging system have been designed at the National Institute for Marine Research and Development "Grigore Antipa" – Constantza, by the specialists in that field (Nicolaev 2003), and manufactured by the skilled staff of the same institute.

## Dynamics in the Bottom Catches in the Romanian Sector

Although the Romanian littoral has a length of 244 km, before 1980 the Black Sea coastal fishery represented only 8% of the Romanian total marine and ocean fishery and mainly resulted from a passive fishery (with pound nets, beach seines, gillnets,trammel nets, bottom lines) along the seaside from Sulina to Mangalia.

Beginning with the 1980s, when the active fishery started by the creation of the coastal fishing fleet including then two trawlers of 25 m, the catches doubled.

The fish catch at the Romanian littoral were and are dependent either on the operation zone and the fishing technology used.

Thus in 1950-1965, as a result of a passive fishing with pound nets and sometimes an active fishing with small tonnage wooden boats (whaler and seiner types) the catches oscillated between 3171 t in 1950 and 11088 t in 1961, the bottom species representing 15-20% of the total catch, and the main species were *Psetta maeotica* (turbot), *Platichthys flesus luscus* (flounder), *Squalus acanthias* (dogfish) and sturgeons. The dissolution of the offshore fishing fleet has indirectly involved giving up the bottom species fishery, mainly turbot and dogfish fisheries.

In 1966-1980, the marine catches varied between 3120 t in 1969 and 7900 t in 1979 and resulted from the passive fishery with ,150 pound nets and 500-1000 turbo gillnets placed along the Romanian littoral (Sulina-Mangalia). The bottom species represented 8.87-26.77% (Fig.1).

In 1981 the first two trawlers B410 were purchased and the coastal fishing fleet was re-organized : new trawlers (Baltica and TCMN types) were bought and the Romanain catches gradually increased from one year to another, from 10080 t in 1981 to 15835 t in l986. Although the yearly catches doubled, the bottom species proportion reduced to 10%, excepting in 1985 and 1990 when it reached 25.33% and 42.87% respectively,especially because of the increase of whiting *(Merlangius merlangus euxinus)* catches (Fig.1). The bottom species proportion is low because the coastal fishing vessels mainly fished small gregarious fish species (sprat, horse mackerel, European anchovy), aimed at obtaining high production and completely neglected the species diversity and their commercial value; another cause was the low price in the domestic market imposed by the centralized economy and which did not take into consideration the exploitation costs. That is why the bottom fishery was considered unprofitable and practically abandoned.

After 1990 the fishing activity at the Romanian littoral has recorded a decrease : the fishing effort is gradually reduced owing to the decrease of pound nets (from 150 to 29) and trawlers (from 20 to 5) numbers, as well as of the staff involved in this activity. The catches were suddenly reduced to a half and then continued to diminish (13836 t in 1989, 6251 t in 1990, 3060 t in 1994, 2507 t in 1999, 2431 t in 2001, and 2116 t in 2002), the bottom catches representing 10-15% (Fig.1). Although their proportion is high in comparison with the previous period (1980-1990), this fact was due to the increase of the whiting *(M. merlangus euxinus)* catches.

**Species Structure of Bottom Catches**

The F.A.O. Statistics for the Black Sea include more than 20 species; only 10 of them (belonging to 7 families) are listed for the Romanian marine sector. The same as for the entire Black Sea, the highest proportion in the catches at the Romanian littoral belongs to *Gadidae* family *(M. merlangus euxinus* – whiting*)* with more than 88% - it is a less valuable species owing to its poor quality meat. The other bottom species with high nutritious and commercial values are included in small proportions in the catches : 5% *Acipenseridae* family *(Huso huso* – beluga*; Acipenser gueldensteadi* – Danube sturgeon; *Acipenser stellatus* – starry sturgeon *);* 3% *Squalidae* family *(Squalus acanthias* – dogfish *)* ;2% *Gobiidae* family *(Mesogobius batracephalus* – knout goby; *Negobius cephalarges* – ginger goby; *Neogobius melanostomus* – round goby *);* 1% *Scophthalmidae* family *(Psetta maeotica* – turbot *)* and 1% *Mullidae* family *(Mullus barbatus ponticus* – red mullet*)*(Fig. 2).

Besides, some species occurred in isolated individuals, in catches: *Dasyatis pastinaca*; *Raja clavata*; *Platychthys flesus luscus*; *Solea vulgaris*, *Sciaena cirrosa*; *Symphodus ocellatus*, *Symphodus (Crenilabrus) cinereus*, *Scorpena porcus*, *Scorpena notata*, *Parablennius tentacularis*, *Parablennius sanguinolentus*, *Syngnathus typhle*, *Neogobius platyrostris*; *Gaidropsarus mediterraneus*; *Callionymus pussillus*.

An analysis of the Romanian bottom catches of 1970-2002 shows that except the whiting *(M. merlangus euxinus)*, which had constant yearly catches, the values of the other commercially valuable bottom species catches had decreasing tendencies (Table 3). Thus in 1970-1980 the catches of sturgeons *(Acipenseridae)* reached 1426 t , but they decreased very much during the following decades to 340 t in 1981-1990 and to 70 t in 1991-2002; the turbot catches *(Scophthalmidae)* also decreased from 408 t in 1970-1980 to less than 50 t during the following decades. A similar temporal variation has been registered for the species belonging to the *Mullidae* family *(Mullus* spp. – mullets *)* and *Gobiidae* family *(*gobies*)*. Although in 1981-1990 the dogfish catches increased from 277 t to 532 t, they sharply decreased to less than 100 t during the following decade.

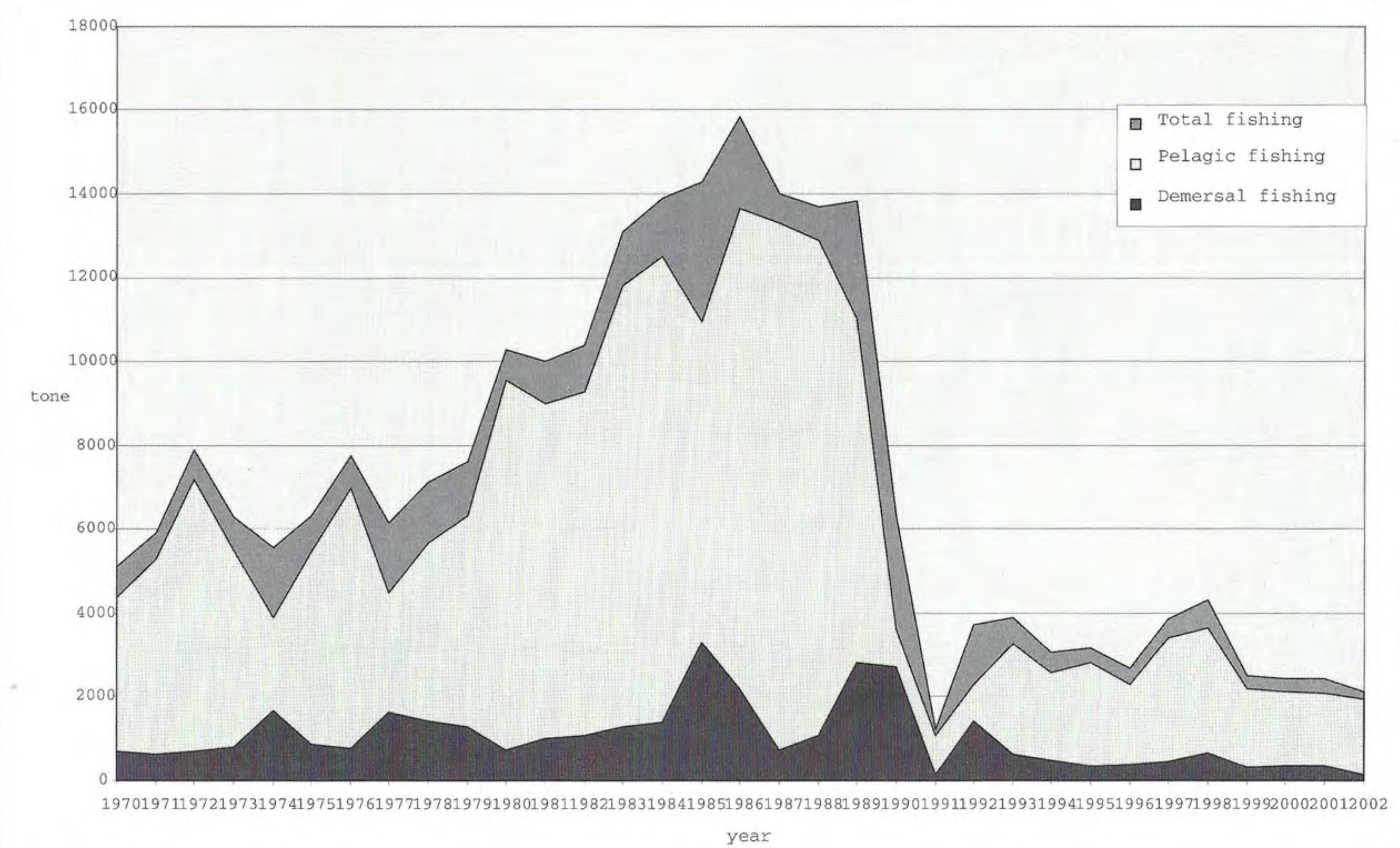



Fig. 1 Demersal fishing dynamics along the Romanian marine area in the Back Sea, during 1970-2002

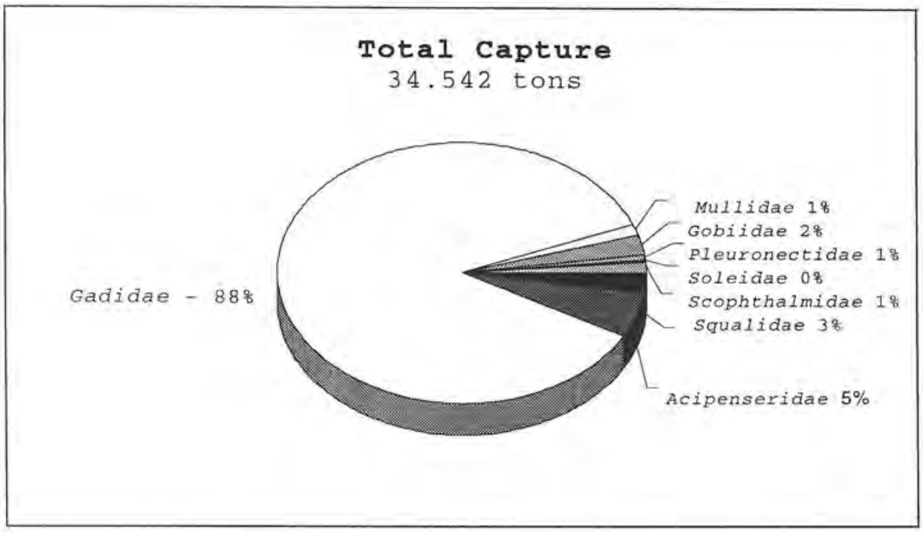



Fig. 2 Percentage of the most important demersal fish species for fishing along the Romanian seaside, during 1970-2002

Table 3. Capture evolution for demersal species, during 1970 – 2002.

| S P E C I E S | Years | | | TOTAL |
|---|---|---|---|---|
| | 1970-1980 | 1981-1990 | 1991-2002 | |
| *Squalus acanthias* | 277 | 532 | 98 | 907 |
| *Acipenseridae* | 1.426 | 340 | 70 | 1.836 |
| *Merlangius merlangus euxinus* | 8.361 | 16.148 | 5.166 | 29.675 |
| *Mullus* spp | 195 | 259 | 55 | 509 |
| *Gobiidae* | 374 | 246 | 201 | 821 |
| *Platichthys flesus* | 181 | 33 | 1 | 215 |
| *Solea solea* | 22 | 11 | 34 | 67 |
| *Psetta maeotica* | 408 | 32 | 59 | 499 |
| Others | 9 | 3 | 2 | 14 |
| T O T A L | 11.253 | 17.604 | 5.685 | 34.543 |

**-The Juridical Frame of the Fishery Activity**

The bottom fishery in the Romanian territorial waters and Exclusive Economic Zone is settled by the Law concerning the fishing resources, fishery and aquaculture (Law no.192/19.04.2001), the Regulation concerning the conditions for carrying out commercial fishery activities in the Black Sea waters (Decree no. 422/30.10.2001) and Prohibition Order issued yearly by the central public authority.

The main regulations include the following obligations:

* a fishing licence and authorization must be obtained from the central public authority for carrying out a marine fishery activity;

* fishing quotas by species are to be allocated yearly;

* the catches must be discharged only at authorized locations; it is not allowed to use fishing gears having a mesh size smaller than a=180mm for turbot gillnets and a=100 mm for gill net;

* it is forbiden to use gillnets and trammel nets made by nylon thread; the prohibition period established by the central public authority must be observed (sturgeons – 90 consecutive days for the marine littoral area up to the isobath of 20 m , between February,15 and May,05; turbot and dogfish – 60 consecutive days between April,15 and June,14);

* the fish under the minimum sizes (40 cm for turbot; 20 cm for flounder; 17o cm for beluga; 100 cm for dogfish; 140 cm for Danube sturgeon; 100 cm for starry sturgeon ) must be thrown to sea.

**CONCLUSIONS**

An analysis of those before presented can point out the following:

* Although there are numerous bottom fish species in the Romanian marine sector, only few of them can be object of the commercial fishery :*Squalus acanthias, Acipenser stellatus, Huso huso, Mesogobius batracephalus, Neogobius melanostomus, Psetta maeotica* and *Merlangius merlangus euxinus.* The last one is abundant but not valuable;

* There are two kinds of fishery in the Romanian marine sector:

- active fishery with coastal trawlers, in the offshore area, at depths exceeding 20 m;

- stationary fishery along the littoral, in 30 fishing locations between Sulina and Vama Veche, in shallow waters;

* The main fishing gears used in the bottom fishery are : pound nets, trammel nets, beach seines,turbot gillnets, gobies gillnets, dogfish longlines, gobies longlines;

* In 1970-2002 the catch of the Romanian marine fishery oscillated between 15835 t and 2116 t, with a very small proportion of the bottom species (10-15%), except for 1985 and 1990 when it was of 25.33% and 42.87% respectively, because of the increase of the whiting *(M. merlangus euxinus)* catches. The proprtion of the bottom species in the marine catches was small because the coastal vessels mainly

aimed at obtaining a big catch and neglected the catch diversity and value; the low prices maintained in the domestic market did not reflect the exploitation costs;

* The *Gadidae* family has the highest proportion among the fish species in the Romanian littoral area (exceeding 88% ) – a less valuable species, followed at a great distance by the families *Acipensaridae* 5%, *Squalidae* 3%, *Gobiidae* 2%, *Schophthalmidae* 1% and *Mullidae* 1%.

* Presently the specialized bottom fishing is carried out only by two commercial companies, a number of more than 50 persons and more than 4000 anglers.

## REFERENCES


BACESCU, M., si al. 1960. Cercetari ecologice bentale in Marea Neagra. Analiza cantitativa, calitativa si comparativa a faunei bentale pontice, Ecologie marina 4, p. 274;

BANARASCU, P. 1964. Fauna Republicii Populare Romane, Pisces Osteichthyes (pesti ganoizi si ososi) volumul XIII, ed. Academia RPR Bucuresti,p. 960;

CARAUSU, S. 1952. Tratat de Ichtiologie, ed. Academia RPR Bucuresti, p. 800;

F.A.O. 2000 - Fishery statistics. Capture production, vol. 90, Roma, p. 725;

MAXIMOV, V., ZAHARIA, T. 2002. Sinteza datelor si informatiilor privind situatia actuala a pescuitului demersal din zona litoralului romanesc al Marii Negre; AGRAL Bucuresti, 29 p;

NICOLAEV, S. 1988. Tehnologia pescuitului prin traulare cu nave de mic tonaj in Marea Neagra, IRCM Constanta, 155 p;

NICOLAEV, S. 1994. Stadiul sectorial privind managementul resurselor pescaresti (zona tampon costiera si marina). Programul de management al mediului pentru Rezervatia Biosferei Delta Dunarii, 27 p;

NICOLAEV, S., RADU, G., BUTOI, G., ANTON, E. 1994. Structura pescariilor romanesti la Marea Neagra, evolutia capturilor si mutatiile structurale produse in ultimii 10 ani. Romanian National Report. Warking Party an Fisheries Constantza, (11-13 aprilie);

PARCALABOIU, S. 1972. Starea si dinamica rezervelor de calcan de pe platforma continentala din dreptul litoralului romanesc al Marii Negre, teza de doctorat, Universitatea Galati, p 250;

VASILIU D. G. 1959. Pesti apelor noastre, ed. Stiintifica Bucuresti, p. 380.

# PRELIMINARY DATA ABOUT THE IMPACT OF FISHING GEARS ON THE DOLPHINS FROM THE BLACK SEA ROMANIAN WATERS

Gheorghe RADU, Simion NICOLAEV, Eugen ANTON, Volodea MAXIMOV, Elena RADU
National Institute for Marine Research and Development
"Grigore Antipa", Constantza, Romania

## ABSTRACT

The present paper presents the results of the actions developed within the Project "Conservation of the dolphins from the Black Sea Romanian waters", co-financed by the European Community LIFE-NATURE Program. It comprises three main sections referring to:

- General considerations regarding the impact of fishery and fishing on cetaceans;
- Main fishing gears used on the Romanian littoral, and their impact on dolphins;
- Data on incidental catch and strandings of the dolphins on the Romanian littoral.

From the land-based observation, the most dangerous fishing gears for dolphins are the turbot gillnets, especially these with three walls, due to the great capacity of retention and tearing strength.

The most of the stranded dolphins on the Romanian beaches resulted from the incidental catches abandoned in the sea by the fishermen practicing a specialized fishing for turbot, especially during the prohibited time.

## INTRODUCTION

From the fishery point of view, there is a mutual antagonism between human and marine mammals, as a consequence of the similar vital interests, meaning the need for feeding, acting sometimes in the same areas and periods.

### Impact of cetaceans on fishery

There is little information about the influence of cetaceans on commercial fishery in the Black Sea. No special assessments were made, except the assessment on the annual quantity of fish consumed by dolphins, leading to the conclusion that the dolphins represent the main threat for fishery, being guilty by the decimation of the fishery resources.

About 30 fish species were found in the dolphin stomachs. As a rule, the prey of common dolphins (*Delphinus delphis*) consists largely of pelagic fish, while for the bottlenose dolphin (*Tursiops truncatus*) and harbour porpoise (*Phocoena phocoena*) the suitable prey are the demersal fish (BIRKUN and ZALKIN, 1940; KLEINENBERG, 1956; TOMILIN, 1957; KRIVOKHISHIN *et al.*, 2000).

**Impact of fisheries on cetaceans**

Fisheries can induce a series of effects on cetaceans, such as:

- modification (diminution or increasing) of feeding possibilities;
- behavioral modification;
- alteration of the distribution, migration and breeding capacity.

Pelagic and coastal fishery can affect the cetacean populations through the overexploitation of the species constituting the feeding resources for them.

The fishing activity can change the dolphins feeding behavior and strategy, they are sometimes seen near the trawlers, hauling trawls, near or even in the passive fishing gears (pound nets, gillnets, and long lines).

Degradation of the dolphin habitats due to the fishing gears is possible in many ways:

- Great numbers of fixed gears, pound nets, gillnets, etc. can considerably reduce the space available for dolphins, and increasing the possibility to be entangled;
- Bottom trawling, besides the direct danger on dolphins, it can destroy the benthic fauna, thus eliminating important links of the trophic chain;
- Pelagic hauling represents also a direct threat, existing the possibility of entanglement, but also act on the feeding resources; being very little selective, it can affect both the adults and juveniles.

However, taking into account the number, area of coverage, etc., the most dangerous for the dolphins in the Black Sea are the turbot gillnets.

## MATERIALS AND METHODS

Data presented in this paper describe the results of actions developed within the Project "Conservation of the dolphins from the Black Sea Romanian waters", during 2002, co-financed by the European Community through its financial instrument LIFE-NATURE. Three partners implement the project: National Institute for Marine Research and Development "Grigore Antipa", NGO "Mare Nostrum" and Dolphinarium from Constanta.

The research aimed the analysis of the present catching systems of the commercial fishery, and assessment of the risk of incidentally catching dolphins.

The materials used included:

- the results of the Romanian research observations on the technical features of the fishing equipments, namely on the catching principle of the fishing object by the passive and active fishing gears;
- the information on this matter received from the experts in the Black Sea riparian countries.

The sector for survey was comprised between Sulina (northern part of the Romanian littoral) and Vama-Veche (southern part), from seashore up to a distance of 30-35 Nm offshore (50-60 depths) (Fig.1).

The work methodology was established in the "Survey plan", which constituted the objective of the Action A1 in the above mentioned project, and the information were gathered by the members of team project and the network volunteers (whose recruitment process constituted the objective of Action A2 in the project).

On the whole, 11 terrestrial expeditions (totaling 20 days of observations), 20 sea cruises (totaling 32 days of observations), and two hours aerial expedition were carried out. In addition, every NIMRD's employers are obliged (through the Survey plan) to register all the information regarding the dolphins, collected during any expedition on land or sea (other than that focused on dolphins).

**For land-based monitoring**, as a first step, we identified the survey sectors, the surveyors and collaborators, who received the dolphin identification sheets. In parallel, some agreements for collaboration and furnishing data were concluded with the National Company "Apele Romane" - Directorate "Dobrogea Litoral" from Constanta, and Inspectorate for Environmental Protection from Constanta.

As the second stage of the land-based survey, by-weekly shore-based observation of live dolphins near the shore and stranded dolphins, as well as the collecting of data from the voluntary surveyors, including those about the incidental catches in the stationary fishery were performed.

Once with the fieldwork or at the collaborator's notifications, the team members made body measurements and collected tissue samples from stranded dolphins.

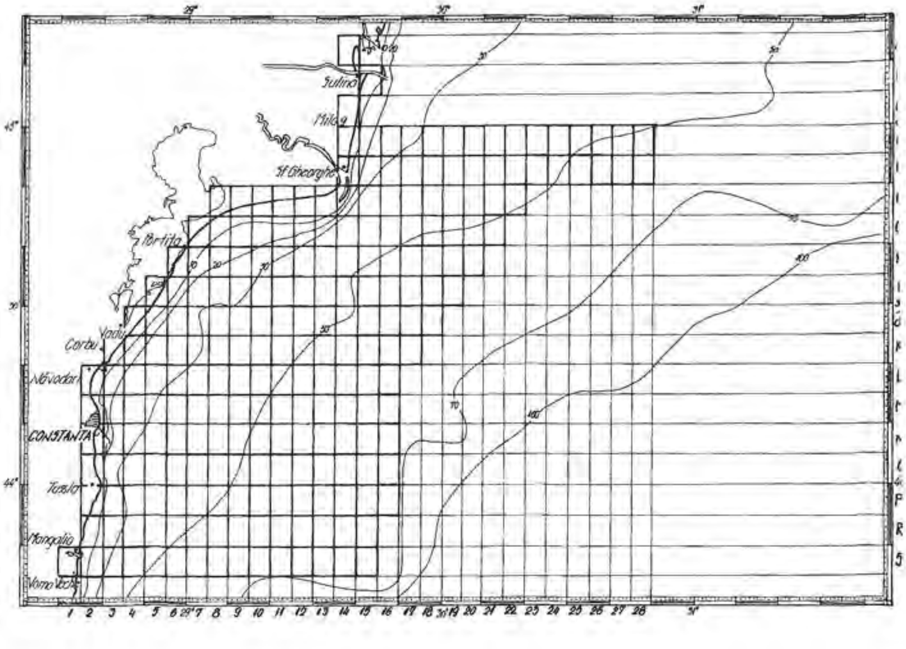



Fig.1. Dolphin monitoring network.

**For sea-based monitoring**, the survey and observation of the dolphins groups in offshore waters were achieved in following ways:

- Embarkation of observers on coastal trawlers;
- Signing some Protocols for collaboration with Ministry of Internal Affairs - County Inspectorate of Frontier Police Constanta, National Society of Petroleum PETROM S.A, PETROMAR Constanta branch, Fishing Society FLAMINGO S.R.L. Constanta;
- Quarterly boat surveys (spring, summer, autumn) with the NIMRD's research vessel "Steaua de Mare 1";
- Observations on dolphins during other research cruises organized by NIMRD;
- Data collection by the collaborators from the coastal trawlers, ships and drilling platform pertaining to PETROMAR Company, ships of Coast Guard.

## RESULTS

### *Fishing gears used at the Romanian littoral*

There are different types of fishing gears for the active and passive fishery practised in our country, in the inshore and offshore coastal waters.

The passive fishing gears include the equipments for catching in general the fish migrating for spawning and feeding in shallow waters, namely (ADAM *et al.*, 1981):

- longlines and bottom lines;
- gill nets and trammel nets for the Danube mackerel, turbot and sturgeons;
- sea pound nets.

The longlines and bottom lines are hook fishing gears for catching high commercial value fish.

The longline is a row of hooks with baits alluring the fish which is caught when swallowing the hook with bait. The longlines are main fishing gears for some species (such as dogfish, goby) and auxiliary fishing gears for turbot, sturgeons, stringray and thornback ray.

The dolphins can become a victim of these fishing gears if they are allured either by the bait in the hooks of the longlines for dogfish, or by the small fish (flounder, turbot juveniles) already caught in the longlines.

The bottom lines are traditional fishing gears exclusively used in fishing sturgeons in the sector Sf. Gheorghe – Ciotic. These fishing equipments consist of rows of big fishing hooks, hanging in the water mass or near the bottom and making up a sort of barrage for the sturgeons moving around the above sector. Unlike the longlines, there is no bait in the bottom line hooks, the fish is caught when trying to cross the hook barrage.

Taking into consideration the way in which the bottom lines catch big fishes when they try to go beyond the hook curtain, it is very likely that the dolphins can also become a victim of these fishing gears when they move around in the sectors where such equipments are fixed (Anton, 2001).

The gill nets and trammel nets belong to the category of fishing gears stopping the fish by catching and tangling .

The Danube shad trammel nets are made of three net sheets, a centre one having the mesh size a=30 mm and thread diameter φ=0,3 mm, and two outer ones having a=250 mm and φ=0,8 mm (Fig.2). These fishing equipments are used for catching the Danube mackerel shoals off the Romanian coast, between the end of March and middle of May, when this species migrates to the spawing grounds.

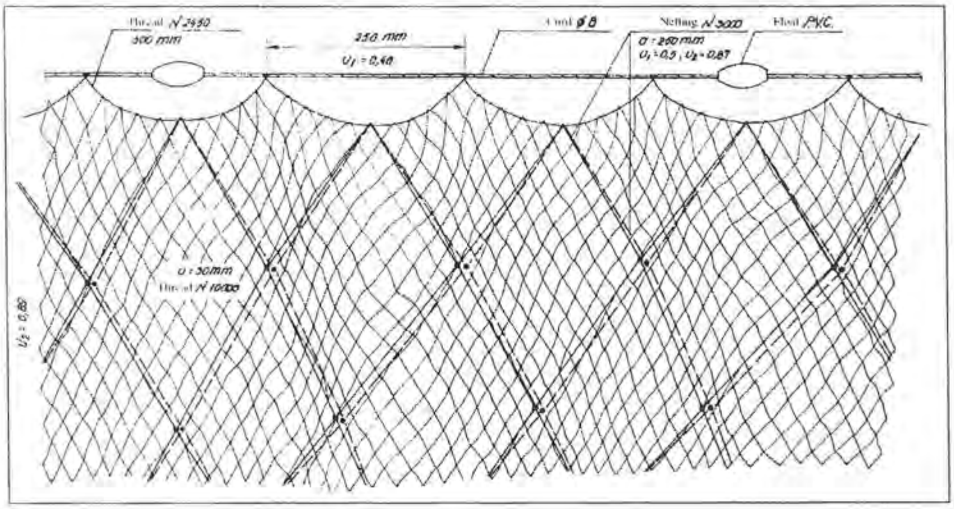


Fig.2. Danube shad trammel net - upper rope hanging detail.

Unlike the Danube shad trammel nets, the turbot gill nets are made of one net sheet having a =200 mm and φ=0,5 mm (Fig. 3). The turbot is especially caught during the spring season (March – June) when it migrates to the spawning grounds. The Danube mackerel trammel nets are installed perpendicular to the shore, while the turbot gill nets are placed parallel to the shore, at a greater depth at the beginning of the season and gradually at smaller depths.

The gill nets for sturgeons are made of one sheet, with a thread having φ=1,4 – 1,5 mm and the mesh size exceeding 100 mm, depending on the target species and the legislation in force.

The turbot and sturgeon gill nets and the Danube shad trammel nets are fishing gears in concern causing victims among the dolphins. These fishing gears are made of thin, less visible and elastic threads, which facilitate the catching and tangling of the specimens trying to cross these nets.

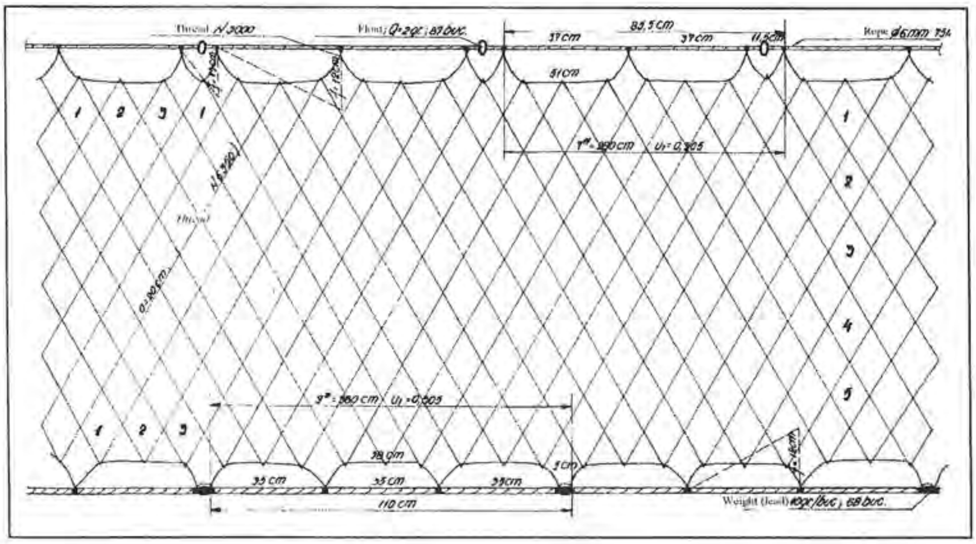


Fig.3. Turbot gill net - hanging details.

The sea pound nets are trap type fishing gears, with big dimmensions, placed at depths of 7 -12 m (Fig. 4). The concentration and stopping enclosures are parallel to the shore and reach a length of 70 m. A leader of 300-500 m and perpendicular to the shore is used for guiding the fish to the trap.

As the marine pound net is made of nets with a small mesh size, it does not facilitate dolphin tangling or catching. This fishing gear is also a big one, so that some extreme situations can occur and dolphins can enter these installations in search for food. In such a case, the dolphins can become captive, especially in the pound nets installed on stakes, because at that type of pound net the aerial wall can be rather high above the water and thus constitutes a real barrage for the dolphins which entered the catching enclosure of the pound net.

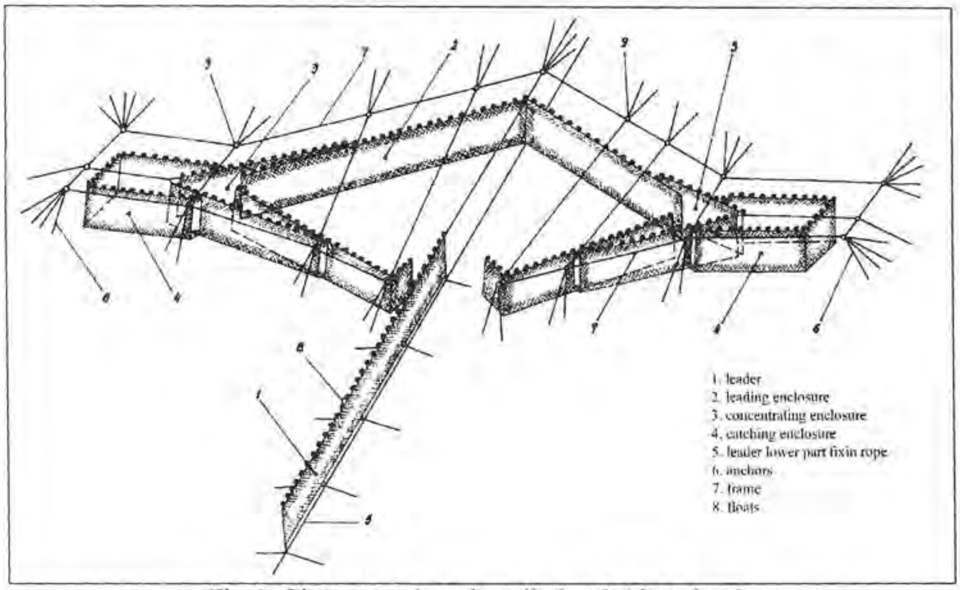



Fig.4. Giant pound net installed at 9-12 m depth.

Another category of fishing equipments used in the Romanian coastal zone includes the active fishing gear; sea seine and pelagic trawl (ADAM *et al.*, 1981).

<u>The beach seine</u> is an enclosing filtering fishing gear which catches the fishing object by reducing the enclosed surface and keeping the fish and other aquatic organisms in the enclosed perimeter. The enclosing fishing gears are in general vertical nets enclosing a certain water surface, up to a certain depth or up to the pool bottom. The building and keeping capacity of the beach seine do not endanger directly the dolphin populations. But there is an indirect disturbing effect of these fishing gears as they affect some links of the trophic chain specific for the benthic and pelagic fish, which in turn are feeding resources for dolphins.

<u>The trawl</u> is an active fishing gear towed by a vessel and provided with a rigging system ensuring it a geometric shape optimum for filtering a water volume as large as possible during fishing (Fig. 5). One can state the active trawl fishery in the Black Sea has a seasonal characteristic owing to the limited period when the fish is present in the area covered by the Romanian coastal trawlers.

The trawl can be considered a fishing equipment directly and indirectly influencing the dolphin populations. Taking into consideration these equipments have large filtering surface (abt. 300 $m^2$), it is possible for some dolphin specimens to enter the trawl, drown and die in the codend as they cannot get out to breathe (ANTON, 2001).

The trawl can indirectly influence the dolphin populations owing to its functioning effects on the biocoenosis components, finally leading to the diminution of food sources as a consequence of the intensive and destructive fishing causing the degradation of the environmental conditions.

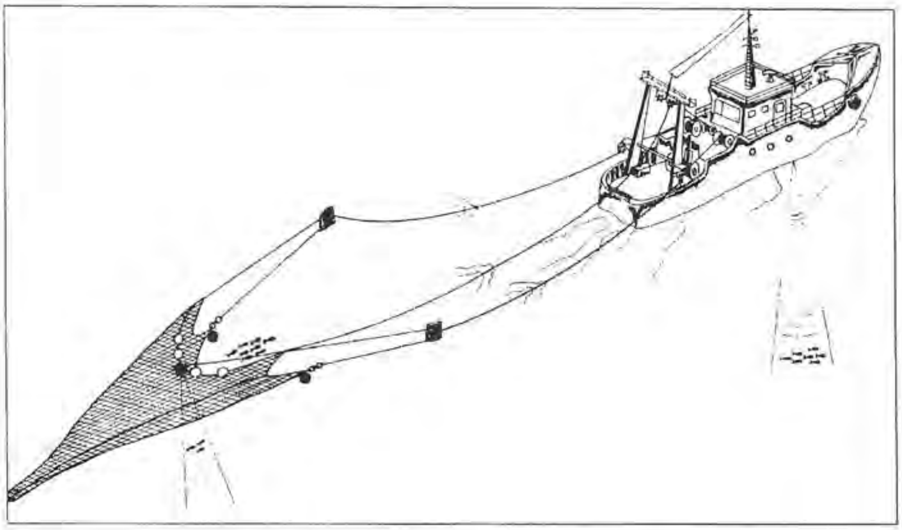


Fig.5. Fishing vessel with trawl.

### *Impact of the fishing gears on dolphins*

The incidental catches of dolphins were registered during the illegal fishing performed by foreign vessels in the Romanian EEZ, during April 2002.

On 18 April 2002, the Romanian Coastguard caught eight foreign vessels illegally fishing in Romanian EEZ, in a sector situated east of Tuzla 40 Nm offshore. Caught in flagrant, the foreign vessels abandoned in the sea the rows of gill nets for turbot (installed before the arrest ), and thrown overboard the capture. None of the vessels had authorization for fishing in the Romanian EEZ; moreover, the turbot and shark specialized fishing was prohibited between 15 April and 14 June.

After the foreign vessels abandoned fishing gears in the sea, the Romanian authorities had to take the necessary measures to retrieve the gears, and also to assess the magnitude of prejudice, and lastly to diminish the damages on the turbot, shark and dolphin populations.

On 24-25 April 2002, the Coast Guard Constanta identified 2 rows of gill nets for turbot, installed in parallel to the coast, in a sector between 43°59'N/29°41'E, respectively 43°59'N/29°41'E, on 67-70 m depths, at distance of 44-48 Nm offshore Tuzla; about 25 km gill nets were retrieved.

Constructively, the retrieved gill nets pertained to two types:

- Gill net with one wall, with mesh size (a) of 180 mm;

- Gill net with three walls (trammel net), with a= 150 mm, Ø0.85 at the external wall.

In accordance with MWEP's Order No. 140/247, Art. g, the turbot gill net with mesh size smaller than 200 mm is forbidden.

Twenty - six specimens of dolphins were entangled in these gears, all of them pertaining to a species *Phocoena phocoena*. Eleven specimens, freshly dead, were brought to shore for measurements. In fact, the number of entangled individuals was greater, but due to the advanced decomposition of carcasses, they detached the nets once with the retrieving action. six individuals were males, five females, one gravid. The body length of the dolphins varied between 111 and 138 cm (Figs. 6, 7).

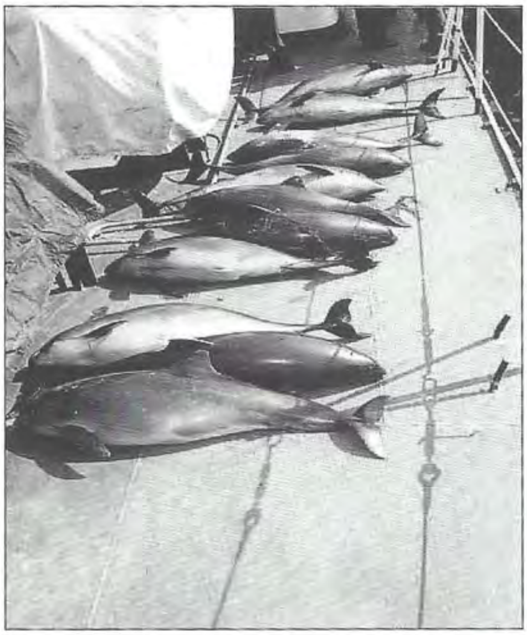


Fig.6. Dolphins which have been entangled in gill nets for turbot.

Fig.7. Gravid female entangled in gill nets for turbot.

Also, on 27-28 April 2002, the Coast Guard identified and retrieved, in the sector 44°05'N/29°43'E and 44°04'N/29°42'E, at a distance of 46 Nm in front of Eforie Nord, in 65-68 m depths, the following fishing equipments:

- 20 gill nets for turbot with one wall, each of them of 80 m in length, a=140 mm, Ø0.65;

- 6 gill nets with 3 walls (trammel net), 80 m length, a=150 mm, Ø0.65 for internal wall, a=500 mm, Ø0.85 for external wall.

Five dolphins were entangled in these nets, 110-120 cm in lenght, pertaining to *Phocoena* species; all of them drowned.

Finally, on 30 April 2002, the Coast Guard identified a row of gill nets, which were retrieved by the NIMRD's research vessel "Steaua de Mare 1". These operations developed in the sector 44°06'N/29°43'E and 44°06'N/29°44'E, on depths of 65-67 m; 39 gill nets for turbot were recovered, with a=180 mm and Ø0.85-1.05 (Figs. 8,9).

Fig.8. Gill net retrieved by the NIMRD's research vessel "Steaua de Mare 1".

Four specimens pertaining to *P.phocoena* species were retrieved (all of them drowned), sized 123-134 cm.

After examination of the gill nets by the NIMRD' specialists, we noted that the foreign gears had the following characteristics:

- Mesh size with 10-25% smaller than minimum admissible, and Ø with 30-60% greater than legal admissible by the Romanian laws.
- Tearing charge of the filament equal with 20-30 Kgf, that is 2-3 times higher then the maximum admissible recommended by the Romanian laws.
- Three walls with mesh size smaller than normal.

Consequently, the foreign fishing equipment had increased the tearing charge, the dolphins entangled in these nets had no chance to escape, despite their efforts to strive against them.

Fig.9. Gill net with a turbot entangled.

Besides, the nets left adrift at sea represent traps for dolphins searching food on the sea bottom.

The actions for finding the gill nets abandoned by the foreign vessels resulted in the retrieval of about 40 km nets.

We assessed that the total number of dolphins incidentally caught was about 100, but we could not bring all of them on board, because many specimens were in advanced decomposition (the actions of retrieval developed within 7 days after the arrest) detached by the nets during the retrieval.

The number of incidentally catches registered at the fraudulent and authorized fishing of turbot, using gill nets, was of 20 specimens, pertaining to *P. phocoena*, with lengths among 111.5 and 138 cm; the females represented 65%.

The structure on length classes of the analyzed specimens was:

- Calves - 2 specimens (10%) - 1 male, 1 female;
- Juveniles - 11 specimens (55%) - 5 males, 6 females;
- Adults - 7 specimens (35%) - 1 male, 6 females.

As it can be seen, the small-sized specimens, with lengths of 111-127 cm (calves and juveniles) were prevailing in the catches.

Following the frequency and the distribution of the strandings at the Romanian littoral, we can summarize that they were recorded between Vama-Veche and Portita, especially during the interdiction of turbot fishing (April-June), when this species (preferred food by *T. truncatus* and *P. phocoena)*, make migrations for reproduction in this period, and the fishermen used to make fraudulent fishing. The dolphins stranded on the Romanian beaches are mostly ( 90-95% ) owed to the poaching practiced by the foreign fishermen, and in a small measure to the artisanal fishing made by the Romanian fishermen (considering the fishing effort) during the prohibition, with forbidden fishing gears; the rest of 5-10% is owed to the diseases and natural mortality. Usually, the carcasses presented marks produced by the mesh nets, scars on flippers, dorsal fins, and flukes caused by the gill net filaments (Fig.10).

Fig.10. Marks produced by the mesh nets.

The great number of porpoises stranded on the Romanian beaches could be explained by their small sizes of the new borns, calves and juveniles, comparatively with the mesh size of the nets. The reaction of these animals in front of the nets is smaller than of that the adults which can break the walls of the nets and manage to escape.

The survey performed for monitoring of strandings was finalized with the registration of 56 carcasses (March-September 2002), between Vama-Veche (southern littoral) and Gura Portitei (northern littoral). The species composition, length-classes and distribution of the stranded animals were as follows (Figs. 11 and 12):

- *D. delphis* - 2 carcasses, adult, 1 male, in the N and S of littoral;
- *T. truncatus* - 13 carcasses, calves and adults, 77% in N and 23% in S of littoral.
- *P. phocoena* - 20 carcasses, newborns, calves, adults, 35% in N, 23% in S of littoral.
- Unidentified (advanced decomposition) - 21 carcasses, 48% in N, 52 in S of littoral.

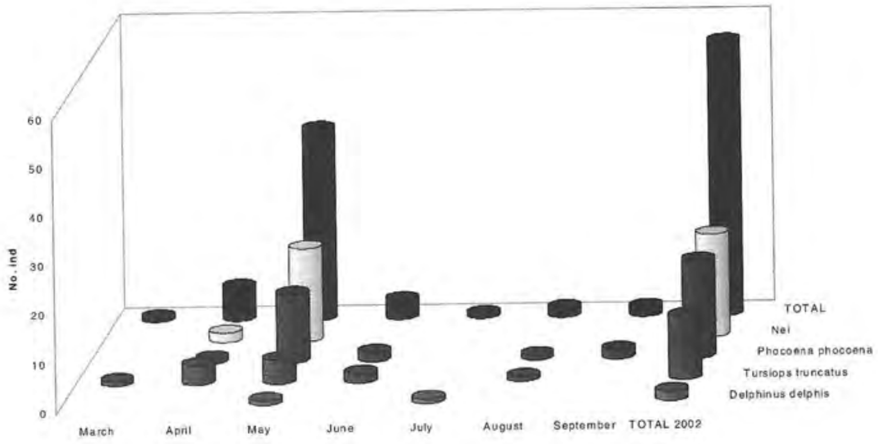



Fig.11. Frequency of strandings, in 2002.

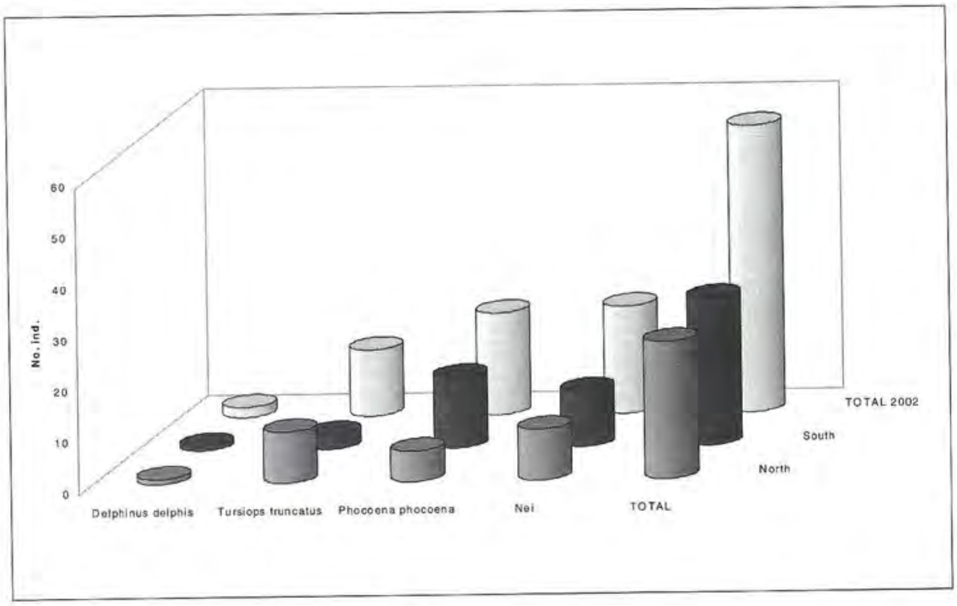



Fig.12. Spatial frequency of strandings, in 2002.

## CONCLUSIONS

Data presented in this paper describes the results of the actions developed within the Project "Conservation of the dolphins from the Black Sea Romanian waters", co-financed by the European Community LIFE-NATURE Program.

- From the fishery point of view, there is a mutual antagonism between human and marine mammals, as a consequence of the similar vital interests, meaning the need for fish for feeding, acting sometimes in the same areas and periods.

- The research aimed the analysis of the present catching systems of the commercial fishery and assessment of the risk of accidentally catching dolphins.

- There are different types of fishing gears for the active and passive fishery practised in our country in the inshore and offshore coastal fishery.

- The passive fishing gears include the equipments for catching in general the fish migrating for spawning and feeding in shallow waters, namely:

  - longlines and bottom lines;
  - gill nets and trammel nets for the Danube shad, turbot and sturgeons;
  - sea pound nets.

- Another category of fishing equipments used in the Romanian coastal zone includes the active fishing gears like sea seine and pelagic trawl.

- The incidental catches of dolphins were registered during the fraudulent fishing performed by foreign vessels in the Romanian EEZ, during April 2002.

- From the land-based observation resulted in the most dangerous fishing gears for dolphins are the turbot gillnets, especially these with three walls, due to the great capacity of retention and tearing strength.

- The most of the stranded dolphins on the Romanian beaches resulted from the incidental catches abandoned in the sea by the fishermen practicing a specialized fishing for turbot, especially during the prohibited period.

## REFERENCES


ADAM, A., BOGATU, D., RAUTA, M., JELESCU N., NICOLAU, C., FIRULESCU, C. 1981. Pescuitul industrial. Editura tehnica, Bucuresti.

ANTON, E. 2001. Analiza sistemelor actuale de captura utilizate in pescuitul comercial si evaluarea riscului de capturare accidentala a delfinilor. Raport tehnic. INCDM, Constanta.

BIRKUN. A. JR. 2001. Interactions between cetaceans and fisheries. Cetaceans of the Mediterranean and Black Sea. ACCOBAMS

KLEINENBERG, S.E. 1956. Mammals of the Black and Azov Seas: Research Experience for biology and hunting. USSR Acad. Science Publ. House, Moscow, 288 p. (in Russian).

KRIVOKHISHIN, S. V., BIRKUN, A.A., NESSONOVA, J.V. 2000. Prey species of Black Sea cetaceans. p. 229 in: P.G.H. Evans. ECS, Rome.

NICOLAEV, S., ANTON, E. 2000. Studiul efectelor functionarii echipamentelor de pescuit prin traulare asupra biocenozelor bentale, recomandari pentru diminuarea efectelor nefavorabile. Cercetari marine, INCDM, 31, p. 157-163.

TOMILIN, A. G. 1957. Mammals of the USSR and Adjacent Countries. Vol. IV. Cetaceans. USSR. Acad. Science Publ. House, Moscow, 717 p. (In Russian).

VASILIU, F., DIMA, L. Quelques considerations sur la presence et la mortalitie des dauphins sur le littoral roumain de ;la mer Noir. Recherches marines, IRCM, 23, p. 171-177.