State of the Environment of the Black Sea

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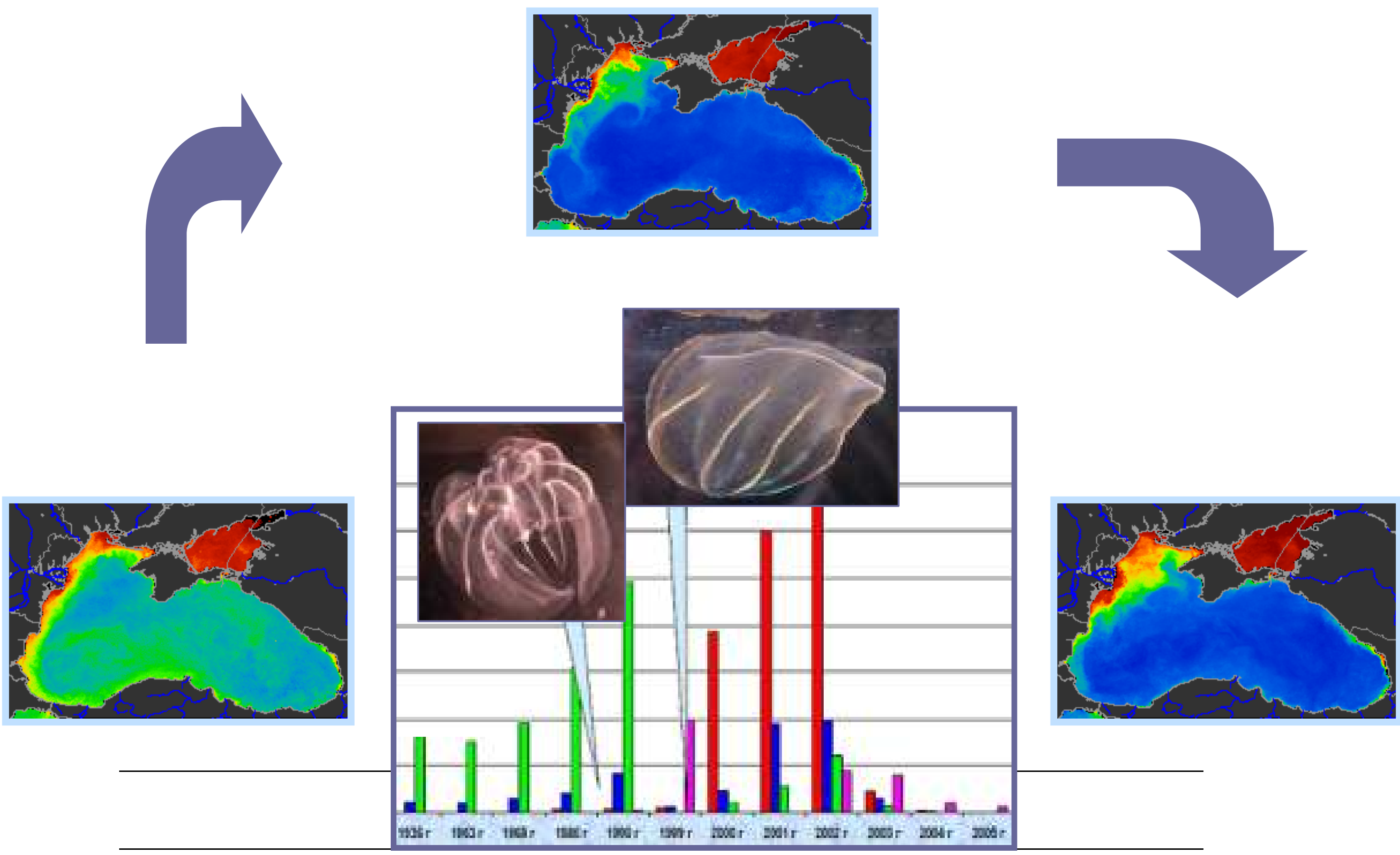

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CHAPTER 9 THE STATE OF MARINE LIVING RESOURCES (V. Shlyakhov & G. Daskalov)

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9.1. Introduction

In the context of this chapter, "Marine living resources" (hereinafter it is referred to as MLR) comprise the populations (exploited, being exploited or being able to be exploited by humans) of finfishes (hereinafter – fishes), mollusks, crustaceans, water plants and other living organisms inhabiting the Black Sea, excluding waterfowl and mammals. About 200 fish species, more than 500 mollusks species and water plants–macrophytes (red and brown algae as well as marine floral plants) inhabit the Black Sea. Among the whole specific diversity, the greatest economic value, however, is not more than two dozens of species that produce about 98% of catch in 1996 – 2005 (Fig. 9.1). The rest 2% included commercially less important fishes, mollusks, crustaceans and other aquatic organisms. The main portion of catches falls into three groups – anadromous, pelagic, and demersal fishes. In each of these groups, more than 90% of capture volume fall on several leading species. As a whole, the total mean annual catch of MLR in 1996 – 2005 was at the level of 410 thousand tons varying annually between 330 thousand tons and 500 thousand tons, that is more than 30 thousand tons higher than the mean catch in 1989 – 1995 (Fig. 9.2).

This chapter summarizes the state of marine living resources in the Black Sea during the last 10 years with respect to the previous decades. In particular, the state of MLR will be assessed for 1996 – 2005 as compared with the earlier period to explain the changes occurred. The chapter was benefited from the data used for the TDA (Technical Task Team National Experts on Fisheries) Reports (2006), kindly submitted to the BSERP - PIU by the authors. Information on MLR catches of the Black Sea countries in 1989 – 2005 was taken from the FAO statistical data base with some corrections made on the basis of TDA reports (2006) and the Black Sea Commission Information System data base.

9.2. The state of key anadromous fishes

The anadromous species of the Black Sea include the pontic shad (*Alosa pontica*) and three sturgeon species *Acipenser gueldenstaedtii*, *Acipenser stellatus*, *Huso huso*. Among fishes by the capture volume, anadromous fishes take the last place (Fig. 9.1), but their high consuming and economical value determines their specific role in the structure of the MLR. Their life cycle consists of marine period (wintering and fattening) and river period (spawning and migration of newly born juveniles into the sea). Stocks of anadromous fishes are formed mainly by the Danube populations. The catch data of anadromous fishes (Fig. 9.3) suggest decline of their commercial value in 1996 – 2005 as compared with the previous period. Following the minimal catch occurred in 1999, nevertheless an increasing trend of annual catches was observed due particularly to the recovery of Pontic shad.

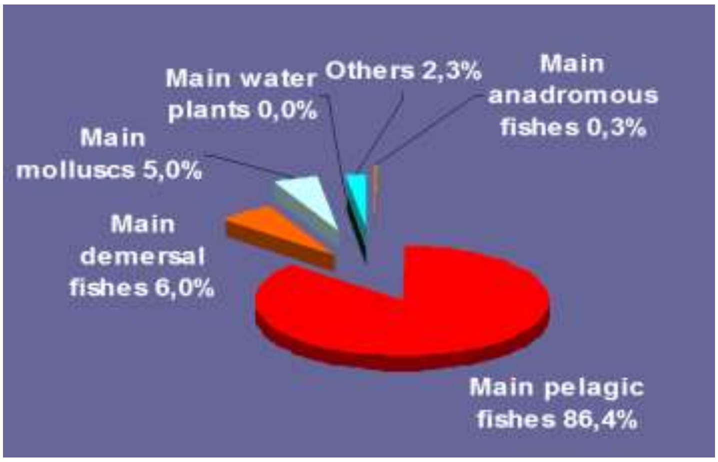

Fig. 9.1. Commercial exploitation of Marine Living Resources in the Black Sea in 1996 – 2005.

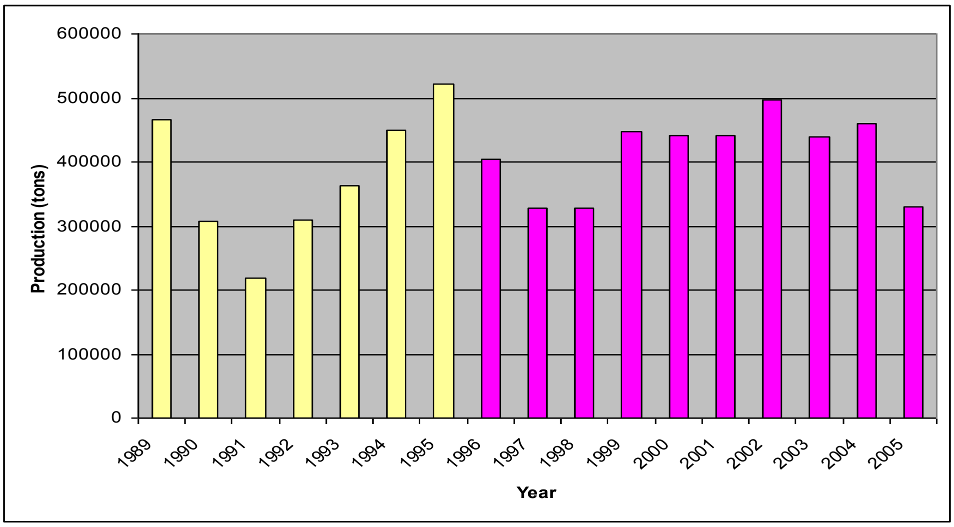

Fig. 9.2. Total capture production of Marine Living Resources in the Black Sea in 1989 – 2005.

9.2.1. Sturgeons

Out of six sturgeon species of family *Acipenseridae* inhabited the Black Sea and inflowing rivers, three species called the Russian sturgeon (*A. gueldenstaedtii*), starred sturgeon (*A. stellatus*) and beluga (*Huso huso*) are most common. They are large-sized fishes with long life cycle: beluga lives up to 100 years and reaches the weight more than 1 ton with length of 490 cm; for Russian sturgeon maximum recorded age is 37 years, the length is 236 cm and weight is 115 kg; starred sturgeon reaches the length of 218 cm, weight 54 kg and age 23 years old (Pirogovskiĭ *et al.*, 1989; Popova *et al.*, 1989; Vlasenko *et al.*, 1989). Russian sturgeon and starred sturgeon feed mainly on benthic organisms, namely mollusks and *Polychaetae*. Beluga is a typical predator, feeding on fish exclusively. Anadromous sturgeons make extended migrations during their life from the sea into the rivers; larvae drift after hatching and juveniles in rivers; and back into the sea after completion of spawning.

species for large predators, dolphins and fish-consuming birds. Whiting juveniles and bottom-dwelling whiting at age less than 2 years old distributed mainly in shallow depths are the most vulnerable for eutrophication effects.

9.4.2. Picked dogfish

Picked dogfish inhabits the whole Black Sea shelf at water temperatures 6 – 15º C. They migrate in the form of large schools for feeding and overwintering on anchovy and horse mackerel to the Crimean, Caucasus and Anatolian coasts in autumn. In the Ukrainian and Romanian grounds of whiting and sprat concentrations, abundant wintering concentrations of picked dogfish are also observed at depths from 70-80 m to 100 – 120 (Kirnosova and Lushnicova, 1990). Reproductive migrations of picked dogfish take place in spring and autumn at coastal shallows at 10 – 30 m depths zones (Maklakova and Taranenko, 1974). The major grounds for reproduction are the Crimean coastal waters such as the Karkinitsky Bay, the vicinity of Kerch Strait, and the Feodosia Bay. Picked dogfish belongs to long-living viviparous fish; therefore reproduction process includes copulation and birth of fries. Near the coasts of Bulgaria, Georgia, Romania, Russian Federation and Ukraine the maximum copulation takes place in March – May. Two peaks of birth of juveniles can be distinguished – spring (April-May) and more powerful – summer-autumn (August – September) at water temperature range of 12 – 18°C (Serobaba *et al.*, 1988). The picked dogfish population includes 19 year-classes and among commercial fish species of the Black Sea this species is inferior only to sturgeons in duration of life cycle.

It is not a target species of fisheries, and mostly caught as by-catch in trawl and purse seine operations mainly during their wintering period. The largest catches of picked dogfish are along the coasts of Turkey. In the Ukrainian waters, picked dogfish is mainly harvested in spring and autumn months by target fishing with nets of 100 mm in mesh and with long-lines as well as during sprat trawl fisheries as by-catch. For the whole population of picked dogfish in the Black Sea stock assessments for 1972 – 1992 were produced by the VPA method (Prodanov *et al.*, 1997), and trawl surveys and mathematical modelling (Shlyakhov and Charova, 2006) (Table 9.7). In 1989 – 2005, picked dogfish stock on the Ukraine shelf reduced gradually. Such dynamics of the stock agrees well with Turkish data concerning variations of CPUE (see Fig. 9.15). According to the assessments of Prodanov *et al.* (1997), the picked dogfish stock increased until 1981 due to increased abundance of their main dietary species (whiting, sprat, anchovy and horse mackerel), and then started decreasing due to intensification of the dogfish fishery.

Evidently, the role of fisheries in reduction of picked dogfish stock was over-estimated at that time. In fact, for 1979 – 1984 the mean annual capture from the stock in the Black Sea made up 8254 tons or about 4% of the initial stock, and it reduced to 3.5% in 1989 – 1992 (Kirnosova, 1990). Even taking into account unreported catches of picked dogfish, which in late 1980s seemed not to exceed the official catch (at least in the waters of Ukraine – Shlyakhov and Charova, 2003), real capture was not excessive. The mean length of picked dogfish in the northwestern Black Sea in trawl catches in 1989 – 2005 did not reduce and even increased (Fig. 9.15), that do not imply overexploitation of this species. The causes of reduction of picked dogfish stock should therefore be related to the changes in the Black Sea ecosystem due to pollution and subsequent progressive deterioration of reproductive ability of females (Shlyakhov and Charova, 2003). In the 1970-1980s, the mean number of yolk ovocytes and embryos for one female was 22 and14, respectively, and they were reduced to 19.5 and 12.4 by late 1990s. As a result, the abundance of recruits reduced year by year.

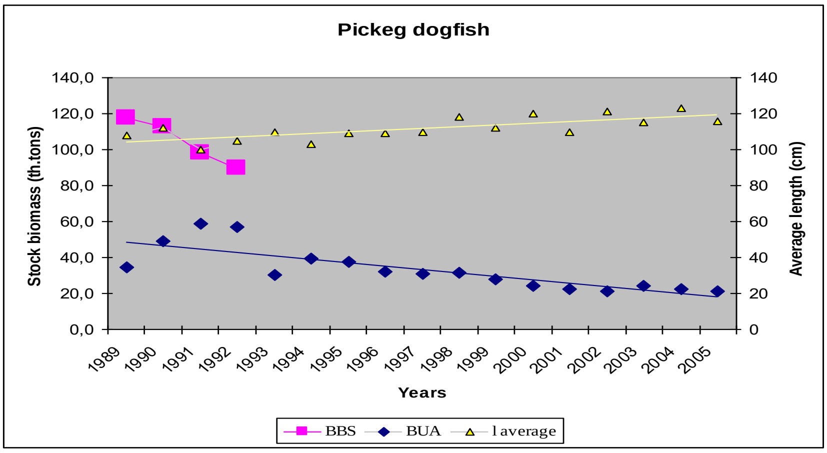

Fig. 9.15. Biomass of picked dogfish in the Black Sea-BBS (Prodanov *et al.*, 1997), in the waters of Ukraine– BUA (Shlyakhov, Charova, 2006) and the mean standard length (l average) in trawl catches of picked dogfish in the northwestern part of the sea: Trend lines are shown for the BUA and l average data series.

Table 9.7. Commercial stock of picked dogfish in the Black Sea and along the coast of the former USSR and in the water of Ukraine in 1989 – 2005, thousand tons

Years	**Whole Black Sea shelf**	**Waters of Ukraine, the Russian Federation and Georgia**		**Waters of Ukraine**	
	VPA	Trawl survey	Modeling	Trawl survey	Modeling
1989	117.8	58.5	63.5	34.6	-
1990	112.9	58.7	63.2	48.8	-
1991	97.9	17.2/69.9*	64.0	14.4/58.5*	-
1992	90.0	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
2003	-	-	-	-	22.1
2004	-	-	-	-	22.3
2005	-	-	-	-	21.0

* stock assessment is reduced to the average area of the registration (survey) zone

The main threats for the Black Sea picked dogfish resource with transboundary significance are the same as for whiting. One more threat may be added to that list:

Pollution from land based sources (rivers) and direct discharges (inshore area). As a long-living predator as compared with other fishes in the Black Sea, picked dogfish has the ability to accumulate toxic pollutants – heavy metals (mercury, arsenic, lead, copper, cadmium and zinc) and chlorine organic compounds (including and its metabolites, polychloride biphenyls, etc.).

9.4.3. Turbot

Turbot occurs all over the shelf of the Black Sea. It is a large-sized fish with long life cycle; it reaches length of 85 cm, weight of 12 kg and age of more than 17 years old in the Black Sea (Svetovidov, 1964). Turbot fecundity is very high, up to 12.8 million of eggs per year. Larvae and fries in the first two months inhabit in the pelagic zone, feeding on zooplankton. Adults feed on fish mainly, both on demersal (whiting, red mullet and gobies), and with pelagic species (anchovy, sprat, horse mackerel, shad) species. Diet of turbot also includes crustaceans (shrimps, crabs, etc.), mollusks and polychaetes. 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 matures in majority at the age of 3 – 5 years in the waters of Bulgaria (Ivanov and Beverton, 1985), at the age of 5 – 6 years in the waters of Ukraine and the Russian Federation (Popova, 1967). It spawns in spring, from the late March until the late-June, at water temperature range 8 – 12ºC. The peak of spawning occurs in May at depths from 20 – 40 to 60 m. After the spawning, turbot moves downwards to the depths 50 – 90 m and maintains low-activity life with limited feeding until the early autumn. In autumn turbot returns coastal waters again, where it feeds intensively. For wintering it migrates to the depths from 60 m to 140 m.

In all the Black Sea countries, turbot is one of the most valuable fish species. Its target fisheries is conducted with bottom (turbot) gill nets with minimum mesh size 180 mm in the waters of Bulgaria, Georgia, Romania, the Russian Federation and Ukraine (Prodanov *et al.*, 1997) and with minimum mesh size 160 – 200 mm as well as with bottom trawls with minimum mesh 40 mm in the waters of Turkey (Tonay and Öztürk, 2003). Turbot as a by-catch is harvested during target fisheries of other species with trawls, long-lines and purse seines. According to Zengin (2003), 72% of turbot fishing in Turkish waters of the Black Sea has been carried out by bottom gill nets, 26% by trawls and 2% as the by-catch from purse seines. More than 80% of the Ukrainian turbot catches were performed by target fisheries using nets with mesh size 180–200 mm, the rest part mainly corresponded to by-catch. In 1996 – 2005, the mean annual Turkish turbot catch was 1235 tons, and 177 tons for the rest of the Black Sea countries (Table 9.8). The turbot fishery was completely banned or largely limited by the Total Permitted Catch in all countries except Turkey in the early 1990s and therefore was at a negligible level.

Like for many demersal fish species, the serious problem for estimating the status of turbot population and justifying efficient measures for its fisheries regulation is considerable difference between the recorded statistics and the real catches. According to the expert assessments (Shlyakhov and Charova, 2003), the unregistered annual yield of turbot for Ukrainian waters was in the range of 0.2 – 0.8 thousand tons in 1992 – 2002. These assessments are not complete, as they included only the unregistered turbot by-catch during sprat fisheries and poaching (illegal) catches of Turkish vessels. But, this unregistered annual yield was even higher than official turbot statistics.

Table 9.8. Turbot catches in the Black Sea in 1989 – 2005 in tons. The last three rows show the average catches for the years indicated in the subscripts.

Year	Turbot					
	BG	GEO	RO	RU	TR	UA
1989	1	8	0	0	1449	2
1990	0	1	0	0	1383	9
1991	0	0	2	0	915	18
1992	0	0	1	1	418	19
1993	0	0	6	2	1585	18
1994	0	0	6	5	2114	16
1995	60	0	2	19	2850	10
1996	62	0	4	17	1924	39
1997	59	0	1	11	911	42
1998	64	0	0	14	1468	42
1999	54	5	2	15	1804	73
2000	55	9	2	4	2639	80
2001	57	11	13	24	2323	129
2002	136	11	17	15	335	104
2003	41	1	24	15	119	124
2004	16	7	42	2	274	133
2005	13	6	28	15	548	129
Y89/95	9	1	2	4	1531	13
Y96/05	56	5	13	13	1235	90
Y00/05	53	8	21	13	1040	117

Caddy (2006) interpreted the landing data in terms of trends and suggested the baseline trend before 1989, the decreasing trend in the collapse years 1989-92, gradually increasing trend in 1992 – 2002, a more pronounced increasing trend in 1998 – 2002. The landing in 1998 – 2002 was 70% of the baseline and therefore suggested partial recovery in recent years. If the catch analysis takes into account exploitation of different stock units, the interpretation given by the trend analysis however changes greatly. In the base period (1967 – 1988) Turkish landings made up 82% of total catches of all the countries. Its fisheries was conducted mainly on local turbot stocks existed in its own waters in 1967-71 and 1985-92, but extended into the western and northwestern stocks within the international waters in 1972 – 1984 (Acara, 1985). By 1985, the western and northwestern stocks appeared to be overfished; for this reason since 1986 the former USSR imposed banning for turbot fisheries in its waters to which Bulgaria and Romania joined soon but Turkey refused to join to this banning. In 1986 – 1992 (i.e. at the end of the base period and in the years of collapse) recovery of the stocks took place with the negative trend of landings, as in this period only stocks in the Turkish waters were fished. The positive trend of landings in 1992 – 2002 and its steep increase in 1998 – 2002 was explained not only by recovery of turbot stocks in the waters of Ukraine, but by the intensification of illegal fishing of the western and northeastern stocks by Turkish vessels. As indicated by the available studies carried out in different Black Sea countries (Table 9.9), turbot stocks decreased prior to 1989 and a partial recovery of turbot biomass took place in waters of all countries except Turkey as a result of banning and limiting the fisheries by the early–1990s.

Table 9.9. Some studies carried out in the Black Sea regions on turbot stocks.

Researchers	**Location**	**Years and periods**	**Biomass assessment (tons)**	**MSY or TAC (tons)**	**Methods**
Prodanov et al., 1997	Waters of the Black Sea	1989-1990 1991-1992	19100 6200	-	LCA Jones' method
Bingel et al., 1996	Southern Black Sea (Sinop-Georgia board) Western Black Sea	1990 1991 1992 1990	124 410 766 130.5	-	Swept area method (trawl surveys)
Zengin, 2000	Southern Black Sea (Sinop- Georgia board)	1990 1991 1992 1993	686.3 250.4 222.4 134.3	96.1 26.3 24.5 15.4	Swept area method (trawl surveys)
Prodanov and Mikhailov, 2003	Waters of Bulgaria	2002	Mean – 352 Initial – 425	60	LCA Jones' method
Shlyakhov and Charova, 2003	Waters of the Russian Federation	1992	1800	-	Swept area method (trawl surveys)
Volovik, Agapov, 2003	Waters of the Russian Federation	2000-2002	1000-1700	100	Swept area method (trawl surveys)
Shlyakhov and Charova, 2003	Waters of the Russian Federation	1992-1994	4280 (1800-5900)	-	Trawl surveys and Baranov's modified equation
Maximov et al., 2006	Waters of Romania	2003-2005	427-1066	-	Swept area method (trawl surveys)
Shlyakhov and Charova, 2003; 2006	Waters of Ukraine	1992-1995 1996-2002 2003-2005	8830 (8200-10400) 10980 (8400-13700) 9570 (8500-10200)	-	Swept area method (trawl surveys)
Shlyakhov and Charova, 2003; 2006	Waters of Ukraine	1992-2002 2003-2005	10590 (8200-13700) 8900 (8200-10200)	-	Trawl surveys and Baranov's modified equation
Panayotova et al., 2006	Waters of Bulgaria	2006	1440	-	Swept area method (trawl surveys)
Raykov et al., 2008	Waters of Bulgaria	2006	1567	-	Swept area method (trawl surveys)

Analyzing the state of the stock using official statistics of turbot capture near the coasts of Bulgaria, Prodanov and Mikhailov (2003) concluded that biomass of this species was about 2500 tons in early 60s. By late 1970s biomass reduced to 355 tons as a result of overfishing and deteriorating environment, and to 100 tons in 1993. Applying LCA method, they assessed the turbot stock as 424 tons in 2002. Increased biomass was the consequence of five-year banning for fisheries. However, comparing stock abundance and capture, they determined that the catches were composed by fish size 42 – 47 cm and 2 – 4 year old indicating turbot excessive exploitation again. According to the official statistics, landings in 2003 made up 49 tons, and in subsequent two years it reduced to 16 tons and 13 tons respectively. The last assessment indicated the turbot biomass in the Bulgarian waters as 1440 – 1567 tons in 2006 (Panayotova *et al.*, 2006; Raykov *et al.*, 2007).

Table 9.10. Biomass and catches of the turbot of the Black Sea in the waters of Ukraine in 1996 – 2006 (tons), mean fishing mortality, relevant to its official catches in 1992 – 1995 and 1996 – 2005.

Years	Biomass of stocks (B)		Catch (Y) for:		Total Permitted Catch (Limit)	Official landings
	Swept area method (trawl surveys)	Baranov's modified equation	F0.1=0.15	Fmax=0.20		
1996	-	13500	1792	2333	84	39
1997	-	13600	1805	2350	90	42
1998	8400	13300	1440	1875	90	42
1999	-	12600	1672	2177	190	73
2000	-	9600	1274	1659	185	80
2001	9900	10500	1354	1762	370	129
2002	10000	8700	1241	1616	395	104
2003	10000	8900	1254	1633	310	124
2004	8500	8200	1108	1443	350	133
2005	10200	7800	1194	1555	319	129
2006	10400	7600	1194	1555	323	162
1992-95	8871		1177	1533	-	14 Fof = 0.001
1996-05	10094		1411	1744	238	90 Fof = 0.009

The last research on turbot stock in the waters of Bulgaria and Romania pointed to their level of exploitation. In 2005 biomass of this species was assessed as 1066 tons (Maximov *et al.*, 2006). Near the Russian coast, the long-term banning for turbot fisheries (since mid 1980s till mid 1990s) resulted in improvement of the state of northeastern stock. By the end of banning it was assessed as 1800 tons. According to AzNIIRKH research, the state of turbot stock is not stable, but changes occur in a rather narrow range of 1000 – 1700 tons (Volovik, Agapov, 2003). The observed interannual fluctuations in biomass assessments in 2000s may be caused by re-distribution of turbot between Russian and Ukrainian waters. In the opinion of Russian scientists, overexploitation of turbot in their waters for recent 10 years has not been observed.

Direct assessments of turbot biomass made using the data of trawl surveys near the coasts of Turkey eastwards to Sinop for 1990 – 1992 differed greatly. According to Bingel *et al.* (1996) increase in biomass took place in those years, and according to Zengin (2000), on the contrary, reduction in biomass occurred. According to the assessments of Prodanov *et al.* (1997) on the grounds of cohort analysis of the length composition of catches between 1989 and 1992 turbot biomass reduced 3.1 times in the waters of Turkey, and this tendency agreed well with 3.9 times reduction assessed by Zengin (2000). Composition of Turkish catches was evidence of capture of immature turbot at ages under 4^+ that was about 63% in 1990 – 1995 and 62% in 1996 – 2000 of the population.

For recent 10 years, continuous set of the published assessments of turbot biomass is available for the waters of Ukraine where the greater part of its western population distributes. Table 9.10 gives the most detailed information on biomass dynamics and potential catch of turbot after 1996.

According to the data of the last trawl surveys proportion of biomass of the western stock and northeastern is close to 9:1, and the percentage of fish from the western stock in the annual catch of Ukraine is even more. As compared with 1992 – 1995, in 1996 – 2005 turbot biomass in the Ukrainian waters increased slightly. Trawl surveys undertaken each year since 2001 is the evidence of stable level of turbot biomass in the waters of Ukraine. In 1996 – 2005 the control measures enabled to avoid overfishing of turbot, and stabilized the length-weight composition of catches in the northwestern Black Sea (Fig. 9.16).

The list and significance of the main threats for turbot resources in the Black Sea are similar to those for whiting. The first place should be given to *Illegal fishing and use of destructive harvest techniques*. In the broad sense it is not only poaching but deliberate avoidance of adopted measures of regulation by fishermen. This threat is of social and economic character, and not easy to reduce it. An almost equivalent, in experts' opinion, threat is the *lack of regional cooperative management of fisheries*.

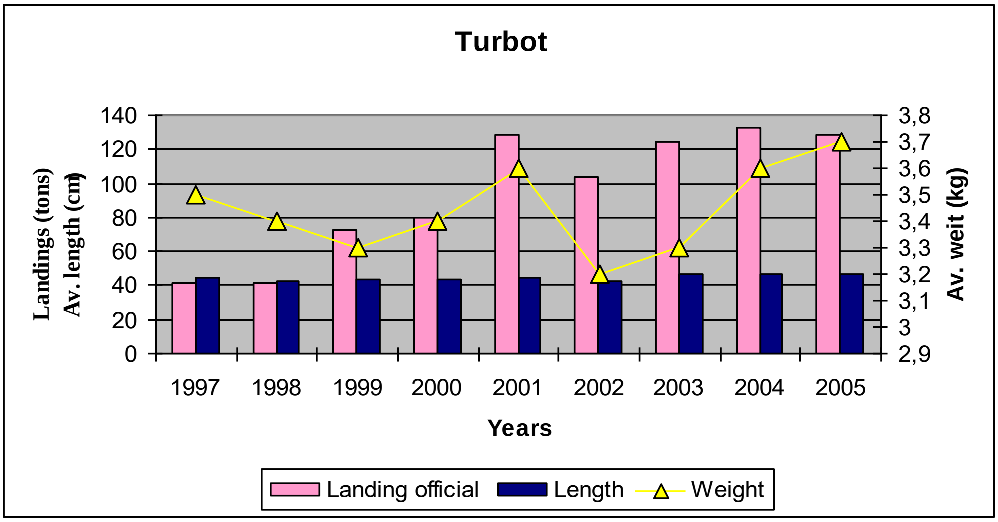

Fig. 9.16. Mean length and weight of turbot in the northwestern Black sea and its landings by Ukraine in 1997 – 2005.

9.4.4. Striped and red mullets

Two physiologically similar species *Mullus barbatus* and *Mullus surmuletus* belong to the family *Mullidae*. The species *M. barbatus* is also called as red mullet or striped mullet. In FAO terminology, *M. barbatus* is also named as striped mullet. For the convenience's sake we use hereinafter this name to both species of the family *Mullidae*.

Striped mullet is distributed all over the shelf of Black Sea. It prefers waters with the temperature higher 8º C and salinity more than 17‰. Striped mullet reaches maturity in the first-second year of its life. It lives usually until 4 – 5 years old reaching length of 20 cm and more. Striped mullet spawns in the warm period of time with a maximum in mid-summer. Eggs and juveniles (up to the age of 1.5 months) are pelagic; adults live near bottom, feeding on *Polychaetae*, crustaceans and mollusks. In the vicinity of the Crimean and Caucasus coasts, it is customarily distinguished in two particular forms –

settled and migratory ones. The latter has higher rate of growth. Migratory form has the greater commercial value, moving to the Kerch Strait and the Sea of Azov for fattening and spawning in spring and coming back to the coasts of the Crimea for wintering.

Due to its taste, the striped mullet is a valuable target species for fisheries. Most of all striped mullet is harvested in the Turkish waters (Table 9.11) where it is the second important target species in the bottom trawling fisheries after whiting. In 1990 – 2000, around 75% of landings of striped mullet were caught by trawl along the eastern Black Sea coast of Turkey (Zengin, 2003). Its mean annual catch made up 2590 tons and as compared with the previous 7-year period it reduced 46% in 1996 – 2005 due mainly to decreased catches in the eastern part of the sea. Beginning from 1999, more than half of striped mullet landings have realized on the western Black Sea of Turkey where the proportion of trawl fisheries is much less (Fig. 9.17). To some extent it is the evidence of excessive pressure of trawl fisheries on striped mullet stocks near the Turkish coasts. The years 1989, 1993 and 1996 are identified as particularly abundant years with relatively high catches in the eastern part whereas higher catches in the western part follows with a 2 – 3 years phase lag (1991, 1996 and 1999).

Table 9.11. Landings of mullets in the Black Sea according to the official statistics (tons).

Year	**Striped mullet**						**Mullets (Mugilidae)**					
	BG	GEO	RO	RU	TR	UA	BG	GEO	RO	RU	TR	UA
1989	0	0	5	324	6753	0	3	5	8	12	2843	22
1990	0	0	7	132	3507	0	1	19	0	4	1749	6
1991	0	0	25	210	3610	0	7	0	0	2	4026	8
1992	1	0	0	37	2988	5	5	0	0	2	2358	0
1993	0	0	0	0	2877	12	6	0	0	70	4061	0
1994	0	0	5	25	2337	10	6	0	0	70	5112	0
1995	0	0	9	324	4348	13	24	0	1	65	7779	4
1996	0	0	1	76	5419	2	29	3	0	382	12901	12
1997	0	14	3	68	4040	17	30	0	0	480	8680	118
1998	0	11	3	119	2536	26	13	0	0	401	8198	82
1999	0	8	1	92	2989	26	16	9	0	35	9887	211
2000	0	3	2	127	2355	10	15	19	0	85	14189	178
2001	26	22	3	119	1498	19	57	28	1	7	6705	459
2002	33	67	2	47	1651	40	96	73	2	33	4048	187
2003	36	50	3	177	1073	26	34	80	1	312	3711	59
2004	17	35	40	99	1187	16	18	68	3	366	4191	51
2005	1	51	15	92	1649	15	10	74	2	92	3882	91
Y89/95	0	0	7	150	3774	6	7	3	1	32	3990	6
Y96/05	14	28	8	114	2590	22	38	38	1	220	8310	191
Y00/05	19	38	11	110	1569	21	38	57	2	149	6121	171

In the waters of Bulgaria and Romania the striped mullet is not a valuable target species for fisheries. It is harvested as by-catch during trawl fisheries or together with other fishes during non-selective fisheries with trap nets. In 1996 – 2005 catches of striped mullet in the Bulgarian waters increased slightly. In the waters of Georgia according to the data of official statistics in 1989 – 1996 catches of striped mullet were absent or was categorized within the "other fish" group. In 1997 – 2005, its mean annual catch was equal to 28 tons. According to Komakhidze *et al.* (2003), the striped mullet was captured recently in higher amounts that provided an indirect evidence of increasing abundance. Along the coasts of the Russian Federation target fisheries of striped mullet are performed mainly with passive fishing gears. The stocks exceeded over 100 tons by 1998, which was mainly related to the reduction of *Mnemiopsis leidyi* population (Volovik, Agapov, 2003). In 2002, the total biomass was estimated as 1200 tons, exploited biomass as 960 tons and TAC as 200 tons. In the Ukrainian waters, target fishing of the striped mullet was permitted only with beach seines and scrapers; however, the greater part of its catches corresponded to the non-target fishing with bottom traps (Shlyakhov and Charova, 2003). The major share of striped mullet was harvested in autumn in Balaklava Bay, near Sebastopol. The amount of non-registered catches of striped mullet was undefined. The annual determination of limits for striped mullet harvesting was 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.). Its value was estimated as 50 – 60 tons for recent years.

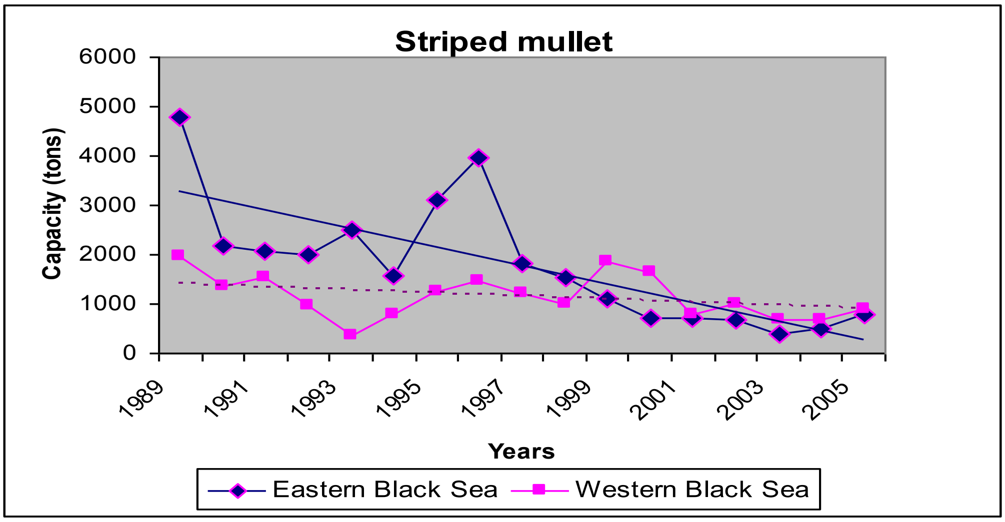

Fig. 9.17. Landings of striped mullet in the Black Sea waters of Turkey (according to data of the TDA Technical Task Team National Experts – Turkey, Duzgunes, 2006).

9.4.5. Mullets (*Mugilidae*)

Among 6 species of mullets from family *Mugilidae* inhabiting the Black Sea, three aboriginal species *Liza aurata* (Risso), *Mugil cephalus* L., *Liza saliens* (Risso) and one acclimatized species *Mugil so-iuy* Basilevsky (*Liza haematocheilus* (Temminch et Schlegel) are of 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 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 and bays at depths less than 25 m. The wintering grounds of *so-iuy* mullet are not studied well-enough but known to spend winter in the northwestern Black Sea 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. Spawning migrations of aboriginal mullets from feeding grounds to the Black Sea take place in late August-September. Their stock is the most abundant in the northern Black Sea in the waters of the Russian Federation and Ukraine Crimean-Caucasus.

All coastal countries are engaged in mullet fisheries. Due to their geographical position and wide application of active fishing gears for mullets capture, Turkey has the largest landings (Table 9.11). *So-iuy* mullet fisheries along the coasts of Anatolia are mainly based on fishing off pre-spawning and spawning concentrations. Vessels with engine power from 5 to 380 Hp are engaged (Knudsen and Zengin, 2006). In other countries, the mullet fisheries are carried out with passive fishing gears with traps of different design.

The separate statistics for catch of mullets by species is not available although the Russian Federation and Ukraine compiled the separate statistic for *So-iuy* mullet. Lack of separate statistics for catches of mullets, availability of local stocks as well as their un-reporting catch obstructed producing the mullet biomass assessments for the whole Black Sea.

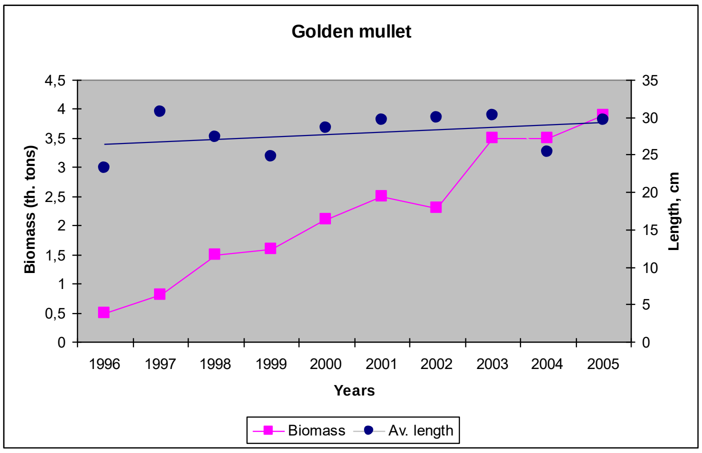

Fig. 9.18. Biomass and mean length changes of golden mullet in the Crimean waters of Ukraine during 1996-2005.

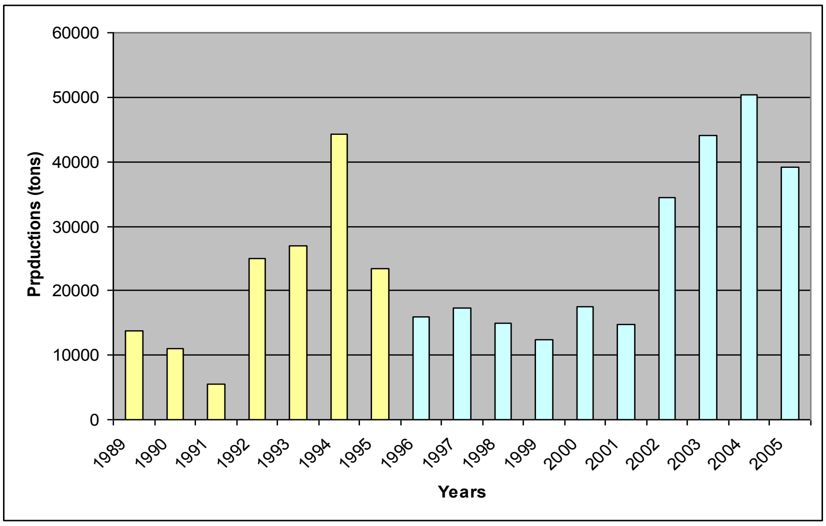

Fig. 9.19. Total catch of main mollusks in the Black Sea in 1989 – 2005.

The 1980s and early 1990s was a period of very low mullet stocks in the Crimean-Caucasus coasts and thus their fisheries were prohibited. Populations of mullets started to be restored only by the late-1990 (Fig. 9.18); however, their renewed fisheries became less intensive. Its stock increase was accompanied by an increase in its total length (Fig. 9.18) that is an additional evidence of improvement of stocks of this fish in the waters of Ukraine. Along the coasts of Caucasus in the waters of the Russian Federation, the state of So-iuy mullet stocks, golden mullet and flathead grey mullet stocks was rather favorable in 2002 to conduct target fisheries within TAC 150 tons (Volovik and Agapov, 2003).

9.5. Commercial mollusks

Among mollusks, the clams (*Chamelea gallina*, *Tapes spp.*), Mediterranean mussel (*Mytilus galloprovincialis*), and sea snail (*Rapana thomassiana*) have the greatest commercial value. The former two species are harvested only by Turkey and the latter species – by all the countries of the region except Romania. The capture of mollusks in 1996 – 2005 has the tendency to increase (Fig. 9.19).

9.5.1. Mediterranean mussel

Among the Black Sea mollusks, Mediterranean mussel (*Mytilus galloprovincialis*) is the one with highest commercial value. It is one of the most abundant macrozoobenthos species in the Black Sea. It forms the communities along all the coasts from the shoreline to the depth of 55 – 60 meters.

In 1989 – 2005 mussel fisheries was developed in Turkey and Ukraine, while its harvesting in the waters of Bulgaria and the Russian Federation was much less, and Georgia and Romania did not harvest this mollusk at all. Comparison of mussel harvesting in 1989 – 1995 and 1996 – 2005 demonstrated a major reduction in the waters of Turkey and Ukraine for the last10 years (Table 9.12).

According to the opinion of Turkish experts, Mediterranean mussel banks were seriously affected and production rates were decreased. Recently mussel harvesting in