BLACK SEA TURBOT, *PSETTA MAEOTICA* PALLAS

Commercially the Black Sea turbot is one of the most valuable species in the basin, and currently is fished with gillnets and bottom trawls even though, at present, the latter gear is prohibited.

In Bulgaria a minimal mesh size (180 mm) has been established for gillnets, and in 1989-1993 the turbot fishery was closed with a view to promoting the recovery of the stock along the Bulgarian coast. Actually the ban is valid only for the spawning season (May-June).

Prior to the prohibition of bottom trawling the Turkish fishery was carried out with this gear, but with a mesh size of 200 mm.

Table 68 shows turbot landings by countries during the period 1950-1992. During the years 1964-1992 Turkey had the largest landings, with a mean of 1990.1 tonnes that comprised 71.26% the mean total landing of 2793.1 tonnes. The next in size were the catches of the former USSR (531.7 tonnes or 19.04%), while those of Bulgaria and Romania were considerably lower, 196.9 tonnes (7.05%) and 74.0 tonnes (2.65%), respectively.

The big landings of Turkey are determined not only by the intensive fishery of this country along its own coast but also off the coasts of other Black Sea countries (**Table 69**).

Without indicating the fishing areas, apparently Turkish catches (following Turkish fishery statistics the landings taken west of Sinop refer to the western part of the basin), were greater in the western part of the Black Sea than in the eastern part, and totalled 1216.1 tonnes (60.83%) and 783.0 tonnes (39.17%), respectively. According to Ivanov and Karapetkova (1979) and Ivanov and Beverton (1985), the fishing mortality of the exploited stock in Bulgarian waters was around 0.57 but mainly as a result of the Turkish fishery.

TABLE 68. Turbot landings in the Black Sea (in tonnes) during the period 1950-1992

Year	Bulgaria	Romania	former USSR	Turkey	Total	Year	Bulgaria	Romania	former USSR	Turkey	Total
1950	195.3		2600.0			1972	175.1	70.0	680.0	2124.3	3049.4
1951	160.0	156.0	2980.0			1973	248.5	118.0	530.0	2808.1	3704.6
1952	95.9	195.0	2420.0			1974	311.5	29.0	400.0	955.9	1696.4
1953	103.0	470.0	1940.0			1975	203.3	16.0	300.0	753.6	1272.9
1954	255.1	678.0	2000.0			1976	217.2	36.0	204.0	1126.3	1583.5
1955	198.9	383.0	1430.0			1977	63.1	15.0	96.0	1837.6	2011.7
1956	234.0	402.0	1500.0			1978	121.3	11.0	120.0	1907.4	2159.7
1957	458.4	169.0	740.0			1979	69.9	7.0	120.0	5250.3	5447.2
1958	368.6	80.0	940.0			1980	88.8	9.0	120.0	2625.0	2842.8
1959	247.5	275.0	1230.0			1981	9.5	2.0	120.0	3144.0	3275.5
1960	215.8	214.0	960.0			1982	9.4	2.0	110.0	4541.0	4662.4
1961	174.3	164.0	1200.0			1983	7.5	3.0	80.0	5216.0	5306.5
1962	431.7	182.0	1500.0			1984	20.8	4.0	50.0	2777.0	2851.8
1963	435.3	317.0	1600.0			1985	50.9	11.0	60.0	405.0	526.9
1964	460.2	393.0	1400.0	1521.8	3775.0	1986	12.4	7.0	10.0	399.0	428.4
1965	324.9	247.0	1300.0	1426.7	3298.6	1987	3.4	1.0	10.0	835.0	849.4
1966	425.6	134.0	1400.0	1331.5	3291.1	1988	3.6	2.0	0.0	1110.0	1115.6
1967	312.3	62.0	900.0	1528.6	2802.9	1989	0.9	0.0	0.0	1449.0	1449.9
1968	304.3	92.0	900.0	1679.7	2994.0	1990	0.1	0.0	0.0	1383.0	1383.1
1969	200.2	112.0	700.0	2128.6	3140.8	1991	0.1*	2.0	0.0	915.0	917.1
1970	267.9	124.0	700.0	4181.5	5273.4	1992	0.1*	1.0	25.0	418.0	444.1
1971	222.1	43.0	840.0	1946.5	3051.6						
Average							196.9	74.0	531.7	1990.5	2793.1
%							7.05	2.65	19.04	71.26	100.00

TABLE 69. Turkish catches of turbot by regions (in tonnes)

Years	Eastern part of the Black Sea	Western part of the Black Sea	Total
1972	1690.2	434.1	2124.3
1973	298.7	2509.4	2808.1
1974	532.8	423.1	955.9
1975	161.6	592.0	753.6
1976	251.6	874.7	1126.3
1977	213.9	1623.7	1837.6
1978	711.1	1196.3	1907.4
1979	3026.7	2223.6	5250.0
1980	1211.0	1414.0	2625.0
1981	1396.0	1748.0	3144.0
1982	903.0	3638.0	4541.0
1983	1365.0	3851.0	5216.0
1984	1202.0	1575.0	2777.0
1985	263.0	142.0	405.0
1986	228.0	171.0	399.0
1987	477.0	358.0	835.0
1988	1001.0	448.0	1449.0
1989	610.0	500.0	1110.0
1990	475.0	908.0	1383.0
1991	315.0	600.0	915.0
1992	110.0	308.0	418.8
Average	783.0	1216.1	1999.1
%	39.17	60.83	100.00

The problem of determining the turbot age composition is rather complicated. Following the mentioned authors the latter was made of 2-10 year old fish, and rarely included 11-12 year old fish. After Russian and Ukrainian data the age composition consists of 2-15 year old fish; rarely 16-17 year old ones. This was presumably due to different ageing interpretations pointed out by Ivanov and Beverton (1985). This further reflected on some population parameters, such as growth rate, natural mortality, etc. Thus for instance, Ivanov and Beverton (1985) obtained the following values for the parameters in von Bertalanffy's equation: W_{oo} =13765.1 g , k = 0.125 and n = 3.116.

According to Ukrainian data for length at age and weight at age the above-mentioned parameters were estimated:

L_{oo}	= 77.1 cm	W_{oo}	= 17793.8 g
k	= 0.130	k	= 0.051
t_o	= -0.881	t_o	= -2.843
		n	= 1.921

Following Ivanov and Beverton (1985) the values of M by age groups were:

Age	2	3	4	5	6	7	8	9	10	11	12	13
M_t	0.25	0.20	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60

On the basis of this data the authors' mean value of M was 0.19 (M/k = 1.5).

Efimov *et al.* (1986) gave mean values of M for males and females: 0.103 and 0.138 respectively. In the same paper they used average values of M = 0.100 and F_{ST} = 0.200 when performing VPA. Similar analysis was conducted by Ivanov and Beverton (1985) who used values of 0.190 and 0.500 respectively for the coefficients in consideration.

Popova showed that along the former USSR coast, the total biomass during 1950-1963 ranged from 10 300 tonnes (1958) to 15 800 tonnes (1954). Following Ivanov and Beverton, the biomass (B2+) of turbot along the Bulgarian Black Sea coast varied between 400 tonnes (1979) and 1710 tonnes (1963). Effimov *et al.* believed that for 1974-1984 it averaged to 17 000 tonnes (in former USSR waters). According to Acara (1985) who used Fox's production model, the biomass of turbot in the entire Black Sea was about 26 000 tonnes (11 000 tonnes in the eastern and 15 000 tonnes in the western parts).

As already noted for the Russian sturgeon, the accuracy of biomass assessments depends to a great extent on the reliability of catch magnitude. This concerns also turbot since sizeable amounts of landings are lacking from the fishery statistics. One can find support for this assertion in the Ukrainian data for turbot catches taken during the sprat fishery. This latter uses trawls with mesh size 6 mm, so that immature turbot are caught as well. Following this data the mean turbot number in April-June, season during which the sprat fishery is the most intensive, is 5.5 specimens per trawl haul of 160 minute duration . Similar is the case with Bulgarian and Romanian turbot catches. For instance during the trawl survey in September 1979 designed to establish the whiting distribution and biomass by depth, turbot numbers in catches of control trawl hauls with a duration of 60 minutes, varied from 4-5 to 8-9 specimens. Having in mind that during 1978-1989 total hours trawling for sprat approached and even exceeded 100 000 hours annually, it is not difficult to conclude that turbot landings recorded in fishery statistics are much below real catches. After the turbot fishery was halted (except for the Turkish fishery) its biomass showed signs of recovery. As a result, positive changes in turbot population structure took place that is supported by the Ukrainian data from YugNIRO:

Relationships between recruitment and spawning stock (in %) during 1980-1985 and 1989-1993

Periods	Recruitment (up to 45 cm)	Spawning stock (over 45 cm)
1980-1985	43.73	56.27
1989-1993	31.48	68.52

The YugNIRO data have to be assessed carefully because in the latter years juvenile catches increased excessively and this may be the real cause for the indicated changes in the relation between recruitment and parent stock.

Table 70 shows the proportional age composition of total turbot catches during 1970-1988

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TABLE 70. Age composition of the turbot catches (x 10^{-3}) and mean weight (W; kg) during the period 1970-1988

Year	2+	3+	4+	5+	6+	7+	8+	9+	10+
1970	94.921	462.441	224.711	706.313	406.052	306.826	109.558	49.936	14.529
1971	3.256	86.051	779.262	360.454	338.448	256.630	75.647	30.331	10.589
1972	2.815	109.343	74.783	303.940	314.250	263.336	108.762	42.401	16.409
1973	4.926	68.381	90.040	401.258	344.068	302.546	112.531	49.626	26.318
1974	3.342	8.920	14.118	71.015	164.262	162.345	57.732	35.460	17.073
1975	0.286	15.219	41.674	198.185	135.558	86.844	26.510	9.851	3.265
1976	38.796	121.633	49.187	145.583	130.540	90.853	26.821	17.814	9.402
1977	28.938	68.088	32.032	104.841	133.082	126.737	42.091	35.205	18.647
1978	31.278	89.925	70.004	273.314	187.205	138.891	42.635	26.810	14.429
1979	5.135	212.865	152.254	583.676	476.630	362.663	111.958	74.229	33.598
1980	18.629	110.325	60.000	236.010	281.131	214.600	71.735	37.017	14.516
1981	27.783	115.374	36.996	116.115	208.813	255.314	139.355	78.232	35.533
1982	0.100	180.744	108.300	314.743	267.140	268.608	119.803	110.380	57.882
1983	0.100	234.916	146.595	558.273	315.725	285.921	115.338	105.161	50.763
1984	0.100	87.748	80.728	74.586	122.847	131.622	107.930	74.586	20.182
1985	0.100	1.400	4.061	7.841	15.262	27.444	13.022	21.983	15.262
1986	0.100	0.100	0.400	8.819	10.322	21.044	0.401	4.610	9.821
1987	0.100	2.024	14.165	21.501	81.449	23.777	23.271	14.671	29.342
1988	0.100	0.100	0.400	34.493	52.206	43.195	67.433	15.227	29.521

TABLE 70 - continued

Year	11+	12+	13+	14+	15+	16+	17+	C_N	W
1970	10.762	13.129	5.704	3.013	4.735	2.475	0.000	2415.108	2.184
1971	9.243	3.141	1.076	1.346	1.705	0.808	0.000	1255.992	2.430
1972	14.231	12.488	2.614	1.743	0.581	0.000	0.000	1267.696	2.405
1973	17.751	18.600	4.476	2.701	1.466	0.463	0.000	1445.151	2.563
1974	13.626	16.964	5.855	3.064	5.472	1.861	0.000	581.109	2.919
1975	2.933	2.214	1.384	1.328	1.328	1.107	0.000	527.686	2.412
1976	8.610	11.876	5.641	4.849	6.037	1.781	0.099	669.522	2.365
1977	14.701	24.373	10.136	5.493	10.368	4.875	3.250	662.857	3.035
1978	11.636	9.961	2.793	2.700	2.700	0.465	0.093	904.839	2.387
1979	27.459	35.161	14.623	11.051	22.213	8.595	2.121	2134.231	2.552
1980	9.920	21.654	10.161	5.202	9.557	4.476	0.121	1105.530	2.573
1981	27.345	31.293	11.406	7.019	11.113	3.948	0.146	1105.785	2.962
1982	46.746	55.802	21.048	16.276	34.509	12.237	0.857	1615.175	2.887
1983	42.888	54.519	21.565	13.448	29.319	10.661	0.121	1985.313	2.673
1984	21.937	50.894	25.447	56.159	20.182	2.632	0.000	877.580	3.250
1985	12.042	7.841	6.301	3.220	2.940	1.400	0.000	140.119	3.763
1986	5.211	5.211	12.226	16.034	3.608	2.906	0.000	100.813	4.275
1987	7.841	7.588	7.588	9.359	8.347	2.024	0.000	253.040	3.358
1988	19.888	23.306	9.322	9.322	4.972	1.864	0.000	311.349	3.590

The indicated age structure is defined on the basis of the age composition of catches by all Black Sea countries. For Bulgarian and Romanian catches since 1979, the age composition of former USSR was used. The latter was also applied to Turkish catches when data for size composition were not available. The results of VPA with tuning are presented in **Tables 71, 72** and **Figure 26**.

From the given data it is seen that the turbot biomass (B2+) in the Black Sea during 1970-1988 ranged between 6 100 tonnes (1988) and 25 800 tonnes (1979).

According to Ivanov and Beverton (1985) the turbot biomass (B2+) along the Bulgarian Black Sea coast during 1970-1979 varied from 1 210 tonnes (1973) to 450 tonnes (1978). Following our estimates, the range was 18 700 and 25 800 tonnes, respectively (for the entire Black Sea).

TABLE 71. Number (x 10^{-6}) and biomass (last column: tonnes x 10^{-3}) of turbot in the Black Sea during 1970-1988

Years	2	3	4	5	6	7	8	9	10
1970	3.168	2.688	1.907	1.839	1.090	0.585	0.310	0.175	0.160
1971	1.853	2.384	1.784	1.433	0.995	0.622	0.258	0.188	0.115
1972	2.381	1.441	1.874	1.464	0.995	0.598	0.345	0.172	0.146
1973	2.019	1.852	1.081	1.544	1.037	0.584	0.313	0.219	0.119
1974	2.585	1.568	1.454	0.847	1.016	0.631	0.262	0.188	0.155
1975	3.260	2.010	1.276	1.239	0.699	0.785	0.442	0.193	0.140
1976	3.470	2.539	1.632	1.059	0.933	0.518	0.662	0.395	0.169
1977	2.696	2.668	1.969	1.359	0.820	0.740	0.404	0.605	0.349
1978	2.638	2.074	2.123	1.665	1.130	0.633	0.580	0.344	0.262
1979	2.379	2.027	1.617	1.762	1.247	0.869	0.467	0.510	0.293
1980	2.442	1.848	1.468	1.251	1.042	0.699	0.473	0.335	0.402
1981	1.011	1.885	1.413	1.208	0.908	0.696	0.456	0.380	0.275
1982	1.272	0.763	1.439	1.182	0.983	0.641	0.414	0.298	0.277
1983	0.615	0.990	0.462	1.138	0.771	0.655	0.349	0.277	0.171
1984	0.454	0.479	0.600	0.263	0.502	0.412	0.345	0.219	0.156
1985	0.329	0.354	0.313	0.441	0.167	0.348	0.264	0.223	0.132
1986	0.012	0.256	0.288	0.266	0.392	0.140	0.304	0.239	0.185
1987	0.002	0.009	0.209	0.248	0.232	0.354	0.113	0.289	0.217
1988	0.010	0.001	0.006	0.167	0.204	0.137	0.313	0.085	0.254

Table 71 - continued

Years	11	12	13	14	15	16	17	B_{2-17}
1970	0.050	0.052	0.015	0.016	0.012	0.009	0.000	21.8
1971	0.131	0.033	0.031	0.007	0.009	0.005	0.000	18.9
1972	0.094	0.104	0.024	0.023	0.004	0.000	0.000	18.7
1973	0.116	0.068	0.074	0.017	0.016	0.002	0.000	18.1
1974	0.082	0.084	0.039	0.054	0.010	0.010	0.000	17.4
1975	0.124	0.058	0.053	0.025	0.037	0.003	0.000	19.5
1976	0.124	0.104	0.046	0.040	0.017	0.025	0.001	22.5
1977	0.144	0.099	0.075	0.031	0.026	0.007	0.015	24.4
1978	0.298	0.110	0.059	0.049	0.018	0.010	0.001	24.8
1979	0.223	0.246	0.081	0.043	0.034	0.011	0.006	25.8
1980	0.233	0.167	0.170	0.051	0.023	0.006	0.001	23.1
1981	0.350	0.191	0.117	0.123	0.033	0.008	0.001	21.7
1982	0.215	0.276	0.129	0.081	0.085	0.014	0.002	20.0
1983	0.196	0.142	0.176	0.082	0.046	0.032	0.000	15.9
1984	0.106	0.129	0.068	0.118	0.049	0.009	0.000	10.7
1985	0.122	0.071	0.060	0.030	0.040	0.018	0.000	8.0
1986	0.105	0.094	0.051	0.041	0.020	0.026	0.000	7.5
1987	0.158	0.085	0.072	0.029	0.017	0.011	0.000	7.0
1988	0.168	0.129	0.063	0.049	0.014	0.005	0.000	6.1

TABLE 72. Fishing mortality rate of turbot in the Black Sea during 1970-1988

Year	2	3	4	5	6	7	8	9	10
1970	0.0344	0.2097	0.1355	0.5141	0.4869	0.7683	0.4486	0.3492	0.1001
1971	0.0020	0.0406	0.0477	0.3060	0.4339	0.5490	0.3569	0.1826	0.1019
1972	0.0013	0.0873	0.0439	0.2455	0.4166	0.5986	0.3945	0.2954	0.1259
1973	0.0028	0.0416	0.0940	0.3180	0.4211	0.7536	0.4591	0.2677	0.2649
1974	0.0015	0.0063	0.0105	0.0922	0.1834	0.3057	0.2563	0.2175	0.1226
1975	0.0001	0.0084	0.0358	0.1838	0.2245	0.1204	0.0634	0.0546	0.0248
1976	0.0127	0.0543	0.0330	01558	0.1568	0.1980	0.0424	0.0480	0.0602
1977	0.0122	0.0286	0.0177	0.0845	0.1842	0.1930	0.1129	0.0861	0.0577
1978	0.0135	0.0490	0.0361	0.1891	0.1884	0.2545	0.0783	0.0845	0.0597
1979	0.0024	0.1229	0.1068	0.4259	0.5037	0.5575	0.2818	0.1635	0.1283
1980	0.0087	0.0681	0.0450	0.2206	0.3279	0.3773	01688	0.1218	0.0387
1981	0.0315	0.0699	0.0286	0.1065	0.2724	0.4705	0.3752	0.2399	0.1457
1982	0.0001	0.3012	0.0845	0.3271	0.3308	0.5598	0.3517	0.4835	0.2469
1983	0.0002	0.3017	0.4152	0.7180	0.5514	0.5922	0.4186	0.4995	0.3739
1984	0.0002	0.2251	0.1563	0.3531	0.2922	0.3955	0.3867	0.4343	0.1461
1985	0.0003	0.0044	0.0141	0.0188	0.0997	0.0843	0.0519	0.1081	0.1297
1986	0.0094	0.0004	0.0015	0.0355	0.0277	0.1670	0.0014	0.0203	0.0573
1987	0.0766	0.2721	0.0756	0.0956	0.4520	0.0714	0.2372	0.0541	0.1531
1988	0.0117	0.1051	0.0768	0.2439	0.3086	0.3901	0.2491	0.2063	0.1301

Table 72 - continued

Years	11	12	13	14	15	16	17
1970	0.2613	0.3240	0.5700	0.2440	0.6220	0.4263	0.0000
1971	0.0789	0.1097	0.0402	0.2739	0.2433	0.2433	0.0000
1972	0.1779	0.1412	0.1286	0.0913	0.2084	0.0000	0.0000
1973	0.1793	0.3594	0.0705	0.2057	0.1177	0.3107	0.0000
1974	0.1958	0.2524	0.1871	0.0680	0.9814	0.2603	0.0000
1975	0.0257	0.0428	0.0299	0.0635	0.0431	0.6793	0.0000
1976	0.0778	0.1339	0.1498	0.1498	0.5214	0.0895	0.1486
1977	0.1162	0.3164	0.1658	0.2311	0.6364	1.5017	0.3072
1978	0.0429	0.1046	0.0551	0.0654	0.1944	0.0607	0.1149
1979	0.1420	0.1712	0.2257	0.3459	1.3506	2.5855	0.5739
1980	0.0469	0.1545	0.0700	0.1263	0.6708	1.7354	0.3385
1981	0.0879	0.1982	0.1167	0.0681	0.4991	0.8415	0.2854
1982	0.2655	0.2513	0.2037	0.2630	0.6369	3.2263	0.5960
1983	0.2676	0.5443	0.1489	0.2103	1.2979	0.5113	0.5113
1984	0.2509	0.5635	0.5472	0.7788	0.6519	0.4382	0.0000
1985	0.1123	0.1295	0.1256	0.1303	0.0907	0.0988	0.0000
1986	0.0551	0.0633	0.3127	0.6251	0.2418	0.1462	0.0000
1987	0.0548	0.1031	0.1264	0.4590	0.8349	0.2518	0.0000
1988	0.1358	0.2213	0.1823	0.2445	0.5540	0.5540	0.2850

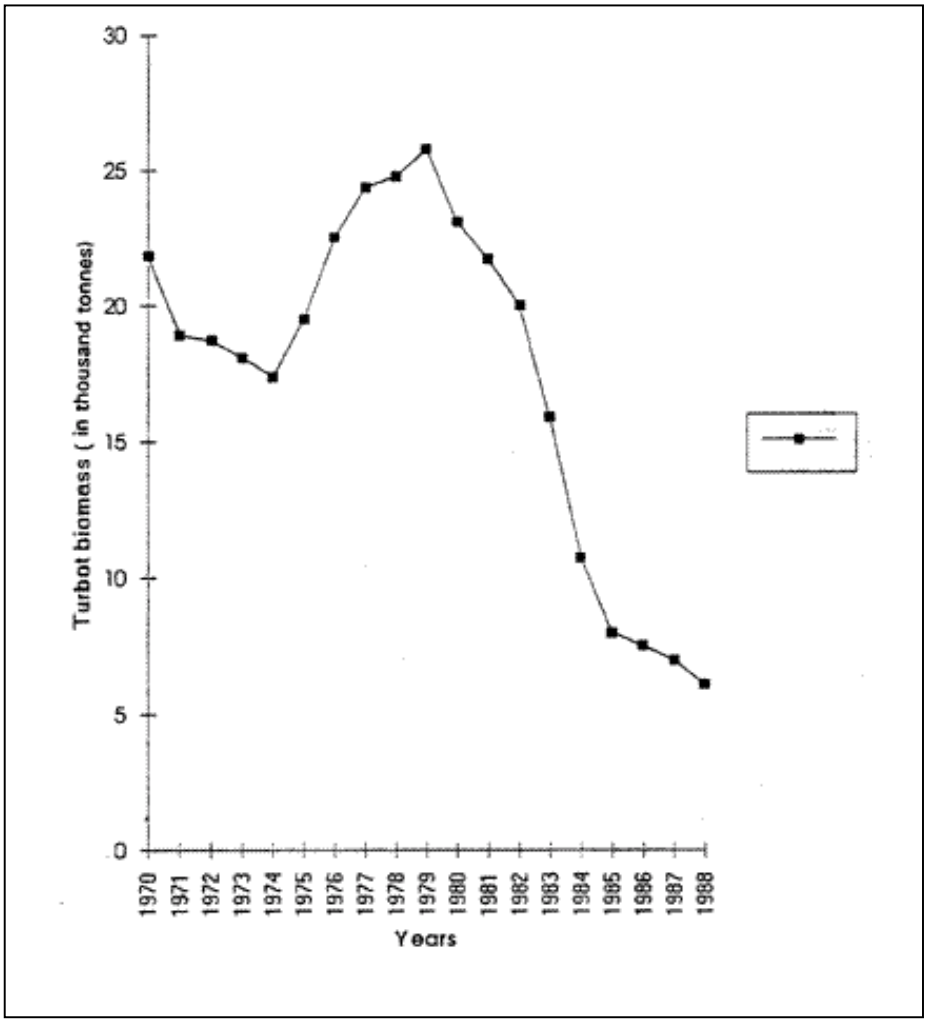

FIGURE 26.Turbot biomass in thousand tonnes in the Black Sea during the period 1970-1992 (VPA results with *ad hoc* tuning of F_{ST} values for the oldest age groups)

Tables 73 and **74** show the results from cohort analysis of the catch size composition during 1989-1990 and 1991-1992 (by Jones' method, 1981).

TABLE 73. Mean number (x 10^{-3}) and biomass (in tonnes) of turbot during the periods 1989-1990

L	XL	CL	NL	F/Z	Z	F	NL*	BL
18	1.04888	0.2298	1624.522	0.0016	0.1402	0.0002	1056.345	507.0
23	1.05375	1.8617	1476.422	0.0125	0.1418	0.0018	1047.522	805.1
28	1.05969	8.1956	1327.884	0.0535	0.1479	0.0079	1035.319	1161.0
33	1.06712	4.1639	1174.760	0.0283	0.1441	0.0041	1020.393	1568.9
38	1.07666	67.4496	1027.721	0.3310	0.2093	0.0693	973.684	1962.9
43	1.08937	108.2086	823.929	0.4726	0.2655	0.1255	862.424	2204.5
48	1.10714	74.8374	594.956	0.4224	0.2424	0.1024	730.905	2307.8
53	1.13375	69.6787	417.784	0.4518	0.2554	0.1154	603.825	2306.2
58	1.17804	57.3478	263.568	0.4688	0.2636	0.1236	464.149	2107.8
63	1.26669	26.6205	141.239	0.3586	0.2182	0.0782	340.182	1810.8
68	1.53791	4.4192	67.011	0.1064	0.1567	0.0167	265.170	1634.5
73		10.6080	25.459	0.4167	0.2400	0.1000	106.08	749.3
Total		433.621						19125.8

TABLE 74. Mean number (x 10^{-3}) and biomass (in tonnes) of turbot during the periods 1991-1992

L	XL	CL	NL	F/Z	Z	F	NL*	BL
18	1.04888	5.1459	692.834	0.0757	0.1515	0.0115	448.679	215.4
23	1.05375	10.0358	624.859	0.1401	0.1628	0.0228	440.058	338.2
28	1.05969	13.7038	553.218	0.1864	0.1721	0.0321	427.098	478.9
33	1.06712	34.9275	479.714	0.3830	0.2269	0.0869	401.853	617.8
38	1.07666	34.9275	338.534	0.4071	0.2361	0.0961	363.409	732.6
43	1.08937	27.8028	302.733	0.3800	0.2258	0.0858	323.985	828.2
48	1.10714	38.1643	229.577	0.4972	0.2784	0.1384	275.695	870.5
53	1.13375	48.4170	152.823	0.6318	0.3802	0.2402	201.567	769.8
58	1.17804	23.5065	76.188	0.5700	0.3256	0.1856	126.667	575.2
63	1.26669	10.7578	34.945	0.4967	0.2782	0.1382	77.852	414.4
68	1.53791	5.0296	13.287	0.4598	0.2592	0.1192	42.205	260.4
73		0.9780	2.347			0.1000	9.780	69.1
Total		253.397						6170.5

The two assessments of turbot mean biomass during the periods 1989-1990 and 1991-1992 differ substantially. The estimates of mean catches during the two periods, 1 416.5 and 680.6 tonnes respectively, are the major reason for these differences. The catches presented are probably strongly understated especially during the second period, which has an immediate effect on the assessments. This proves once more the extreme importance of the real catch data for the reliability of VPA estimates.

In **Table 75** are shown the turbot biomass assessments obtained from control trawl hauls with a 24.6 metre bottom trawl a catchability of 0.15 being assumed.

The assessments also differ essentially between each other during certain years and periods. Comparing our estimates with those of the mentioned authors we found that the former are very close to estimates of Acara (1985) and Effimov *et al.* (1986) . Therefore, the results from the VPA were used for establishing the impact of the factors influencing the turbot stock dynamics, presented in a separate section together with that for the remaining commercial fish species.

TABLE 75. Turbot biomass (in thousand tonnes) in the Black Sea and in the waters of the former USSR during the periods 1970-1984 and 1989-1993

Years	The minimum biomass of turbot in the waters of former USSR	Turbot biomass in the Black Sea according to YugNIRO trawl surveys	Turbot biomass in the Black Sea (VPA results)	Turbot biomass in the Black Sea as assessed by tagging
1970	5.3			
1971	3.1			
1972	3.0			
1973	3.7			
1974	1.7			
1975	1.3	28.0	9.2	
1976	1.6	28.0	10.3	
1977	2.0	26.7	12.3	
1978	2.2	14.0	9.6	
1979	5.4	13.3	15.8	
1980	2.8	10.0	15.1	
1981	3.3	9.3	17.2	
1982	4.7	8.0	18.9	
1983	5.3	5.3	20.0	
1984		8.3	19.0	
1975-1979*	2.5	22.0	11.4	19.1
1980-1984*	4.0	8.2	18.0	14.2
1989-1993**	9.9			

* according to data of Effimov *et al.* (1986)

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