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The Use of Gillnets for Estimation of Fish Stocks

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Abstract: In this research it has been targeted to estimate fishable stocks of Karakaya Dam Lake (in Turkey) by using fishing with gillnets method that had been suggested as an alternative method for estimating fish stocks. Productivity per hectare in the dam lake and the amount of fishable stocks has been calculated to be 13.67 kg ha^{-1} and 312.005 kg $year^{-1}$, respectively. Fishable stocks have also been analyzed with respect to fish species. According to this, *Capoeta* sp. is estimated to be 184.107 kg $year^{-1}$ (8.06 kg ha^{-1}), *Cyprinus carpio carpio* is estimated to be 56.353 kg $year^{-1}$ (2.47 kg ha^{-1}), *Barbus* sp. is estimated to be 40.580 kg $year^{-1}$ (1.78 kg ha^{-1}), *Squalius cephalus* is estimated to be 30.455 kg $year^{-1}$ (1.34 kg ha^{-1}) and *Onchorincus mykiss* is estimated to be 510 kg $year^{-1}$ (0.02 kg ha^{-1}).

Key words: Fisheries management, fish stocks, gillnets, Karakaya Dam Lake, fishable stocks, fish catching

INTRODUCTION

In the transition to modern fishery research conducted on population size is very important along with the tools and methods used in fisheries (Yuksel, 2002). Sparre and Venema (1992) have indicated that in order to continuously benefit from natural livestock sources, which demonstrate a renewable property and have a certain production level in any area at the highest level of product possible; the status of available stock in that area should be defined and necessary precautions should be taken (Ozyurt *et al*., 2004). Various methods are used by the researchers for the control of the stocks and estimation of population size.

These methods are selected taking into account the water environment where the research is to be conducted and the fish species available in that water environment considering their all characteristics (Hart and Gorfine, 1997; Hart *et al*., 1997; Tuck *et al*., 1997). One of the best methods to obtain the data belonging to population size is to conduct sampling by means of fishing at certain time periods (Atay, 1989). The size of a stock is proportional to the abundance of the fish caught. In other words, if the product obtained is quantitatively high then the respective stock is accepted to be efficient (Avsar, 2005).

It is very important for fisheries management to determine the fishable stock in other words, the maximum amount of fish that could be caught within a certain time period without destroying the stock. In this research it has been targeted to estimate the annual fishable stock by using fishing with gillnets method (Avsar *et al*., 2001). Karakaya Dam Lake (in Turkey) has been selected as the research region.

MATERIALS AND METHODS

Study site: Karakaya Dam Lake, which is the environment of this study was constructed for both electricity and irrigation purposes. It is located in a distance of 17 km from Malatya city centre. In terms of lake surface area, it is the third biggest dam lake in Turkey. Its above sea level is 693 m and the surface area and water storage volume of the dam are 29,800 ha and 9.58×10^{6} m^{3}, respectively. In Karakaya Dam Lake, fishing is realized in an area of 22,828 ha (Anul, 1995; Kalkan *et al*., 2005; Kalkan, 2008). Karakaya Dam Lake has been divided into 10 different fishing areas and then one of these fishing areas (5th fishing area) has been cancelled. The study has been carried out in 3 sub regions containing the 9 fishing areas in Karakaya Dam Lake in 2004. The areas of these sub regions have been measured by a digital area-meter.

Field study: Gillnets with 22, 36, 44, 55 and 70 mm mesh sizes have been used in the studies. In the investigation, the length and width of gillnets have been standardized to be 100 m and 100 meshes, respectively and catching period has been set as 12 h day^{-1}.

In 36 catching trials performed during the study *Cyprinus carpio carpio*, *Squalius cephalus*, *Barbus esocinus*, *Barbus grypus*, *Barbus mystaceus*, *Capoeta trutta*, *Capoeta umbla* and *Onchorincus mykiss* species

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have been caught. Moreover, in 2004-2005 fishing season, interviews have been conducted with fisher cooperatives operating in the 9 distinct catching areas in Karakaya Dam Lake and the amount of fish caught has also been determined.

Data analysis: Using a probable approach, total amount of economic species in the dam lake has been determined by means of projecting the findings obtained from the sub regions on the total area. In order to do this, Fishing with Gillnets method which is a version of Field Scan method proposed by some researchers (Pauly, 1980; Bingel, 1981, 1985, 1987; Sparre *et al*., 1989; Avsar, 1999) and first applied to gillnets by Avsar *et al*. (2001) has been used. For this method, primarily, surface area (ha) of gillnet i has been measured.

$$a_i = (E_i \times B_i) \quad (1)$$

Where:

a_i = Surface area of gillnet i (ha)
E_i = Width of gillnet i (hm)
B_i = Length of gillnet i (hm)

It is assumed that gillnets used for catching are able to catch all the fish in an area that has been equal to its total area (aa_i). This area has been calculated by using the Eq. 2:

$$aa_i = \sum_{i=1}^{n} a_i \quad (2)$$

The amount of product per unit area (U_i) is calculated by dividing the average product (ou_i) caught in sub region i by fishing for half a day by the area (aa_i) where all of the fish are caught.

$$U_i = ou_i/aa_i \text{ kg/ha} \quad (3)$$

Biomass of sub region i (B_i) is calculated by projecting the biomass calculated for unit area (U_i) upon the total area (A_i) of the sub region i.

$$B_i = U_i \times A_i \quad (4)$$

Variation and standard deviation of the biomass is calculated using the Eq. 5:

$$\text{Var}(B) = \sum_{i=1}^{n}[A_i/(n_i - 1)] \times \sum_{i=1}^{n}(BA_i - BA)^2 \quad (5)$$

$$S(B) = \sqrt{\text{Var}(B)} \quad (6)$$

Where:

n_i = Number of catching in sub region i
Ba_i = Weight of the fish caught at each fishing in sub region i
BA = Average weight of all fish caught at all fishing trials (Avsar *et al*., 2001)

Legal fishing size has been considered in the estimation of fishable stock. t test has been used for the statistical analysis of the difference between the values of fishable stock per unit area and the amounts of produced fish obtained by catching.

RESULTS AND DISCUSSION

The study has been carried out in 3 sub regions containing the 9 fishing areas in Karakaya Dam Lake. Fishing areas which have been included in the sub regions and their respective areas have been show in Table 1.

Total catching amounts estimated fishable stock per unit area and fishable stock in total area of the economic species of Karakaya Dam Lake that have been *Cyprinus carpio carpio*, *Squalius cephalus*, *Barbus esocinus*, *Barbus grypus*, *Barbus mystaceus*, *Capoeta trutta* and *Capoeta umbla* have been shown in Table 2-5. The catch per unit effort has been observed to be high generally in the period of May-July in each 3 sub region. Annual fishable stock amount of *Onchorincus mykiss* has been estimated to be 510 kg year^{-1} only for the 10th fishing area.

When the productivity of sub regions in terms of *Capoeta* sp. is analyzed, it is observed that the 2nd sub region is in the first place with 9.64 kg ha^{-1}, it is followed by the 1st sub region with 8.49 kg ha^{-1} and the 3rd sub region is in the last place with a productivity level of 4.27 kg ha^{-1}. When the findings have been evaluated statistically, it has been found that the difference between the 1st sub region and the 2nd sub region in terms of fishable *Capoeta* sp. stock per unit area has been statistically insignificant ($p>0.05$) and the difference between both two regions and the 3rd region has been statistically significant ($p<0.05$). It has been estimated that there have been 45.514 kg *Capoeta* sp. stock amount in

Table 1: Fishing areas in the dam lake

Sub regions	Fishing regions	Surface areas (ha)	Total (ha)
Ist sub-region	1st	3.360	5.360
	2nd	2.000	-
2nd sub-region	3rd	2.240	11.920
	4th	4.000	-
	8th	5.680	-
3rd sub-region	6th	1.440	5.548
	7th	880.000	-
	9th	2.528	-
	10th	700.000	-
Total	-	-	22.828

Table 2: Fishable stock amounts of *Capoeta* sp. in the sub regions

		ou_i (kg day^{-1})			U_i (kg ha^{-1})			B_i (kg year^{-1})		
Months	aa_i (ha)	I	II	III	I	II	III	I	II	III
Jan.	0.29	1.13	2.34	0.40	3.90	8.07	1.38	20,886	96,182	7,652
Feb.	0.29	2.63	2.09	0.55	9.07	7.21	1.90	48,610	85,906	10,522
March	0.29	0.89	1.49	0.60	3.07	5.14	2.07	16,450	61,244	11,479
April	0.29	1.77	2.98	1.68	6.10	10.28	5.79	32,714	122,488	32,140
May	0.29	3.28	3.05	2.05	11.31	10.52	7.07	60,623	125,366	39,219
June	0.29	5.14	6.54	2.47	17.72	22.55	8.52	95,001	268,817	47,254
July	0.29	4.03	3.15	1.88	13.90	10.86	6.48	74,486	129,476	35,966
Aug.	0.29	2.34	2.64	0.74	8.07	9.10	2.55	43,250	108,513	14,157
Sept.	0.29	1.89	2.43	1.15	6.52	8.38	3.97	34,932	99,881	22,001
Oct.	0.29	3.07	3.46	1.97	10.59	11.93	6.79	56,742	142,218	37,688
Nov.	0.29	1.94	1.70	0.82	6.69	5.86	2.83	35,857	69,876	15,687
Dec.	0.29	1.44	1.68	0.54	4.97	5.79	1.86	26,615	69,054	10,331
Avarage	-	2.46	2.80	1.24	8.49	9.64	4.27	45,514	114,918	23,675
SD	-	1.25	1.34	0.73	4.30	4.61	2.51	23,032	55,005	13,917
Variance	-	1.55	1.79	0.53	18.46	21.29	6.29	530450248	3025589686	193672860

Table 3: Fishable stock amounts of *C.c. carpio* in the sub regions

		ou_i (kg day^{-1})			U_i (kg ha^{-1})			B_i (kg year^{-1})		
Months	aa_i (ha)	I	II	III	I	II	III	I	II	III
Jan.	0.29	0.00	0.51	0.78	0.00	1.76	2.69	0	20,963	14,922
Feb.	0.29	0.00	0.55	0.65	0.00	1.90	2.24	0	22,607	12,435
March	0.29	0.37	0.68	0.98	1.28	2.34	3.38	6,839	27,950	18,748
April	0.29	0.46	0.64	1.24	1.59	2.21	4.28	8,502	26,306	23,722
May	0.29	1.04	0.98	1.62	3.59	3.38	5.59	19,222	40,281	30,992
June	0.29	0.81	1.34	1.70	2.79	4.62	5.86	14,971	55,079	32,523
July	0.29	0.63	1.00	1.13	2.17	3.45	3.90	11,644	41,103	21,618
Aug.	0.29	0.55	1.07	0.79	1.90	3.69	2.72	10,166	43,981	15,114
Sept.	0.29	0.00	0.61	0.59	0.00	2.10	2.03	0	25,073	11,287
Oct.	0.29	0.00	0.57	0.62	0.00	1.97	2.14	0	23,429	11,861
Nov.	0.29	0.35	0.75	0.55	1.21	2.59	1.90	6,469	30,828	10,522
Dec.	0.29	0.00	0.66	0.52	0.00	2.28	1.79	0	27,128	9,948
Avarage	-	0.35	0.78	0.93	1.21	2.69	3.21	6,484	32,061	17,808
SD	-	0.36	0.26	0.41	1.24	0.89	1.42	6,667	10,587	7,850
Variance	-	0.13	0.07	0.17	1.55	0.79	2.00	44443510	112090212	61630203

the 1st sub region, 114.918 kg in the 2nd sub region and 23.675 kg in the 3rd sub region with a total amount of 184.107 kg annual fishable stock (Table 2). The most productive sub region in terms of *Cyprinus carpio carpio* has been the 3rd sub region with productivity level of 3.21 kg ha^{-1}. This has been followed by the 2nd sub region with a productivity level of 2.69 kg ha^{-1} and the 1st sub region with a productivity level of 1.21 kg ha^{-1}.

The difference between the 1st sub region and the other sub regions in terms of fishable stock per unit area has been found statistically significant ($p<0.05$), however the difference between the 2nd sub region and the 3rd sub region has been found to be statistically insignificant ($p>0.05$). The estimated annual fishable *C.c. carpio* amount in Karakaya Dam Lake has been calculated to be 6.484 kg in the 1st sub region, 32.061 kg in the 2nd sub region and 17.808 kg in the 3rd sub region where total amount has summed to 56.353 kg (Table 3).

It has been determined that the sub region with the highest productivity for *Barbus* sp. is the 3rd sub region with 2.32 kg ha^{-1} and this has been followed by the 1st sub region (1.76 kg ha^{-1}) and the 2nd sub region (1.53 kg ha^{-1}), respectively. The difference between all three sub regions in terms of the amount of fishable *Barbus* sp. stock per unit area has been found to be statistically insignificant ($p>0.05$). The estimated annual fishable *Barbus* sp. amount available in the dam lake has been found to be 9.457 kg in the 1st sub region, 18.257 kg in the 2nd sub region and 12.866 kg in the 3rd sub region where the total amount has been 40.580 kg (Table 4).

When the sub regions are analyzed in terms of *Squalius cephalus* productivity, it is observed that the 3rd sub region is in the first place with 1.69 kg ha^{-1}, followed by the 2nd sub region with 1.24 kg ha^{-1} and the 1st region is in the last place with 1.17 kg ha^{-1} productivity level. When the results have been analyzed statistically, it has been determined that the difference between all three sub regions in terms of fishable *Squalius cephalus* stock per unit area has been insignificant ($p>0.05$). It is estimated that the annual fishable *Squalius cephalus* stock in the dam lake is 6.284 kg in the 1st sub region, 14.797 kg in the 2nd sub

Table 4: Fishable stock amounts of *Barbus* sp. in the sub regions

		ou_i (kg day^{-1})			U_i (kg ha^{-1})			B_i (kg year^{-1})		
Months	aa_i (ha)	I	II	III	I	II	III	I	II	III
Jan.	0.29	0.21	0.00	0.42	0.72	0.00	1.45	3,881	0	8,035
Feb.	0.29	0.29	0.00	0.27	1.00	0.00	0.93	5,360	0	5,165
March	0.29	0.52	0.54	0.55	1.79	1.86	1.90	9,611	22,196	10,522
April	0.29	0.61	1.17	0.63	2.10	4.03	2.17	11,274	48,091	12,053
May	0.29	1.17	0.98	0.88	4.03	3.38	3.03	21,625	40,281	16,835
June	0.29	1.05	1.14	1.32	3.62	3.93	4.55	19,407	46,858	25,253
July	0.29	0.60	0.57	0.56	2.07	1.97	1.93	11,090	23,429	10,713
Aug.	0.29	0.48	0.36	0.67	1.66	1.24	2.31	8,872	14,797	12,818
Sept.	0.29	0.58	0.22	1.26	2.00	0.76	4.34	10,720	9,043	24,105
Oct.	0.29	0.35	0.35	0.72	1.21	1.21	2.48	6,469	14,386	13,774
Nov.	0.29	0.28	0.00	0.49	0.97	0.00	1.69	5,175	0	9,374
Dec.	0.29	0.00	0.00	0.30	0.00	0.00	1.03	0	0	5,739
Avarage	-	0.51	0.44	0.67	1.76	1.53	2.32	9,457	18,257	12,866
SD	-	0.33	0.45	0.34	1.15	1.53	1.16	6,176	18,292	6,416
Variance	-	0.11	0.20	0.11	1.33	2.35	1.34	38141538	334595220	41158800

Table 5: Fishable stock amounts of *Squalius cephalus* in the sub regions

		ou_i (kg day^{-1})			U_i (kg ha^{-1})			B_i (kg year^{-1})		
Months	aa_i (ha)	I	II	III	I	II	III	I	II	III
Jan.	0.29	0.12	0.24	0.35	0.41	0.83	1.21	2,218	9,865	6,696
Feb.	0.29	0.27	0.13	0.42	0.93	0.45	1.45	4,990	5,343	8,035
March	0.29	0.11	0.00	0.81	0.38	0.00	2.79	2,033	0	15,496
April	0.29	0.36	0.48	0.86	1.24	1.66	2.97	6,654	19,730	16,453
May	0.29	0.48	0.72	0.63	1.66	2.48	2.17	8,872	29,594	12,053
June	0.29	0.83	0.65	0.92	2.86	2.24	3.17	15,341	26,717	17,601
July	0.29	0.00	0.49	0.63	0.00	1.69	2.17	0	20,141	12,053
Aug.	0.29	0.45	0.24	0.31	1.55	0.83	1.07	8,317	9,865	5,931
Sept.	0.29	0.37	0.33	0.59	1.28	1.14	2.03	6,839	13,564	11,287
Oct.	0.29	0.56	0.25	0.36	1.93	0.86	1.24	10,350	10,276	6,887
Nov.	0.29	0.42	0.43	0.00	1.45	1.48	0.00	7,763	17,674	0
Dec.	0.29	0.11	0.36	0.00	0.38	1.24	0.00	2,033	14,797	0
Avarage	-	0.34	0.36	0.49	1.17	1.24	1.69	6,284	14,797	9,374
SD	-	0.23	0.21	0.31	0.81	0.72	1.05	4,326	8,534	5,847
Variance	-	0.05	0.04	0.09	0.65	0.51	1.11	18714147	72832527	34184071

Table 6: Fishable stock amounts respect to economic fish species in the sub regions

	I		II		III		Total	
Species	(kg ha^{-1})	(kg year^{-1})	(kg ha^{-1})	(kg year^{-1})	(kg ha^{-1})	(kg year^{-1})	(kg ha^{-1})	(kg year^{-1})
Capoeta sp.	8.49	45,514	9.64	114,918	4.27	23,675	8.06	184,107
C.c. carpio	1.21	6,484	2.69	32,061	3.21	17,808	2.47	56,353
Barbus sp.	1.76	9,457	1.53	18,257	2.32	12,866	1.78	40,580
S. cephalus	1.17	6,284	1.24	14,797	1.69	9,374	1.34	30,455
O. mykiss	0.00	0	0.00	0	0.02	510	0.02	510
Total	12.63	67,739	15.10	180,033	11.51	64,233	13.67	312,005

region and 9.374 kg in the 3rd sub region where the total amount is 30.455 kg (Table 5). Annual fishable stock amount of *Onchorincus mykiss* has been detected to be 510 kg being available only in the 10th fishing area (Table 6). Annual fishable stocks of the economic fish species available in Karakaya Dam Lake have been estimated with respect to the sub regions and they have been shown in Table 6.

As it can be seen in the Table 6, it is estimated that 67.739 kg year^{-1} fish can be caught in the 1st sub region (5.360 ha), 180.033 kg year^{-1} fish can be caught in the 2nd sub region (11.920 ha) and 64,233 kg year^{-1} fish can be caught in the 3rd sub region (5.548 ha). When the annual productivity per hectare have been analyzed, the productivity levels of the 1st, the 2nd and the 3rd sub regions have been found to be 12.63, 15.1 and 11.51 kg ha^{-1}, respectively. Hence, throughout the dam lake, productivity per hectare is estimated to be 13.67 kg ha^{-1} and the annual fishable stock is estimated to be 312.005 kg year^{-1}.

Distribution of the estimated fishable stock in Karakaya Dam Lake with respect to the fishing areas represented by the study stations has been shown in Table 7. It has been calculated that the 8th fishing area which had the largest area (5,680 ha) had the highest fishable stock (85.788 kg year^{-1}) at the same time. It is

Table 7: Fishable stock amounts respect to fishing regions

		Fishable stock amounts (kg year^{-1})					
Fishing regions	Field (ha)	*Capoeta* sp.	*C.c. carpio*	*Barbus* sp.	*S. cephalus*	*O. mykiss*	Total
1st	3,360	28,531	4,065	5,928	3,939	0	42,463
2nd	2,000	16,983	2,419	3,529	2,345	0	25,276
3rd	2,240	21,595	6,025	3,431	2,781	0	33,832
4th	4,000	38,563	10,759	6,126	4,965	0	60,413
6th	1,440	6,145	4,622	3,339	2,433	0	16,539
7th	880,000	3,755	2,825	2,041	1,487	0	10,108
8th	5,680	54,760	15,277	8,700	7,051	0	85,788
9th	2,528	10,788	8,114	5,863	4,271	0	29,036
10th	700,000	2,987	2,247	1,623	1,183	510	8,550
Total	22,828	184,107	56,353	40,580	30,455	510	312,005

Table 8: The amounts of produced fish obtained by catching in the 2004-2005 fishing season

	Catched fish amounts (kg)				
Fishing region	*Capoeta.* sp.	*C.c. carpio*	*Barbus* sp.	*S. cephalus*	Total
1st	22,500	8,500	8,000	4,500	43,500
2nd	15,000	6,000	4,000	2,000	27,000
3rd	21,500	7,500	3,000	2,000	34,000
4th	37,000	12,000	7,500	0	56,500
6th	14,000	7,000	2,000	0	23,000
7th	6,500	3,000	2,000	1,000	12,500
8th	49,500	18,500	22,500	8,500	99,000
9th	17,000	8,500	6,000	0	31,500
10th	5,000	0	3,000	0	8,000
Total	188,000	71,000	58,000	18,000	335,000

estimated that the lowest amount of fishable stock is in the 10th fishing area (700 ha). In this research in addition to the stock estimation studies, fishing efforts made in the dam lake in 2004-2005 fishing season and the amounts of fish caught have also been determined. There have been 238 fishers registered to 9 different fisheries cooperatives, 119 motor boats and gillnets with a total length of 271,000 m available in Karakaya Dam Lake.

Moreover, the amounts of produced fish obtained by catching in all fishing areas have been determined with respect to the species. About 188 kg *Capoeta* sp., 71 kg *C.c. carpio*, 58 kg *Barbus* sp. and 18 kg *Squalius cephalus* with a total of 335 kg fish has been caught in Karakaya Dam Lake during 2004-2005 fishing season. The region where the highest amount of fish (99 kg) has been caught has been the 8th fishing area; the region where the lowest amount of fish (8 kg) has been caught has been the 10th fishing area (Table 8).

The difference between the estimated fishable stock and the amounts of produced fish obtained by catching in the 2004-2005 fishing season is statistically insignificant ($p>0.05$) for *Capoeta* sp., *C.c. carpio*, *Barbus* sp. and *Squalius cephalus*. Although, it has been estimated that there has been a fishable *Onchorincus mykiss* stock of 510 kg year^{-1} in the 10th fishing area, *Onchorincus mykiss* has not been produced by catching during the fishing season in question. In this study, it is observed that the amount of fish caught per unit time is higher in the warmer months. This finding could be explained with the fact that the metabolic activities of the fish belonging to *Cyprinidae* family are faster in relatively warmer waters and the possibility of them running into passive fishing gear is higher since they are more active.

When the unit fishing quantities of species are analyzed in terms of sub regions, *Capoeta* sp. is observed more in the 2nd sub region, *C.c. carpio*, *Barbus* sp., *Squalius cephalus* ve *Onchorincus mykiss* are observed more in the 3rd sub region. However, when all species are considered, it is understood that the most productive region is the 2nd sub region (15.1 kg ha^{-1}) and it is followed by the 1st sub region (12.63 kg ha^{-1}) and the 3rd sub region (11.51 kg ha^{-1}), respectively. In this study, it has been estimated that there are 184.107 kg (59.0%) *Capoeta* sp., 56.353 kg (18.1%) *C.c. carpio*, 40.580 kg (13.0%) *Barbus* sp., 30.455 kg (9.7%) *Squalius cephalus* and 510 kg (0.2%) *Onchorincus mykiss* fishable stock in Karakaya Dam Lake with a total of 312.005 kg annual fishable stock.

In a report prepared as a result of a fishable stock determination study conducted by using biomass estimation (swept area) in Kar akaya Dam Lake (Anonymous, 2001) it is stated that there are 180.573 kg (40.2%) *Capoeta* sp., 166.191 kg (37.0%) *C.c. carpio*, 47.320 kg (10.5%) *Barbus* sp. and 55.466 kg (12.3%) *Squalius cephalus* in the dam lake with a total annual fishable stock of 449.550 kg. When the percentage distribution of fish species in this study which is conducted 3 years prior to the study is analyzed, it is observed that *Capoeta* sp. is lower with respect to the study, *C.c. carpio* is higher and other species are close to each other.

It is observed that fishable *Onchorincus mykiss* stock is not available in the study in question. The difference between the two studies in terms of total fishable stock may be due to the high fishing efforts practiced in the past three years. In the interviews conducted with the fisheries cooperatives it is indicated

that fishing productivity is significantly decreased over the years. Fish stocks are affected by natural death and death by fishery. The structure of a fish stock which has never been subject to fishing changes when the fishing starts. According to Russel (1942), the greatest losses are caused by fishery. Although, the age groups in the stock are caught at the same proportion, age composition and growth changes, smaller and younger fish are gradually caught. Under these circumstances after some time, unit fish quantity in other words density of the stock decreases. Initially, an increase in the product is observed by the increasing fishing, however a decrease in the product is observed later although the fishing efforts are increased (Bingel, 2002).

It has been detected that 335 kg fish is caught in Karakaya Dam Lake in 2004-2005 fishing season. Productivity per hectare is 14.67 kg ha^{-1}, annual fish quantity per boat is 2.815 kg. The difference between the estimated fishable stock quantity and the fished quantity is statistically insignificant ($p>0.05$) for all species other than *Onchorincus mykiss*.

DISCUSSION

Fishing with gillnets method that has been first used by Avsar *et al*. (2001) has also been used in the studies of Ozyurt *et al*. (2004) and Cicek *et al*. (2006). Demirhan (2006) has reported that one of the methods they have used in the fish stock determination and evaluation studies conducted within the body of General Directorate of State Hydraulic Works. In this study, annual fishable stock of Karakaya Dam Lake is estimated by using fishing with gillnets method which has emerged as an alternative method for population size estimation. It is assumed that this method can be used for inland waters fishery management, however the studies should be repeated at certain intervals and comparison of the amounts of produced fish obtained by catching should give better results.

CONCLUSION

In this study, the fish stock estimation method used in this study can be used for fishery management. It is supposed that better results would be achieved if the studies are repeated periodically and the amounts of produced fish obtained by catching in between the estimation periods are compared to each other.

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