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Research Article

Investigation of the Selectivity Parameters for Carp (*Cyprinus carpio* Linnaeus, 1758) in Seyhan Dam Lake

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Abstract: Selectivity studies are very important for sustainable fisheries. Therefore, in this study, selectivity parameters for the carp in Seyhan Dam Lake were estimated using gill nets having a mesh size of 28, 32, 40 and 45 mm. Gill nets used in pikeperch fishing of mesh size of 28, 30 and 32 mm could cause growth in the overfishing of carp. Therefore, it is recommended that longline fishing should be commonly used instead of gill nets on pikeperch fishing. Consequently gill nets having minimum 50 mm mesh size can be used for carp fishing in Seyhan Dam Lake.

Key Words: Carp (*Cyprinus carpio*), Seyhan Dam Lake, gill net selectivity, fishing

Seyhan Baraj Gölü'ndeki Sazanlar (*Cyprinus carpio* Linnaeus, 1758) İçin Seçicilik Parametrelerinin Araştırılması

Özet: Sürdürülebilir balıkçılık için seçicilik çalışmalarının büyük önemi vardır. Bundan dolayı bu çalışmada 28, 32, 40 ve 45 mm'lik göz genişliğine sahip ağlar kullanılarak Seyhan Baraj Gölü sazanları için seçicilik parametreleri belirlenmiştir. Sudak avcılığında kullanılan 28, 30 ve 32 mm'lik ağ göz genişliğine sahip ağların sazanlar üzerinde büyüme aşırı avcılığı oluşturabileceği, bundan dolayı bu ağlar yerine sudak avcılığında paraketanın yaygınlaştırılmasının gerekli olduğu ortaya konmuştur. Bu sayede Seyhan Baraj Gölü'nde sazan avcılığında 50 mm'lik göz genişliğine sahip ağların kullanılması olanağı da doğmuş olmaktadır.

Anahtar Sözcükler: Sazan (*Cyprinus carpio*), Seyhan baraj gölü, uzatma ağı seçiciliği, avcılık

Introduction

Seyhan Dam Lake is one of the most important freshwater reservoirs for fisheries production in the southern Anatolia region. Avşar and Özyurt (1) reported that annual fish production in this lake is 170 t. This total production is composed of 80% carp (*Cyprinus carpio*), 12% pikeperch (*Sander lucioperca*) and 8% roach (*Rutilus rutilus*). However, carp and pikeperch are not native species for the lake. In previous limnological investigations, several species such as wels catfish (*Silurus glanis*), **Hammigrarimocapoeta sauvagei*, Eurpean eel (*Anguilla anguilla*), chub (*Leuciscus cephalus*), freshwater blenny (*Blennius fluviatilis*), **Leucius lepidus*, spined loach (*Cobitis tenia*), **Garra rufa obtusa*, banded loach (*Nemacheilus argyrogramma*), **Capoeta barresu*, carp bream (*Abramis brama*), **Capoeta demascinus*, Italian bleak (*Alburnus albidus*), spirlin (*Alburnoides bipunctatus*), **Barbus mystaceus*, **Acanthobrama marmid Aphanius* sp,, have been identified in Seyhan Dam Lake (2,3). Commercial fisheries in the lake started in the early 70's just after transplantation of pikeperch (1971 and 1973). Carp transplantation was also carried out between 1976 and 1980 by the General Directorate of State Hydraulic Works (DSI).

The majority of fishing boats (86%) have gill nets, and more than half of them use monofilament nets. Estimation of the selectivity parameters of such gill nets for carp is very important for fisheries management in the lake. Several studies have already been carried out to estimate these parameters for various species in inland waters of Turkey to date, i.e. carp at Beyşehir Lake (4); rudd (*Scardinus erythrophtalmus*) and white bream (*Blicca björkna*) at Apolyont Lake (5); roach and shad (*Alosa maeotica*) at Apolyont Lake (6); and

* There is no common english name for these species

Chalcalburnus tarichi at Van Lake (7). However, comprehensive studies are lacking to determine optimum fisheries management in these inland waters in general, and especially in Seyhan Dam Lake, where fishing is still carried out in traditional ways.

Therefore, this study was carried out to assess gill net selectivity parameters for carp in Seyhan Dam Lake in order to contribute towards better fisheries management in this lake.

Materials and Methods

This study was carried out using a fishing boat 6 m in length with a 13 HP engine between September 1988 and November 1999 in Seyhan Dam Lake. Monofilament gill nets with a mesh size of 28, 32, 40 and 45 mm were used to collect the samples. The length and hanging ratio of each net were 100 m and 0.5 m, respectively (Figure 1). Fishing operations were completed within 12 hours at night. Total length of each individual was measured by using the millimetric class interval.

The indirect method proposed by Holt (8) was used to determine the selectivity parameters. This method depends on the comparison of some size groups caught by two different mesh sizes (m_a and m_b). The method was modified by Sparre et al. (9), and the modified method is given below:

Step 1.

For each length group, number of fish caught by the large mesh size (C_b) was divided by the number of fish caught by the small mesh size (C_a), and then linearization was performed by taking the *In* of this result:

$$y = \ln\left(C_b / C_a\right)$$

Step 2.

Linear regression analysis was performed using the results, which had been found at the first step and mid-point of the length class interval. Therefore, regression constants, intercept (a) and slope (b) were determined.

Step 3.

The optimum length groups (L_{ma} and L_{mb}) for the mesh sizes of m_a and m_b, the selection factor (SF) and standard deviation (SD) were then estimated by using the obtained regression constants (a) and (b) in the relationships given below:

$$Lm_a = \left(\frac{-2*(a*m_a)}{b*(m_a+m_b)}\right) \qquad Lm_b = Lm_a * \left(\frac{m_b}{m_a}\right)$$

$$SF = \frac{-2*a}{b*(m_a+m_b)} \qquad SD = \sqrt{\frac{-2*a*(m_b-m_a)}{b^2*(m_a+m_b)}}$$

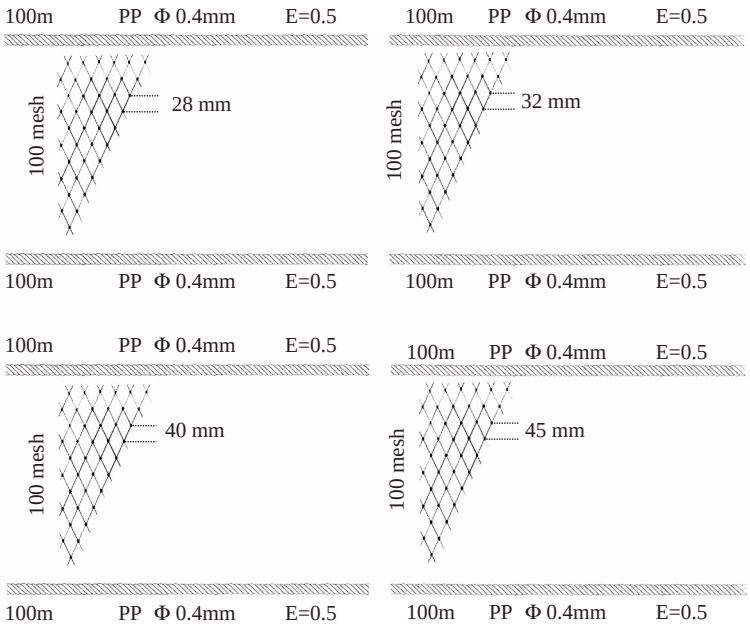

Figure 1. The specifications of the gill nets used in the present study.

Step 4.

Selection curves were constructed with the equation:

$$S_L = \exp\left(\frac{(L-Lm)^2}{2*SD^2}\right)$$

Step 5.

Optimum length for the mesh size (m) was calculated by using the equation given below:

$$Lm = SF*m$$

where m represents the mesh size of the gill net in Step 5.

Step 6.

Due to more than two nets being used in the study, the common selectivity factor was calculated with the following equation:

$$SF = 2 \sum [(a_i / b_i) (m_i + m_{i+1})] / \sum [(m_i + m_{i+1})^2]$$

Step 7.

The common standard deviation was calculated as the mean value of the individual estimates for each consecutive pair of mesh size:

$$SD = \left\{(1/n-1) \sum [2a_i (m_{i+1} - mi)]/[b_i^2 (m_i+m_{i+1})]\right\}^{1/2}$$

Result

The length class interval for the samples was taken as 2 cm for the nets with mesh size of 28-32 mm and 40-45 mm. The length range of the fish captured with nets having mesh size of 28 and 32 mm was between 15.5 and 23.5 cm. This was between 21.5 and 31.5 cm for the mesh size of 40 and 45 mm, respectively (Table 1).

Regression and selectivity parameters derived for gill nets with mesh size of 28-32 mm and 40-45 mm are shown in Table 2. Common selectivity factor and common standard deviation were 6.816 and 2.004, respectively.

Selectivity curves for 28-32 mm and 40-45 mm mesh sizes are shown in Figure 2

Table 1. The number of fish caught with the gill nets of different mesh sizes.

Length Groups (cm)	Mesh Sizes (mm)			
	28	32	40	45
11.5	0	0	0	0
13.5	7	0	0	0
15.5	24	1	3	0
17.5	12	16	14	0
19.5	7	17	12	1
21.5	1	12	24	1
23.5	2	9	15	17
25.5	0	4	7	24
27.5	0	2	15	20
29.5	0	0	5	16
31.5	0	0	1	5
33.5	0	0	0	0

Discussion

For optimum fishing, of the selectivity parameters, Lm and the length at first maturity should be close to each other. In the studies conducted throughout the Turkish lakes, carp stocks were observed to reach length at first maturity at different age groups and naturally at

Table 2. Regression constants and selectivity parameters.

Mesh Sizes		Regression Constants		Selectivity Parameters			
m_a	m_b	a	b	Lm_a	Lm_b	SF	SD
28	32	-10.875	0.57807	17.5587	20.0671	6.2709	2.0830
40	45	-9.6344	0.37189	24.4483	27.5044	6.1120	2.8704

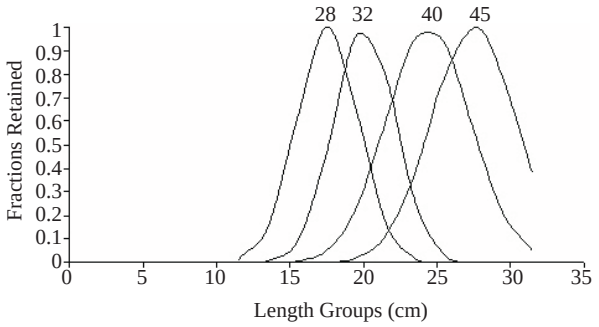

Figure 2. Selectivity curves for 28-32 mm and 40-45 mm mesh sizes.

varying length groups. For example, it was observed in Apa Dam Lake that male individuals reach sexual maturity at age group III while the females achieved sexual maturity at age group IV (10). Similarly, in Çavusçu Lake that of males was IV while that of females was V (11). For both sexes, these were III in Eğridir and Beyşehir Lakes (12), IV in Pötürge Lake (13) and II in Kaz Dam Lake (14). Consequently, the fishing equipment used in these areas should be planned so as to catch the individuals which are older than the specified age groups. However, the MARA* specified only one minimum landing size for all the stocks (15). Considering the length groups equal to the age at first maturity mentioned in the above studies (30.78 cm for males, 38.64 cm for females in Apa Dam Lake; 36.8 cm for males, 42.28 cm for females in Çavuşçu Lake; 36.5 cm for males, 41.04 cm for females in Tödürge Lake; no length groups were specified for Eğridir, Beyşehir and Kaz Dam Lakes), it is obvious that the minimum landing size (30 cm) specified by the MARA is smaller than what is expected for most stocks. In Seyhan Dam Lake, length at first maturity of carp (the length group at which 50% of the individuals in stock attained maturity) was observed to be 28.6 cm and in age group III (16). This value is close to the minimum landing size given by MARA. Therefore, the minimum landing size legally specified can be regarded as the length group to be caught efficiently with fishing equipment. Given the minimum landing size (30 cm) and the selectivity factor (6.816) specified for carp in the present study, it can be concluded that the minimum mesh size to be used for this species should be 44 mm. However, in order to allow the individuals in the stock to reproduce more, it is advised that a relatively larger mesh size than the specified one be used. Therefore, it can be recommended that gill nets with minimum 50 mm mesh size be used in carp fishing in Seyhan Dam Lake. Balık (4) identified the general selection factor for carp as 5.844 in studies conducted in Beyşehir Lake. Depending on this factor, the researcher recorded the minimum mesh size to be used for the minimum landing size (30 cm) specified by MARA as 50 mm. The findings of Balık (4) support the result obtained in this study.

Gill nets with a mesh size of 24, 28 and 30 mm are used for pikeperch fishing in Seyhan Dam Lake. In this region, the question of how pikeperch fishing is going to be sustained with gill nets of 50 mm mesh size is on the agenda. To alleviate this problem, size and species selectivity of longline (17) and carnivorous feeding characteristics of pikeperch (18) should taken into account. The fishing of this species could be conducted by longline using live bait. This would enable the fishing of pikeperch without affecting the carp. The stomach studies conducted have supported this finding. Balık (19) reported that *Gammarus* sp. and *Mysis* sp. comprised the main diet of the individuals below 30 cm, whereas fish were the main diet of those longer than 30 cm. Similarly, Turesson et al. (20) reported through the stomach analysis of 80 pikeperch individuals in the length group of 20.7 cm and 53.3 cm that in one of the individuals, *Mysis relicta*, and in all of rest, fish were identified. These findings give the impression that even the different length groups can be caught using various species comprising the feeding sources of pikeperch. Consequently, there seems to be a potential to conduct pikeperch fishing in Seyhan Dam Lake solely by longline and to protect the carp from the growth of overfishing through the use of a minimum 50 mm mesh size. However, it should be carefully investigated as to which species comprise the major diet of pikeperch in the lake, which of these have potential to be used as live bait, and whether longline could more economically replace gill net fishing.

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