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Monofilament Gillnet Selectivity Parameters for European Chub (*Leuciscus cephalus* L.1758) in Atikhisar Reservoir, Canakkale, Turkey

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Abstract: Selectivity parameters of gillnets used for fish catching are very important for fisheries management in lakes. The main purpose of the present study was to estimate the selectivity parameters of monofilament gill nets mesh size of 56, 64 and 72 mm (stretched mesh size) used for European chub (*Leuciscus cephalus* L.1758) in Atikhisar Reservoir, Canakkale, Turkey. The indirect method proposed by Holt was used for the estimation of the selectivity parameters. The common selection factors and common standard deviation of monofilament gill nets were determined as 4.25 and 2.37, respectively. For sustainable fisheries of european chub, the minimum mesh size of monofilament gill nets must be greater than 47 mm stretched mesh size.

Key words: European chub (*Leuciscus cephalus*), Atikhisar reservoir, gill net selectivity

INTRODUCTION

European chub (*Leuciscus cephalus* L.1758) are members of the Cyprinidae family and are widely distributed throughout Anatolia, Europe, Black Sea and Azov seas (Lelek, 1959; Geldiay and Balik, 1972; Unver, 1998; Sasi, 2004; Kalkan *et al*., 2005). Several studies have been conducted on age, growth and reproduction of european chub in Turkey and other countries, but no gear selectivity study have been carried out for european chub gillnet fisheries.

In Turkey, until 1990s, only multifilament net materials were used for gillnetting, but monofilament net materials are now used very commonly (Balik, 1999). For fisheries management in freshwaters, determination of the selectivity parameters of gillnets is very important. Several studies have been carried out to estimate these parameters for different species in inland waters of Turkey (Balik, 1999; Balik and Cubuk, 2001; Cetinkaya *et al*., 1995; Ozekinci *et al*., 2003; Ozyurt and Avsar, 2005). Since ecological factors affect the biological characteristics of fish species, gillnet selectivity parameters change for different species and different populations. The main purpose of the present study was to estimate the optimum monofilament gill nets mesh size for European chub in Atikhisar Reservoir, Turkey, Canakkale.

MATERIALS AND METHODS

This study was carried out in Atikhisar Reservoir from October 2005 to May 2006 in Canakkale, Turkey. Gillnets with a mesh size of 56 and 64 mm are used for European chub in the lake. Samples were collected with monofilament gill nets that had 56, 64 and 72 mm stretched mesh size. The length of each gill net was 50 m. They were made of white monofilament polyester twine. The twine diameter sizes of all nets were 0.20 mm. The nets were rigged with a hanging coefficient of 0.5 and the number of meshes in depth was 26.

The nets were used simultaneously at the same area. All nets were set before sunset and were hauled at sunrise. After hauling, fish were removed from each net and measured (total length) to the nearest millimeter.

There are two main experimental methods used for selectivity analyses: the direct method and the indirect method. The direct method is based on the proportions of fish caught from different size classes of a population with known length frequency distribution. The indirect methods involve estimation from catches taken by nets of slightly different mesh size (Sparre *et al*., 1989). Data for european chub population in Atikhisar Reservoir with known length frequency distribution could not be obtained due to the bottom structure that restricts the usage of other fishing gears (e.g., beach seine, beam trawl or deep trawl) other than gillnet. Thus, the indirect method proposed by Holt (1963) was used for the estimation of the selectivity parameters. The method allows the estimation of selectivity parameters by comparing the catches in terms of quantity according to two different mesh sizes, m_a and m_b, for the same length class, L. This method was modified by Sparre *et al*. (1989) and expressed as follows;

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The natural logarithms of the number caught per length group, Ca and Cb, by two slightly different mesh sizes, m_a and m_b, are linearly related to fish lengths;

$$\ln (C_b/C_a) = a+bL,$$

Where L is the length class of caught fish, a and b are the intercept and slope of the linear regression, respectively.

The optimum lengths (Lm_a and Lm_b) for mesh sizes m_a and m_b, the selection factor (Sf) and standard deviation (Sd) were then estimated from the following equations:

$$Lm_a = -2 [am_a/b (m_a+ m_b)]$$

$$Lm_b = -2 [am_b/b (m_a+ m_b)] = Lm_a. m_b/m_a$$

and

$$Sf = -2 a/b (m_a+ m_b)$$

$$Sd = \{-2 a (m_b - m_a)/b(m_a+m_b)\}^{½}$$

İf the numbers of mesh sizes used are more than two, the common selectivity factor will be calculated as fallows (Sparre *et al.*, 1989),

$$SF = -2 \Sigma [(a_i/b_i) (m_i + m_{i+1})]/\Sigma[(m_i+m_{i+1})^2] \text{ for I = 1 to n-1}$$

The common standard deviation (SD) was calculated as the mean value of the individual estimates for each consecutive pair of mesh sizes,

$$SD = \{1/(n-1) \Sigma [(2a_i (m_{i+1} - m_1)]/[b_i^2 (m_i+m_{i+1})]\}^{½}$$

The optimum length (corresponding to a 100% of probability of retention) for each mesh-sizes m was obtained as: Lm = (SF) x m

The probability of capture (P) for a given length L in a gill net with mesh size m was determined from the following equation:

$$P = \exp [-(L-Lm)^2/(2SD^2)]$$

RESULTS

Total length frequency of european chub (*L. cephalus* L.1758) caught by the experimental gillnets with three mesh size (56, 64 and 72 mm stretched mesh) in Atikhisar Reservoir in Canakkale are given in Fig. 1. The total length of fish caught ranges from 21.3 to 34.3 cm. Caught fish length in gillnets increases analogously with expanding mesh sizes. As a result, the average length of european chub captured with experimental nets increased from 23.8±1.43 cm for the 56 mm net to 28.5±0.90 cm for the 72 mm net.

The calculations of the selectivity parameters were based on the nets pairs of 64-56 and 72-64. The regression slope, intercept and coefficient for optimum lengths and selectivity parameters (selection factors and standard deviation) were assessed from length frequency distributions for each mesh size combination (Table 1).

Values from Table 1 were used to estimate the common selectivity factor, the common standard deviation and optimum selection length per mesh size. The common selectivity factor and the common standard deviation were 4.242 and 2.379, respectively. Estimated optimum selectivity length were 23.75 cm for 56 mm net, 27.75 cm for 64 mm net and 30.54 cm for 72 mm net.

The selection curve of monofilament gillnets for european chub obtained with the probability of capture (P) equation and are shown in Fig. 2.

Table 1: The selectivity parameters of monofilament gillnets with different mesh sizes

Mesh sizes		Selectivity parameters						
m_a	m_b	A	b	r^2	Lm_a	Lm_b	Sf	Sd
5.6	6.4	-26.504	1.006	0.987	24.568	28.078	4.387	1.864
6.4	7.2	-11.840	0.421	0.947	26.727	29.730	4.129	2.798

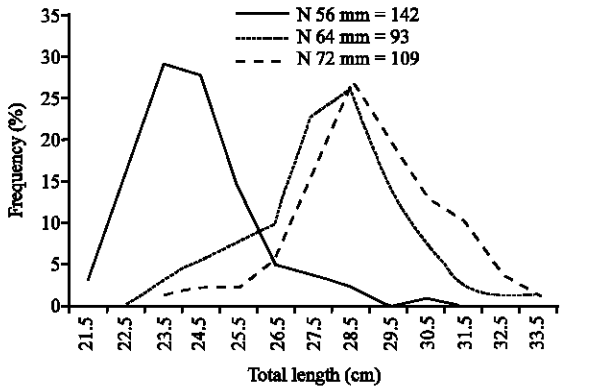

Fig. 1: Length frequency distributions of european chub caught in for each mesh size

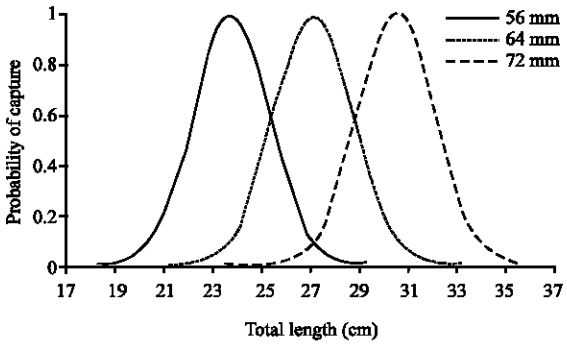

Fig. 2: Selectivity curve for experimental gillnets

DISCUSSION

Fishing gear selectivity studies are important tools for fisheries management; by regulating the mesh size of gillnet, the approximate minimum catch sizes of the target species can be recognized (Sparre *et al*., 1989). Hence, selectivity of gillnets has received wide attention in various parts of the world (Hamley, 1975; Regier and Robson, 1966; Reis and Pawson, 1992; Petrakis and Stergiou, 1994; Hovgard and Lassen, 2000; Pet *et al*., 1995). Fishery regulations recommend that organisms can be caught once they have been recruited to reproduction. In the studies conducted throughout the Turkish inland waters, european chub were observed to reach length at first maturity at different age groups. Sexual maturity for this species was reported as ages of II and III and as about 15-20 cm length (Slastenenko, 1956; Lelek, 1959; Geldiay and Balik, 1972; Neophito, 1988; Unver, 1998; Sasi, 2004; Kalkan *et al*., 2005). The fishing circular for european chub fishing prohibits the catching of fish smaller than 20 cm in total length (Anonymous, 2006). According to the results of this study all caught fish larger than the prohibited length with experimental mesh size.

The selection factor is a very important constant and usually varies between 5 and 10 (Andreev, 1962). In this study, the values of the common selection factors and common standard deviation of monofilament gill nets were determined as 4.25 and 2.37, respectively. Ozyurt and Avsar (2005) used similar nets for carp (*Cyprinus carpio* L.1758) and calculated common selection factor parameter as 6.270. The observed selectivity factor change in body proportions due to sexual maturity, time and depth of setting nets (Dayaratne, 1988) and swimming speed of species (Borgstrom, 1989) and individual behavior.

Consequently, this study showed that the european chub of 20 cm total length will be caught with monofilament gill nets of 47 mm (Lm = SF x m) mesh size. Therefore, the minimum mesh size of gill nets must be larger than 47 mm stretched mesh size. This is very important for the sustainability of european chub fishing.

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