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Is It Possible to Prevent the Collapse of Fish Stocks by the Evaluating Simple Overfishing Indicators? An example: Seyhan Dam Lake.

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Abstract

Due to the collapse of fish stocks, commercial fishery at Seyhan Dam Lake is completely over in 2013. As a result, both financial and social problems have been experienced. In this study, it was evaluated whether it would be prevented the collapse of the pikeperch (Sander lucioperca) stock by following simple overfishing indicators. For this, the data of the sampling performed in Seyhan Dam Lake in 2008 was used. Catching was carried out with gillnets with 20-22 and 24 mm mesh size. With the data obtained; length distribution, length at first maturity, length-weight relationship, optimum length, optimum size and mega-spawner size were determined. Using these results, an assessment was made on the status of the pikeperch stock in terms of overfishing. For this species, length at first maturity, optimum length, optimum size and the lower limit of mega-spawner were determined as 26cm, 34cm, 30-38cm and 42cm respectively. It was also found that if fishermen would have used 32-34 mm mesh size instead of 20-22 mm, even if they caught the same number of fish, the biomass would have increased 58 times.

Keywords: *Mega Spawner, Maturity, Optimum Size, Overfishing, Pikeperch*

1. INTRODUCTION

Seyhan Dam Lake built in 1956 for irrigation, flood prevention and energy production has a surface area of 6800 hectares, a maximum depth of 45 meters and an altitude of 67m. The lake, which is located on the subtropical climatic zone, is mesotrophic [1]. A large number of juvenile *Sander lucioperca* (Linnaeus, 1758) was released in this dam lake between 1971 and 1973. Over time, a fleet of 80 fishing boats which catch especially this species whose population density increased rapidly was formed. This fishing fleet was catching with completely gill and trammel nets. However, the fishermen complained that their incomes could not even afford to their cost after a while. When it came to 2012, commercial fishing is completely over in the lake. As a result, many fishing boats were discarded and many people had to look for different jobs.

In global fisheries, there is increasing evidence that natural stocks consume are much faster than they can regenerate themselves [2], [3], [4]. In order to solve this problem, fishery researchers have developed increasingly complex stock management models over the past century. However, in terms of legislators and law enforcement, social and political issues can take precedence over scientific data. The complexity of scientific methods makes them more difficult to be taken into account. For this reason, Froese [5] has suggested that overfishing be pursued with simpler and clearer indicators in order to avoid stock collapse.

There are three indicators proposed by Froese [5] for the protection of stocks and monitoring of overfishing: a) The proportion of mature individuals in catch is 100%. b) The proportion of individuals of optimum size in catch is 100%. c) The proportion of mega-spawner in catch is 0%. Froese defined the optimum length as a slightly larger length than the length at first maturity and the optimum size as the optimum length ± 10% and researcher stated that 10% bigger size of the upper limit of the optimum size can be regarded as mega-spawner.

Experimental studies have not been conducted on the condition of stocks in Seyhan Dam Lake. Therefore, it is a rough estimate to say that the fishing activity on the Seyhan Dam Lake is over due to overfishing. In this study, experimental samplings were carried out in Seyhan Dam Lake and the condition of pikeperch stock was evaluated in terms of overfishing parameters mentioned above.

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2. MATERIAL AND METHOD

This study was carried out in the Seyhan Dam Lake in 2008 (Figure 1). Gillnets with the same technical characteristics as those used in commercial fishing were used in the samples (mesh size: 20, 22, 24 mm (knot to knot)). The obtained samples were brought to the faculty laboratories and the total length (mm) and weight with the sensitivity of 0.01 gr of each individual were measured. Later, fish were dissected and sex determination was made with the naked eye. With the help of the obtained data; length distribution of the stock, length-weight relationship, length at first maturity, optimum size, mega-spawner length and their proportion in catch were calculated.

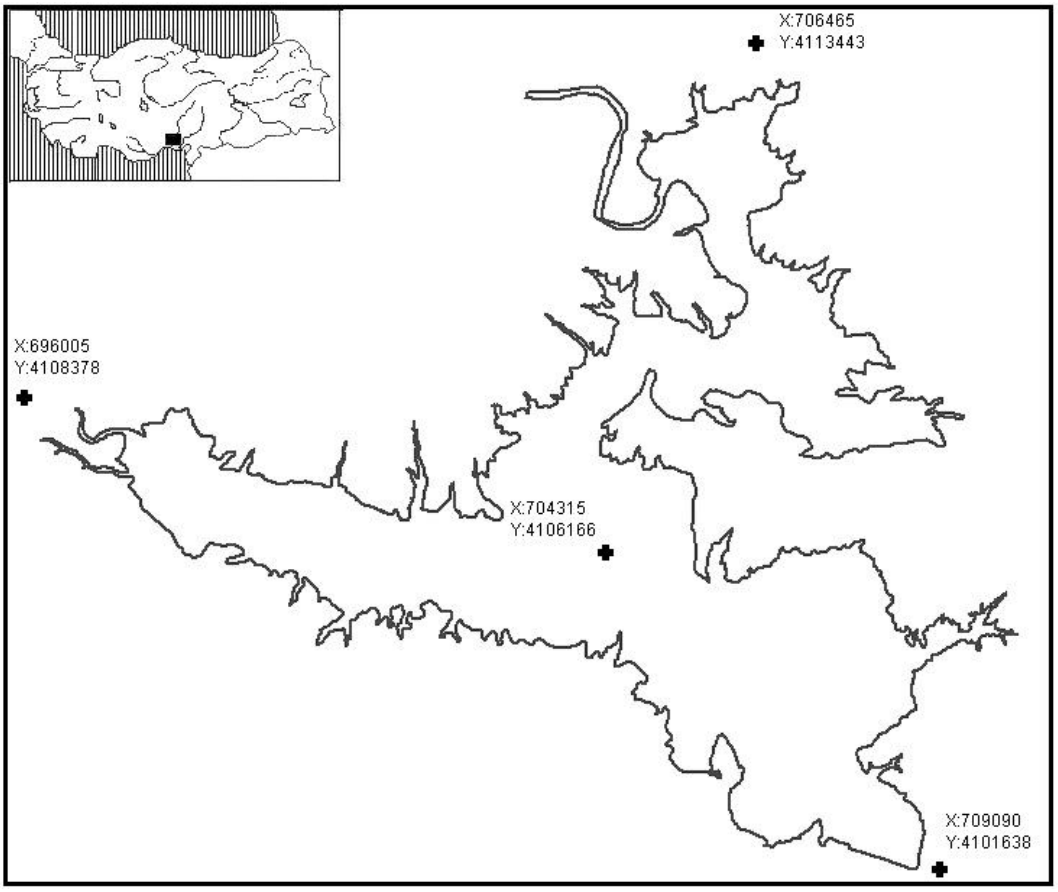


Figure 1. Sehan Dam Lake (UTM Zone 36 North)

The functional length-weight relationship given by Ricker [6] was used for the estimation of the biomass. The size group in which the individuals in the stock reached 50% sexual maturity was accepted as length at first maturity [7]. For the calculation of this size group, a two-stage (mature and immature) scale was used. In the months when gonadal development was observed, female and male individuals were divided into two groups, mature and immature for each length group. Therefore, the sexual maturity rate was obtained according to the lenght group. This data was then fit using the logistic function, $M(L)=1/1+e^{a-b*L}$ [8]. The length at first maturity was calculated by the equation $M(L_{50})=a/b$. The size 8 cm larger than the length at first maturity was considered as the optimum length. Optimum lengths of about ±10% were considered as the optimum size. The length 10% larger than the upper limit of the optimal size was considered as the lower limit of the mega spawner size [5].

3. RESULTS AND DISCUSSION

A total of 819 individuals were caught during the study and 458 of these individuals female, 349 male and 12 juvenile.

Sexual maturity rates by length for females and males were fitted with logistic functions (Figure 2; female: $y = {1}/{1 + (e^{5.2854-0.2004*l})}$; male: $y = {1}/{1 + (e^{5.6047-0.2236*l})}$. According to these functions,

length at first maturity of female and male were determined as 26.4 and 25.13cm, respectively. For the entire stock, the length at first maturity was accepted as 26cm. The length-weight relationship for female, male and entire stock was shown in Figure 3 (female: $\boldsymbol{y = 0.0108x^{2.8912}}$; male: $\boldsymbol{y = 0.0123x^{2.8527}}$; entire stock $\boldsymbol{y = 0.0115x^{2.8734}}$)

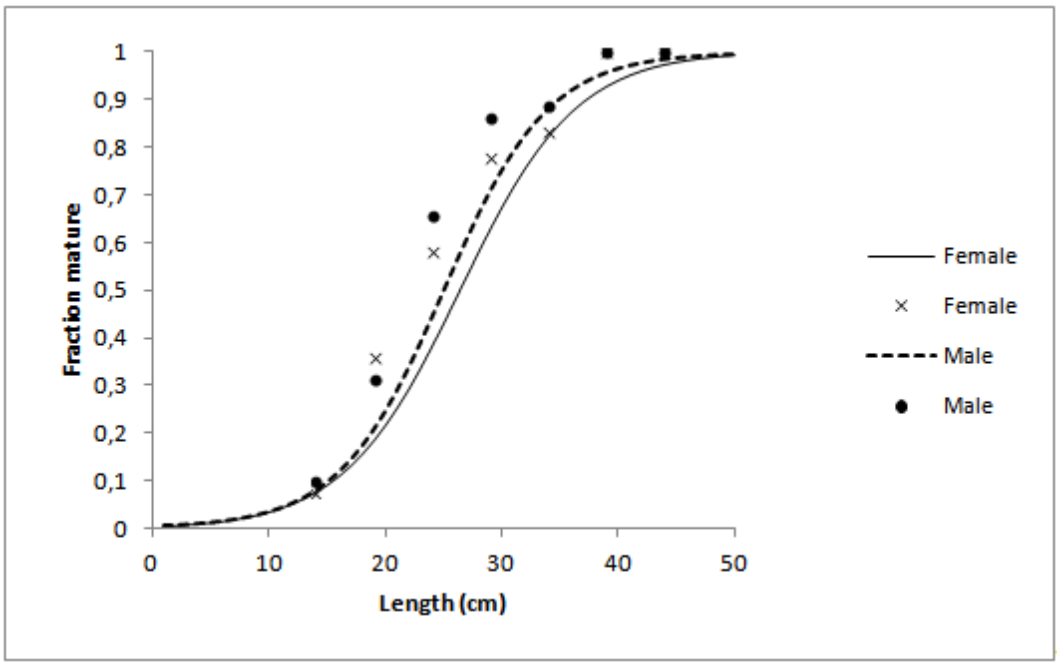
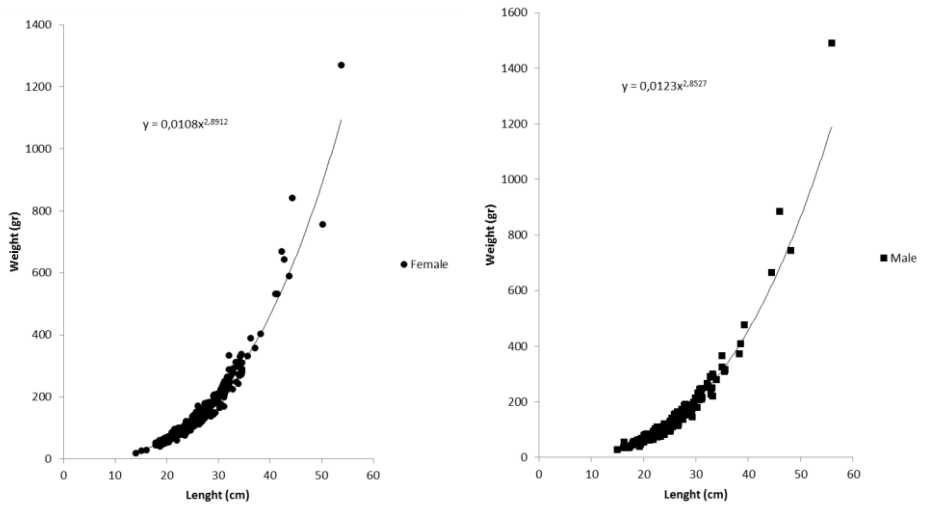


Figure 2. Proportion of mature individuals according to length

Optimum length was determined as 34cm (8cm more than the length at first maturity). Accordingly, the optimum size was accepted as 30-38cm. About 10% more than the upper limit of the optimum size (42cm) was defined as the lower limit of the mega-spawner size (Figure 4). The data obtained showed that 54% of the biomass of caught individuals was mature, 46% immature and 28% in optimum size. As number of individuals, it was found that 32% of the individuals caught were mature, 68% immature and only 16% the optimum size. The mega-spawner ratio in catch was determined as 1.58%.

Froese [5] stated that for protection of stock size, all individuals in the catch should be in mature and optimum size. Furthermore, the researcher stated that if the mega-spawner ratio in stock is between 30-40%, the age and length distribution of the stock is healthy, but if this ratio is less than 20%, there may be a problem. From the point of view of these simple overfishing indicators, it is possible to say that the pikeperch stock in Seyhan Dam Lake is under overfishing pressure.



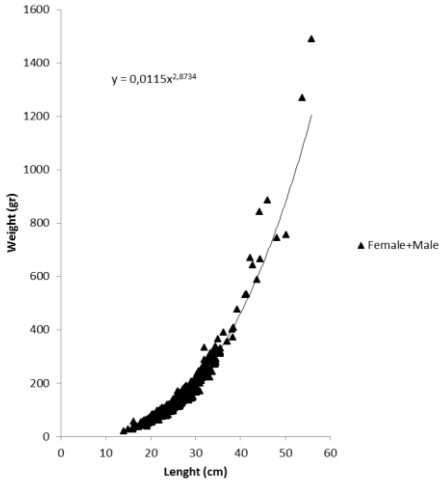


Figure 3. Length-Weight relationship

The proportion of immature individuals in catch was over 60%, which should be 0%. The mega-spawner rate that should be at least 30% was only 1.58%. In the face of this situation, it is inevitable that the pikeperch stock would collapse. Indeed, five years after this work (2013), the commercial fishery activity in the lake was completely stopped. At the Seyhan Dam Lake, fishermen used a 32 mm and 34 mm mesh size to catch pikeperch in the late 1990s [9]. However, at the end of the 2000s, it was observed that fishermen used 20 and 24 mm mesh size [9]. In fact, this change in mesh size clearly shows that fishermen were beginning to catch smaller and smaller fish. If the fishermen had used a 32-34 mm mesh size, how would have been the size distribution of the pikeperch catch? Unfortunately, this information was not available from past studies. However, the selectivity factor of gillnet used in the pikeperch catch was determined as 10.58 [10]. According to this selectivity factor, the optimum lengths for gillnet with mesh sizes of 32 and 34 mm are 33.8 and 35.9 cm, respectively. If these mesh sizes had been used, the length distribution of the catch pikeperch would have been shown in Figure 4. According to this length distribution, it is understood that all of the caught fish would have been mature and 70% of the captured individuals of optimal size (Figure 4). In fact, these values are quite consistent with the ratios proposed by Froese [5]. In addition, biomass was found to be increased by 58 times, even if the same number of fish were caught when using 32 and 34 mm mesh instead of 22-24 mm mesh size. This would mean that fishermen would earn more income. In fact, in these conditions, the stock should have not been collapse. So why did the fishermen narrow the mesh size of the nets they used? There were almost no fishing pressures at Seyhan Dam Lake in the early 1970's, but by the 1990's the number of boats reached 80. It seems that the fishing power applied in this area has exceeded the ability of stock to replenish itself. As a result of the decline of large individuals, fishermen with income anxiety have narrowed their net mesh size in order to catch smaller individuals. This situation caused the stock to collapse. In fact, the problem was that the fishing power was high (number of boats, number of nets vs.).

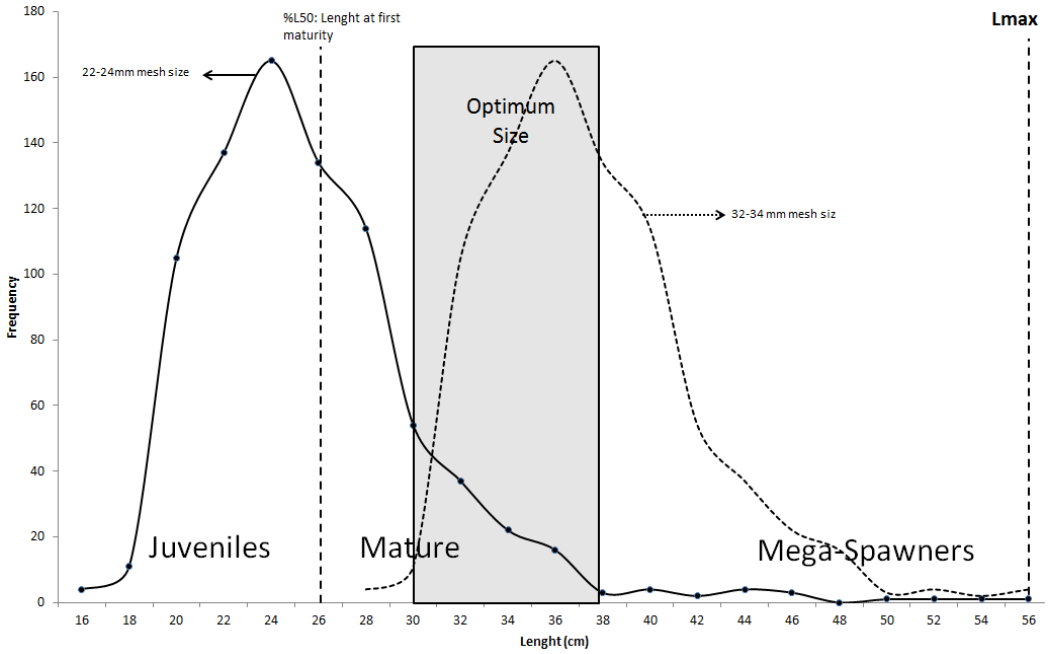


Figure 4. Length frequencies for different mesh size

4. CONCLUSION

If the simple overfishing indicators suggested by Froese [5] had been followed, could have been prevent the collapse of the pikeperch stock? Despite some weaknesses, this seems possible. If deterioration in overfishing indicators had been noticed, simple measures could have been applied. For example, new fishing boats might not have been licensed. So the number of boats had not reached 80. In addition, the number of nets to be used on a fishing boat could have been limited.

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