

GROWTH AND MORTALITY ESTIMATION PARAMETERS FOR THE PIKE-PERCH (*Sander lucioperca*, Linnaeus, 1758) POPULATION IN ROMANIAN SECTION OF THE DANUBE RIVER

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Abstract

The objective of this study was to estimate growth and mortality parameters of the Pike perch population (*Sander lucioperca*, Linnaeus, 1758) in the Danube River (kmD 197 – kmD 170) and to assess the effects of fishing on this stocks. This study was performed on 175 specimens of pike perch caught in 2015. The purpose of this study was to determine the relationships: length – weight ($L - W$), to estimate the growth parameters (von Bertalanffy) L_{∞} , k , and the mortality rates (Z , M , F) for the pike perch population. The relationship between length – weight ($L - W$) found is $W = 0.0057 * TL^{3.122}$. The asymptotic length (L_{∞}), growth coefficient (k) were estimated at 89.25 cm, 0.430 per year. The estimated values of the mortality rates for the studied population are high thus: total mortality (Z) is 2.18 per year; the natural mortality (M) reaches 0.512 per year and fishing mortality (F) 1.668 per year. Exploitation rate, $E = 0.77$ calculated for the pike perch population exceeds the optimum value (0.5) suggesting that the population in the studied area is over fished.

Key words: growth, exploitation mortality, parameters.

INTRODUCTION

Pikeperch *Sander lucioperca* (L.) is a predatory fish, native to Eastern Europe and Western Asia (M'Hetli et al., 2011).

The species is widespread (natural or introduced) in northern to southern European countries (Welcomme, 1988; Lehtonen et al., 1996) in Central Asia (Petr and Mitrofanov, 1998), Western China (Walker & Yang, 1999) and in North Africa (Zaouali, 1981; Meddour et al., 2005).

In Romania it meets in the Danube and in the lower and middle courses of large tributaries, as well as in some hills and lakes (in many cases introduced). In the Danube Delta is found on the Danube River and its arms, Razim - Sinoe Lake and less frequently in the brackish water of the Black Sea.

It is the most valuable percid of our waters, being an important species for both commercial and recreational fishing.

In the commercial catches of this sector, the pike perch held small percentages over time, so between 1972 and 1986 the percentage in multiannual industrial catches was 0.4% and in

the period 2006 - 2009 the average percentage was ~ 1.7% (Gheorghe, 2011).

Although, at national and global level, it is not appeared on conservation lists, our country is threatened by pollution and overfishing.

The overfishing and the water degradation lead to a reduction of these populations in the waters of our country.

Sustainability is one of the central concerns in fisheries (Pauly et al., 2002; Gaichas, 2008).

There is increasing recognition that it is necessary to manage fisheries in a broader ecological context (Constable, 2001; Garcia et al., 2003; Sainsbury and Sumaila, 2003; Pikitch et al., 2004; Fulton et al., 2005; Fogarty, 2014).

The objective of this study is to estimate the growth and mortality parameters of the population of pike perch to assess the effects of fishing on stocks and to develop coherent management measures.

MATERIALS AND METHODS

The area of study is represented by the Danube River section between km D 170 – km D 197 (Figure 1).

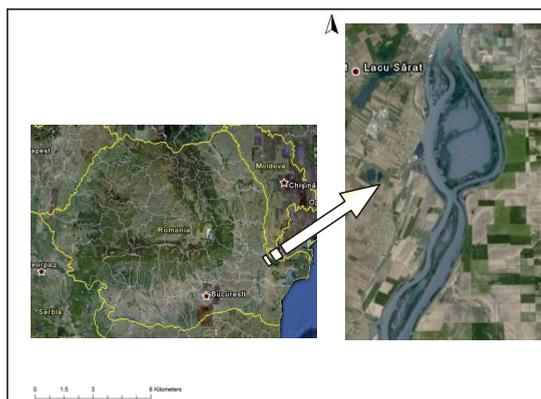


Figure 1. Area of study

Samples of *Sander lucioperca* were collected between April and July 2015 using gillnets (32, 40, 50 mm mesh size). A total of 175 individuals with a total biomass of ~ 143 kg were captured and sampled. The captured exemplars were biometrical and gravimetrically measured. It has been measured the total length (TL; to the nearest lower 0.1 cm) and the total weight (TW; to the nearest 0.01 g) of each specimen.

The relationship between length and weight was described by: $W = a \times L^b$ (Ricker, 1973), where W is the total weight (in grams), “a” is the intercept, “b” is the slope (fish growth rate), and “L” is the total length (in centimetres).

Growth parameters (L_∞ , k) were estimated by using length frequency analysis with the ELEFAN I which is an analysis of modal progression.

The total mortality rate (Z), natural mortality rate (M), fishing mortality rate (F) and rate of exploitation (E) were estimated by Pauly (1980, 1982) at the mean habitat temperature which was 12 °C.

Also, using length frequency data were estimated: length at first maturity (TL 50), probability of length classes in catches and the exploitation rate that maximizes yield per recruit. The data were analysed using FiSAT II (FAO - ICLARM Stock Assessment Tools).

RESULTS AND DISCUSSIONS

Length - weight relationship

The length of specimens sampled varied between 20.8 ÷ 76 cm with an average value of 44.6 ± 1.64 cm and a weight of 78 ÷ 3700 g with an average of 987.93 ± 104.12 g.

Regression curve shows a positive relationship between the total length (TL) and mass (TW) ($r = 0.972$).

The relationship between TL and TW for the pike perch population from the studied section is: $W = 0.0057 \cdot TL^{3.122}$ (Figure 2).

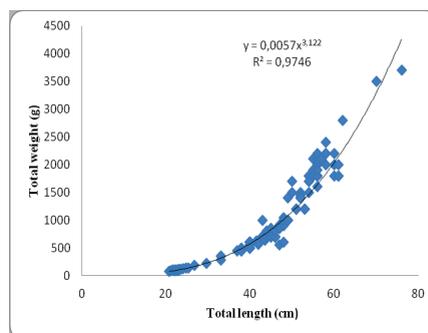


Figure 2. Length – weight relationship of *Sander lucioperca*

The length – weight relationship has a great importance in the ecology and management of the fisheries stocks (Savaş et al., 2011).

This relationship can also be helpful to assess the feeding rate, gonad maturity and metamorphosis of fish (Le Cren, 1951).

The coefficient b from the length – weight relationship according to Tesch (1968), is a measure of the environmental conditions that can be useful to compare different environments conditions, the fatness or the well – being of fish. The growth character revealed by the “b” coefficient value (3.122) shows an allometric growth of the pike perch population meaning that the increase in weight is made faster than the growth in length.

Estimation of growth parameters

The asymptotic length (L_{∞}) and growth coefficient (k) were estimated at 89.25 cm, 0.43 cm per year.

The value of asymptotic length ($L_{\infty}=89.25$ cm) which was determined is close to the values found in specialized literature for our country (fishbase.org).

The k parameter value (0.43) is relatively high which indicates that this species is rapidly approaching the maximum age, so it has a reduced longevity.

Mortality and exploitation

The total mortality (Z) of *Sander lucioperca* estimated by the length converted catch curve was 2.18 per year while the natural mortality (M) was found to be 0.512 per year and the estimated fishing mortality (F) was 1.668 per year (Figure 3). The exploitation ratio E was found to be 0.77.

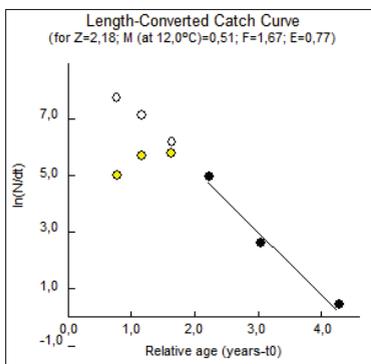


Figure 3. Length converted catch curves of *Sander lucioperca*

Table 1. The values of growth and mortality parameters of *Sander lucioperca*

Parameters	Value
L_{∞}	89.25
k	0.430
Z	2.18
M	0.512
F	1.668
E	0.77

In Table 1 are presented the values of the growth and mortality rates of the pike perch population.

The values obtained show that the pike perch population in this sector has high mortality rates, especially those resulting from fishing. Also, the value of the exploitation rate E (0.765) shows that this species is overfishing in this sector.

The length of the first catch (TL50)

TL50 is the length of the first catch or the length at which 50% and of the individuals are held in the net.

TL50 has been suggested as an indicator for both marine and freshwater species (Chen and Paloheimo, 1994; Gangl and Pereira, 2003). The mean length in the catch (L_c) in relation to TL50 has been suggested as a potential indicator of fishing pressure for data-limited stocks. If L_c exceeds TL50, the biomass of a mature stock is probably above that which can produce a maximum sustainable yield (ICES, 2012a), implying that the fishery is probably sustainable.

The estimated value for TL50 is 40.63 cm and the mean length (L_c) is 44.6 cm. It can be noted that L_c is slightly higher than TL50 (only 4 cm), we could say that the mature stock biomass could support sustainable fisheries.

The probability of capture by groups of lengths is shown in Figure 4.

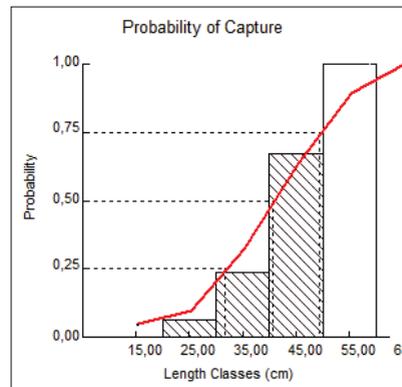


Figure 4. Probability of capture of the *Sander lucioperca*

CONCLUSIONS

In this study, a total of 175 specimens of *Sander lucioperca* from Danube River were examined.

- The size of the pike perch population recorded in this study ranged from 20.8 ÷ 76

cm for total length and $78 \div 3700$ g for total weight.

- The length-weight relationship in fish may change with age, season, nutrition, sexual maturity and species (Ricker, 1975; Bagenal, 1978). It was determined that the length - weight relationship was $W=0.0057*TL^{3.122}$.
- The length - weight relationship revealed a highly correlation ($r=0,972$), and the coefficient b value of 3.122 indicating an allometric increase meaning that the growth in weight increase faster than in length.
- Growth parameters (L_{∞} , k,) have values similar to those from specialized literature.
- k - is considered the growing constant which indicates us the speed with which a fish approaches the asymptotic length (maximum theoretical) and it has been also demonstrated that it is bound to the fish longevity (Lai et.al., 1996). Well, the bigger the value of this constant is, the smaller the longevity is.
- The total mortality (Z) recorded in this study was 2.18. The fishing mortality (1.668 per year) was also higher than natural mortality of 0.512 per year which shows that the fishing activities in this section of riverput pressure on the stock of this population, which is also shown by the value of the exploitation rate $E = 0.77$.
- In this study, the estimated length at first capture (L_{50}) was estimated at 40.63 cm which shows that 50% of the catches are individuals of small age. This situation is also described by Froese (2004) as growth overfishing; when fishes are caught before they can realize their full potential.

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