Scientific Papers. Series D. Animal Science. Vol. LXV, No. 2, 2022
ISSN 2285-5750; ISSN CD-ROM 2285-5769; ISSN Online 2393-2260; ISSN-L 2285-5750

GROWTH OF BREAM, *ABRAMIS BRAMA* (LINNAEUS, 1758), IN THE ROMANIAN SECTION OF THE DANUBE RIVER

Daniela Cristina IBĂNESCU, Lorena DEDIU

"Dunărea de Jos" University of Galați, Faculty of Food Science and Engineering, Center for Modelling Recirculating Aquaculture, 47 Domnească Street, Galați, Romania

Corresponding author email: dgheorghe@ugal.ro

Abstract

The main aim of the paper is to investigate the condition of the population of this fish species in a sector of the Romanian Danube River. The common bream is an important species in commercial catches, therefore the knowledge of its growth parameters is important for management of the multi - species fishery. The study is based on a sample of 1580 specimens caught with a total biomass of 197.66 kg. The study took place between 2018 and 2019. Our objective was to estimate the growth parameters (von Bertalanffy) L∞, k, t and the mortality rates (Z, M, F) for the bream population (Abramis brama, Linnaeus, 1758) in the Danube. The relationship between length - weight (L-W) in the study period for common bream population is $W = 0.0201 * Lt^{2,9212}$. *Von Bertalanffy growth parameters were found as, asymptotic length* L_{∞} = *49.35 cm, growth coefficient (K) = 0.37* yr^{-1}. *The estimated values of the mortality rates for the studied population are: total mortality (Z) is 1. 51, the natural (M) reaches 0.55. and fishing mortality (F) is .0.96.*

Key words*: growth parameters, mortality rates, von Bertalanffy's equation.*

INTRODUCTION

The commercial inland fisheries are considered a central environmental resource of large rivers, providing a protein source and income for multitudes of people worldwide (Schletterer et al., 2018).

Common bream, *Abramis brama* (L., 1758), is a benthic freshwater species that is distributed throughout Western and Central Europe and Asia (Guettaf et al., 2019). Adults inhabit a wide variety of lakes and large to medium sized rivers. Most abundant in backwaters, lower parts of slow - flowing rivers, brackish estuaries and warm and shallow lakes.

In Romania, it is found all over the Danube, floodplain and in the most rivers and lakes from the hilly area to the plain.

The bream is one of the commercially valuable species of the Romanian inland fishery.

It is one of the most abundant fish species in the commercial catch of 2008-2018, representing 11.16% of these catches (Ibanescu et al., 2020).

For sustainable management of fishery stocks, it is important to know the dynamics of component populations.

The objective of this paper is to know the dynamics of the bream population, from an important sector of the Danube, the bream being the second most caught species from commercial catches in the period 2008-2018.

MATERIALS AND METHODS

Fishing area. The Danubian sector taken into consideration for this study is located between km 170 - Brăila locality and km 197 - Gropeni locality, upstream Brăila municipality (Figure 1). The scientific fishing was realized in 2018-2019. Fish samples were collected from Danube river arms.

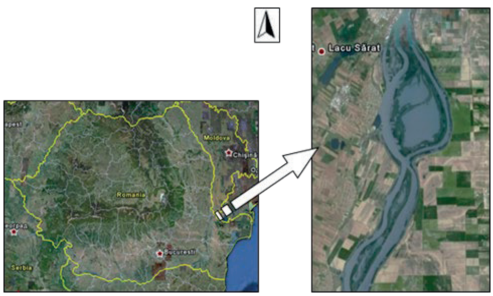

Figure 1. Area study

Data collection. It was collected and sampled a number of 1580 individuals which the total biomass being ~ 198 kg. The main biological parameters registered for each individual were:

total length (Lt ± 1 mm), individual mass (W ± 1 g).

The estimation of the growth parameters and mortality. For data analysis was used software package FiSAT II (FAO - ICLARM Stock Assessment Tool) based on length frequency distribution (Gayanilo F.C. et al., 2003).

The length-weight relationship

The length-weight relationship (LWR) was estimated using the equation, $W = a * L^b$

where: W - total body weight (g), L_t - total length (cm), b and a are the coefficients of the functional regression between W and L

The estimation of the growth parameters

The growth of the fish was assumed to follow the von Bertalanffy growth function (VBGF)

$$L_t = L_\infty \left(1 - e^{-\left[K(t - t_0)\right]}\right)$$

where, L_t = length at age t, L_∞ = the asymptotic length of fish; k = curvature parameter that determines how fast the fish approaching to L_∞; t_0= the theoretical age at which the fish length is 0 (Ricker W.E., 1975; Pauly D.,1983; Sparre P.; et al., 1989).

The mortality

The estimation of mortality rates represent an important component of fisheries management.

The total instantaneous mortality rate (Z) was estimated using length converted catch curve method as implemented in FiSAT II. Natural mortality rate (M) was estimated using Pauly's empirical relationship

$$\ln M = -0.0152 - 0.279 \ln L\infty + 0.6543 \ln k + 0.463 \ln T^0 C$$

(Pauly, 1983; Jones, 1984; Sparre et al., 1989).

M is instantaneous natural mortality, k and L_∞ are growth parameters from VBGF; T^0C - is the annual average temperature.

The average temperature at Braila I judged $T=12^0C$.

The fishing mortality (F) was calculated using the relationship: F = Z – M (Gulland, 1971), where Z is the total mortality, F the fishing mortality and M is the natural mortality. The exploitation level (E) was obtained using the relationship: E = F/Z (Gulland, 1971), Optimum fishing (F_{opt}) which is directly related to the natural mortality (M) was calculated for the selected fish species using the expression below: $F_{opt}=0.4*M$ (Pauly, 1984).

Length at first capture (Lc50)

The ascending left arm of the length converted catch curve incorporated in FiSAT II tool was used to estimate the probability of length at first capture (Lc50). The probability of capture gives clear idea about the estimate of the real size of the fish in the fishing area that is being caught by specific gear. It is an important tool for fisheries managers in sustainably managing a target fisher, because it helps would be managers determining the minimum mesh size of a fishing fleet (Wehye et al., 2017).

Length at first maturity (Lm)

To estimate the length at first maturity (Lm) for this bream population was used the procedure by Hoggarth et al. (2006).

Length at first maturity (Lm) = L∞ * 2/3.

RESULTS AND DISCUSSIONS

Growth and mortality parameters

The total length ranged from 12 to 48 cm, with a mean of 33.86±0.18 and weight ranged between 34-1500 g with a mean value of 670 ± 8.83.

The equation expressing the length-weight (LWR) relationship for bream population from the studied sector is $W = 0.0201 * Lt^{2.9212}$ (r = 0.97) (Figure 2).

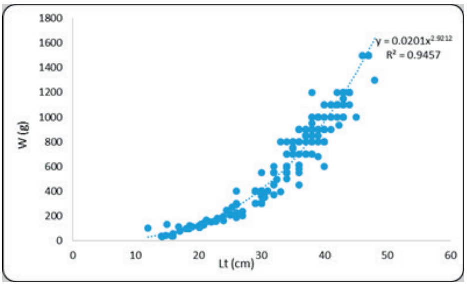

Figure 2. Length-Weight relationship for the bream population

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

The growth character revealed by the "b" coefficient value (2.92) shows us an allometrical

growth of the bream population (that increased weight is slower than the length increase).
For our country, values of the "b" coefficient for this species reported on fishbase are between 2.98 and 3.38 (lakes in the Danube Delta).
The asymptotic length (L∞) and growth coefficient (K) values for the bream were obtained to be 49.35 cm respectively 0.37 y^{-1}.
The index of growth performance (φ – phi prime) were estimated at 2.96.
This value is comparable to that reported by Staras (1992; 1995) and Cernișencu (1992) for the lakes and ponds of the Danube Delta.
The growth performance of a fish population is influenced by the geographical area, the type of aquatic ecosystem in which it lives, the abundance and availability of food. Kakareko (2001) and Stankus (2006) indicated that growth rates of *A. brama* depended on the abundance of benthic organisms.

Mortality coefficiens and current exploitation rate

The total mortality (Z) of *bream* estimated by the length converted catch curve was 1.51 per year while the natural mortality as per Pauly's empirical formula keeping the habitat temperature as 12°C was found to be 0.55 per year and the estimated fishing mortality (F =Z-M) was 0.96 per year (Figure 3).

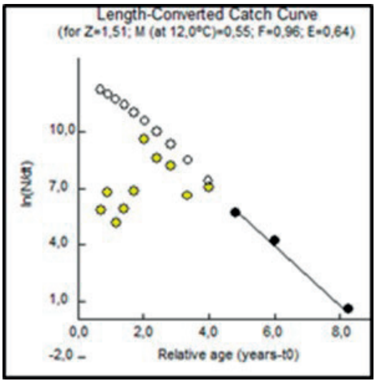

Figure 3. Length converted catch curves of *Abramis brama*

The exploitation ratio (E) of *Abramis brama* was found to be 0.64.
The value of the optimum fishing is Fopt = 0.22, a value that is much exceeded (Table 1).

Table 1. The growth and mortality parameters of bream

Parameters	Value
L∞	49.35
K (yr^{-1})	0.37
φ	2.96
Z (yr^{-1})	1.51
M (yr^{-1})	0.55
F (yr^{-1})	0.96
F opt (yr^{-1})	0.22
E	0,64

Figure 4 shows the length at which 25%, 50%, 75% of the specimens of the studied bream population are vulnerable to fishing gear. L_{50} is considerated the length at first capture (Lc_{50}) and at this length the fish has 50 % chance of being retained by the gear used to capture it (King, 2007).
For the studied bream population these values are: L_{25}=27.06 cm, L_{50}=36.42 cm, L_{75}= 39.40 cm.

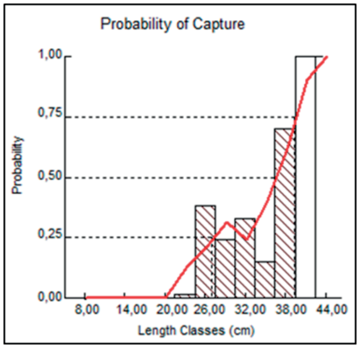

Figure 4. The probability of capture of bream population

The value of the length at the first maturity of the studied bream population is Lm=32.9 cm.

Virtual Population Analysis (VPA)

From virtual population analysis it was found that the maximum fishing mortality of *Abramis brama* occurred at the length range between 26 cm and 38 cm (Figure 5).
As can be seen from the VPA, the highest fishing mortality is in the 26 cm length group.
The abundance of small - sized fishes in the catches could be explained by the indiscriminate use of small mesh sized gears and the non-selectivity of fishing gears mostly deployed within the nursery zone of juvenile fishes (Wehye et al., 2017).

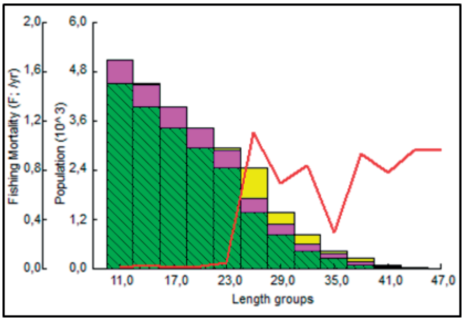

Figure 5. Virtual population analysis of *Abramis brama*

CONCLUSIONS

The length-weight relationship (LWR) for the common bream population in this section of the Danube revealed a strong correlation (r = 0.97) between the two variables, and the exponent (b) value of 2.92 indicating an allometric increase that implies the increase in length faster than weight.

The values of the parameters of the von Bertalanffy linear growth model, and the overall growth performance index (Ö) calculated in this study are comparable to those published for this species in other sectors of the Romanian Danube River.

The fishing mortality (0.96 yr^{-1}) for *Abramis brama* from the current study was greater than the optimum fishing rate (F_{opt}=0.22 yr^{-1}). Also, the estimated current exploitation rate (E) was 0.64, which indicated heavy exploitation (Beverton et al., 1957).

From the probability of capture analysis L_{25}, L_{50} and L_{75} values of *Abramis brama* were found to be 27.06 cm, 36.42 cm and 39.40 cm, respectively.

In this case, the fish becomes susceptible to fishing gear when it reach at length of 36.42 cm and at this length there is a 50% chance of catching it.

Value of the length at the first maturity (L_m) in this study is 32.9 cm.

The high values of the exploitation rate (E) and additionally the high fishing mortality rate (F) comparable to F_{opt} shows that the bream stock is overexploited.

ACKNOWLEDGEMENTS

This paper was supported by the UDJ Research Center MoRAS.

REFERENCES

Beverton, R.J.H., & Holt J.S. (1957). On the dynamics of exploited fish populations. *Fish Invest*, 533.

Cernisencu, I., & Staras M. (1992). Sustainable use of fishery resources - a basic principle in fishing in the Danube Delta. *Scientific Annals of the Institute - Danube Delta*.

Gayanilo, F.C., Sparre, P., & Pauly, D., (2003). *FAO, ICLARM Stock Assessment Tool (FiSAT-II).* User's Guide FAO, Computerized Information Series (Fisheries), No. 8, FAO, Rome, p. 266.

Guettaf, M., Rachedi, M., Gueroui, Y., Bousbia, A., Chelaghmia, M.A., & Maoui, A. (2019). Age and growth of common bream, *Abramis brama* (L., 1857), caught at Hammam Debagh Reservoir (Guelma, northeast Algeria). *Fish. Aquat. Life*, 27, 149-158.

Gulland, J. (1971). *He Fish Resources of the Oceans*. FAO/Fishing News Books, Surrey pp: 255.

Hoggarth, D.D., Abeyasekera, S., Arthur R.I., Beddington, J.R., & Burn, R.W. (2006). *Stock Assessment for fisher\ management. A framework guide to the stock assessment tools of the Fisheries Management Science Programme* (FMSP). Rome, 261.

Ibănescu, D.C., Popescu A., & Vasilean I. (2020). An analysis of the dynamics of fishing catches in the Romanian Danube sector. *Scientific Papers. Series D. Animal Science, LXIII*(2), 521-525.

Jones, R. (1984). *Assessing the effects of changes in exploitation pattern using length composition data*, FAO Fish. Tech. Pap., 256, 118p.

Kakareko, T. (2001). The diet, growth and condition of common bream, *Abramis brama* (L.) in Wloclawek Reservoir. *Acta Ichthyol. Piscat*., 31, 37-57.

King, M. (2007). *Fisheries biology, assessment and management*. Oxford, UK: Blackwell Publishing House, 341.

Pauly, D. (1984). *Fish population dynamics in tropical waters: a manual for use with programmable calculations*. ICLARM Stud., pp. 325.

Pauly, D. (1983). *Some simple methods for assessment of tropical fish stocks*, FAO Fish. Tech. Pap., 52 p. Issued also in French and Spanish.

Ricker, W.E. (1975). Computation and interpretation of biological statistics of fish populations. *Bull. Fish Res. Board Can*., 191, 382.

Savaş, Y., & Nazmi P. (2011). Length - Weight Relationship and Condition Factor of Pontic Shad, *Alosa immaculata* (Pisces: Clupeidae) from the Southern Black Sea. *Research Journal of Fisheries and Hydrobiology, 6*(2), 49-53.

Schletterer, M., Kuzovlev, V.V., Zhenikov, Y.N., Tuhtan, J.A., Haidvogl, G., Friedrich, T., Górski, K., & Füreder, L. (2018). Fish fauna and fisheries of large European rivers: examples from the Volga and the Danube. *Hydrobiologia,* 814, 45–60.

Sparre, P., Ursin, E., & Venema, S. (1989). *Introduction to tropical fish stock assessment*, FAO Fish. Tech. Pap., Roma, 306.

Stankus, S. (2006). Growth parameters of bream *(Abramis brama L.)* in the Curonian Lagoon, Lithuania. *Acta Zool. Lituanica*, 16, 293-302.

Staras, M., & Cernisencu I. (1992). Comparative study on the exploitation of bream populations *(Abramis brama danubi,* Pavlov, 1956) from Razim and Puiu - Rosu lakes. *Scientific Annals of the Danube Delta Institute*, 175 - 182.

Staras, M., Cernisencu I., & Năvodaru I. (1995). *Study of the growth of the main fish species in the Razim - Sinoe complex*. Aquaropi, Galaxi, Romania, 417-420.

Wehye, A.S., Danson, P.K.O., & Lamptey, A.M. (2017). Population Dynamics of *Pseudotolithus senegalensis* and *Pseudotolithus* Typus and Their Implications for Management and Conservation within the Coastal Waters of Liberia. *Fisheries and Aquaculture Journal*, DOI:10.4172/2150-3508.1000201.