ANALELE UNIVERSITATII DIN ORADEA
FASCICULA: ECOTOXICOLOGIE, ZOOTEHNIE SI TEHNOLOGII DE INDUSTRIE ALIMENTARA, VOL. VII, ANUL 7, 2008

COMPLETE STOCK ASSESSMENT MODEL FOR INLAND FISHERIES – AN EXAMPLE OF TWO FLOODPLAIN OXBOWS-

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Abstract

It is known that many factors have an impact on the success of the fishery, as well as some information in connection with the water area and the fish stock are necessary, the knowledge of which make it possible to manage the fishery in a planned way. One part of the information is available, while the other is incomplete or not deep enough. The necessary data vary depending on their nature, and can be obtained from different places, by different methods. The Water Framework Directive, among others, require the complex assessment of several inland waters, which – taking as a basis the present situation – demands huge material and human resource input from the research ***(STÜNDL et al., 1999)***

Key words: fishery, two floodplain oxbows

INTRODUCTION

Experts agree that traditional commercial fishery in the freshwater must be preserved, and furthermore, some areas of this type of fishery must be expanded for the following reasons:

- it provides food and it requires labor (creates jobs),
- it is the only reasonable method of exploitation on larger areas,
- it creates a sound balance within fish communities and within a broader ecosystem as well,
- it can enhance the quality of the environment by eliminating the excess biomass of carps from the highly eutrophic waters,
- it is an important tool of water protection and management,
- in order to enhance the conditions of recreational fishery,
- it can regulate and improve fish composition of waters for recreational and tourism,
- it is an important aspect of gastronomy and rural tourism. (SZŰCS et al., 2006)

Sustainability is also to be considered within the fields of environment protection, nature conservation, and production cycles. Thus, the sector has to meet the criteria of sustainability, i.e., to be profitable, financially sound, socially accepted, and environment- and resource-preserving. In parallel with production, the natural values of fishponds need to be managed and protected. Moreover, production has to contribute to the rational and economical use of aquatic resources (Bársony P. and Stündl L. 2004).

The inland fish stocks in Central and Eastern Europe are characterized by the dominance of the smaller-size members of the Cyprinids and the relative small share of carps, as the cumulative result of the heavy overfishing and the lack of spawning ground (habitat deterioration). This is the reason why inland commercial fisheries play marginal role in the total carp landings. In contrary to that, recreational fisheries heavily stock carps – almost exclusively above the legal size – and catch them in the same year, consequently this has no impact on the recruitment in inland waters. (SZŰCS et al., 2006)

MATERIALS AND METHODS

The surveys involved two oxbows in the flood-plain at the upper Tisza (Boroszlókerti Oxbow and the Marótzugi Oxbow). The devices for the taking of samples were the following: row of panel gill-nets, and electric fishing machine with direct current. As the first step for executing the field surveys and processing data, we developed a complex model (*Figures 2 and 3*), which contains a unified system for the estimation of the fish stock. Part of the model is a fish faunistic survey, as well as a morphological survey of the water. The information gained from these are important for making more accurate the system of devices of the samplings for stock estimation (duration, number of net-rows) and for assigning its place. The major stages of stock-survey: A) faunistic survey, B) physical survey of the bed, and C) sampling with the help of gill-nets. This is followed by the evaluation by the computer module. For the processing of field data collection, we developed a computer module, which – with the help of auxiliary programs (macros) – executes the summing up of the results of the samplings, faunistic and biomass calculations, then presents the results in graphical and table form.

As a result of its design, the module is also suitable for studying all the species of fish occurring in our country.

The definition of population-biological indices took place by calculating the Shannon Diversity Index (SDI) and the Relative Uniformity (RE); calculations of stock dynamics are the information that can be obtained about the mortality, biomass and production of the fish stock of a water (*Table 1*). These, projected to the whole water area, give information about the state and changes of the fish biomass. In the case of all species that were caught in evaluable quantity. The results of all the three samplings are represented even graphically, according to the following points of view: frequency of body length of the caught fish, frequency of body length of fish caught by the certain net panels, as well as the quantity, ratio of the certain age groups. By graphic representation, it becomes possible to compare the results of catching measured at different times with data from literature, as well as with the ideal theoretical values (of normal distribution).

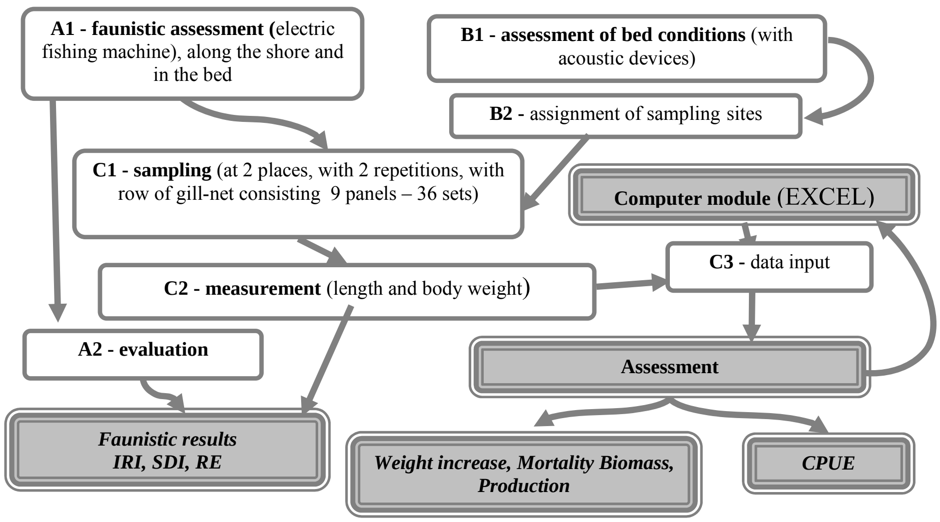

Fig. 2. The structure of the stock assessment model

RESULTS AND DISCUSSION

In the course of the faunistic survey of the oxbow, 17 and 27 species from the Boroszlókerti Oxbow, and the Marótzugi Oxbow were found, respectively. The first is average, the second is a prominently high number. According to the indices calculated on the basis of the three samplings of the population biological surveys, the Shannon diversity index for species (SDI value) of the Boroszlókerti Oxbow can be said to be average, while the relative evenness of species (RE) is low. In the course of the three samplings, no major differences occurred in the SDI and RE values, so the present fish stock of the backwater is balanced. In the case of Marótzugi Oxbow, the values are different. The reason for this is the fact that the amount of the fish caught differed significantly.

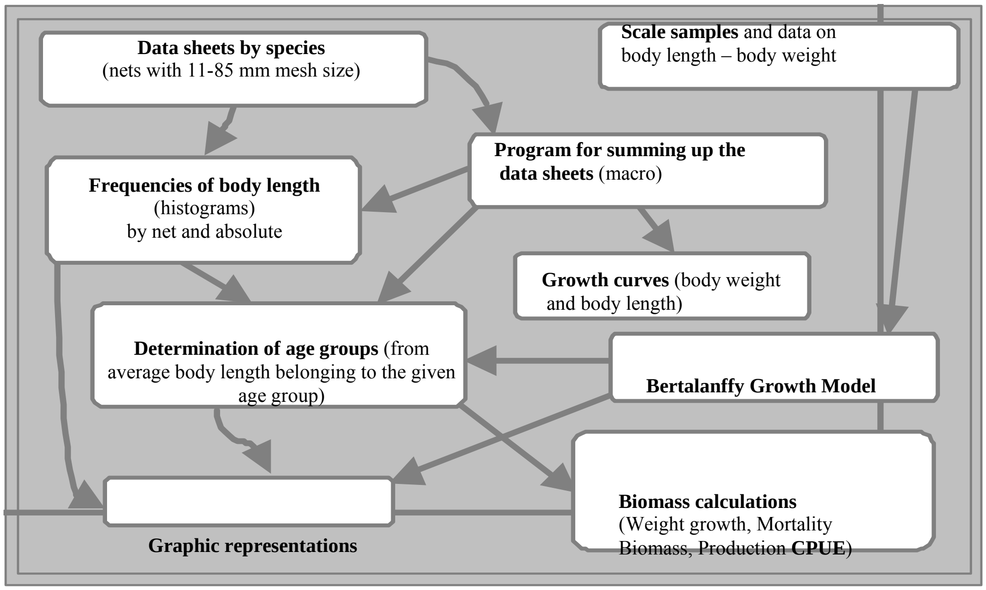

Fig. 3. The computerized part of the model

Table 1

The output table of the model

Parameters	**Age-groups**					
	1	**2**	**3**	**4**	**5**	**…**
n: number of fish						
W (avg.): average weight of the given age-group(kg)						
B: biomass of the moment(kg)						
Z: complete mortality of the moment						
G: coefficient of weight growth						
G-Z, or **Z-G:** change of the biomass during a time unit (growth, or decrease)						
Batl $_{G\text{-}Z}$: yearly avg. biomass in case of growth (kg)						
Batl $_{Z\text{-}G}$: yearly avg. biom. in case of decrease (kg)						
P $_{G\text{-}Z}$: yearly production – in case of growth (kg)						
P $_{Z\text{-}G}$: yearly production – in case of decrease (kg)						
P% $_{G\text{-}Z}$: yearly production – in case of growth (%)						
P% $_{Z\text{-}G}$: yearly production – in case of decrease (%)						

The biomass, growth and production of the fish stock of Boroszlókerti Oxbow are rather small (Table 2). The biomass per hectare estimated to be 48.7 kg and the production level at 25.8% are low, even regarding the domestic conditions. Among the reasons, first of all, we have to mention the restricted nature of the possibilities of reproduction of the fish stock. Because of the relatively low biomass value and the less valuable fish stock, the development of the fish stock is to be suggested in any case, since this is supported by the calculations of the food bases. Development should mean the introduction of rare fish, or the introduction and the amelioration of the conditions for the spawning of fish. This latter combination is supported by the fact that it is more economical regarding the expenses, and the amount and quality of the natural progeny can be formed in accordance with the characteristics of the water area.

It can be stated on the basis of Marótzugi Oxbow catch data (*Figure 4*) that the certain age-groups have different dynamic characteristics, that is to say, they show increasing or decreasing tendencies. On the basis of the data, the total biomass of the dominant species (*Table 3*) is 128.9 kg/ha, its production is 19.7%, which data can be said to be average related to the domestic natural waters with similar potentialities. The structure of fish species on the territory is unfavourable, in case the proportion of the rare fish is modest. This condition can be improved, on the one hand, by introductions, on the other, by the establishment of natural places of breeding – that has been discussed above as well. Besides these, the presence of rheophil fish species can first of all be discovered in the fish stock of Marótzugi Oxbow. This means that this backwater has the most live connection with the river Tisza, since in the last ten years, most of the floods took place here.

Table 2

Population dynamic parameters of the dominant species

Boroszlókerti Oxbow		**For the whole territory**			**For 1 hectare**		
		Biom. (kg)	**Prod.** (kg)	**Prod.** (%)	**Biom.** (kg)	**Prod.** (kg)	**Prod.** (%)
1.	4. Roach	234,3	42,2	18,0	19,5	3,5	1,5
2.	7. Rudd	54,1	47,3	87,5	4,5	3,9	7,3
3.	15. Bleak	104,0	17,0	16,3	8,7	1,4	1,4
4.	33. Prussian carp	101,2	37,8	37,3	8,4	3,1	3,1
5.	43. Bullhead	91,0	6,6	7,2	7,6	0,5	0,6
Total:		**584,6**	**150,8**	**25,8**	**48,7**	**12,6**	**25,8**

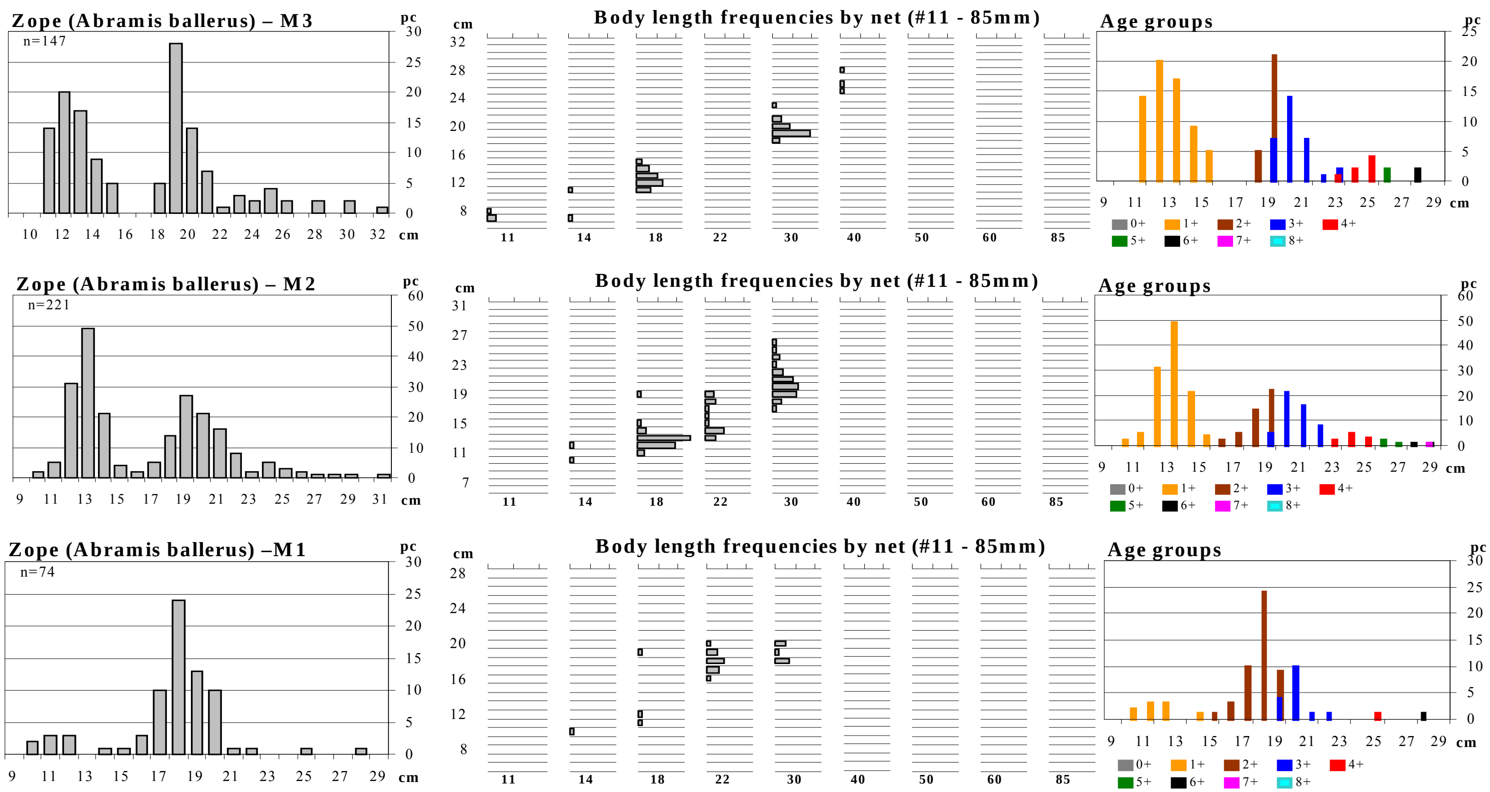

Fig.4. **Body length frequencies and age distribution output charts– example of Zope (Abramis ballerus) (Marótzugi oxbow)**

Table 3

Population dynamic parameters of the dominant species

Marótzugi Oxbow		**For the whole territory**			**For 1 hectare**		
		Biom. (kg)	**Prod.** (kg)	**Prod.** (%)	**Biom.** (kg)	**Prod.** (kg)	**Prod.** (%)
1.	4. Roach	41,5	15,9	38,3	3,9	1,5	3,7
2.	7. Rudd	3,0	0,8	27,9	0,3	0,1	2,7
3.	15. Bleak	137,4	39,4	28,7	13,1	3,8	2,7
4.	17. Silver Bream	2,1	0,6	26,4	0,2	0,1	2,5
5.	18. Bream	275,5	24,4	8,9	26,2	2,3	0,8
6.	20. Zope	770,3	161,3	20,9	73,4	15,4	2,0
7.	43. Bullhead	123,7	24,3	19,6	11,8	2,3	1,9
Total:		**1353,5**	**266,7**	**19,7**	**128,9**	**25,4**	**19,7**

From the studied water areas, in the growth surveys (Bertalanffy, 1957; Beverton Holt, 1959, Ricker, 1958) made at Marótzugi Oxbow , the dominant Zope (*Abramis ballerus)* and its predator, the Pike-perch (*Stizostedion lucioperca*) appeared (*Figures 5 and 6*). The growth of both species is allometric in the oxbow, their body weight grows faster than their body length. This proves the existence of the satisfactory food base. The growth of the Zope (*Abramis ballerus)* can be said to be rather good on the territory, its intensity is similar to that of the stock of Tisza, which, besides the same genetic background, depends to a large extent on the potentialities of the habitat. The population reaches in the first year the body length of 10 cm, while the length of 20 cm is reached by the age of 4. The adequate population intensity of the Pike-perch (*Stizostedion lucioperca*) can be explained by the good environmental potentialities of the oxbow. Its growth is better in the oxbow than in the Upper-Tisza. The Pike-perch (*Stizostedion lucioperca*) reaches the catching size at the territory by the age of 3-4.

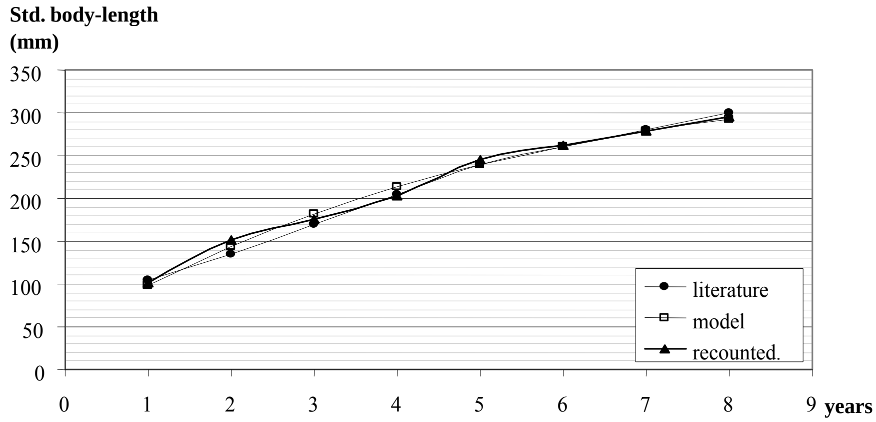

Fig. 5. Growth of the Zope (Abramis ballerus) on the basis of the Bertalanffy model, the recounted body lengths and literature data

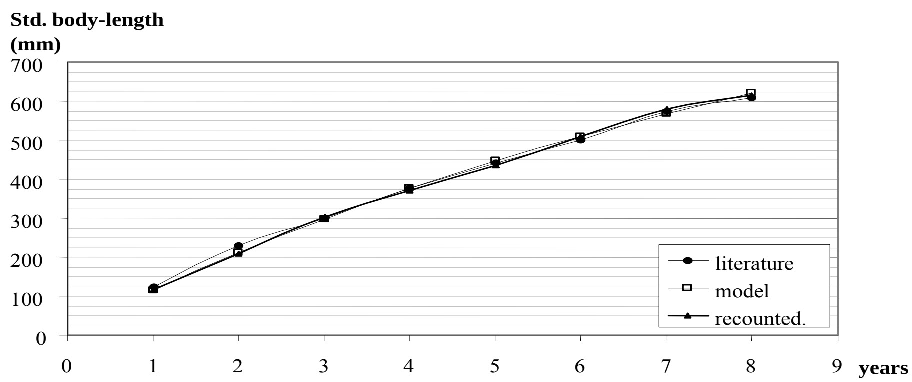

Fig. 6. Growth of Pike-perch Sander lucioperca on the basis of the Bertalanffy model, the recounted body lengths and literature data

Recommendations

- The developed model for the survey of stocks is suitable for evaluating the results of sample fisheries made at other natural waters, in case the were performed on the basis of sampling procedures used in practice (electric fishery, row of panel gill-nets).

- The model (completed with hydrobiologic and water management parameters), as well as the system of instruments for the morphologic survey of the water areas makes such a complex method with the help of which in one year, information about the natural waters directly usable in fisheries can be obtained in an effective and economic way.

- The number of species occurring in the model can be enlarged, this way, it is suitable not only for the study of species characterizing the domestic fauna.

- The study of the growth of Zope *Abramis ballerus* and Pike-perch *Sander lucioperca* has made valuable contributions to the domestic literature, especially in the case of the oxbows in the flood bed along Tisza, about the fish stock of which quite few population dynamic data are available.

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