ZINGEL ZINGEL (LINNAEUS, 1766)
ON SITE MANAGEMENT DECISIONS SUPPORT SYSTEM - STUDY CASE

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ABSTRACT

The ADONIS:CE was utilised here, in the biology/ecology domain, to produce a framework management model of *Zingel zingel* fish species based on this species' identified needs, regarding: the habitat, the indicators which reveal the favourable conservation status and the proper measures, and the identified pressures and threats on this fish species.

If these suggested management elements will not be implemented in ROSCI0132, the presence of the *Zingel zingel* species will be endangered in the next one or two decades.

Such management systems, based on: the site, the habitats and on numerous species should be implemented in the conservative interest Natura 2000 case of ROSCI0132.

RÉSUMÉ: Système support pour le processus décisionnel dans la gestion d'un site - étude du cas de *Zingel zingel* (Linnaeus, 1766).

ADONIS:CE a été employé dans le domaine de la biologie/écologie afin de produire un management modèle cadre de l'espèce de poisson *Zingel zingel* ayant comme point de départ les besoins identifiés pour cette espèce en ce qui concerne l'habitat, les indicateurs révélant le statut de conservation favorable ainsi que les mesures appropriées, les pressions identifiées et les menaces pesant sur cette espèce.

Si les éléments de gestion suggérés n'étaient pas implémentés dans le ROSCI0132, la présence de l'espèce *Zingel zingel* serait mise en danger dans les prochains dix ou vingt ans.

Ainsi, des systèmes de gestion basées sur la bonne connaissance du site, des habitats et des espèces devront être implémentés dans le cas du ROSCI0132 pour d'autres espèces de poissons d'intérêt communautaire au titre de Natura 2000.

REZUMAT: Sistem suport pentru luarea deciziilor de management in situ pentru conservarea speciei *Zingel zingel* (Linnaeus, 1766) - studiu de caz.

ADONIS:CE a fost utilizat aici în domeniul biologie/ecologie pentru a realiza un model de management cadru pentru specia de pește *Zingel zingel*, la baza elaborării modelului au stat necesitățile pentru habitat ale speciei, indicatori care relevă starea de conservare favorabilă și măsurile potrivite, presiunile și amenințările identificate asupra acestei specii de pește.

Dacă aceste elemente de management sugerate nu vor fi implementate în ROSCI0132, prezența speciei *Zingel zingel* va fi periclitată în următorii 10-20 ani.

Astfel de sisteme de management, pentru un sit, pentru habitate și pentru o specie, trebuie realizate și pentru alte specii de interes conservativ Natura 2000 în cazul ROSCI0132.

INTRODUCTION

The European Union states should create the needed conditions for the protection of all the Habitats Directive (Annex 2) species and habitats in order to preserve or better increase their conservation status (*, 1992). The Natura 2000 sites designated for the Romanian national territory, including those selected for fish species' protection, were selected for their importance in relation with their conservative value. The acceptance of these sites, at the biogeographical seminars for Romania, was based on special selected criteria, as follows: well conserved, healthy and stable fish populations, representative habitats, good geographical location, and low anthropogenic impact. Based on the Natura 2000 European process, there are important ways the EU states' nature protection should improve: institution capacity building; protected natural areas' surface increasing; raising the citizens' awareness, optimum management plans, and implementation for protected areas, (Bănăduc, 2001, 2007, 2008, 2010, 2011; Bănăduc et al., 2012; Curtean-Bănăduc and Bănăduc, 2008).

A Community interest species is *Zingel zingel* (Linnaeus, 1766). This fish is a demersal freshwater species, is more active at night, and lives in relatively fast-flowing, deep and big lotic systems complete with sand, pebbles and clay riverbeds. The reproduction period is March-April; the roes are laid down on gravel or rocks. Its food consists of aquatic insects, crustaceans, roes and small fish, (Bănărescu, 1964; Bănărescu and Bănăduc, 2007).

In the Romanian territory, the distribution range of *Zingel zingel* is more restricted and fragmented than in the past century (Bănărescu, 1964), due to the impact of human activities, impacts which differ quantitatively and qualitatively from one watershed/watershed sector to another, and from one nature protected area to another (Oțel, 2007).

The fish fauna structure, where the *Zingel zingel* species was found, in ROSCI0132 (Natura 2000 site Oltul Mijlociu - Cibin - Hârtibaciu) reveals very few individuals as a direct effect of heavy anthropogenic impacts. The distribution area of the fish populations and their abundance differs in this Natura 2000 site reflecting the related quality decrease results of the Olt River watershed lotic habitat (Bănăduc, 1999, 2000, 2001, 2005; Curtean-Bănăduc et al., 2007; Curtean-Bănăduc and Bănăduc 2001, 2004a, b; Curtean et al., 1999).

In the worldwide swerve in which the rivers become more and more evident as a precious natural resource, the anthropic impacts on it will change its accessibility in quantitative and qualitative terms (Curtean-Bănăduc and Bănăduc, 2012). If this swerve will continue, no general management tools will be enough in protecting areas, because diverse habitat elements should be assessed; after that particular management, elements have to be adapted and suggested for the local and/or regional habitats' peculiar conditions.

The process modelling can be applied in acquiring a "broad picture" of discrete systems and/or actions of a domain. The modelling processes are used in understanding management steps. The modelling tools are software products which are used to make business organization models, as well as highlight information regarding said models. Three functions are highlighted: corroborate an existing situation, examine the results of potential modifications, and propose plans to modify the actual situation in a better direction. Ways to make diverse diagrams which include proper management elements are offered (Hall and Harmon, 2005). The main goals of this study are: to show the state of *Zingel zingel* populations in the ROSCI0132; to highlight the human impact pressures and threats; to advise management elements for the increase of this fish species' conservation status supported by a management model made for the specific habitat requirements of this species; based on specific habitat indicators as a decisional backup system for management decisions and strategies.

MATERIAL AND METHODS

The ROSCI0132 protected area (45.682778 latitude, 24.324444 longitude, 2,826.10 ha surface, between 314 and 568 a.s.l. m) is situated in the administrative units of Sibiu, Braşov and Vâlcea counties (Romania), in the Continental and Alpine European biogeographic regions. This Natura 2000 site was proposed and accepted including for ten fish species, species which belong to the Annex 2 of the Habitats Directive (92/43/EEC), (*Zingel zingel* Natura 2000 code 1159, *Zingel streber*, *Gobio kessleri*, *Pelecus cultratus*, *Barbus meridionalis*, *Cobitis taenia*, *Sabanejewia aurata*, *Rhodeus amarus*, *Aspius aspius* and *Gobio uranoscopus*). (*)

The river sectors of the researched zone where *Zingel zingel* were sampled are shown in figure number 1.

The fish individuals were sampled with fishing nets in 2010-2013. The sampled individuals were identified in the field and released back in their habitats.

Figure 1: *Zingel zingel* individuals sampling stations in Olt River, 322 and 328.
(Geographic Information System support Mr. Pătrulescu A.).

Zingel zingel populations were under assessment in this research period and their ecological status was evaluated in relation to the local human threats and pressures on this fish species' habitats and populations.

The ecological status of the fish population was evaluated based on the following criteria: equilibrated distribution of fish individuals on age classes, size area distribution, population size and a high/low number of individuals of this fish species in the local fish communities.

The *Zingel zingel* species' particular habitat requirements, pressures and threats, were ascertained based on their presence or absence, interdependence between them, and the fish populations' ecological status in the researched zone.

To identify the proper management elements needed in order to assure the fish species' survival in the studied area, and in order to reveal the needed process, the authors used a specific management model. Therefore the authors used ADONIS:CE, created by Business Object Consulting. ADONIS: Community Edition, which is actually a free tool given by the BOC Group which should be useful as a good entry point to Business Process Management and as a proper modality to become familiarized with ADONIS. ADONIS:CE is a rich feature, stand-alone version of ADONIS with some limitations in comparison with its commercial edition. Business Process Model and Notation (BPMN) is a standardized modelling language which is appropriate for the illustration of processes. Based on uniform notation, the processes can be clear, fast, and intuitively modelled (**).

RESULTS AND DISCUSSION

Zingel zingel populations ecological state evaluation

The ecological state of *Zingel zingel* populations in the Olt River sampling sectors 322 and 328 (Fig. 1) is very low in conformity with: unbalanced distribution of individuals on age classes, population sizes, and a very low percentage of fish individuals of the species of interest in the structure of the local fish fauna. In the Olt River, the habitats of the studied species in the sampling sectors are in very low ecological condition, in respect of *Zingel zingel* ecological requirements.

Human pressures and threats

During this specific study, the following threats and pressures on *Zingel zingel* species populations were identified: pressures - destruction/major modification of natural habitats of this fish species, lotic habitats destruction or fragmentation along the rivers due to major hydrotechnical works (dams and lakes) and pollution; threats - water pollution, poaching, river regularization and mineral substrata overexploitation. The presence of all these human pressures and threats, and their negative effects on the ichthyofauna are well known in the middle Olt River sectors (Bănăduc, 1999), but nothing was changed as of yet to mitigate these effects.

Specific requirements

Zingel zingel adults generally need relatively big river sectors with fairly deep and fast flowing water which contains sectors with sand, pebbles and/or clay. In the reproduction period, the adults need big or medium river sectors with relatively deep and fast water flowing sectors, complete with riverbeds of pebbles and vegetal debris. The water should not be polluted and with low organic loads. (Bănărescu and Bănăduc, 2007)

Specific habitat indicators

Based on the *Zingel zingel* species' presence and abundance in the researched sectors, the following habitat indicators were suggested: surfaces in the minor riverbed with a depth of the water over one m (66%); plant debris percentage on the riverbed (15%); fast flowing water surface percentage (66%); and percentage of the substrate covered with pebbles (66%).

Management measures

In the natural riverbeds' morphodynamics preservation/reconstruction, it is strongly recommended that new dams/hydrotechnical constructions be forbidden; this modifies the lotic regime of the water in lentic regime and also the substratum characteristics.

A complex functional fish leader system should be created to diminish the negative impact of the large and numerous dams and lakes.

The riverbed mineral exploitation, and respectively the total evacuation of the pebbles substrata, should not be allowed in order for the preservation of this species' habitat to be possible. The riverbed mineral exploitation should be forbidden especially in the river sectors with medium and/or fast flowing sectors, relatively deep water and stoney substrata. These exploitations should not be allowed at distances under five km from each other, or in the sectors between two stagnant or semistagnant water sectors.

In the reproduction period (March-April) fishing should be banned, as well as any activity which can influence the natural rate of sedimentation of suspensions in the river.

Poaching in the study area is very frequent, and a phenomenon which should be stopped.

The riverine vegetation corridors (herbaceous, shrubs and ligneous) should be protected on stripes of a minimum 25-100 m in length on both sides; assuring the vegetal debris needs in the trophic and reproduction processes of this species.

The illegal waste deposits should not be allowed in proximity of the water courses.

An integrated monitoring system for ichthyofauna should be created, adapted and implemented.

Site adjusted management model

The process for the on-site model management is actually based on activities (squares - please see below) and decisions (triangles - please see below) (Figs. 3, 4 and 5a-d).

The main objects used to create the management model for *Zingel zingel* in the ROSCI0132 area with ADONIS:CE tool are shown below (from Hall and Harmon, 2005 - Version 1.1, November, 2005, [http://mhc-net.com/whitepapers_presentations/2005_Process_Trends_\(040306\).pdf](http://mhc-net.com/whitepapers_presentations/2005_Process_Trends_(040306).pdf)):

A process represents a range of steps in which information is processed or transformed for different models. A process is possible to be modelled based on activities, decisions, subprocesses, documents attached to different activities, and notes.

The activity is the smallest part of a process and comprises the realised tasks along the process. In the modelling process, there are activities that rely on decisions. The decisions are a significant part of the process due to the fact that for each decision, a certain probability for accomplishing the following activities can be selected, (used in analysis and simulation). To every existent decision, a condition of probability can be assigned. For this, variables are defined (paths can be followed in accordance to the assignment of variables - defined in the transition conditions) as are generators (induce values to variables to which they are in connection with). The generator is directly associated by connectors with decisions and variables.

Model structuring in subprocesses is helpful for improving process organization and judgment. The subprocess works as a structured process; it is suggested to be applied, predominantly when the model is highly elaborate, and with their support, the user "comes along" straight to the process from the topmost to the lowmost level.

In this paper we attempted to model habitat ecological requirements of the species *Zingel zingel* and the conditions that ensure favorable conservation status. As one can see in the following figure (Fig. 2 - Hierarchy models), the basic process is *Zingel zingel* species. The subprocesses showed in the figure are part of the basic model. They can be viewed by a simple click, both using the Explorer window and also from the starting model.

Figure 2: Hierarchy of process modeled.

The initial “process” is called *Zingel zingel* species (Fig. 3) and contains two “activities” (*Habitat specific requirements* and *Current pressures and threats*), a subprocess called *Habitat indicators for Zingel zingel species* and a decision that ensures favorable conservation status. During the measurements and observations made in the field, it was noted that ensuring favorable conservation status indicators is likely to succeed only 30% of the time (e.g. Decision: if Conservation_state = 0.3, we follow the branch “Yes” of the decision, if Conservation_state = 0.7 we follow the branch “No” of the specific decision).

The next figure (Fig. 4) is the subprocess called from the starting model, named *Habitat indicators for Zingel zingel species*.

This process is modelled only by decision (represented by indicators are taken into account), subprocesses (Figs. 5a-d) presenting management measures and two activities (*Field Observations* and *Implementation of an integrated monitoring system*).

Considering that we took into account four indicators, we call the four subprocesses to ensure important management measures to be taken if the indicators do not provide favorable conservation status. After calling each subprocess, the last activity is reached, namely *Implementation of an integrated monitoring system*, and then the process ends.

For each decision, we assigned a variable (e.g. *Water_depths*, *Gravel_substrate*) and a generator (type discrete, e.g. “Yes” branch = 0.66, “No” branch = 0.34 for *Water_depths*) which - based on measurements taken - can determine the condition probability that the indicator exists in favorable conservation status.

If you follow all these outlined management measures, and if the integrated monitoring system is carried out by specialized personnel, it will ensure the conservation of the endangered *Zingel zingel* species.

Figure 3: Process model *Zingel zingel* species.

Figure 4: Habitat indicators for *Zingel zingel* species model process.

Figure 5a: Measures for the first indicator.

Figure 5b: Measures for the second indicator.

Figure 5c: Measures for the third indicator.

Figure 5d: Measures for the fourth indicator.

CONCLUSIONS

The principal threats to the *Zingel zingel* species ecological status in the Natura 2000 site ROSCI0132 are: river regulation and mineral substratum overexploitation, water pollution and poaching. The highlighted pressures on this fish species' populations of conservative interest are: destruction/major modification of natural habitats, lotic habitats' destruction or fragmentation along the rivers due to major hydrotechnical works (dams and lakes), and pollution. A significant impact on *Zingel zingel* species is the absence of functional fish leaders for dams and lakes which drastically fragmented the lotic habitats continuum. The riverbed mineral overexploitation with the uncovering of hard massive rocks substrate should be banned, thinking about the mobile mineral substrata needed for this species. In the reproduction period of this species, fishing should be restricted as well as all human activities which can increase the sedimentation rate of the suspensions. The poaching phenomenon should be stopped. The Olt River should be managed with the purpose of keeping a good water chemical quality. The riverine vegetation (herbaceous, shrubs and ligneous) should not be harmed in a minimum of 100 m on both sides of the river banks in sectors as long as possible.

Seasonal integrated monitoring is needed, including water quality monitoring.

In this research, the authors "realized" a framework of *Zingel zingel* species. The ADONIS:CE was used here in the biology/ecology domain, creating a model of *Zingel zingel* species that presents all the needs for the habitat, the indicators that offer a favorable conservation status - the adequate measures, and the species' pressures/threats. If all these management requirements will not be put in to practice, the presence of this species will be jeopardized in the next one or two decades. On this site, the habitats and species management model for *Zingel zingel*, should be integrated in a management model for ichthyofauna, which is why such management systems should be implemented for other fish species of community conservative interest in the case of ROSCI0132.

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