MANAGEMENT ELEMENTS FOR TWO ALBURNINAE SPECIES, 
*ALBURNUS ALBURNUS* (LINNAEUS, 1758) 
AND *ALBURNOIDES BIPUNCTATUS* (BLOCH, 1782) 
BASED ON A DECISION-SUPPORT SYSTEM STUDY CASE

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DOI: 10.2478/trser-2019-0014

**KEYWORDS:** Bleak, Schneider, fish habitat needs, human activities negative effects, conservation management elements.

**ABSTRACT**
ADONIS:CE has been used as a base to create a support-system management decision-making model for *Alburnus alburnus* (Linnaeus, 1758) and *Alburnoides bipunctatus* (Bloch, 1782) species. Investigation of the habitat necessities and the identification of the necessary elements for a good status of conservation of these two fish species populations has revealed the pressures and threats to these congener species, for which specific management activities have been finally recommended.


**REZUMAT:** Elemente de management pentru două specii de Albuminace, *Alburnus alburnus* (Linnaeus, 1758) ȘI *Alburnoides bipunctatus* (Bloch, 1782) bazate pe un studiu de caz al unui sistem de suport decizional. ADONIS:CE a fost utilizat pentru a crea un model de sistem-suport pentru luarea deciziilor de management pentru speciile *Alburnus alburnus* (Linnaeus, 1758) ȘI *Alburnoides bipunctatus* (Bloch, 1782). Investigarea necesităților de habitat și a elementelor necesare pentru un statut bun de conservare al populațiilor acestor două specii, au relevat presiunile și amenințările asupra acestor specii congenere pentru care au fost recomandate în final măsuri specifice de management.
INTRODUCTION

Regardless of variation in need and reserve induced by the dynamic of fishing activities results, fish remain a significant source of food in many regions (*, 2002). Fish population management systems, to assure the protein and also the game needs of the humans, need to be complex, innovative, and highly adaptative to the local/regional habitat, biotic and human-related conditions (Cochrane, 1999). The increasing desire for more fish protein is evident everywhere, and this threat demands a focused, creative struggle in identifying practical answers for conservative and economic issues (Agnew et al., 2009; Monte-Luna et al., 2016).

Usually only the conservation and high-direct, economic valuable fish species benefit from adapted management plans, and very rarely the indirect economic valuable fish species, which consist the trophic base for upper trophic level fish species (Bănăduc et al., 2011).

Too often, many different fish species, belonging to a certain overspecific taxonomic group with different economic and/or conservation value, are confused by the local fisherman (Oţel, 2007), situations in which a proper conservation is hard to implement and sustain. In some such cases, specific on site and on species adapted management systems can offer integrated management elements, which is the goal of this Târnava Mare River study case.

The Alburninae subfamily (Actinopterygii, Cypriniformes, Cyprinidae) include over eighteen species (Fish Base, 2018) including *Alburnus alburnus* (Linnaeus, 1758) and *Alburnoides bipunctatus* (Bloch, 1782). A relatively common fish species in the Târnava Mare River, with relative, similar morphological and colour aspects, these two fish species, especially in young age classes (Bănărescu, 1964, 2005), can be difficult to identify, creating problems in their populations’ assessment, monitoring, and management.

The Târnava Mare Basin is a well known area under constant and variable human impact and effects on local biota (Cupşa, 2005; Sîrbu, 2005; Momeu and Péterfi, 2005; Robert and Curtean-Bănăduc, 2005), including species of fish fauna containing *Alburnus alburnus* and *Alburnoides bipunctatus* (Bănăduc, 2005; Curtean-Bănăduc, 2005; Păpuc et al., 2017).

There is no general accepted “golden rule” in Carpathian streams and rivers fish populations’ optimum management, but it is obvious that one feature is usually correlated with beneficial consequences, namely science-based adequate management, the goal of this study relaying on this specific approach.

In nature conservation, modeling is frequently used to obtain the “large picture” of various systems and/or actions of peculiar domains. The pieces of the modeling process are practical in discriminating the specific phases of adaptive species and their environment management. Using ADONIS:CE, we can construct models that support management objectives. This type of model targets three operational sectors important for environment conservation: 1) to determine the present state, 2) to assess the effects of modifications and 3) to suggest actions to improve the actual state in a desired way. Convincingly, diversified diagrams can be developed to highlight management elements (Hall and Harmon, 2005).

MATERIAL AND METHODS

The researched area, the Târnava River watershed (Fig. 1) is located in the central area of the Romanian Carpathians arch, running off the Transylvania Depression, in precisely its southern sector of the Târnavelor Plateau. With a watershed of 6,157 km², a length of 249 km and a falling elevation of about 1,250 m, the Târnava River is one of the main tributaries of the Mureş River, delineating 21% of its watershed. It is composed of the confluence of Târnava Mare River (3,606 km² watershed surface; 221 km length) and Târnava Mică River (2,049 km² watershed surface and 191 km length) near Blaj locality. (Tufescu, 1966; Posea et al., 1983)
Figure 1: The Târnava River basin location (Bănăduc, 2005).

*Alburnus alburnus* and *Alburnoides bipunctatus* are a well known species in Romania (Bănărescu, 1964) with a relatively large distribution in Transylvanian medium and large rivers (Bacalu, 1997; Bănăduc, 1999; Bănărescu et al., 1999; Bănărescu, 2005; Curtean-Bănăduc and Bănăduc, 2007; Telcean and Cupşa, 2009; Bănăduc et al., 2013, 2014; Bănăduc and Curtean-Bănăduc, 2014; Telcean et al., 2014; Cocan et al., 2015; Păpuc et al., 2017; Stavrescu-Bedivan et al., 2017; Voicu et al., 2016, 2017) where the studied area is located.

These fish species individuals were found for this research and analyzed in Târnava River in 2016; all of them were immediately released alive after an in situ identification, in their natural habitat.

Supplementary reference data for these fish species’ presence and ecological status were based on a similar approach study of Bănăduc (2005) and on the local fisherman’s captures.

The researched habitat characteristics of the fish populations were evaluated based on specific selected criteria including: population size, size of range, the balanced allocation of fish in age classes, and high/low number of individual fish species individuals in fish communities.

The local lotic habitat necessities, pressures, and threats on the two fish species were studied in connection with their populations’ ecological status, the correlations between them and the conservation situation of these species.
An in situ-on species adaptable management model was projected to build up a suitable management plan that would protect the researched fish species that are living in the studied lotic sectors, with a priority on required processes.

The ADONIS:Community Edition (ADONIS:CE), made-up by the Business Object Consulting (BOC) Group, was applied here. This software is a freely accessible form of ADONIS with few restraints (in comparison with the commercial version). It uses a Business Process Model and Notation (BPMN), a standardized modeling language that supports detectable processes. ADONIS:CE is typically used as an access point to Business Process Management. These processes can be modeled using compatible notation.

RESULTS AND DISCUSSION

The study results reveal that the main common threats on *Alburnus alburnus* and *Alburnoides bipunctatus* fish species are: modifying and fragmentation of specific habitats, water pollution, and overfishing and poaching.

**Identified specific requirements**

Both the juveniles and adults need a significant/close to natural water flow and relatively high depths of the water (minimum 0.5 m), with rocky-sandy substrata, variable speed of the water flow, and not abundant aquatic vegetation.

**Proposed specific habitat indicators**

In the studied lotic sectors, principal habitat indicators as causes for the presence/absence and abundance of *Alburnus alburnus* and *Alburnoides bipunctatus* are: average water flowing surface speed (proportion 50% of the river), relatively slow water flowing surface speed (proportion 50% of the river), mixed sandy with rocky substrata (50% of the river), and water surface with relatively high depth of the water (50% of the river).

**Management measures**

Management characteristics have been a suggestion for analytical research and, a request for managers which face many pressures and threats on lotic systems. As a result, there are many viewpoints and models which fluctuate based on source, system, and design intricacy. The management indicators can be match based on a process which includes six levels (Krause and Mertins, 1999): designing a process value chain model, determining the key success factors, giving the description of the performance indicators, data acquiring and checking, assessment of the performance indicators, and putting into action process.

This pathway based on a model is sustained by the learning process which appears while realising the process maps; and set up the need for management elements grouped around the record sheets of management measures. It is meaningful to highlight that constructing the essentiality to identify an indicator set for assessment of an entity’s overall achievement, the proposed model find the preeminent value delivery process, to which an indicator set for process assessment can be designated, which are generated by diagnosing the success factors for the process and for the entity’s performance (Miricescu, 2011, 2014).

 Appropriately with this model, we propose that the main management measures include the conservation of: the natural morphology of the lotic systems – natural dynamic of banks and water flow regime; rocky-sandy substratum and relatively deep water depth; the forbiddance of the disposing of wastes in water and on the banks; keeping a medium level of the water including in drought periods based on avoiding of important water removals and use; decreasing water pollution; and implementation of a long term monitoring system for fish.
Adjusted model for the site management

The proposed model of the two species of fish *Alburnus alburnus* and *Alburnoides bipunctatus* uses common objects of the ADONIS:CE for modeling business processes (BPM), namely: the beginning of the process (활동), activities (활동), decisions (결정), parallelism (게임), and merging (결합) – in the case of parallel activities, notes (노트), subprocesses (리모델) – processes that are used within the basic process, variables (변수) and generators (발생) – are used to highlight the percentage of achievement of the habitat indicators (the percentage indicators that ensure conservation status) and the end of the process (최종).

To better visualize the model structure proposed for the two fish species, figure 2 highlights the inter-model references between processes modeled.

![Figure 2: Hierarchy of modeled process and inter-model references.](image)

Model description

The basic process of these two fish species modeled (Fig. 3) is conceived as a description of them, being presented with the help of the following activities: the habitat type, the specific identified requirements (these were modeled with the help of parallelism and merging – independent activities), continues with the “Habitat indicators of *Alburnus alburnus* and *Alburnoides bipunctatus* species” subprocess call (Fig. 4), then follows another two activities field observations, pressures and threats on the habitat, and implicitly, on the species *Alburnus alburnus* and *Alburnoides bipunctatus* and the process ends. With the help of notes, it was possible to graphically exemplify the characteristics of certain process activities.

The “Habitat indicators of *Alburnus alburnus* and *Alburnoides bipunctatus* species” subprocess (Fig. 4) have the same characteristics as a process and contain the specific habitat indicators – proposed for this research, the decisions for verifying them – whether or not they ensure the favourable conservation status of the studied two species *Alburnus alburnus* and *Alburnoides bipunctatus*, the management measures to be taken (subprocess – Fig. 5) and the final activity, the implementation of a long-term fish species monitoring system.

For example, the model begins with the first indicator (“Average water flowing surface speed” – proportion 50% of the river), and the first decision verifies whether it does or does not meet fair conservation status (basically, this was compared to the current state of the indicator – resulting from field measurements – with favourable conservation status).

If for this indicator, the favourable conservation status is fulfilled (the “YES” branch of the decision, variable: Water_flowing_surface_speed = “Yes”, probability: 99%), then the model continues with the second indicator. If the first indicator does not fulfill the favourable conservation status (the “NO” branch of the decision, variable: Water_flowing_surface_speed = “No”, probability: 1%) then, the model continues with the management measure subprocess – goes through every measure – after which, it returns to the first indicator, and once again checks (after the management measures applied) whether or not the fair conservation status is fulfilled. A loop is formed and the process does not go through the other indicators unless the current indicator meets that condition.
Figure 3: Species *Alburnus alburnus* and *Alburnoides bipunctatus* – critical requirements of habitat.
Figure 4: Habitat indicators of *Alburnus alburnus* and *Alburnoides bipunctatus* species.

The last subprocess shows the management measures (Fig. 5) model made only with activities. Here are the management measures that should be taken to ensure that the *Alburnus alburnus* and *Alburnoides bipunctatus* species preserve their favourable conservation status. Among these, we mention the conservation of the natural morphology of the lotic systems, the preservation of the rocky and sandy substrate, the prohibition of the discharge into the rivers of any type of waste, the maintenance of a medium level of water during periods of drought.
CONCLUSIONS

The principal recorded pressures and threats to the fish species *Alburnus alburnus* and *Alburnoides bipunctatus* in the studied lotic sectors of the Târnava Watershed were the following: modifying and fragmentation of characteristic lotic habitats, water pollution, and overfishing and poaching.

Critical for *Alburnus alburnus* and *Alburnoides bipunctatus* fish species conservation are the following: the characteristic/natural riverbed morphodynamics guardianship, the diminishment of the existing flowing water habitats fragmentation, the prohibition of riverbed heavy exploitation, the riverine vegetation preservation, the ecological restoration of the riverbeds’ characteristic morphodynamic, complex waste management, reducing water pollution, effective poaching restriction, and the creation of an integrated monitoring system where the fish fauna is a core element.

In this particular research, a necessary model for decisions in management in order to back the two *Alburninae* species was produced, ready to be implemented in the researched area.
The ADONIS:CE was used here for fish conservation in an area of concern, coming up with a specific management model for *Alburnus alburnus* and *Alburnoides bipunctatus* fish species that contain their main necessities regarding the habitat, and the elements that reveal a good ecological status. The suggested management elements help to prevent and/or diminish the identified pressures and negative effects on these species’ populations.

This particular on-site, on habitats and on species management decisions supporting model scheme for *Alburnus alburnus* and *Alburnoides alburnoides*, will be more effective if integrated in a management model for the Târnava Watershed fish associations.
ACKNOWLEDGEMENTS

The authors wish to thank Mr. Popa E. M. for his continuous support in informatics and to many fishers of the Târnava Basin for their help during the research. This study data was acquired in the period of the projects POS Mediu, priority ax four project code SMIS – CSNR 17049 “Pentru Comunităţi Locale şi Natură – Bazele managementului integrat Natura 2000 în zona Hârtibaciu – Târnava Mare – Olt (PH+ PRO MANAGEMENT Natura 2000)” and Project ID 66243, SIDPOP – “Instrument suport pentru luarea deciziilor în domeniul managementului poluanţilor organici persistenţi. Studiu de caz: Bazinul hidrografic Mureş”, finanţat în cadrul programului R004 – „Reducerea substanţelor periculoase, prin Mecanismul Financiar al Spaţiului Economic European (SEE)”. 


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