NATURA MONTENEGRINA, Podgorica, 2013, 12(3-4): 793-802

ORIGINAL RESEARCH PAPER

IMPLEMENTING THE EUROPEAN FISH INDEX (EFI) FOR ASSESSMENT OF THE STATE OF CENTRAL ALBANIAN RIVER SYSTEM

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Key words:
Albania,
fish-based assessment,
Erzeni,
biotic integrity,
Water Framework Directive.

SYNOPSIS

This paper presents the results of implementation of European Fish Index (EFI) in assessing the state of central Albanian river system that includes several water bodies: Rivers Shkumbini, Erzeni, Devolli, Osumi and Vjosa. Along with implementation of method following the FAME program, we specifically compares the different approaches developed in other countries and further to that discuss advantages and disadvantages. Also in case of Albania we tried to identify advances in the development of assessment methods, in time when country is planning to enter and follow the EU commitments. We do consider that in our case the major steps in case of method development, i.e. data requirements, identification of reference conditions, quantifying human pressures, selection of metrics, index calibration, index validation and practical way of method implementation. Following the Water Framework Directive (WFD) there is strong requirement for monitoring of fish fauna in rivers and other water bodies.

Following data analyses we develop an index for Albanian rivers (ARI) with priory advantages that ARI has been especially prepared for Albanian rivers and its possibility to indicate the human interventions, where other biological parameters are not so sensitive.

INTRODUCTION

The Balkan area with its freshwaters is the home of the very diverse and highly endemic species. According to Fryhof (2010), from all European threatened fish species, 52 freshwater fishes (28%) occur in the Balkan making it as a most

important ‘hotspot’ for the threatened biodiversity in Europe and also within Mediterranean biodiversity hotspot. In recent years aquatic ecosystems in Albania are suffering from a permanent increase of pollution caused by the agriculture and urbanization.

Nowadays the biological monitoring and assessment are important components of aquatic resource management, particularly as they support the Water framework directive objectives to restore and maintain the chemical, physical, and biological integrity of surface waters. Although traditional water monitoring programs focused on chemical monitoring, water quality within WFD is already considered and practiced on biological assessments to provide critical information on ecosystem conditions. An important advantage of using biology to characterize overall condition is that biota integrates the history of stressors at a site. One of the most widely accepted bio-assessment approaches is to apply a multi-metric indicator of condition known as the Index of Biotic Integrity (IBI) (Karr, 1981; 1991). The IBI uses the characteristics of the fish assemblage to evaluate the biological integrity at a stream site. Biological integrity is defined as the ability to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of the natural habitat of the region (Karr, 1991).

Beside the existing data different aspects like diversity, distribution, and conservation status of freshwater fish in different standing and running waters are still very poorly known. The recent publications on loaches (Cobitidae and Nemacheilidae) (Šanda et al., 2008), salmonids (Snoj et al., 2009) and barbells (genus *Barbus*; Cyprinidae) (Marková et al., 2010), revealed interesting elements that need further approaches. The available sources of information for Albanian freshwaters are mostly those of Poljakov et al. (1958) who included 36 freshwater species and Rakaj (1995), 77 species. The described new species within transboundary water systems in neighboring countries (Montenegro and Greece), makes the area highly interesting (Šanda et al., 2008).

Using of fish for assessing of the water quality has been emphasized in the EU Water Framework Directive (EU, 2000) and all European country members obliged to carry out that monitoring. Albania is not an EU member, but country must show the willingness in all integration steps. The project FAME (FAME, 2004), intended to develop a universal fish index applicable in all European county members. It results to the creation of European Fish Index (EFI), based on the theory of biological integrity, but including usage of many abiotic variables. The current paper work intends to develop preliminary contribution in development and calibration of the method.

MATERIALS AND METHODS

Following the European standard EN 14011 (CEN, 2000) and specific conditions described below has been developed an index adaptation based on samples collected by electro fishing in the period of 2006-2013 in different water courses of Albania. The sampling season was concentrated in period of July-October, when is occurred the major migration process and larvae being sufficiently sizeable for recognition. The data based on sample collected in considered drainages in Albania during the period 2006–2013 include 106 different surveyed locations. For collecting fishes, portable engine or battery electrofishing gear was used. Some of the specimens collected were euthanized by over anaesthetization and preserved in 5% formaldehyde and deposited in the collection of Agricultural University of Tirana. Following the standard electro fishing for areas of 100 meters length section, 200 m^2 were covered. In that case all possible present species including young's has to be caught. In some cases for species that are sensitive to electric currents the visual method can be used.

Following FAME methodology the site selection is a crucial part of sampling itself. Other important elements to be considered are: (i) areas to at least 1 km distance from of nearest significant influx; (ii) site must be free of pollutants, migration barriers, etc.; (iii) not to be near point of flow (at least 5 km upstream) river, sea, dam or other water bodies; (iv) not situated near settlements (at least one kilometer before or after settlements); (v) not to be place of intensive angling. The main objective of the index development is to assess the rate of undisturbed fish communities and further to that to see at which scale the state is affected from the human impacts. The objectives of approaches are base don fish sensitivity and other particularities.

RESULTS AND DISCUSSION

Following this interpretation for the Albanian water we considered five groups of variables as presented in Table 1.

The most widespread native species or genera recorded here for Albania are *Pachichilon pictum*, *Alburnus scoranza*, *Cobitis ohridana*, catadromous *Anguilla anguilla*, and members of the genera *Alburnoides*, *Squalius*, *Chondrostoma* and *Gobio.* Along with these species there are in increase the non-native ones. The anthropogenic threats to populations of freshwater fishes in Albania are seriously increased in the last decades. These include fishing with non friendly methods and habitat degradation. In many areas of Albania there has been widespread logging, which began in year '70 and has continued ever since, and which has led to severe soil erosion in many places, and a consequent silting up of rivers and streams. The

river mining, gravel excavation and lack of waste water treatment facilities are directly influencing to river freshwater populations.

Table 1: Variety of considered metrics for Albanian rivers.

Metric	Expected response to the stress
Species richness and composition	
Total number of species / Total number of native species Decrease	Decrease
Number of darter species / Number of benthic fish species	Decrease
Indicator species	
Number of intolerant species	Decrease
% tolerant individuals	Increase
% pioneering species	Increase
% abundance of the dominant species	Increase
Trophic composition	
% omnivores	Increase
% generalists and omnivores	Increase
% generalists, omnivores, and invertivores	Increase
% omnivores and invertivores	Increase
% insectivorous cyprinids	Decrease
% top predators	Decrease
Fish abundance and condition	
Number of individuals	Decrease
Biomass	Increase
% of individuals with anomalies	Increase
Reproductive function	
% hybrids	Increase
% lithophilic spawners	Decrease
% native species	Decrease

The introduced species represent a serious threat in many water bodies (Prespa Lakes, Ohrid and Shkodra/Scadar Lake). They are quite common in these water bodies, where established populations of several invasive species, namely *C. carpio*, *C. auratus* and *P. parva* exist, the last mentioned of which seems to be very abundant in all these lakes. In Prepsa lakes two other introduced species *Tinca tinca* and *Lepomis gibbosus were* established. The aquaculture reservoirs along many rivers and around Lake Ohrid increase the possibility of presence of *Oncorhynchus mykiss*.

Following the current state of the Albanian rivers, that are subject of very intensive intervention with hydropower construction and damming, the case is very specific and that's way this metric takes considerable importance with highest value and weight. Also this fish as a major biotic indicator of the presence of migration barriers, the variable will indicate the stress of tendencies. Following different assessment in Vjosa, Mati and Drini River it is clear that its value depends not only on the number of migratory species, but also their age structure and the fact of its breeding capacity. Migratory species includes potamodromous species (*Chalcalburnus* sp., *Alburnus* sp., *Chondrostoma* sp., etc) and long-distance migrants (*Anguilla anguilla*, *Alosa* sp., *Mugil* sp., etc).

Generally in case of Albania for the highest rivers zone (above 500 m a.s.l.) the migratory species has to be replaced by *Salmo* sp. Easily can be assessed that response to anthropogenic pressure brings to deteriorates of the status of migratory species (Table 2).

Table 2: Metrics and their maximum weight in calculation of index.

Selected metrics		Maximum score
1. Status of predatory species	or/1a. Status of indicator species	10
2. Status of migratory species	or 2a. Status of brown trout population	25
3. Relative number and status of sensitive species		20
4. Tolerance of dominant taxa		15
5. Total number and biomass		5
6. Relative number of alien species		10
7. Species richness		15
Total		100

Actually ones we start in establishing an index following FAME methodology the basic consideration is that the systems itself have to be not affected by the human interventions. So, the index itself has to show the rate of 'shifting' from that conception. In such an option there is large variation of sensitive and tolerant species establishing solid populations. Definition of fish species in certain region and the types they present is an essential element for the calculations. The correlation between biotic indexes and rate of dominance by groups is made after Nastase et al. (2009).

The sensitive species are scored with following rating: when they represents > 40% of all species, numerous with well balanced age structure with 20 scores; 20-40% of all species, prevalence of one age group with 15; <20 % of all species with 10 and Single individuals with 5 scores.

The all variable and metrics are organized according to Mihov (2010) and total scoring in presented in table 3.

Table 3: Total scorings for index values.

Status class	scores
High	>0,86
Good	0,60 - 0,85
Moderate	0,30 - 0,59
Poor	0,16 - 0,29
Bad	<0,15

The migratory species group present with more than one species they are scored with 20 points; with one species well presented with all edge groups with 15; one species with not well presence in edge structure with 10 and single individual with 5 scores.

Following the preliminary preparations the testing procedure was implemented in five different rives and data are presented in Figures 1 and 2, and table 4.

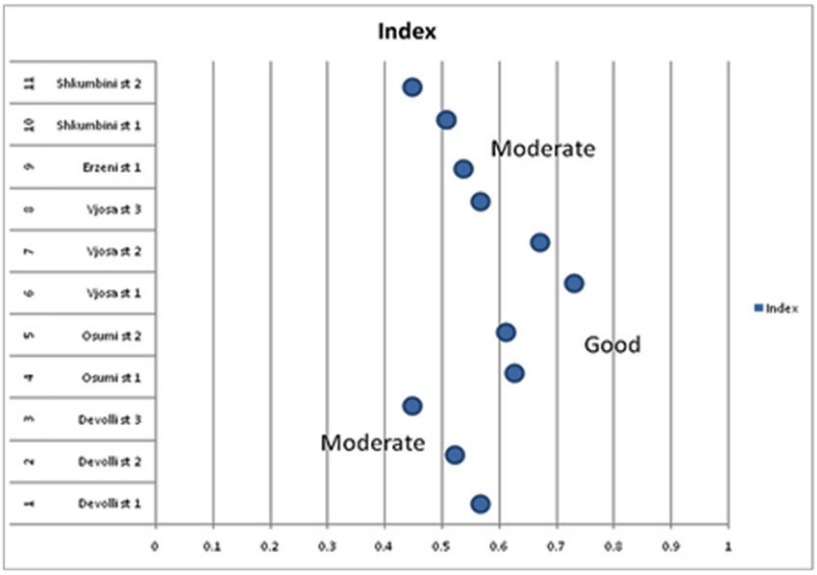

Figure 1: Fish index for several Albanian rivers.

After the calculation of scores for all variables predicted the process follows with final estimation of indexes. The sum of the resulting score is divided into 100 and compared with the table with index scores and classes to determine the quality class of the river under requirements of the Water Framework Directive. Following

that the testing has been developed for several rivers in Albania and data are presented in following table 4.

Table 4: Testing of index for several Albanian Rivers.

River station	Year	Index	Status
Devolli st 1	2010	0,49	Moderate
Devolli st 2	2010	0,51	Moderate
Devolli st 3	2010	0,58	Moderate
Osumi st 1	2012	0,62	Good
Osumi st 2	2012	0,61	Good
Vjosa st 1	2013	0,67	Good
Vjosa st 2	2013	0,72	Good
Vjosa st 3	2013	0,77	Good
Erzeni st 1	2013	0, 55	Moderate
Shkumbini st 1	2011	0, 44	Moderate
Shkumbini st 2	2011	0,51	Moderate

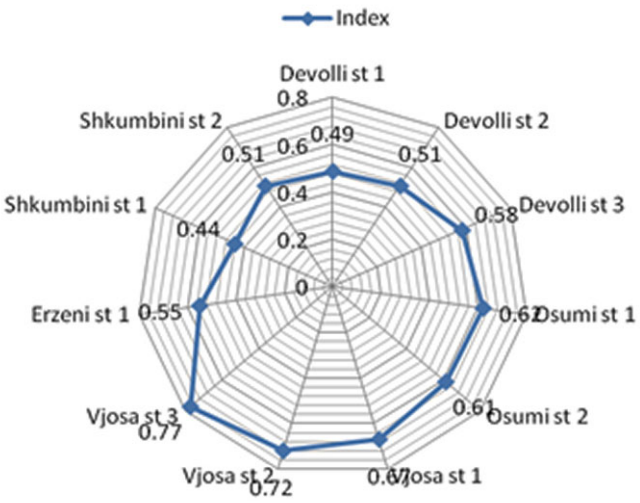

Figure 2:
Calculated Fish Index values for several Albanian rivers.

Table 5: Fish species and particularities.

Species	Predatory species	Migratory species	Sensitive species	Less tolerant species	Tolerant species	Alien species	Indicators of damming influence	Indicator species
Alburnus spp.				X				
Alburnoides spp.			X					X
Alosa spp.		X	X					
Anguilla anguilla (Lnnaeus, 1758)	X	X	X					
Barbus spp.				X				
Carassius carassius (Linnaeus, 1758)			X			X		
Carassius gibelio (Bloch, 1782)					X	X		
Chondrostoma prespensis (Karaman, 1924)		X	X					X
Chondrostoma ssp.		X	X					X
Cobitis spp.			X					
Cotus spp.			X					
Gambusia spp.						X		
Gobio sp.				X				
Lepomis gibbosus (Linnaeus, 1758)					X	X		
Oncorhynchus mykiss (Walbaum, 1792)					X			
Oxynoemacheilus pindus (Economidis, 2005)			X			X		
Pachichilon pictum (Heckel&Kner 1925)								
Pelasgus prespensis (Karaman, 1924)			X					X
Perca fluviatilis (Linnaeus, 1758)	X						X	
Phoxinus ssp.			X					
Pseudorasbora parva (Temminck & Schlegel, 1846)					X	X		
Rhodeus amarus (Bloch, 1782)				X				
Romanogobio ssp.			X					
Rutilus spp						X	X	
Rutilus prespensis (Karaman, 1924)				X				X
Salmo ssp.			X					X
Sander lucioperca (Linnaeus, 1758)	X					X	X	
Squalius ssp.				X				
Squalius prespensis (Flowler, 1975)				X				

Ones we test the index, there are many problems in terms of application for the Hellenic Western Balkan eco-region, as it has been classified by the FAME consortium. To that fact the index itself in case of Albanian rivers is an adaptation following neighboring eco-regions. Further to that the list of species and other elements has to be arranged.

CONCLUSIONS

Albania is not an EU member country and Directive 2000/60/EC of the European Parliament and of the Council is not an obligatory one. Looking to its EU integration processes there is necessity for advances in field of water policy that has to be in line with EU in order meet all the requirements of the WFD.

The calculated index for certain rivers is a reflection of their integrity and intends to establish local values and give different weight to the variables upon the specific national condition.

The current survey represents the first attempts for developing an Albanian River index based on fishes, while there is missing the river classification and typology development.

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RECEIVED: 21 September 2013.