



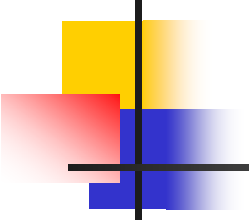
Biological evaluation

Andelka Mijatović



Habitats

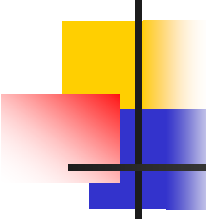
- Habitat is, from ecological point of view, location (e.g. plain, rock, river beds, forest, etc.), where organisms live (plant, fungi, and animal) or biological community (Biocoenosis).
- Habitat with biological community (Biocoenosis) makes higher unit which is called ecological system (Ecosystem).
- Diversity of certain habitat is in close connection with geographical location, indentedness of the relief, geological, climate and hydrographical circumstances and human influences.

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- By different actions in the area, many of the habitats are endangered and some of them are already destroyed. Consequently, many types of organisms are endangered and some of them are considered to be extinct in this area.



Endangered habitats

- Habitats noted as endangered in Croatia are shown in the Table.
- According to: Antonić, O.; Kušan, V.; Bakran-Petricioli, T.; Alegro, A.; Gootstein-Matočec, S.; Peternel, H.; Tkalčec, Z. (2005): Habitat classification of the Republic of Croatia. Drypis 1/1 : 1-12.

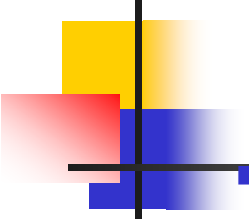


Stanišni tip	NATURA	PHYSIS	NKS
Panonski slani travnjaci	1340	15.4	C.37
Vrištine bujadnice s običnom borovicom	5130	31.882	D1215
Karbonatna vrela	7220	54.12	A34
Cretne brezove šumice na sfagnumskom cretu	91D0	44.A12	E327
Galerije oleandra	92D0	44.81	D322
Šume i nasadi pinije i primorskog bora	9540	42.80	E8210
Sedrotvorne riječne zajednice		24.422	A35
Sedrotvorna vegetacija na slapovima		24.423	A36
Kompleks	NATURA	PHYSIS	NKS
Estuariji	1130	11.2, 13.2	K1
Obalne lagune	1150	21	K2
Velike plitke uvale i zaljevi	1160	12	K3



Explanation of abbreviations from the table

- **NATURA** – NATURA 2000 is ecological network of European Union which includes areas important for preservation of endangered species and habitat types. This program that is basic protection of nature in EU, emerges from Council Directive on the conservation of wild birds (Council Directive 79/409/EEC) and Council Directive on the conservation of natural habitats and wild fauna and flora (Council Directive 92/43/EEC).
- **PHYSIS** – data basis on habitat types created in Institut Royal des Sciences Naturelles de Belgique.
- **NKS** – National habitat classification is data basis on habitats in the Republic of Croatia.

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- On the area Tihaljina - Mlade several habitat types can be named, which, by the table above, can be sorted as endangered habitats.

- Those are, first of all, petrifying springs, where we can name spring of Tihaljina in Peć Mlini and spring of Modro oko – left confluent of Mlada river; Calcareous river communities that are spread all around mentioned area, bigger or smaller and Calcareous vegetation on falls on which, unfortunately, we don't have recent information, thus it wasn't possible to assess degree of endangerment. Only existing data are from 1963.



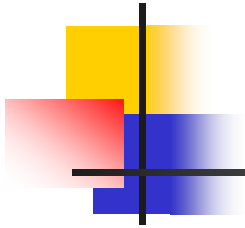
Tihaljina spring

- is a spring revolving type, with strong water aeration and rocky ground, wells, under pressure, on the surface from underground and crates a spring. Limestone wells are specific, form which, in the raining period, a great quantity of water pours out, and suddenly creates strong stream and during dry periods it dry out



Tihaljina spring



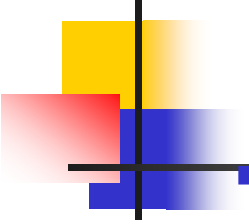


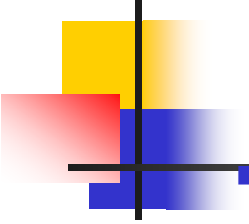
- Representatives, so called krenobionti, among spineless are some crustaceans (*Fontogammarus dalmatinus*, *Gammarus balcanicus*, *Gammarus Fossarum*, *Niphargus castellanus*), insects larva from the groups *Diptera* (*Atherix* spp.), *Ephemeroptera* (*Baetis rhodani*, *Ecdynurus* spp., *Ephemerella* spp.), *Odonata* (*Cordulegaster*), *Plecoptera* (*Leuctra* spp., *Protonemura* spp.) and *Trichoptera* (*Drusus synagapetus*), water ambrosia beetles (*Helmis* spp.), turbellaria (*Crenobia alpina*), snails *Ancylus fluviatilis* and *Belgrandiella*, *Bithynia*, *Dalmatella*, etc. (Matonićkin & Pavletić 1972)
- This type of habitat is considered as unique ecological unit in which few factors can vary, and that is the flow and water staleness, and vegetation capping which can influence to foundation and habitat shading

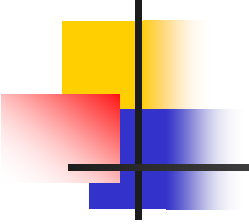


Travertine-forming riparian communities

- Development of calcareous sinter is formation of calcareous barriers and waterfalls on the Trebižat River.
- Community of calcareous creators is very sensitive because it depends on a combination of several conditions, and especially on fresh clean water.
- Creation of calcareous is complex process in which are involved many physical and chemistry and biotic factors.
- In the summer time temperature of water is always higher than temperature of sedimentation limit of 14°C.

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- Calcareous layers grow slowly and occur in those parts of the river or the spring where splashing and aeration of water is very intensive.
 - However, for the creation of calcareous layers presence of certain organisms is necessary, especially hygrophyte and hydrophytes moss and algae.
 - At lower speed of flow number of organisms populate, which then by their vegetative bodies or creations keep excreted particles of calcium carbonate and create calcareous layers, which grow along with growth of calcareous organisms.
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 - The most optimal speed is 1-2 m/s, where tehv biggest number of calcareous organisms is retained.

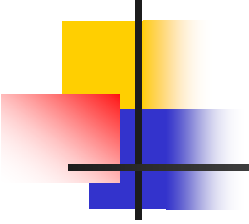
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- In the creation of calcareous layers participate not only plants, moss or algae but some animals also (Matoničkin & Pavletić 1972).
 - At big old barriers in natural vegetation succession occur woody species, mostly willow and alder, which can destroy them with their roots.
 - Same destroying effects have changes of water regime, i.e. periodic insufficient water flow.
 - If they run out of water, calcareous organism die, and barriers can cave in (Nikolić 2006).
 - Recommended safety measures are: keep sufficient constant flow of clean fresh water and prevent barrier covering with woody species.

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- According to Environmental protection law of B&H, **protected environmental objects on Trebižat River are:** Travertine-forming around Kravice waterfall, which is one of the geological monuments of the nature, and geomorphologic monuments, are: Tihaljina spring in Peć Mlini, Vrioštica spring in Vitina and Koćuša, Kravice and Bučine waterfalls.



Results of the previous researches on Trebižat River (Tihaljina and Mlade)

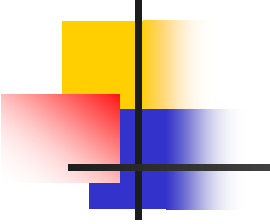
- Matoničkin, I. & Pavletić, Z. 1963. Sudjelovanje pojedinih životinjskih i biljnih skupina u izgradnji životnih zajednica na sedrenim i erozijskim slapovima Bosne i Hercegovine. Iz Biološkog instituta i Instituta za botaniku Sveučilišta Zagreb.
- In this paper biological communities are mentioned (flora and fauna) which are involved in building travertine-forming waterfall Kravice on Trebižat River.

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- Bogut, I., Pavličević J., Ivanković, S., Petrović, D., 2003. Kvalitativni i kvantitativni sastav ihtiofaune rijeke Trebižat. Znanstveno stručni simpozij s međunarodnim sudjelovanjem Voda u kršu slivova Cetine, Neretve i Trebišnjice, Zbornik radova, Neum. Parts from this paper are mentioned further in the text titled Ihtiofauna.



Aquatic and Littoral Flora

- For distribution of water and swamp plant communities the most important factor is water, and especially water level in ecosystem (Fernández – Aláez and associates 1999., Jasprica and associates. 2003).

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- In the paper are noted two categories of endangerment of certain plant species, according to:
Šilić Č., 1996: List of botanical species (Pteridophyta and Spermatophyta) for the Red book of Bosnia and Herzegovina. National Museum of Bosnia and Herzegovina, Sarajevo.
 - System of endangerment evaluation consists of following categories:

Ex – extinct-vanished species

Ex? – probably extinct species

E – very endangered species

V – endangered and vulnerable species

R – rare or potentially endangered species

K – insufficiently known species.



Sampling sites

- Aquatic and litoral flora were analysed on 5 sampling sites:
 1. Peć – Mlini upstream:(sampling site T1)
 2. Peć – Mlini downstream:(sampling site T2)
 3. Blue – eye spring: (sampling site T3)
 4. The Kavasbaša's bridge:(sampling site T4)
 5. Grabovo vrelo: (sampling site T5)



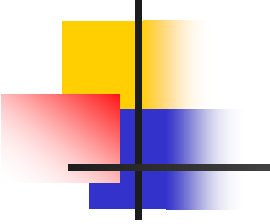
Materials and Methods

- Analyses at sampling sites T1, T2 and T3 were done in the year 2007 in the context of PhD thesis.
- Field researches are done during 2007 (at sampling sites 4 and 5) and in 28 th of April 2008, when water level was rather high.
- The families are determined by use of standard keys and iconography for determination (FIORI 1923 – 1929, 1933; TUTIN et all. 1964 – 1980; TRINAJSTIĆ 1975 – 1986; PIGNATTI 1982; DOMAC 1994; BURNIE 1995; DELFORGE 1995, 2001; BLAMEY i GREY – WILSON 1998). The plants are collected and put in Department of Biology, Faculty of science and education, University of Mostar.



Research results

- T1: Peć – Mlini upstream
- On a rocky bottom, individually in smaller turfs, water moss *Fontinalis antipyretica* occurs. The *Fontinalis antipyretica* moss is important specie by water springs where it builds distinctive biological community *Fontinaletum antipyreticae* (Jasprica 2001). That is a community of very polymorph moss on rocks by the springs where the water is fast. Approx. 0,5 m long turfs detach by water flow and can be found floating on the water surface

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- In shallow, not too fast water, by the shore where the ground is rocky – gravel developed are *Sium erectum*, *Mentha pulegium*, *Rumex obtusifolius*, *Rorippa amphibia*. On the rocks by the stream, which are exposed to the light and have enough humid, are developed *Campanula frenestellata*, *Hepatica nobilis*, *Parietaria judaica*, *Lysmachia vulgaris*, *Umbilicus horizontalis* and other. On half-caves and caves next to the spring, which are in the shadow, following species are noted *Adiantum capillus veneris*, *Asplenium trichomanes*, *Polystichum lochitis i* *Polypodium vulgare*.
 - Species noted on this site are characteristic for mentioned habitat types.



T2 - Peć – Mlini downstream

- Broomrape family is very rare on this area. Species like *Ranunculus trichofilus*, *Sium latifolium* and *Potamogeton crispus* occur individually and are noted by the bank of river at time of the lowest water level. As there is no higher plants in water system, the role of primary producer take algae. Lack of plentiful water vegetation can be explained by type of river bottom (rocky), banks (steep and rocky), great quantity of water and big flows. All of that makes impossible for water vegetation to root in the ground. Recorded botanical species are at higher parts of banks which are periodically splashed.



T3 - Blue eye spring

- The Blue eye well, which forms small creek, is left confluent of Trebižat River. Water spurrs out from cave and bottom of white sand (it is assumed that water erupt it from the cave). Water is transparent and bottom can be seen clearly. Among water plant species recorded is, at deeper level, *Potamogeton pectinatus*. In case of shallow water, by the banks, recorded are *Mentha pulegium*, *Mentha aquatica* and *Ajuga reptans*. At the higher level of banks there are *Phragmites australis*, *Asplenium petrarchae*, *Thelypteris palustris* and other. Little bit further, on flooded meadows, which, in the time of cause, were under water, where the ground is soft and muddy, recorded are *Edraianthus graminifolius*, *Galium lucidum*, *Limodorum abortivum* and other. At this locality anthropogenic influence is almost insignificant, and vegetation is specific for this ecosystem.



T4 - The Kavasbaša's Bridge

- Downstream from Kavabaša's Bridge on the right side, where sandy and not so rocky bottom, in shallow and still water up to 1 m is developed swamp vegetation from the Phragmitetalia family. Vegetation is well developed. Communities of this family present usual developed vegetation in which development is often involved great number of flora species. Swamp vegetation is here developed better than water vegetation, it is assumed that it is because in the time of cause, water level was very high and flow was very fast. At this locality, especially noted is species *Iris pseudacorus* which is in B&H, besides here, recorded only in Hutovo Blato. According to ecological conditions and habitat type, recorded botanical species are characteristic



T5 - Grabovo vrelo

- At this locality the ground is very sandy. In still and deep water, where the current isn't strong, a types of storks occur periodically *Myriophyllum*, *Nuphar lutea* i *Nymphaea alba*. These types take small areas. In the deepest parts, regardless of the current, there is complete underwater meadow of pondweed. This comes to expression especially in time of low water level. Swamp vegetation in which *Phragmites australis* dominates is very rich and developed here, as slower current of water and light suits it, because there is no woody vegetation at the banks, which would create shadow.



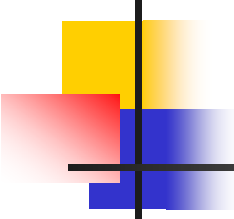
Conclusion

- Water regime determines the plant – species composition in the studied area. It is significant for plant communities at the beginning of the vegetation period as well as its dynamics in the course of a year.



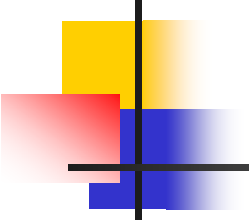
IHTIOFAUNA

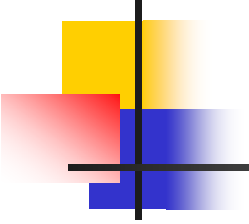
- According to information from Bogut, I., Pavličević, J., Ivanković, S., Petrović, D., 2001, Qualitative and quantitative content of ihtiofauna of Trebižat River, at the part of the river Tihaljina i Mlade, following fish species are recorded:

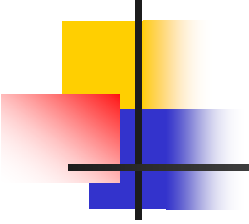
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- With every mentioned type there is category of endangerment according to: Mrakovčić, M., et al. (2007): The Red book of freshwater fish in Croatia. National Institute of Environment Protection, Zagreb.
 - CR – critically endangered – there is an extremely high risk from extinction.
 - EN – endangered – there is an extremely high risk from extinction;
 - EN – risk – there is a high risk from extinction;
 - DD – not known enough – there isn't enough information for assessment of the risk from extinction (population and distribution state).
 - Endemic specie is labeled with the star beside the category.

Vrsta ribe	Crvena knjiga BiH
Potočna pastrva <i>Salmo trutta m. fario</i>	VU
Kalifornijska pastrva <i>Oncorhynchus mykiss</i>	-
Bijeli klen, kljen <i>Leuciscus cephalus albus</i>	VU
Strugač, svalić <i>Leuciscus svallize</i>	VU
Masnica, žutalj, babur, mazenica <i>Rutilus rubilio rubilio</i>	VU
Keljavac, peškelj <i>Scardinius erythrophthalmus scardofa</i>	VU
Podustva <i>Chondrostoma kneri</i>	DD
Šaran <i>Cyprinus carpio</i>	EN
Linjak, cinkva <i>Tinca tinca</i>	EN

Vrsta ribe	Crvena knjiga Hrvatske
Potočna pastrva <i>Salmo trutta m. fario</i>	VU
Neretvanska mekousna <i>Salmothymus obtusirostris oxyrhynchus</i>	CR*
Kalifornijska pastrva <i>Oncorhynchus mykiss</i>	-
Bijeli klen, kljen <i>Leuciscus cephalus albus</i>	VU
Strugač, svalić <i>Leuciscus svallize</i>	VU
Podustva <i>Chondrostoma kneri</i>	EN*
Masnica <i>Rutilus rubilio rubilio</i>	VU
Keljavac, peškelj, lola <i>Scadinus erythrophthalmus scardofa</i>	DD
Linjak <i>Tinca tinca</i>	-
Šaran <i>Cyprinus carpio</i>	EN
Imotska gaovica <i>Phoxinellus adpersus</i>	VU*

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- In the upper flow of Tihaljina river water current is the strongest and temperature is the lowest. Quantity of resolved oxygen is rather considerable, and there is very little of waste substances. This area is populated with brown trout (*Salmo trutta m. fario*). There is none of these in the waters with temperature higher than 20°C.
 - Next, downstream water current is strong, the water is rich with oxygen, but with rather high temperature. The bottom is boulder. At the bank area vegetation is rather developing, and is routing in drift of boulder and sand. In this area characteristic are these fish types: White chub, scraper, scardinius plotizza and rainbow trout

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- Different fish species which live in certain area of the river can be sorted out according to the way of spawn. One spawn on places where - water flows on gravel, and other in more slack waters - on plants.
 - For those that spawn on plants it is important to so called soft progress and hard water plants retrogress. Myriophyllum, Ceratophyllum, Ranunculus fluviatilis and different types of pondweed (Potamogeton) are representatives of soft water plants.

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- None of the freshwater fish hasn't been legally protected. Practically, protection of the majority of species can be implemented only by protection of their habitats, what asks for action plan for each species.