

## **EXPLORATION METHODS AND DEVICE SYSTEM FOR ANALYSIS AND COGNITION OF THE ENVIRONMENT**

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### ***Abstract:***

*Sets of tests to adequately analyze the environment in a complex way are practically non-existent. The few that exist are focused on some particular, narrow area, primarily examining inanimate environmental factors. As the result of my researches, a set of tests was compiled to examine the following: Microclimatic and air quality values, establishing the level of air pollution by observing bioindicators, testing the reducing effect of vegetation on noise pollution, testing the soil from the ecological aspect, evaluating the condition of natural waters by observing bioindicators, geological and geomorphologic observations, examining characteristics and quality indicators in communities of living organisms.*

*Each test is built on the principle of practical evaluation of the environment: When examining the conditions in a biocoenosis, both the qualitative and quantitative biological composition, and also the abiotic factors causing the particular distribution in space and time are taken into consideration as characteristic traits.*

### ***Keywords:***

*Qualification of Environment, Matter-of-fact Environmental Qualification, Qualification of Natural habitat, Ecological Qualification of Environment, Supraindividual Biological Qualification of Environment*

## **INTRODUCTION**

Sets of tests to adequately analyze the environment in a complex way are practically non-existent. The few that exist are focused on some particular, narrow area, primarily examining inanimate environmental factors. The majority of these tests are chemical quick tests to detect the presence and level of a specific substance polluting the environment. The results are descriptive observations, merely stating facts, without offering any explanation for the causes of different phenomena, simply providing factual data measured in a particular moment in time. Based merely on these results, it could be hard or impossible to make any responsible suggestion regarding environmental or land development issues.

## **MATERIALS AND METHOD**

Field explorations can be analytic and holistic. The analytic explorations are observations completed with the help of the proper measurement instruments. The results of the measurements and the measurements themselves are specified, the received results demonstrate specific characteristics regarding the environment, providing one specific information (for example measurement of noise).

In the case of the holistic field exercises the impressions operate in their completeness.

They refer to the character of the habitat, they aim at defining its main features which were formed as a result of the simultaneous influence of the environmental aspects. Instead of instrumental measurements, the most prominent methods are the subjective sense impressions, experience, the individual or group information compilation is dominant for this type of examination. Regarding the content of information these examinations are characterized by versatility.

Regarding their contents the field explorations aim at the cognition and measurement of the state of the living and non-living elements of the environment, therefore they can be systematized in the following categories:

Another way of categorizing the explorations is according to scientific fields:

- geological, examinations of the relief (available stone types, defining the minerals, drawing of block-segments)
- examinations of the soil (examinations of the features regarding physical features and chemical features of the soil, types of soil, structure of the soil)
- Examinations of the micro-climate and air pollution (temperature, humidity, strength and direction of the wind, air pressure and strength of sunlight)
- Water examinations (physical and chemical features of the water)
- Area characteristics of plant associations, examination of the vegetation (number of individuals, coverage, sociality, life capacity, fidelity)
- Examination of animal associations (at the level of tree-crown, on tree trunk, in the tree trunk, at bush level, at grass level, at moss level, in the soil)
- Complex examination of biocoenoses, coenological recording

This two-type categorization does not mean significant difference regarding the aims and content of the examinations. The traditional categorization comprising geological, soil, climatic, hydrological examinations aims at the analysis of the abiotic environmental aspects, while the botanical and zoological examinations provide for the characterization of the living elements.

However, the approach and accordingly the examination methods differ. The scientific field categorization does not specify cause-consequence except when completing the complex examination of biocoenosis. The latter comprises all the examination fields and for this reason, it is worth to complete the analysis using this method.

Within the framework of the current presentation I have systematized the examinations using the ecological approach aiming at the education of sustainable development. The observations, tasks regarding the formal and biological characteristics of the living creatures, their tolerance, adaptability, community-sociality behaviour have been placed in their natural habitat and have been analysed in close interaction. The causes for the transformations in the living systems cannot be analysed without the recognition of the non-living components of the environment.

Regarding from the environmental analysis aspect the majority of the examinations (with the exception of the noiselevel measurement) are holistic by character. Instrumental measurement tasks comprise certain segments of the observation tasks (i.g. measurement of temperature, humidity, speed of wind).

## RESULTS

### 1 Examination of natural water with the help of biological indicators

According to contemporary ecological concepts the natural relief entities can be classified into three types regarding types of habitat (*Dévai Gy. 2004*)

- Aquatic habitat, with surface-ratio average depth of more than 2 meters at mid water level where no macrovegetation can be found
- Semi-aquatic habitat are natural entities, which average depth at mid water level does not exceed two meters, or such parts of deeper water basins which have at least one-third of their surface covered by macro-vegetation (tongue, sea-weed, marsh or margin plants), and also areas which surface is covered with hydromorph soil (reed and marsh plants or soft or tough wood)
- Terrestrial habitat are areas with no water surface, and where upper layers of soil are not constantly waterlogged (only temporarily and for a short period)

The examination of the features of the microclimate, the stones, the relief, the soil, the aquatic features of the area can provide data and knowledge about the characteristics of the habitat and the state of the abiotic environmental aspects.

To complete these examinations nowadays, apart from traditional devices, there are a number of so called environment-examination sets to be used in the field, which contain the most necessary devices and materials in a form which can be easily and safely transported (portable environment-examination set) (see soil and water examinations).

In my presentation among the examinations aiming at the state of the non-living environment I have pointed out the living creatures as examination modes measurable by indicators, as an example evaluating the condition of natural waters by observing bioindicators.

These proceedings do not require serious chemical analysis or complex technical equipment, therefore they are significantly cheaper. Nonetheless they provide reliable information about the state of the environmental aspects.

Biotechnological proceedings are becoming more widely-accepted; for water- and soil qualification the application of biological indicators is indispensable nowadays.

#### 1.1 Determination of the ecological state of water currents, the quality of water with the help of BISEL method

**Task.** Getting sample from 10-20m deep running water current with the help of a metal-framed hand net (*Figure 1*). For currents not wider than 2 meters time of sampling is 3 minutes. Sample areas are places such as waterbed grit (earth), area with macro vegetation, zones of tree roots. Separation of the living creatures, found in the sample water through a multi-holed sieve, then with the help of a categorization tray determining the number of numbers of the various taxons (a tray with surface 30x50 cm, divided into squares. Defining types of species with the help of a species defining manual. Fixing the results of the observation and examination on a work-sheet. Classification of the quality of the water, defining hue using BISEL method.



Figure 1 The condition of natural waters evaluation by observing bioindicators (The figure 1 is the author's work)

Guideway for BISEL method:

- 1). Defining number of considerable toxons (crossing out toxons, which are represented in the sample by only one piece)
- 2). Defining the most sensitive toxon (Plecoptera /Figure 2, 3/, after that Trichoptera /Figure 4/)
- 3). Calculating the biological Index denoting the water quality by observing the number of types of toxons and the number of pieces of the most sensitive toxon.



Figure 2 A *Capnura manitoba* male larva, B *Capnura manitoba* adult ([www.discoverlife.org](http://www.discoverlife.org))





Figure 3 A *Alloperla petasata* larva B *Alloperla petasata* adult ([www.discoverlife.org](http://www.discoverlife.org))



Figure 4 A *Phryganea grandis* larva, B *Phryganea grandis* adult ([www.discoverlife.org](http://www.discoverlife.org))

**Anticipated results with application of knowledge-processing methods.** The BISEL method is suitable for ascertaining the fact of water contamination on the basis of the reaction of macro invertebrate indicators. Biological Index calculated on the basis of the bioindication of low tolerance special species, where variations in the quality of water are marked by different colours.

In the case of a large quantity of organic substances as a result of biological disintegrating processes the oxygen content of the water decreases, therefore some species among the macro invertebrate decrease by number, or the species may disappear entirely from the water.

The most sensitive species are Plecoptera, Trichoptera and Ephemeroptera (Figure 5), the most tolerant are Tubificidae (Figure 6), Chironomidae (Figure 7), and Syrphidae.

Biotical Index is a scale numbered 1-10, where the higher number denotes the availability of more sensitive species, which expresses the level of water adequacy (small amount of contamination).



Values 0-5 denote contaminated water, at value 0 all species are absent from the water, except the the group of Eristalinae (Syrphidae). Applied together with chemical methods, this method allows the deduction of the causes of contamination.



Figure 5 **A** *Ameletus browni* larva, **B** *Ameletus browni* male adult ([www.discoverlife.org](http://www.discoverlife.org))

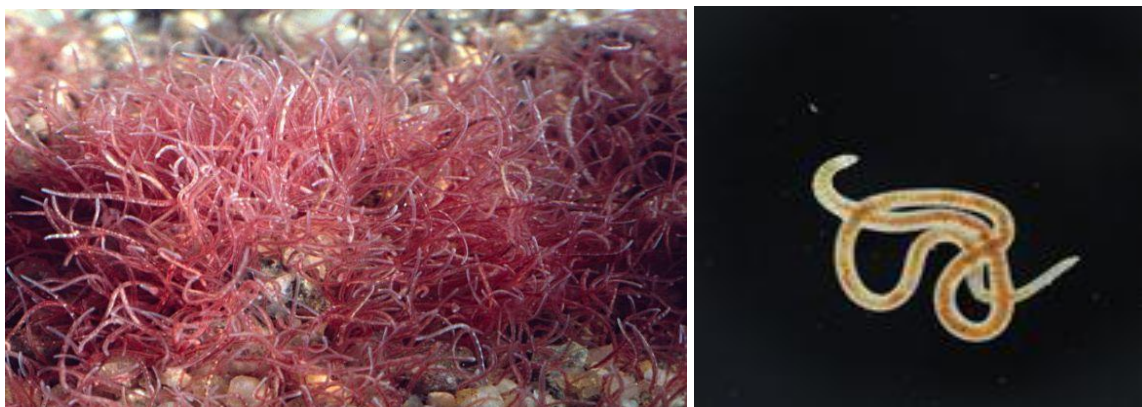


Figure 6 **A**, **B** *Tubifex* Worm Tubificidae ([www.animalsandearth.com](http://www.animalsandearth.com))



Figure 7 **A** *Chironomus plumosus* larva ([www.natur.cuni.cz](http://www.natur.cuni.cz)), **B** *Chironomus plumosus* adult  
(no.wikipedia.org)

## 1.2 Defining the anaerobic state of the water, demonstrating its sulphur-hydrogen content

Task. 1. Warming of a sample of water in a test-glass the experienced smell reminds of rotten egg, as a control observation filter paper saturated with solution of lead-nitrate is placed at the mouth of the test-glass.

Task. 2. Microscopic examination of water.

Anticipated results with application of knowledge-processing methods. Significant presence of sulphur-hydrogen in the water suggests anaerobic conditions. The lead-nitrate is blackened by the influence of sulphide ions.

Sulphur bacteria, Thiocystis, Chromatium, and Beggiatoa species (*Figure 8*) point to insufficient clarification level, the formation of hydrogen sulphide, and the stage of putrefaction due to oxygen deficiency. A significant increase in the number of these bacteria results in a white, “furlike” coating. The presence of nematode bacterium Thiotrix nivea (*Figure 9*) is an indication of the final stage, the ultimate putrefaction of water: hydrogen sulphide indicator. This stage can be avoided if the other indicators are paid attention to in a timely manner.



*Figure 8 Beggiatoa thread (magnified 400 times)*

## 1.3 Complex examination of the water with the help of an environment –examining bag and environment analysing set

The fact of water contamination can be established with the help of the bioindicator examination described above. For defining level of contamination on location the portable environment-examining bag can be applied successfully. It is suitable for demonstration of halogenous elements in the water (chlorine, bromide, iodine), oil, iron, lead, sulphates, nitrate ions, ammonia ions.



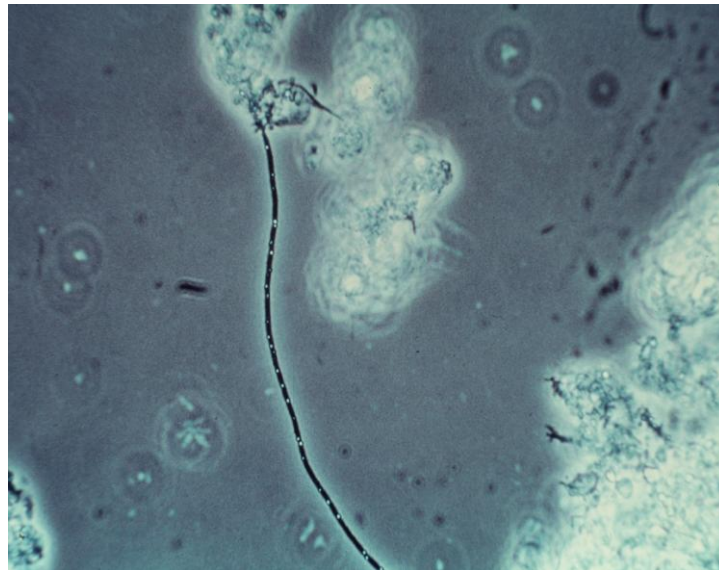


Figure 9 Thiotrix nivea (magnified 400 times)

#### 1.4 Defining surface forming influence of water brooks (currents) by defining water speed and water runoff

**Task.** Defining speed of water flow (m/s) at a measured distance (m) besides the measurement of the flowing time of an object placed in the water. Measurement of the average width of waterflow (with a tape-measure) and average depth (with a planked and measured stick). On the basis of data regarding width, depth and speed calculation of the water runoff of the water flow (m<sup>3</sup>/s).

**Anticipated results with application of knowledge-processing methods.** The runoff of flowing water, its speed and surface forming activity show correlation.

## DISCUSSION

Zoocoenoses can be characterized by defining the animal species, which they comprise of, and the number of individuals, which live within the biocoenosis (number of individuals and frequency of appearance).

The characteristics of quantity conditions of animal associations, their numerical values can be acquired by recording data of zoocoenoses. Thus, various animal associations can be compared:

Formula of Sorensen: $K_s = \frac{2cX100}{a + b}$
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In this formula „a” is the number of taxons recorded in the first zoocoenosis on the basis of the survey, „b” signifies the number in a different zoocoenosis, „c” signifies the number of taxons which can be



found in both „a” and „b” associations. The two survey result can be considered similar if **Ks**. The two survey result can be considered similar if **Ks** >50%.

During recording data of zoocoenoses quantity data refers to numerical characteristics. The absolute characteristics are abundance and production, relative characteristics are dominance and weight-dominance.

Among structural characteristics the most important is constancy, which expresses the percentage of the examined area (or cubic content) where a species (type) appears.

## CONCLUSIONS

Richness of species in a given area, i.e. its diversity is an outstanding quality indicator. It reflects the number of different populations which exist in a given area, and the number of individuals in each type.

$$D = \log M - 1/M \sum f_i \times \log f_i + f_2 \times \log f_2 \dots f_n \times \log f_n$$



(**D** = diversity, **M** = totality of individuals, **f<sub>1</sub>** ....**f<sub>n</sub>** = the number of individuals in a given type)

Diversity is increased by the variety of the environmental aspects, and the relative constant value of the living conditions. The greatest advantage of diversity is that it provides genetic variety (within the population and among populations), and the greater the diversity of the hereditary information among the living creatures in a given area, the greater the probability that a larger number of species can adapt to potential changes in the environment, therefore the total flora or fauna of the area is less likely to perish.

The aim of the measurement of conditions during the field practice is qualification, the determination of the consideration significance (weight) of a given living community.

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