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Biological Quality Assessment of Water Courses : Methods for Selecting Reference Sites

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The protection of watercourses is an integral part of the sustainable development of the territory. Watercourses provide homes for biodiversity, irrigation water reservoirs, groundwater recharge sites and drinking water supply taps. But the anthropization of watercourses remains considerable. Discharges of domestic and industrial effluents as well as the use of chemicals in agriculture are the main contributors to watercourses pollution [1,2]. The characterization of pollutants presents in surface water using Physico-chemical measurements does not always allow us to know their impact on the living environment. In order to protect watercourses, it is imperative to assess their biological quality with the help of biotic index based on macroinvertebrates, macrophytes and microalgae [3]. The biotic index provides information on the effects of substances on aquatic ecosystems [4,5]. The classification of biological quality of a mass of water is established by comparison with a reference ecological status in which the mass of water should be found outside of any anthropogenic impact.

The assessment result of a biotic index of a mass of water is compared to a reference score obtained under natural conditions not impacted by human activities [6]. The biotic index is expressed in Ecological Quality Ratio (EQR).

EQR Score = Observed Index Score / Benchmark Index Score

The result of the EQR is a ratio on a scale of 0 to 1. There are five classes (High, Good, Moderate, Poor and Bad).

The Ecological Quality Ratio of a biotic index of watercourses, it is necessary to define the reference value of the index under reference conditions.

The reference value has two uses:

I. Be able to convert metric values into EQR.

II. Set EQR class limits.

Below, here are some explanations.

Several indices were not initially designed to assess biological quality in relation to a reference situation, implicitly the value of 20/20 was considered as a universal reference value (the IBGN in France for example). It is only secondarily that the quality class limits have been adapted to consider the typology of watercourses.

For the second generation indices (the I_2M_2 in France, for example), the reference values were calculated from sampling campaigns carried out on sites with the lowest possible anthropogenic impact (all candidate stations were characterized in terms of both water quality and hydro morphological quality). These values are defined by "watercourses type". The types of watercourses have been defined according to their size (5 classes: (High, Good, Moderate, Poor and Bad) and their hydro ecoregion which correspond to homogeneous zones in terms of climatic and hydro/morpho/geological conditions) [7-9].

The reference values for each type of watercourse can be calculated with a minimum number of operations, two to three campaigns over contrasting seasons in terms of temperature/ hydrological regime/ possible development of aquatic plants, but on several sites (ideally at least 3) comparable from a typological point of view. If these campaigns are repeated two consecutive years, this will give a good idea of the spatio-temporal variability of microbenthic communities (macroinvertebrates, macrophytes, microalgae) on this type of watercourse, under conditions of "less anthropic impact".

To validate the status of "reference site" for each of the stations in your sample, it would seem appropriate to carry out at least one fairly complete campaign of measurements of the Physico-chemical characteristics of the water in two contrasting hydrological situations. It would also seem good to identify possible signs of habitat alteration (alteration of the hydrological

regime by a dam, clogging of the substrate, etc.) [10]. After having acquired a minimum of control operations on a reference site, each one allowing the evaluation of an index value; a strategy frequently used in Europe is to consider the median value of the distribution of values obtained as a reference value and the value corresponding to the first quartile of this distribution (= Q25) as the limit between the class "high" status and "good" ecological status.

Then, to define the class limits, you can subdivide the extent of variation of the metric between the very good/good limit and its minimum possible value into four intervals of equal amplitude, which will allow you to determine the good/moderate, moderate/poor and poor/bad limits respectively. Finally, the monitoring of reference sites can be envisaged to make the reference values evolve in a global change context. This adjustment can be planned every three years.

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