

# Eco-AlpsWater

Innovative Ecological Assessment and Water Management Strategy  
for the Protection of Ecosystem Services in Alpine Lakes and Rivers

Priority 3: Liveable Alpine Space. SO3.2 - Enhance the protection, the  
conservation and the ecological connectivity of Alpine Space

## Deliverable D.T2.1.1 – Annex 2

### **Mutual awareness, learning and exchange of experiences and approaches in water quality assessment among PPs**

Project Eco-AlpsWater  
Work Package WPT2  
Activity A.T2.1  
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## Water quality assessment-National methods Additional Biological Quality Elements (BQE)

**Country: France**

**Category: River**

**Biological Quality Element: Phytoplankton**

### Short description of sampling procedure

Phytoplankton and chlorophyll has to be sampled conjointly.

Only one sampling point is needed per station. The sampling point must chose in the middle of the main channel. About 2 liters has to be sample in the first meter of the water column.

### Sampling period/frequency

At least 4 samples must be taken between Mai and October and the sampling period must cover the summertime. Sampling occasions must be separated by two weeks at least.

### Characterisation of representative sampling site

This protocol is design for large rivers and canals.

### Short description of processing method and evaluation (e.g. metrics, level of identification)

No method is available yet, it is still in development.

### Additional abiotic data recorded

Transparency, water temperature, pH, conductivity and dissolved oxygen.

### Method features compliant with WFD

The sampling protocol was designed to get along with WFD requirements.

### Rules to define ecological classes and reference conditions

None

### Literature Reference

Protocole standardisé d'échantillonnage et de conservation du phytoplancton en grands cours d'eau applicable aux réseaux de mesure DCE. C. Laplace-Treyture, C. Chauvin, M. Menay, A. Dutartre. Rapport Cemagref, Version 2. Décembre 2010.

[https://hydrobio-dce.irstea.fr/wp-content/uploads/2014/05/PHYTOPLANKTON -  
PROTOCOLE\\_GCE.pdf](https://hydrobio-dce.irstea.fr/wp-content/uploads/2014/05/PHYTOPLANKTON_-_PROTOCOLE_GCE.pdf)

**Method reported by:**  
**Maxime Logez**  
**AFB/Irstea**

**Country: Germany**

**Category: Rivers**

**Biological Quality Element: phytobenthos without benthic diatoms**

**Short description of sampling procedure**

The German method PHYLIB assess the bio-component “macrophytes/phytobenthos” and covers three biological groups “macrophytes”, “benthic diatoms” and “phytobenthos without diatoms = PoD” in rivers (Schaumburg et al. 2015).

Sampling for PoD follows a „Multiple Habitat Sampling” (MHS) in a river stretch of at least 20 to 50m, usually 100m in correspondence to macrophytes sampling. Moveable substratum is taken in bags or containers. Abundance classes of every kind of benthic algae are recorded in the field following a detailed field protocol. The sample are stored without preservation for the microscopic analysis performed no later than the next day. Fixation of sub- samples with formalin (37%) or Lugol, and storage at low temperature in the dark.

**Sampling period/frequency**

Summer, July until middle of August. One occasion per sampling season.

**Characterisation of representative sampling site**

Multiple Habitat Sampling” (MHS) for PoD with 4 -8 sub-samples.

**Short description of processing method and evaluation (e.g. metrics, level of identification)**

the subsamples are analyzed with microscopes, and the abundance of the algae is estimated at a scale 1 (very rare) up to 5 (abundant)

**Additional abiotic data recorded**

Information about the river channel e.g. morphology, structure, sediment and substratum, velocity

**Method features compliant with WFD**

All compliant Method name: [German Assessment System for Macrophytes and Phytobenthos according to the EU WFD](#)

**Rules to define ecological classes and reference conditions**

According to WFD: “Normative definitions of ecological status classifications”, Annex V, Chapter 1.2

**Literature Reference**

Schaumburg, J., Schranz, C., Stelzer, D., Vogel, A., Gutowski, A. (2012): Verfahrensanleitung für die ökologische Bewertung von Fließgewässern zur Umsetzung der EU-Wasserrahmenrichtlinie:

Makrophyten und Phytobenthos . Stand Februar 2012. Bayerisches Landesamt für Umwelt. Im Auftrag des Umweltbundesamtes(FKZ 3707 28 201), 137 S., Augsburg/Wielenbach

**Comments**

See in <http://www.wiser.eu/results/method-database/>

**Method reported by:**

**Ute Mischke & Christine Schranz**

**Bavarian Environmental Agency (LfU)**

**Country: Italy**

**Category: Lake**

**Biological Quality Element: Macroinvertebrates**

#### Short description of sampling procedure

The selection of sampling sites, in which to place transects, is closely related to:

- the extension of the lake itself,
- the possible diversification of habitats (granulometry of the substrate and presence of vegetation),
- the morphology of the lake,
- the extension of the coastline and to the presence of anthropic impacts (for example artificial banks, urbanized areas, waste etc.).

The positioning of the transept must take into account the vertical zonations of the lake (littoral, subletral and deep) and the type of sediment (silty, sandy, stony, etc.). The minimum number of transects indicative planned for monitoring is related to the size of the lake.

Within each transept, for each of the 3 areas: littoral/river, sublittoral/intermediate and deep/lacustral, 1 sampling station is planned. At each sampling station, soft substrates should be sampled using quantitative samplers (dredgers, buckets or cores).

#### Sampling period/frequency

Macroinvertebrate sampling is carried out in at least two seasonal periods:- in spring, corresponding to the period of water circulation in most of our waterslakes,- in autumn, in the period following the establishment of the summer stratification due to the high temperatures reached on the surface.

The minimum number of samples, statistically acceptable, is equal to three per station (coast / river, subterranean / intermediate and deep / lake areas), if buckets with a useful opening equal to or greater than 225 cm<sup>2</sup> are used, otherwise, if samplers are used of smaller dimensions (Eg: buckets with useful opening lower or cored) we must consider the collection of a number of replicates per station so as to cover a useful area of at least 675 cm<sup>2</sup> (equal to the sum of the useful areas of the standard number of replicates  $225 * 3 \text{ cm}^2 = 675 \text{ cm}^2$ ).

#### Characterisation of representative sampling site

The choice of sampling sites, in which to place the transects, is strictly related to the extension of the lake itself, the possible diversification of the habitats (granulometry of the substratum and the presence of vegetation), to the morphology of the lake, to the development of the line of coast and the presence of anthropic impacts (for example, artificialization of the banks, urbanized areas, waste disposal, etc.). The set of sampling sites, as a whole, must be representative of the environmental

characteristics and the main insistent pressures on the water body and must not be affected by overly localized alterations.

In the positioning of the stations the information deriving from the monitoring of the macrophytes is important, as they allow to identify the soft-spring coastal areas; it's also important verify the slope of the coastline by analyzing the bathymetric map to identify and exclude areas with steep slopes where the buckets close with difficulty. In lakes where, due to the total coverage of macrophytes or the lack of depth (in general shallow lakes, laminaria or poly-mittics) it is not possible to highlight a deep area or even a sublittoral zone, it is not necessary to operate through transects, but to sample distributing the sampling stations randomly within the lake basin, always taking into account the presence of tributaries and / or emissaries and the different composition of macrophytes or of the substrate (if differences are highlighted).

#### **Short description of processing method and evaluation (e.g. metrics, level of identification)**

The BQIES index (Benthic Quality Index ) is a useful tool for the ecological assessment of the quality of deep Italian lakes. The final index is based on: number of species, density of individual species / groups of species, indicator weight of the species, total density.

#### **Additional abiotic data recorded**

Temperature, pH, conductivity, total phosphorus, nitrogen total, total organic carbon, chlorophyll a, dissolved oxygen.

#### **Method features compliant with WFD**

GIG Alpine  
GIG Mediterranean

#### **Rules to define ecological classes and reference conditions**

Reference conditions: Hystorical data

This index considers all the lake typologies in their entirety and as a consequence currently does not present any type-specific reference sites, but it will have to be validated for all types of lakes.

#### **Literature Reference**

Italy Legislative Decree No. 152 approving the Code on the Environment. Gazzetta Ufficiale della Repubblica Italiana No. 88, 14 April 2006

ISPRA. Biological methods for internal surface waters. Rome. 2014 ( Manuali e Linee Guida, Vol. 111/2014)

Indici per la valutazione della qualità ecologica dei laghi 2013. Report CNR ISE, 02-13: 195 pp.(Versione 2018)

ISO 5667-4. 1987. Water quality. Sampling – Part 4: Guidance on sampling from lakes, natural and manmade.

ISO 9391. 1993. Water quality. Sampling in deep waters for macro-invertebrates. Guidance on the use of colonization, qualitative and quantitative samplers: 13 pp.

ISO 10870. 2012. Water quality. Guidelines for the selection of sampling methods and devices for benthic macroinvertebrates in fresh waters: 24 pp.

UNI EN ISO 5667-1. Qualità dell'acqua, Campionamento - Parte 1: Linee guida per la definizione dei programmi e delle tecniche di campionamento.

**Method reported by:**

**Cristina Martone**

**ISPRA**



**Country: Italy**

**Category: River**

**Biological Quality Element: Macrobenthos**

#### **Short description of sampling procedure**

The method is based on a multi-habitat approach that provides a macro-invertebrate collection proportional to the relative extension of the different microhabitats observed in a fluvial site. The sampling procedure is applicable to all wading watercourses. Sampling tools: Surber net, hand net. A sample consists of the set of 10 sampling units (replicas or increments) collected in a defined sampling area (mesohabitat). Sampling units are allocated based on the presence of mineral and biotic microhabitats, whose percentage coverage is recorded at 10% minimum intervals, relative to the total sampling area (1 m<sup>2</sup> or 0.5 m<sup>2</sup>).

A sampling unit corresponds to the sample collected by moving the substrate located immediately upstream of the point where the mouth of the net is positioned.

Sampling is quantitative, therefore we will refer to a total area of 0.5 m<sup>2</sup> or 1 m<sup>2</sup>, specific according to the hydroecoregion to which the water body analyzed belongs.

The faunistic lists obtained from the proportional multihabitat sampling can be used for the definition of the ecological status of the water body on the basis of the evaluation method suitable for the purpose.

#### **Sampling period/frequency**

In many Italian fluvial types, the best seasons for sampling are: winter (February, early March), late spring (May), late summer (September). The most suitable sampling period is mainly linked to the fluvial type under examination and to the eventual seasonal nature of the impacts / pressures. In any case, it is preferable to proceed with the sampling in low or moderate flow regime derived from decreasing flow rates, regardless of the season.

The frequency is 3 times a year.

#### **Characterisation of representative sampling site**

The site should include a riffle / pool sequence, if placed within a river type that provides it. The extent of the site to be sampled depends mainly on the variability of aquatic habitats and the width of the river bed. Some aspects to be assessed in the selection of the sampling sites are: Morphology and habitat composition, Hydrology, Riparian vegetation, Presence of anthropogenic structures, Point sources of pollution.

#### **Short description of processing method and evaluation (e.g. metrics, level of identification)**

The macroinvertebrate classification system, called MacrOper, is based on the calculation of the multi-metric STAR intercalibration index (STAR\_ICMi). The STAR\_ICMi is a multimetric index composed of six suitably normalized and weighted metrics, which include the main aspects that the Framework Directive asks to consider. The six metrics are: ASPT, Log10 (sel\_EPTD + 1), 1-GOLD, Number of families of EPT, Total number of families and diversity index of Shannon-Weiner.

The taxonomic identification level required for the calculation of the STAR\_ICMi index is the Family.

**Additional abiotic data recorded**

Basic physical and chemical parameters (pH, water temperature, electric conductivity, dissolved oxygen, and saturation) are measured onsite with portable multimeter.

**Method features compliant with WFD**

The six metrics include the main aspects that the Framework Directive asks to consider (composition and abundance)

GIG: Alpine, Mediterranean, Central/Baltic

Relevant intercalibration types:

Alpine: RA1, RA2; Central/Baltic: C; Mediterranean: RM1, RM2, RM4, RM5

**Rules to define ecological classes and reference conditions**

Rules to define reference conditions are reported in REFCOND Guidance (EC 2003a), and in some technical report by the activities of GIGs in the IC process (Alpine GIG, 2006, Central/Baltic GIG, 2007; Mediterranean GIG, 2007).

The calculation of the STAR\_ICMi index includes 4 successive steps:

1. calculation of the raw values of the six metrics that define the index;
2. conversion of the values of each metric into RQE, dividing the observed value by the median value relative to the reference samples of the fluvial type analyzed;
3. calculation of the weighted average of the RQE values of the six metrics;
4. normalization of the value thus obtained, by dividing the value of the sample concerned by the own value of the STAR\_ICMi index in the reference conditions

The procedure for deriving the class limits provides that once the values of the index of the samples collected at the reference sites are calculated, the value equal to the 25th percentile of the values obtained for these samples is set as the class limit between the “high state” and the “good state”. The limits for the following classes are established by dividing the remaining range of values into four equal parts.

**Literature Reference**

Gazzetta Ufficiale della Repubblica Italiana, Decreto Ministero dell'ambiente e della tutela del territorio e del mare 8 novembre 2010, n. 260. Regolamento recante «Criteri tecnici per la classificazione dello stato ecologico dei corpi idrici superficiali per la modifica delle norme tecniche del decreto legislativo 3 aprile 2006, n. 152, recante Norme in materia ambientale, predisposto ai sensi dell'articolo 75, comma 3, del decreto legislativo medesimo». 190 pp.

Italy Legislative Decree No. 152 approving the Code on the Environment. Gazzetta Ufficiale della Repubblica Italiana No. 88, 14 April 2006

ISPRA. Linee guida per la valutazione della componente macrobentonica fluviale ai sensi del DM 260/2010 (ISPRA, MLG 107/2014)

ISPRA. Biological methods for internal surface waters. Rome. 2014 (Manuali e Linee Guida, Vol. 111/2014)

IRSA-CNR. Macroinvertebrati e Direttiva 2000/60/CE. Notiziario dei metodi analitici 03/07.

IRSA-CNR. Definizione dello stato ecologico dei fiumi sulla base dei macroinvertebrati bentonici per la 2000/60/CE(WFD): il sistema di classificazione MacrOper, IRSA-CNR, Notiziario dei Metodi Analitici, numero speciale 2008 24-46.

**Method reported by:**  
**Cristina Martone**  
**ISPRA**

**Country: Italy**  
**Category: Lake**  
**Biological Quality Element: Macrophytes**

#### **Short description of sampling procedure**

In each site, only one transept will be traveled, inspected and sampled without taking into account of the extension of the site itself.

The inspection is carried out with the boat positioned (anchored) within the depth range [transept portion between the depth  $x$  and depth  $x + 1$  meter within which observation or sampling is carried out. The first depth range is between 0 m (shore) and the depth of 1 meter. Inside there are 4 points of observation or sampling. The observation or sampling then continues at the next interval, then ending at the maximum point lake depth or at the end of the vegetated zone]. The observation or sampling points are 4 in total: one towards the bow and one towards the stern on each side of the boat. At the point where the boat is positioned, which is only one for each interval, the depth is measured and the type of bottom is determined, using dredgers if necessary. The inspection of the transept is carried out starting from the shore and proceeding towards the lake and ends when there is no vegetation on all 4 points in two consecutive depth intervals or when the maximum depth of the lake has been reached. The inspection must allow the detection of the species present and assign a value of abundance for each species identified. The abundance is assigned using the Kohler method which has 5 classes [1 Very rare Presence of 1 - 5 plants; 2 Rare Presence of 6 - 10 plants; 3 Common, when can found without a search dedicated specifically; 4 Frequent Frequent but with zones extended in which it is absent; 5 Very frequent or Dominant, when is present with a coverage over the 50%.

#### **Sampling period/frequency**

Between May and September, but still trying to make observations or sampling during the period of maximum expansion of the macrophytic flora.

The sampling rate is twice a year.

#### **Characterisation of representative sampling site**

Identification of the sites based on a preliminary collection of information about the presence of macrophytes by consulting the visitors and users of the lake, by means of bibliographic research and following preliminary sampling inspections.

#### **Short description of processing method and evaluation (e.g. metrics, level of identification)**

The macroIMMI index is composed of 3 metrics obtained from the data processing of the macrofitic communities of the Alpine ecoregion present in the GIG Alpine lakes database.

The 3 metrics are respectively:

- maximum depth of colonization (The maximum depth of colonization is to be understood as the deepest point in which the presence of aquatic vegetation was detected in the entire body of water);
- trophic score (The trophic score ( $Sk$ ) is calculated by transect for transect and is then defined as the trophic score of the transect ( $Skt$ ). It is calculated from the weighted average of the abundance ( $Ak$ ) and the trophic value ( $vk$ ) of each species found in the water body);

- Bray-Curtis dissimilarity index (The dissimilarity index is obtained according to the formula:  $\text{dissimilarity index} = 1 - B \& C$ ,  $B \& C = \text{Bray \& Curtis distance from reference transect}$ ).

#### **Additional abiotic data recorded**

Basic physical and chemical parameters (pH, water temperature, electric conductivity, dissolved oxygen, and saturation) are measured onsite with portable multimeter.

#### **Method features compliant with WFD**

The five metrics include the main aspects that the Framework Directive asks to consider (composition and abundance).

GIG Alpine: L-AL3, L-AL4 (MacroIMMI)

#### **Rules to define ecological classes and reference conditions**

Reference conditions: existing near-natural reference sites, hystorical data.

#### **Literature Reference**

Italy Legislative Decree No. 152 approving the Code on the Environment. Gazzetta Ufficiale della Repubblica Italiana No. 88, 14 April 2006

ISPRA. Biological methods for internal surface waters. Rome. 2014 ( Manuali e Linee Guida, Vol. 111/2014)

Indici per la valutazione della qualità ecologica dei laghi. 2013. Report CNR ISE, 02-13: 195 pp.(Versione 2018)

#### **Method reported by:**

**Cristina Martone**

**ISPRA**

**Country: Italy**

**Category: River**

**Biological Quality Element: Macrophytes**

#### **Short description of sampling procedure**

Within the station, sampling involves:

- the survey of all the macrophytic taxa present
- collection of samples of the taxa present;
- the assessment of the total community coverage of the macrophytes present in the water, in terms of percentage coverage of the community compared to the total surface of the riverbed in the station;
- the assessment of the coverage of the individual taxa present in relation to the totality of the present macrophytic community.

The macrophytic community that must be taken into consideration is the aquatic one (that is the one constituted by the organisms settled in permanently submerged areas) within the sampling station.

For the observation and the collection one must travel in zig zag, in the sense of the current (where possible), the entire development of the station by detecting and noting the presence of all the taxa present in the station and carrying out collection at the same time. Once the first survey route has been completed at the direction of the current, the station must be retraced in the opposite direction, against the current (where possible) and a second observation is made. The attribution of the percentages of coverage is an important phase of the survey, fundamental for the next one data processing.

Coverage assessments must be carried out, wherever possible, through a visual examination.

The values of coverage are expressed according to a scale ranging from 5% to 100% according to values that however coincide with whole number multiples of five.

The total coverage of the community should be expressed in terms of percentage coverage of the macrophytic community with respect to the surface of the wet bed in the station under survey.

The assessment of the coverage of the various taxa present must also be reported at 100, which represents the totality of the macrophytic community found. That is, for each taxon the percentage of coverage must be expressed with respect to a total (100%) represented by the coverage of the entire macrophytic community present in that station.

#### **Sampling period/frequency**

Sampling must be carried out in correspondence with the maximum development of the aquatic vegetation, in a period between late spring and the beginning of the autumn season, indicatively from April to October, depending on the local climatic differences and the hydrological regime of the water investigated.

The frequency is twice a year.

#### **Characterisation of representative sampling site**

The station must have a longitudinal extension of at least 100 m and in the case of watercourses wider than 50 m the station must be extended by at least twice the width of the watercourse. In the

case of the presence of a community characterized by poor coverage or particularly inhomogeneous distribution, the extension of the station should be increased by about 1/3 with respect to the expected longitudinal extension. The macrophytic community must have a coverage of not less than 5%, compared to the extension of the wet riverbed, within the station.

#### **Short description of processing method and evaluation (e.g. metrics, level of identification)**

The IBMR is an index aimed at the evaluation of the trophic status that is based on a list of 210 taxa indicators for which it was evaluated, from field data, the sensitivity in particular to the concentrations of ammonia nitrogen and phosphate garden. The methodology is described by the AFNOR standard NF T 90-395 "Qualité de l'eau. Détermination de l'index biologique macrophytique en rivière (IBMR) ". The IBMR is measured at a station and is calculated based on a survey.

#### **Additional abiotic data recorded**

Basic physical and chemical parameters (pH, water temperature, electric conductivity, dissolved oxygen, and saturation) are measured onsite with portable multimeter.

#### **Method features compliant with WFD**

The method is based on composition and abundance parameters as required by WFD.

GIG: Mediterranean, Central, Baltic

Relevant intercalibration types:

Central and Baltic: RC1, RC4; Mediterranean: RM1, RM2, RM4

#### **Rules to define ecological classes and reference conditions**

For the calculation of the RQE\_IBMR for each site, the values of IBMR detected at the monitoring sites must be compared with the average value of IBMR calculated on the values measured at the reference sites identified for each type (Minciardi et al., 2009). The references for each typology belonging to the Alpine, Central and Mediterranean geographical areas are provided by the D.M. 260/2010.

The result is a numerical value between 0 and 1 and is called RQE (Ecological Quality Report).

The D.M. 260/2010 shows the limits of RQE\_IBMR related to the classes High and Good, Sufficient, Poor and Bad differentiating for the two Alpine and Central-Mediterranean geographical areas.

#### **Literature Reference**

Gazzetta Ufficiale della Repubblica Italiana, Decreto Ministero dell'ambiente e della tutela del territorio e del mare 8 novembre 2010, n. 260. Regolamento recante «Criteri tecnici per la classificazione dello stato ecologico dei corpi idrici superficiali per la modifica delle norme tecniche del decreto legislativo 3 aprile 2006, n. 152, recante Norme in materia ambientale, predisposto ai sensi dell'articolo 75, comma 3, del decreto legislativo medesimo». 190 pp.

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ISPRA. Biological methods for internal surface waters. Rome. 2014 ( Manuali e Linee Guida, Vol. 111/2014)

AFNOR (2003) Qualité de l'eau: Détermination de l'indice biologique macrophytique en rivière (IBMR) – NF T 90-395: 28 pp.

Minciardi M.R., Spada C.D., Rossi G.L., Angius R., Orrù G., Mancini L., Pace G., Marcheggiani S., Puccinelli C. (2009). Metodo per la valutazione e la classificazione dei corsi d'acqua utilizzando la comunità delle Macrofite acquatiche. Rapporto Tecnico ENEA RT/2009/23/ENEA: 35pp.

**Method reported by:**  
**Cristina Martone**  
**ISPRA**