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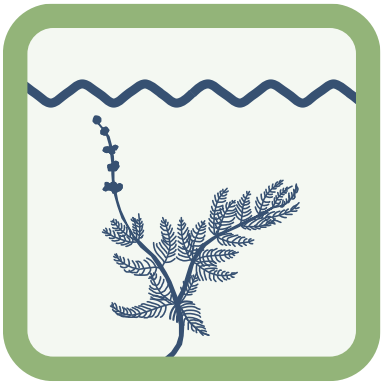
Technical Sheet: Indicator Set 5 Macrophytes



Indicator(s):
- 5.1 Macrophyte community (Känel et al. 2017)

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This publication is also available in French, German and Italian.

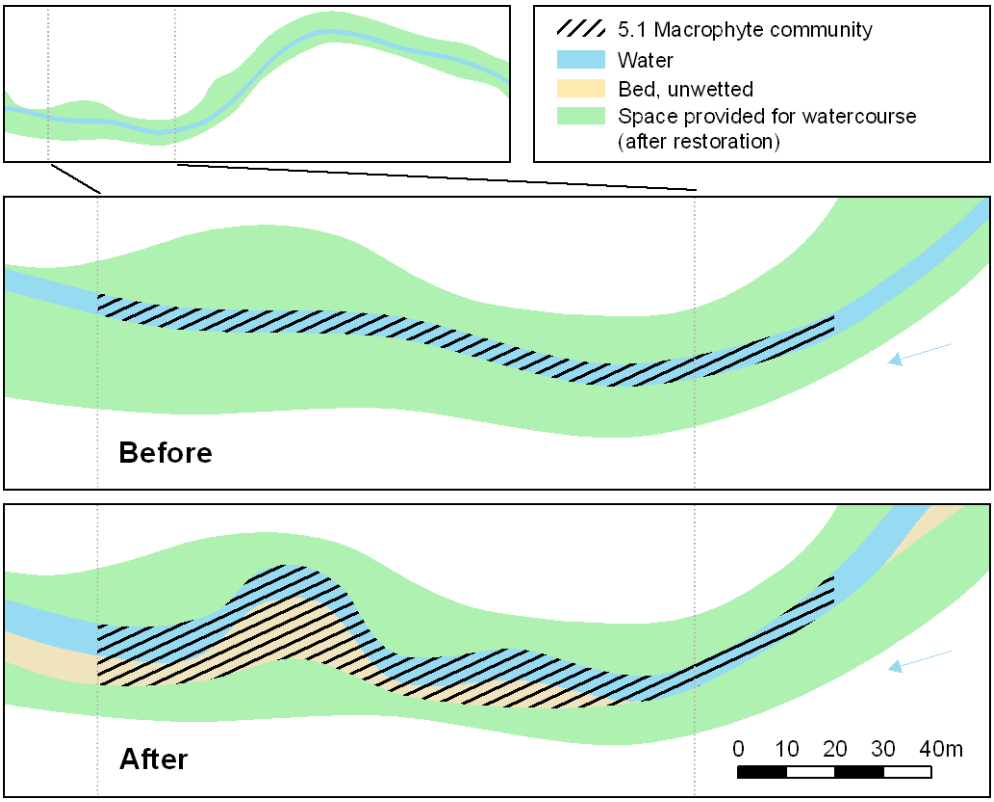
This Indicator Set forms part of the Swiss STANDARD outcome evaluation and is to be used in conjunction with the practice documentation "Evaluating the outcome of restoration projects – collaborative learning for the future" (FOEN 2019). The indicators included in the Indicator Set derive from various sources (e.g. Woolsey et al. 2005; Modular Stepwise Procedure) and, where appropriate, have been updated or adapted for the practice documentation. An overview of the most important modifications made can be found in Factsheet 7.

Principle

Macrophytes – i.e. vascular plants, bryophytes and macroscopic algae – unlike other biological indicators, are not present in all streams. However, in streams on valley plains, where the slope is gentle and there is no complete shade, they are an important part of the ecosystem. They provide habitats for fish and macroinvertebrates and – as primary producers – represent an important food source, as well as playing a significant role in the oxygen balance and nutrient cycle. As macrophytes are generally sessile and perennial, they reflect the totality of environmental impacts over prolonged periods. The composition of aquatic vegetation varies according to site conditions. Indicator set 5 records five abiotic station parameters, based on which a stream section is assigned to a vegetation type and the aquatic vegetation assessed according to this type. An electronic tool is available for raw data entry and evaluation.

Parameters	All vascular plants, bryophytes, charophyceae, green-colored filamentous algae and mat-forming algae are recorded according to the taxa list (MSK module, Appendix DA1, chap. 4.4 - 4.5). All taxa are determined to the lowest possible level. This level is defined in the taxalist in the column "determinability". For each taxon, the absolute cover is recorded. Exceptions are the bryophytes and the filamentous green algae. For these, the cover only has to be recorded in total for the taxon "Bryophyta" or "filamentous green algae", an estimation of the absolute cover at a lower determination level is not necessary. Site conditions: determination of gradient, discharge, shading, depth and substrate is obligatory, as these are required to classify the type of study section. Unlike in the MSP module, the determination of Ecomorphology Level R and Physical Appearance is optional.
Applicability	Can be selected for all project sizes (small, medium-sized, large and individual projects). In wadeable streams with a low slope (< 1.5%) and for projects aiming for shading < 75%. If macrophytes are already present in the watercourse prior to restoration, a survey is recommended. The method is also suitable for watercourses where no macrophytes can be observed before restoration, but where they are expected to develop after restoration.
Special considerations	If macrophytes were introduced in the course of restoration, e.g. through planting or cuttings, this must be taken into account in the plausibility check for the evaluation and in the interpretation of results. In addition, the list of introduced macrophyte species must be provided by construction site management, at the latest, with the “after” survey.
Survey site	Subreach, if possible within the subsection (see Fig. 5.1)
Timing	June to September Medium to low water levels and good visibility
Frequency	A single survey is sufficient unless a common species cannot be identified to species level. In this case, it is recommended (i) to carry out a second site visit at a time when the species has developed further characteristics relevant for identification and/or (ii) to call in an additional expert. Such efforts are not required in the case of individual finds since the evaluation and final results will scarcely be influenced.
Material	A detailed list of the materials required can be found in Annex A2 (p. 92) of the MSP module.

Figure 5.1: Survey site for the indicator from Indicator Set 5.



Survey

The individual steps involved in the survey are explained below, in chronological order.

Step	Description	Indicator
Definition of the study section	• A representative, uniform subreach is identified (see Section 4.3 of the MSP module). • To exploit synergies and reduce the effort required, the subreach should ideally be the same as the subsection selected for Indicator Set 1 “Habitat diversity”. • If the subsection of Set 1 is selected for the survey, a macrophyte expert (e.g., designated surveyor) must verify on the basis of plans that it is suitable for macrophyte development after restoration as part of the impact monitoring planning process. If the subsection is not suitable for macrophyte development, e.g., due to a desired shading of the watercourse (>75%) by continuous stocking of the banks, the subsection must be moved. If relocation is not possible, macrophyte survey shall be waived. • If the subsection from Set 1 is suitable for the development of macrophytes, it must be assessed whether it is sufficiently long for species diversity to be determined (requirements specified in the methodology). If the length is insufficient, the subreach must be extended in accordance with the MSP module to a total length of approx. 20 times the mean wetted width. • The start and end point of the subreach should not change before and after restoration, so that the subreaches remain comparable.	5.1
Photographing the subreach	• For the documentation, an aerial photograph must be made during the vegetation period, or the start and end point of the subreach must be photographed.	5.1
Determination of abiotic site parameters	• The abiotic site parameters relevant for type classification (shading, water depth, discharge, gradient and substrate composition) are determined in the field. For this purpose, the field protocol of the MSP module is used.	5.1

	• Other abiotic site parameters may optionally be additionally determined, using the same field protocol (e.g. Ecomorphology Level R, Physical Appearance).	
Identification of macrophyte vegetation	• In the field, the macrophytes are mapped and determined to the lowest possible level according to the operational taxalist (Appendix DA1, Chapters 4.4 - 4.6 in the MSP module).	5.1
Digitalisation of raw data using electronic data entry form	• For further analysis, the raw data from the field protocols is digitalised using an electronic data entry form. The data is now prepared for the type classification and evaluation by the electronic tool (see MSP website).	5.1

Evaluation

The raw data compiled is automatically analysed by means of an electronic tool (typology and type-specific evaluation).

Indicator	Description
5.1 Macrophyte community	The electronic tool evaluates the following: The vegetation is evaluated type-specifically, by comparing the current survey with a near-natural (as far as possible) reference for the vegetation-river type in question (p. 56 of MSP module, DA5). The evaluation is performed with the aid of type-specific goal hierarchies and value functions in five classes. It is based on the ecological goals specified in Annex 1 of the Waters Protection Ordinance (WPO). It covers the following areas: • composition (proportions of type-appropriate growth forms and neophytes, and dominance structure) • diversity (number of type-appropriate species and growth forms) • biomass (absolute cover of higher macrophytes and algae). In addition to this aquatic ecology evaluation, an evaluation is performed from a conservation perspective, based on the national priority rating of the species present and their contribution to biodiversity in terms of target values (see section 6.5 of the MSP module).

The typology and evaluation by the electronic tool must subsequently be checked for plausibility by a macrophyte expert (e.g. surveyor) (chap. 7 MSP module).
Restoration changes the site conditions in the watercourse. Under certain circumstances, this can result in the tool applying different typologies to the study section before and after restoration, i.e. assigning it to different vegetation flow types. This results in the section before and after restoration being evaluated based on different criteria. To prevent this, the macrophyte expert must assign the study section to the same vegetation flow type as part of the plausibility check. To determine the vegetation flow type, the macrophyte expert is guided by a near-natural condition in the given cultural landscape (according to chap. 6.2 and chap. 5.5, MSP module).
Based on the expected characteristics of the typology parameters gradient, discharge, shading, water depth and substrate under reference conditions and the typology scheme (Fig. 13, p. 53, MSP module), a macrophyte expert should be able to estimate the near-natural vegetation flow type.

Time required

Table 5.1: Estimated time required in person-hours for the determination and evaluation of Indicator Set 5. General items (e.g. travel time for fieldwork) are not taken into account. A rough cost estimate can be found in Table 2.1 of Factsheet 2.

Step	Specialists		Assistants	
	Persons	Time per person (h)	Persons	Time per person (h)
Mapping of vegetation and site conditions	1	1.5		
Digitalisation of raw data using electronic data entry form	1	1		

Evaluation using electronic tool	1	0.25		
Plausibility check by processor	1	0.25		
Post-determination of difficult taxa in the laboratory, without archiving (e.g. bryophytes*)	1	0.5		
Total person-hours		3.5		

Notes: The time required for mapping depends on the accessibility of the reach, species diversity and the experience of mapping personnel. It may vary between 20 minutes and an hour per subreach. The safety measures specified in the MSP module are to be complied with. * In case of difficulties in species identification of bryophytes, a current list of experts can be consulted at swissbryophytes.ch

Further information

Data arising	• End products of the electronic tool: KT_ProCode_ERHEBUNG_Set5_Output_Standortdaten.txt, KT_ProCode_ERHEBUNG_Set5_Output_TaxaVerwendet.txt, KT_ProCode_ERHEBUNG_Set5_Output_TaxaVerworfen.txt AND Site documentation as pdf • Photos: KT_ProCode_ERHEBUNG_Set5_up.jpeg AND KT_ProCode_ERHEBUNG_Set5_down.jpeg OR KT_ProCode_ERHEBUNG_Set5_air.jpeg • List of any macrophytes planted, sowed or introduced with cuttings (to be submitted with “after” survey; data format not specified): KT_ProCode_ERHEBUNG_Set5_Stock Elements of the file naming scheme (see Factsheet 5) • KT = two-capital-letter cantonal abbreviation (e.g. BE) • ProCode = project code • ERHEBUNG = survey time point, i.e. VORHER (= before), NACHHER1 (= after 1), NACHHER2 (= after 2), or VERTIEFT (= EXTENDED) • V# = version number of the data entry form
Attachments	For data entry and evaluation, it is essential that the latest versions of the electronic form and tools are used (see below). These are available on the Modular Stepwise Procedure website Relevant for the determination and evaluation of Indicator Set 5: • Field protocol: Modular Stepwise Procedure website • Electronic data entry form: Modular Stepwise Procedure website • Electronic tool for evaluation of raw data: Modular Stepwise Procedure website

List of modifications

Relevant changes are marked in green.

Date (mm/yy)	Version	Change	Responsibility
4/2020	1.02	Correction of typographical errors, minor design adjustments	Eawag
4/2020	1.02	Small graphic adjustments	Eawag
4/2020	1.02	Addition to applicability (project sizes)	Eawag
1/2022	1.03	Details on the level of identification, section selection, stream type identification before and after restoration, workload for difficult taxa and data to be returned.	Eawag
12/2024	1.04	Clarification of applicability and importance of involving macrophyte experts in sub-section selection.	Expert group