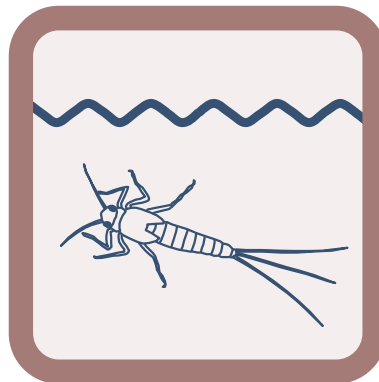




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Technical Sheet: Indicator Set 6

Macroinvertebrates



- Indicator(s):**
- 6.1 Macroinvertebrate community (in accordance with the MSP module, FOEN 2019)

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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

The term “benthic macroinvertebrates” (MI) refers to bottom-dwelling invertebrates visible to the naked eye. By analysing their diversity and abundance, it is possible to assess the overall ecological quality of a watercourse, since benthic macroinvertebrates respond to any changes in habitat conditions. They thus indicate not only the morphological and hydrological conditions and the dynamics of the watercourse, but also chemical water quality. Indicator Set 6 is based on the new Modular Stepwise Procedure (MSP) module for assessment of the quality and diversity of benthic macroinvertebrates (FOEN 2019), but it has been adapted for the STANDARD outcome evaluation. This Technical Sheet only describes the differences compared to the methodology specified in the relevant MSP module.

Parameters	Collection of at least 8 samples from 8 different substrate-flow velocity combinations in the study section; the surface-area percentage is indicated for each of the 8 habitats; the 8 samples are separately sorted, identified and analysed; species-level identification of ephemeroptera, plecoptera and trichoptera (EPT) taxa; abundance is determined for all taxa, i.e. also for each EPT species (see also «Erläuterungen zu den Laborarbeiten» in the attachments).
Applicability	The area of application and methodology are identical to the MSP module (see Section 2.3, MSP module). Application of the indicator is not restricted by project size (small, medium-sized, large or individual project).
Special considerations	Application of this method must never be entrusted to inexperienced personnel. Consequently, the volume of work indicated here represents the time required by a specialist. In addition, the same person should be responsible for carrying out the surveys before and after restoration, so as to minimise the influence of the operator. The final results are to be submitted to the MIDAT database.
Survey site	Subsection (see Fig. 6.1)
Timing and frequency	Sampling must take place outside high-flow or particularly dry periods (see Section 2.3 of the MSP module). At least one survey is required, to be carried out if possible in spring, within the same sampling window as in the MSP module. A second campaign is not mandatory, but is highly recommended. This will permit the identification of larvae which in spring are too small for species-level identification, as well as the addition of new species to the list. Alternatively, adult specimens could be collected during the first campaign. This rapid and straightforward technique would provide added value for species-level identification of EPT taxa, especially plecoptera (Knispel, 2020). Unlike in the MSP module, the second campaign must be carried out in August/September instead of September/October, at elevations over 1400 m asl.
Material and equipment	All the field and laboratory equipment required is listed in Annex A5 of the MSP module. The safety measures to be observed are described in Section 3.2.3 of the MSP module.

Table 6.1: Recommended priority sampling window according to elevation. Z = sampling window, P = buffer for hydrological special cases. First campaign shown in turquoise; second (optional) campaign in dark blue.

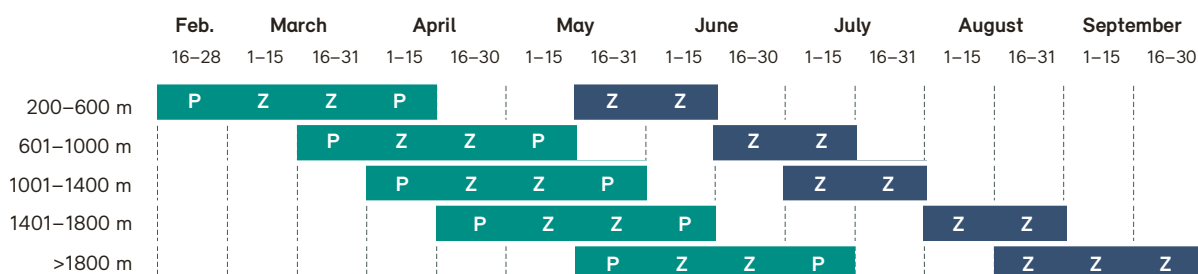
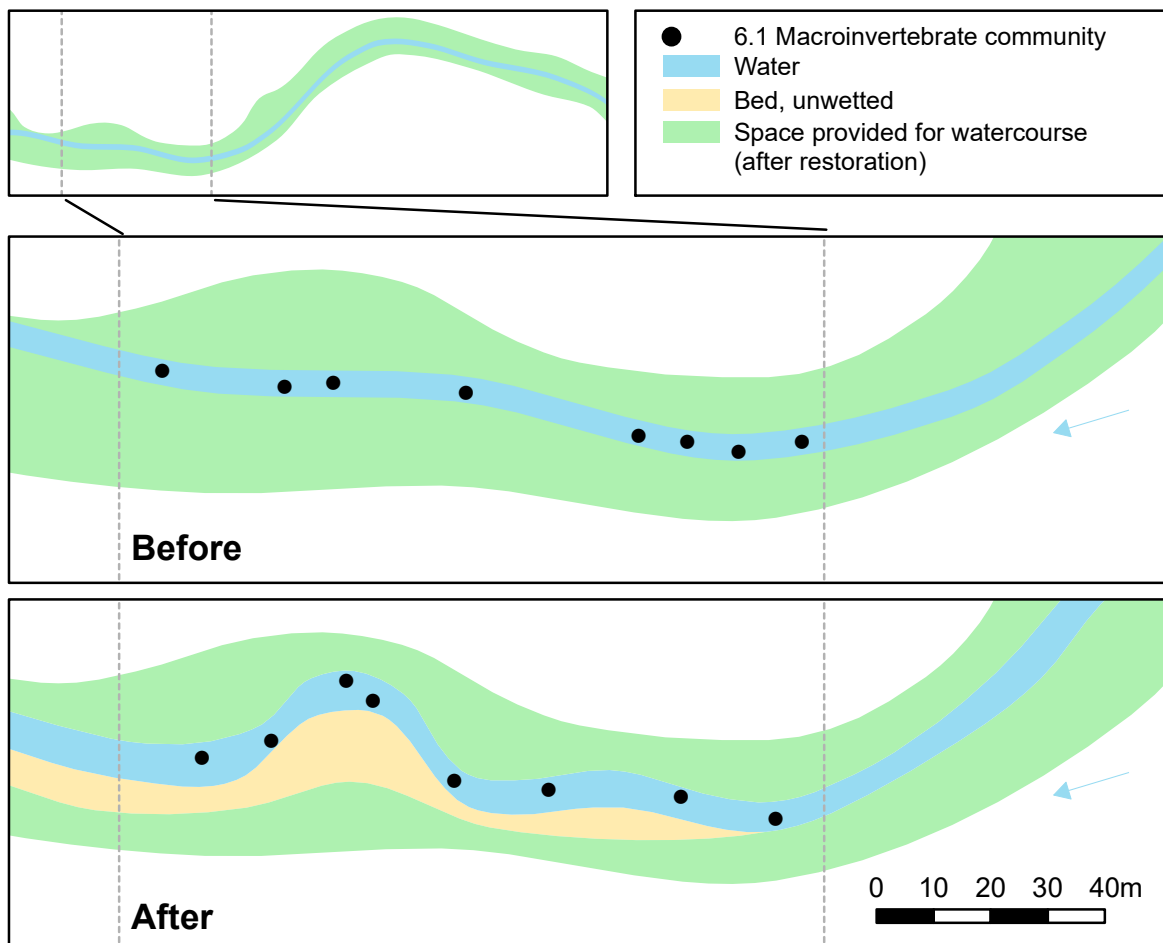


Figure 6.1: Survey site for indicator 6.1 from Indicator Set 6. The black marks indicate the sampling points. At each sampling point, 1 sample is collected (= 1 individual sample, as specified in the MSP module), i.e. 8 samples are collected across the 8 sampling points (not 8x8 samples).



Survey

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

Step	Description	Indicator
Selection of a representative watercourse section	<ul style="list-style-type: none"> A section representative of the watercourse has already been defined and mapped for Indicator Set 1 “Habitat diversity”. For sampling of benthic macroinvertebrates, the same section or subsection must be chosen. 	6.1
Completion of survey grid (taken from Annex A1-2, IBCH_2019 module)	<ul style="list-style-type: none"> The survey grid is completed according to the instructions given in the MSP module. However, some adjustments have been made to improve the transfer of data to the database. It is therefore necessary to use the data entry form for Indicator Set 6 (see appendices). At least 8 sampling points are selected on the basis of the survey grid (only in substrates with $\geq 1\%$ coverage). They are to be numbered from 1 to 8. As a supplement to the survey grid, one photo per substrate-flow velocity combination must be created. 	6.1
Sample collection	<ul style="list-style-type: none"> Samples are collected at each point by means of kick sampling (method described in Section 3.3.4 of the IBCH_2019 module). Unlike the method specified in the MSP module, each (kick) sample must be separately labelled and stored in the field (the 8 samples are not to be combined in a single container). Accordingly, the habitat type (i.e. substrate-flow velocity combination) must always be indicated on the label (see «Erläuterungen zu den Laborarbeiten», standard labels). 	6.1

Sorting method: The sorting method is the same as that described in the MSP module (Section 3.4.2). It is imperative that all EPT material is stored separately by area for the examination of EPT species.

Identification	<p>Unlike in the MSP module, the 8 samples are analysed separately (see modified laboratory protocol), and the EPT taxa must be identified to species level (see the form for the EPT species list). Caution: Identification to species level is difficult and requires a lot of experience. If the identifier is not confident, it is perfectly possible to leave the determination of the EPT taxa at species level to a more experienced person. The results are transferred to the laboratory protocols of Indicator Set 6 (appendices).</p>	
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Enumeration of sorted individuals	<p>Sorted individuals are enumerated as described in the MSP module (Section 3.4.4). Subsampling (estimation by counting the individuals of a randomly selected part of the sample) is not permitted. However, if more than 200-300 individuals of the same taxon are estimated, it is permissible to carry out a partial count with multiplication only for this taxon according to the procedure described in the “Erläuterungen zu den Laborarbeiten” in the appendices. In this case, a balance is kept for the area concerned.</p>	
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Expert quality control (QC), archiving and storage of the specific material	<p>Once the EPT samples have been determined, quality control by experts is mandatory. The aim is to check the EPT samples determined at species level with the purpose of learning process and quality assurance in the determination at species level. The following is a step-by-step overview of the quality control process (QC, see also Fig. 6.2 below):</p> <ol style="list-style-type: none"> 1. Dispatch of EPT to experts for QC: The scope of the material to be reviewed must be determined in consultation with the expert depending on the project. The specialist office then sends the EPT taxa it has determined to the QC experts (see «Erläuterungen zu den Laborarbeiten» in the attachments for a recommendation). At this stage, a non-exhaustive list of experts for quality control can be requested from Info fauna. A different expert will be appointed for each EPT order. The names of the selected experts should be noted on the laboratory protocol. 2. Implementing QC: The QC experts carry out the QC as agreed with the specialised office. A maximum of CHF 250 (incl. VAT) per order (E, P, T) can be claimed for the quality control, i.e. a maximum of CHF 750 (incl. VAT) per survey on programme objective 1 of the programme agreement. 3. Completing the anonymised QC form: The experts carrying out the quality control must complete the QC form for the outcome evaluation separately for each order and each project. The QC form can be downloaded from the FOEN website (see attachments). The experts send the completed form to wiko_revit@bafu.admin.ch. Accordingly, three QC forms are required for a project in which species of all three EPT orders were found. 4. Feedback on the QC to the MI specialist office: This form also serves as the basis for the feedback to the assessors. The experts are free to provide their feedback in order to achieve more complete reporting for the assessors (e.g. via the laboratory protocol, where the column "X" is available for this purpose). Unless otherwise agreed between the MI specialist office and the expert, all sample material will be returned to the MI specialist office by the expert. 5. Correction of the MI data: After the quality control has been sent back to the assessor, the assessor makes the necessary corrections. 6. Archiving of the material (recommended): To allow for possible later verification of observations or more detailed taxonomic analysis by Info fauna (see steps 13 and 14), it is strongly recommended to keep all material identified per station (i.e. EPT and IBCH taxa), ideally for a period of 10 years. For this purpose, all designated taxa should be stored in separate tubes, but without separation by subsample. The appropriate 	
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equipment and method for archiving is described in the document «Erläuterungen zu den Laborarbeiten» in the attachments.

7. **Sending the corrected MI data to the canton:** The assessor is instructed to send the corrected and complete data of Indicator Set 6 (data entry form, area photos and shapefile) to their client.
8. **Check MI data and send to Wiko team with data from other sets:** The canton sends the checked data to the FOEN via the address wiko_revit@bafu.admin.ch, together with all other sets of the project.
9. **Checking the MI data:** The MI data is checked for completeness by the Wiko team. If necessary, the Wiko team will enquire with the canton.
10. **Integration of MI data into the Wiko database:** The Wiko team integrates the MI data into the Wiko database.
11. **Centralised dispatch of MI data to Info fauna:** The Wiko team sends newly received MI data to Info fauna at regular intervals.
12. **Standardised plausibility check of MI data for Info fauna database:** Info fauna carries out a standardised plausibility check of the MI data.
13. **Possible selective verification of material:** If necessary, Info fauna will request material from the MI specialist offices for verification. If the material is not available for verification by Info fauna, the corresponding MI data will not be included in the Info fauna database.
14. **Cross-project evaluation of anonymised QC forms:** The Wiko team collates the information from the QC forms and creates overviews of common problems in the species identification of EPT.
15. **Organisation of courses based on QC results for the further training of MI specialist offices and cantons:** Regular further training courses for MI specialist offices and cantons are organised based on the QC results. The problems identified in the QC are addressed in the courses.

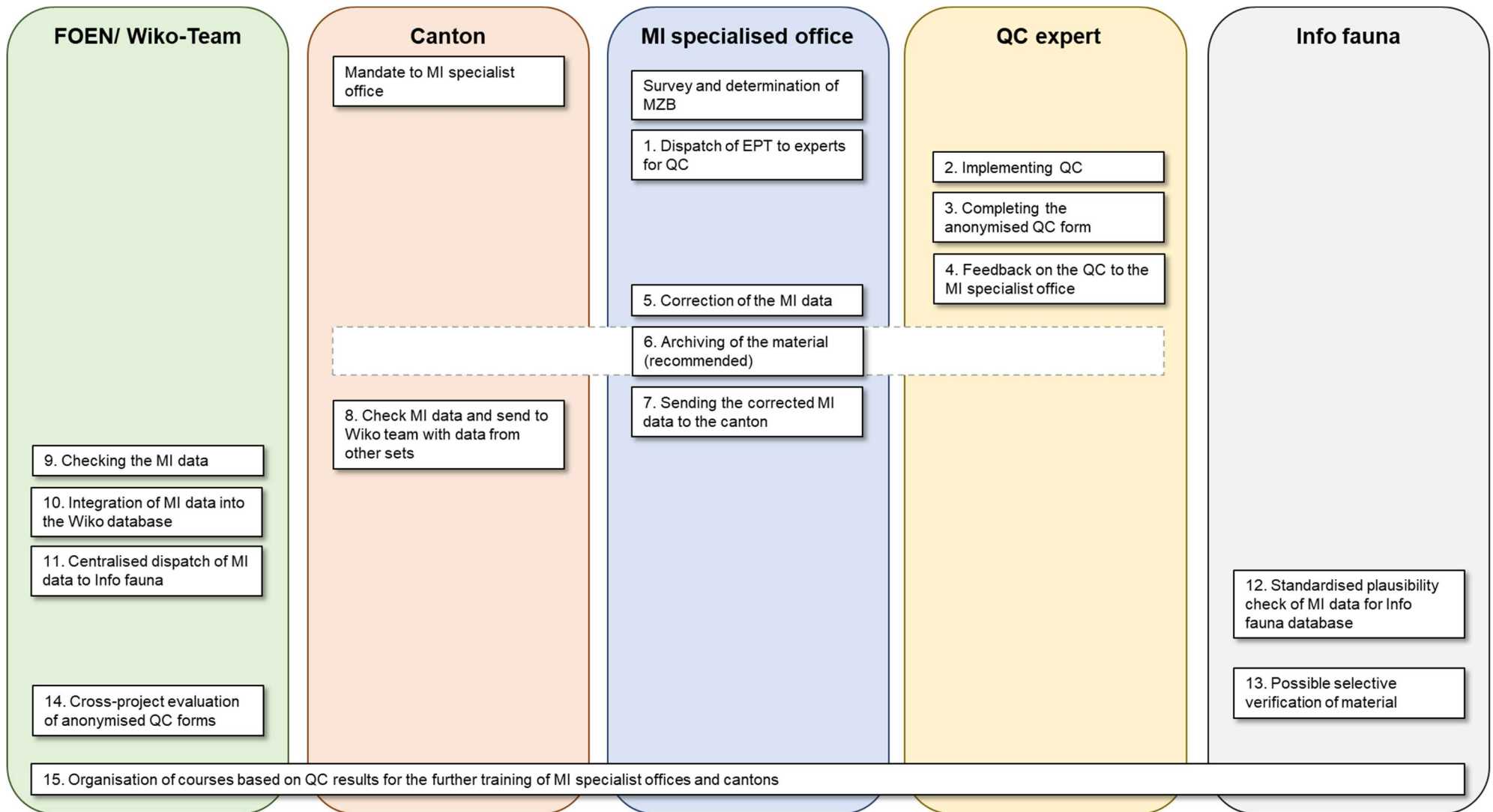


Figure 6.2: Visualization of the step-by-step process of quality control (QC) of the macroinvertebrate (MI) data in the context of indicator set 6.

Evaluation

The method for evaluation of the more detailed data (e.g. EPT species) has not yet been finalised. For the time being, therefore, only the raw is to be submitted, i.e. [the data entry form from Indicator Set 6](#), [the photos of the sample points and the shapefile \(see attachments\)](#).

If an interpretation of the results is nonetheless desired, then the following parameters could be suitable:

- Occurrence of additional EPT species in the restored section (if water quality is good)
- Occurrence of new habitats, progressively colonised by new taxa
- Change in habitat quality and distribution
- Change in the distribution of EPT species in the restored section (to be analysed in parallel with the surface-area percentages of the various habitats)
- Occurrence of taxa included in the Red List ([link](#)) or the list of national priority species ([link](#))
- Change in relation to [various ecological preferences \(ecological traits\)](#) (further information available at: <https://www.freshwaterecology.info/>)
- General improvement in the IBCH evaluation or one of the two components thereof:
 - increase in the diversity class (DK) value
 - potential shift in the fauna indicator group (IG) towards taxa with higher sensitivity to contaminants (only possible if water quality has improved)

Calculation of the IBCH index is not in itself sufficient, as this also includes the ecological quality of the habitat and is not a direct restoration indicator. It must be analysed alongside other parameters such as diversity class (DK), fauna indicator group (IG), IBCH_2019_R (robust), total species (robustness), EPT, total non-native species and habitat evaluation.

Time required

Table 6.2: Overview of the time required in person-hours for the determination and evaluation of Indicator Set 6. General items (e.g. travel time) 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)
Completion of survey grid	1	1.5-3	-	-
Collection of benthic macroinvertebrates	1	3-5	1	1.5
Sorting, identification and enumeration of organisms in the laboratory	1	8-15	-	-
More detailed analysis of EPT species	1	6-12	-	-
Quality control EPT species by experts*	1-3	1.5-5		
Total person-hours		20-40		

Notes: The time required partly depends on the diversity and abundance of the sorted taxa, and on the amount of organic material and filamentous algae in the samples. For example, the preparation and identification of samples from a variety of substrates in a lowland watercourse of the Jura will require about three times as much time as is required for samples from a coarse mineral substrate in a mountain watercourse.

* **Time required for the quality controls: A maximum of CHF 250 (incl. VAT) per order (E, P, T), i.e. a maximum of CHF 750 (incl. VAT) per survey can be claimed via program objective 1 of the program agreement.**

Further information

- Data arising
- Data entry form Indicator Set 6: «KT_ProCode_ERHEBUNG_Set6_V#.xls»
If a spring and summer sample is taken, the documents must be named as follows:
«KT_ProCode_ERHEBUNG_Set6_V#_Frühling.xls» UND
«KT_ProCode_ERHEBUNG_Set6_V#_Sommer.xls»
 - Photos from the sampling points jpeg:
«KT_ProCode_ERHEBUNG_Set6_Probestelle1.jpeg»,
«KT_ProCode_ERHEBUNG_Set6_Probestelle2.jpeg»,
«KT_ProCode_ERHEBUNG_Set6_Probestelle3.jpeg»,
«KT_ProCode_ERHEBUNG_Set6_Probestelle4.jpeg»,
«KT_ProCode_ERHEBUNG_Set6_Probestelle5.jpeg»,
«KT_ProCode_ERHEBUNG_Set6_Probestelle6.jpeg»,
«KT_ProCode_ERHEBUNG_Set6_Probestelle7.jpeg»,
«KT_ProCode_ERHEBUNG_Set6_Probestelle8.jpeg»
 - IBCH survey grid: KT_ProCode_ERHEBUNG_Set6_Raster.xls
 - Modified IBCH laboratory protocol:
KT_ProCode_ERHEBUNG_Set6_LaborProtokoll_V#.xls
 - EPT species list: KT_ProCode_ERHEBUNG_Set6_EPT_V#.xls
 - Sampling sites as point shapefile: KT_ProCode_ERHEBUNG_Set6_Probestellen.shp
- Elements of the file naming scheme (see Factsheet 5):
- KT = two-capital-letter cantonal abbreviation (e.g. VD)
 - ProCode = project code
 - ERHEBUNG = survey time point (relative to restoration), i.e. VORHER (= before), NACHHER1 (= after 1), NACHHER2 (= after 2), or VERTIEFT (= EXTENDED)
 - V# = version number.

Attachments

The data entry form (which includes the IBCH survey grid and the laboratory protocols), the quality control form, the «Erläuterungen zu den Laborarbeiten» can be downloaded from: <https://www.bafu.admin.ch/wirkungskontrolle-revit>

The MSP module (FOEN 2019; available in French/German) can be downloaded [here](#)