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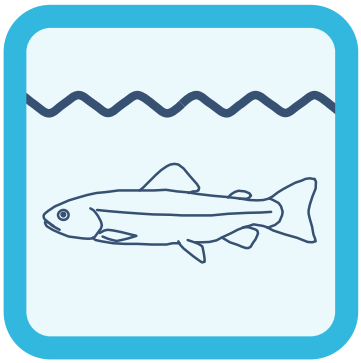
Technical Sheet: Indicator Set 7 Fish



Indicators

- 7.1 Fish community (in accordance with Woolsey et al. 2005; no. 9)
- 7.2 Age structure of fish population (in accordance with Woolsey et al. 2005; no. 8)
- 7.3 Ecological guilds of fish (in accordance with Woolsey et al. 2005; no. 10)

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PDF download:
http://www.bafu.admin.ch/outcome-evaluation-resto
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This publication is also available in French, German and Italian.

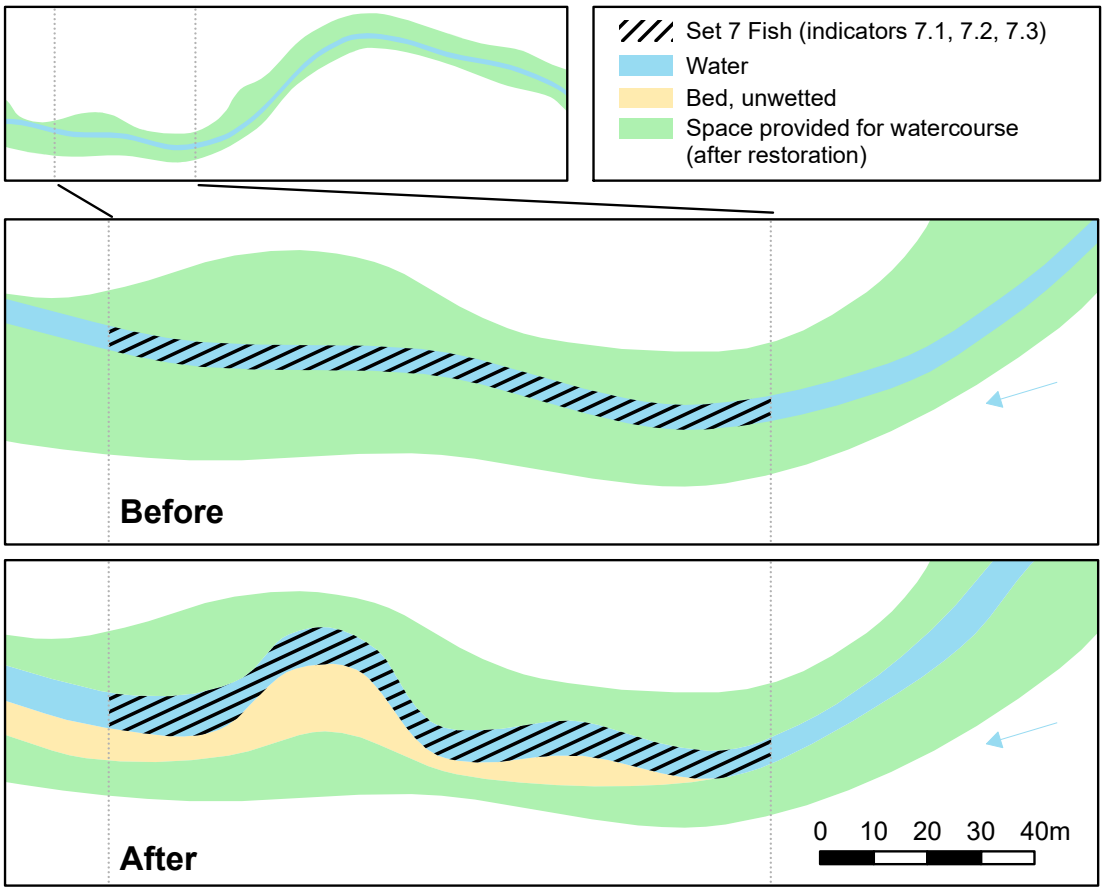
This Indicator Set forms part of the Swiss STANDARD outcome evaluation and is to be used in conjunction with the practice documentation “Evaluating the outcome of restoration projects – collaborative learning for the future” (FOEN 2019). The indicators included in the Indicator Set derive from various 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

Fish are valuable biological indicators: as long-lived and mobile organisms, they reflect habitat conditions over extended periods and along lengthy river reaches. They are also widely distributed and usually relatively easy to identify. Indicator Set 7 investigates the diversity and relative abundance of fish species. Also of interest is the occurrence of different age classes, permitting conclusions as to reproduction and growth. Finally, guilds (i.e. ecological groups) are used to investigate the ecological requirements of the fish species present; this provides information on habitat diversity and resource availability.

Parameters	Quantitative electrofishing (3 runs) to determine the following parameters: • number of species and guilds present • density [individuals/ha] and biomass [kg/ha] of all fish species present, and for each guild, species and age class (0+ fish, juveniles, adults; only for typical species) • relative species abundance as a percentage of the total number of individuals
Applicability	The methods are suitable for small and medium-sized watercourses which are fishable by wading over 95% of the wetted area. For deep, fast-flowing watercourses where quantitative electrofishing is not possible, the fish community is to be assessed in a project-specific manner, with no strict methodological requirements, by means of appropriate techniques (e.g. point abundance sampling, strip fishing, net fishing, juvenile counting, etc.) and expert evaluations.
Special considerations	The evolution of the three indicators over time is strongly dependent on the development potential of the waterbody, e.g. sources for recolonisation and their connectivity. As a result of restoration, there may also be changes in the fishability of the subsection, e.g. due to the emergence of deep pools or large, dense collections of woody debris. In certain situations (e.g. mass catches of large fish), smaller fish species and juveniles can be easily overlooked. The fishing teams must ensure that all species and age classes are appropriately sampled. Fish populations may be directly influenced by stocking, angling or pollution.
Survey site	Subsection (see Fig. 7.1)
Timing	Mean low flow, good transparency. Late summer/autumn (favourable time in terms of development of juveniles) “Before” and “after” survey under comparable conditions and in the same season. Disturbance and damage to the fish community should be kept to a minimum (no fishing during extreme temperatures, avoidance of the spawning and incubation period).
Material	Equipment for electrofishing, holding, anaesthetisation and measurement of fish.

Figure 7.1: Survey site for the indicators from Indicator Set 7 before and after restoration.



Survey

The individual steps involved in the survey are explained below, in chronological order. The procedure for electrofishing is in accordance with the ongoing revision of the "Fish – Regional scale level" module of the Modular Stepwise Procedure (MSP, Schager & Peter 2004).

* Tools from the original source of the technical sheets presented here (Woolsey et al. 2005) will be updated in the coming years in coordination with the revision of the MSP. The original tools are available for download at: www.rivermanagement.ch > Produkte & Publikationen > Hilfsmittel für die Praxis > Rhone-Thur-Projekt.

Step	Description	Indicator
Survey of current species set	• Quantitative electrofishing of the subsection surveyed in Indicator Set 1 (at least 100 m and at most 200 m long). • Electrofishing in an upstream direction in three runs. Barrier (e.g. stop net, electrical barrier) installed at the upstream and, if necessary, the downstream end. • Identification, measurement (to 1 mm) and weighing (to 1 g; <10 cm to 0.1 g) of all captured individuals. If there is a high abundance of juvenile or small fish (e.g. mass catches of cyprinids): counting and weighing in species-specific groups (see Fig. 7.2). • For all separately measured individuals, abnormalities or injuries are to be recorded in accordance with the code on the field form.	7.1, 7.2, 7.3
Processing of capture results	• Estimation of population for species with adequate capture numbers per electrofishing run. The choice of method is left to the user, but the same method must be used for the "before" and "after" surveys. • The electrofished area is the result of the mean wetted width (determined in Indicator Set 1) x length electrofished.	7.1, 7.2, 7.3

Determination of typical species set	• If available: use of data on historical fish populations. • Use of a theoretical reference, based on biocoenotic classification/fish regions, taking account of particular local conditions (e.g. lake outflow, groundwater inflow; major catchment (Rhône, Rhine, Doubs, etc.)). • The typical species set remains the same for the duration of the outcome evaluation.	7.1, 7.2, 7.3

Determination of presence/absence	• Comparison of species set with typical species set:
	  • absence: a species listed in the typical species set does not occur in the current species set.
	  • presence, typical: a species found in the current species set is also included in the typical species set.
	  • presence, non-typical: a species is found in the current species set, but not in the typical species set.
	• Calculation of dominance structure: relative species abundance as a percentage of the total number of individuals.
	• Calculation of density and biomass: number and biomass of all fish per hectare. For this, the total number or the biomass of all fish is divided by the electrofished area.
		7.1

Determination of age classes (typical species only)	For typical species: determination of the abundance and density of three age classes (0+ fish, juveniles, adults) using a length frequency distribution chart (see Fig. 7.3).	7.2

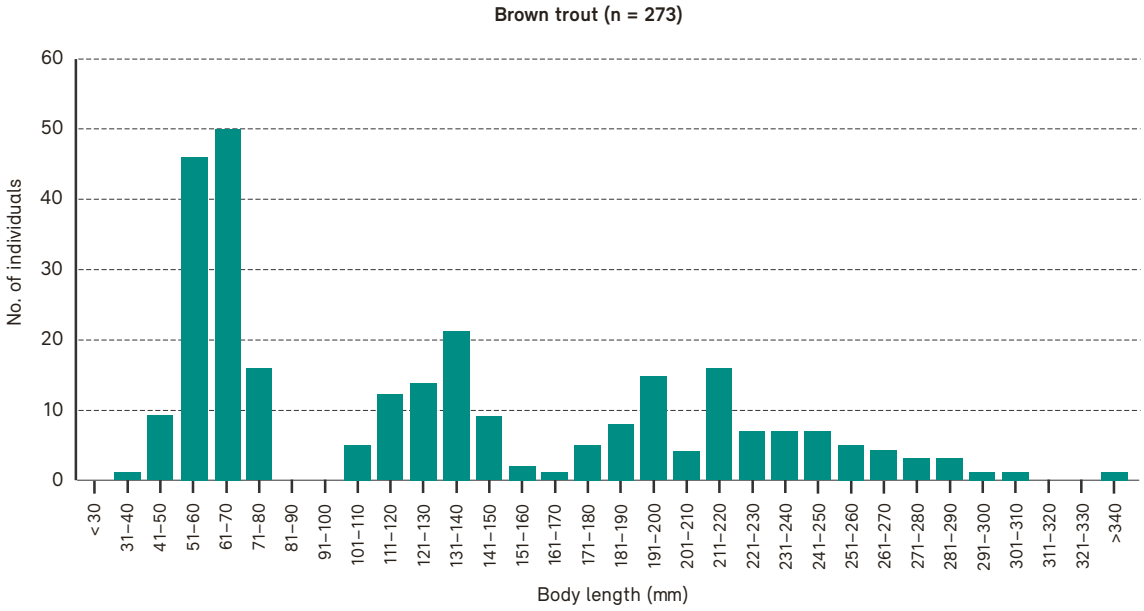
Determination of guild membership and diversity	• Assignment of species to ecological guilds in accordance with Table 7.5 (see also the species list in the data entry form for Indicator Set 7)
	• Separately, for the current species set (before/after) and for the typical species set:
	  • Determination of guild number, i.e. number of guilds for each area (e.g. temperature, migration).
	  • Determination of guild strength, i.e. density for each guild and area (e.g. temperature, migration).
		7.3

Figure 7.2: Measurement and weighing of captured fish. The following rules apply:
All fish are identified to species level and individually measured and weighed (* = I), example in blue.
Exception: simplified procedure for mass catches of fish <10 cm:

- *First 100 fish of each species:* measured individually and weighed individually (* = I; example in purple) or in groups (* = G; example in red).
- *From 100 fish of a given species:* length no longer measured. To be counted and weighed in groups (no. of fish and total weight of group, * = G), example in green.

No.	Fish species	No. of fish	Individual/ group	Total length [mm]	Weight [g]	Deformities/ abnormalities	Comments	Tagging	Run
1	Brown trout	1	I	452	950	A	Angling injury, left		1
2	Bullhead	1	I	131	25				1
3	Barbel	1	I	253	140				1
4	Chub	1	I	76	4				1
5	Chub	4	G	60	7				1
6	Chub		G	55					1
7	Chub		G	57					1
8	Chub		G	54					1
501	Barbel	15	G		60				2
502	Chub	20	G		65				2
503	Bullhead	19	G		54				2
504	Loach	25	G		105				2

Figure 7.3: Example of a length frequency distribution chart. Electrofishing of the Schwendibach (Appenzell Innerrhoden) on 22 August 2000 (Schager & Peter 2001). The length class width is 10 mm. With larger class widths, analysis of age structure is scarcely possible.



Evaluation

The assessment methods given below derive from the original Indicator method sheets included in the "Handbook for evaluating rehabilitation projects in rivers and streams". These provide guidance and are to be revised in the coming years on the basis of experience accumulated in the STANDARD and EXTENDED outcome evaluation, and in synergy with the ongoing revision of the MSP module "Fish – Regional scale level" (e.g. inclusion of biomass).
Because of the difficulties involved in capture and identification, fish smaller than 30 mm are excluded from the evaluation.

Indicator	Description
7.1 Fish community	• The current species set (before or after restoration) is compared with the typical species set. For this purpose, Table 7.1 (adapted from Schmutz et al. 2000) can be used. • The scores for the 5 rows are added up. • The total is divided by 5. The final value resulting is a normalised value between 0 and 1.
7.2 Age structure of fish population	• For each typical species, density is evaluated using Table 7.2. • For each species, the sum of the scores for the 3 rows is divided by 3, resulting in a normalised value between 0 and 1. • The values for all typical species are averaged.
7.3 Ecological guilds of fish	• The guild number and strength of the current species set (before or after restoration) is compared with that of the typical species set. For this purpose, Table 7.3 can be used. The scores for the 2 rows are added up. • The sum of the scores for the 2 rows is divided by 2. The final value resulting is a normalised value between 0 and 1.

Table 7.1: Determination of evaluation scores for indicator 7.1 Fish community.

	Evaluation scores				
	0	**0.25**	**0.5**	**0.75**	**1**
Fish density*	Massive change (>100%)	Substantial change (50–100%)	Marked change (approx. 50%)	Slight change (approx. 25%)	No change (approx. 10%)
Biomass	Massive change (>100%)	Substantial change (50–100%)	Marked change (approx. 50%)	Slight change (approx. 25%)	No change (approx. 10%)
Typical species (no. of species)	Most absent (>80%)	Many absent (60–80%)	Several absent (40–60%)	Certain species absent (20–40%)	(Almost) none absent (<20%)
Non-typical species (no. of individuals)	Dominate the community (>50%)	Considerable proportion (10–50%)	Numerous specimens present (2–10%)	Individual specimens present (<2%)	None present
Dominance structure**	Massive change	Substantial change	Marked change	Slight change	No change

* Fish density may be subject to substantial annual variation. However, fish density is considered to be a parameter capable of rough evaluation.
** Evaluation based on the 3–4 dominant typical species (biomass and density).

Table 7.2: Determination of evaluation scores for indicator 7.2 Age structure of fish population.

	Evaluation scores				
	0	**0.25**	**0.5**	**0.75**	**1**
0+ fish	Absent	Individual specimens	Low abundance	Medium abundance to adequate density	Adequately represented
Juveniles	Absent	Individual specimens	Low abundance	Medium abundance to adequate density	Adequately represented
Adults	Absent	Individual specimens	Low abundance	Medium abundance to adequate density	Adequately represented

Table 7.3: Determination of evaluation scores for indicator 7.3 Ecological guilds of fish.

	Evaluation scores				
	0	**0.25**	**0.5**	**0.75**	**1**
Guild number (no. of guilds)	Most guilds absent	Many guilds absent	Several guilds absent	Certain guilds absent	No guilds absent
Guild strength (density per guild)	Complete change	Fundamental change	Marked change	Slight change	No change

Time required

Table 7.4: Estimated time required in person-hours for the determination and evaluation of Indicator Set 7. 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)
Preparation for electrofishing	1	3		
Electrofishing in the field per 5 m watercourse width	1–7	5–7	2–12	5–7
Data processing (e.g. entry)			1	2–4
Data evaluation	1	12		
Total person-hours	20–64		12–88	

Notes: -

Further information

Data arising	• Data entry form Indicator Set 7: KT_ProCode_ERHEBUNG_Set7_V#.xls 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	The field protocol, data entry form and other tools can be downloaded at: https://www.bafu.admin.ch/wirkungskontrolle-revit

Table 7.5: Ecological guilds taken into consideration (adapted from Schmutz 2000). A list showing the guild membership of fish species found in Switzerland is included in the data entry form for Indicator Set 7, available at: https://www.bafu.admin.ch/wirkungskontrolle-revit

General flow preference	rheophilic	preference for flowing water
	indifferent	no clear preference for flowing or standing water
	limnophilic/stagnophilic	preference for standing water
Dependence on structures	structure dependent	strongly dependent on structures
	moderately structure dependent	living close to structures
	structure independent	not dependent on any essential structures
Temperature tolerance	oligo-stenothermal	entire life cycle restricted to a small range of relatively low temperatures
	meso-eurythermal	adapted to moderate temperatures, with greater variability in temperature requirements, according to developmental stage and season (e.g. minimum temperatures in spring/summer for successful reproduction).
Preferred spawning substrate	polyphilic	no particular spawning substrate requirements
	lithophilic	stones
	pelagophilic	open water
	phytophilic	vegetation
	psammophilic	sand
	ostracophilic	shells
	speleophilic	cavities/caves
Feeding type	detritivorous	filtering algae and detritus from sediments
	benthivorous/insectivorous	feeding on benthic resources/insects
	piscivorous	feeding on fish/predatory – mainly fish, but also a low proportion of terrestrial and other aquatic resources.
	planktivorous	filtering mainly zooplankton but also phytoplankton
	omnivorous/euryphagous	eating a wide variety of foods
	herbivorous	feeding on plants
Migration type	short	migrating over short distances (a few kilometres); spawning migration confined to freshwater
	medium	migrating over medium distances (up to 100 km or more); spawning migration within freshwater (potamodromous)
	long	migrating over long distances (several hundred kilometres); spawning migration between fresh and salt water (diadromous)
Tolerance to pollution/ degradation	tolerant	not sensitive to anthropogenic disturbances
	intolerant	sensitive to anthropogenic disturbances

Longevity	short-lived	individuals live less than 5 years
	intermediate lifespan	individuals live for 5–15 years
	long-lived	individuals live for more than 15 years