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Proportion of Adversely Affected Watercourses

Straightening has curbed many watercourses in the past. When natural structures were replaced by control structures such as artificial river banks and beds, valuable habitats disappeared, along with hiding places for small organisms and fishes. Unlike controlled rivers, watercourses with natural beds and banks are rich in structures, offering important habitats to a large number of species, particularly fingerlings and their prey.

Currently, some 14'000 kilometers or 22% of Switzerland's watercourses are adversely affected. The goal is to restore 4'000 river kilometers in the future.

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Watercourses have been diked, straightened and culverted for centuries. These measures were meant to allow watercourses to be used as transportation routes or for energy generation, to gain agricultural land, or to protect infrastructures and settlements against flooding. However, control structures not only cause habitats to vanish, but also interrupt longitudinal river network connectivity, making it impossible for fishes and other aquatic organisms to follow traditional migration patterns.

Efforts have increasingly been made in the past to restore natural functions by removing man-made structures and obstacles. Key factor for renaturation is, at most extensively managed, adequate space.

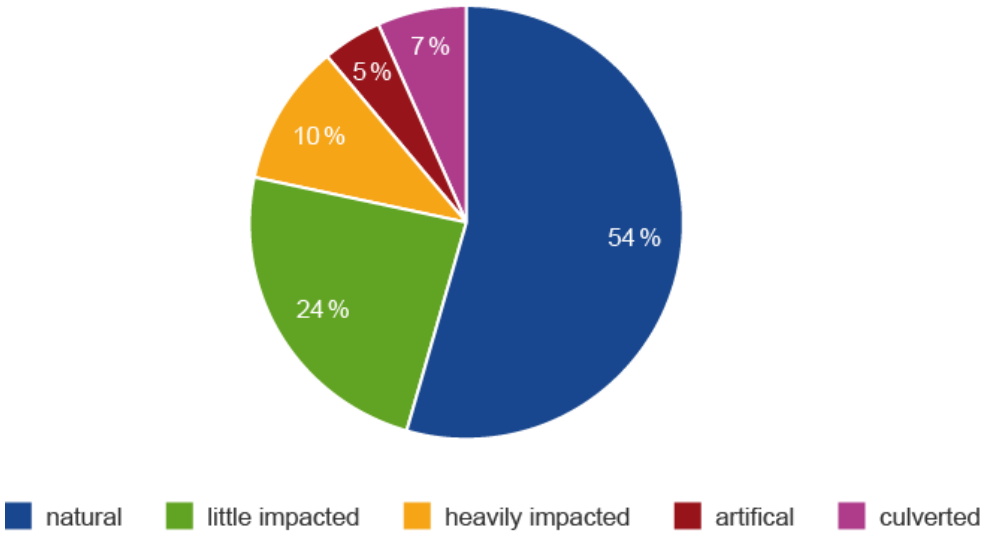
Structural impairments diminish the ecomorphological quality of watercourses. For the purposes of the E12 indicator, ecomorphology is defined to be the structure of watercourse habitats. In addition to ecomorphology, any assessment of a watercourse's quality also needs to consider water withdrawals (cf. E11 indicator "Volume of Water Withdrawn from Watercourses"), water quality (cf. E13 "Water Quality"), hydropeaking and sediment transport.

Development in Switzerland

Switzerland's watercourse network consists of roughly 65'000 kilometers of rivers and creeks. The ecomorphology of watercourses was surveyed by the cantons between 1997 and 2008. However, survey density varied greatly, with mapping in the Central and Southern Alps restricted to major watercourses.

Fig. 1: Ecomorphological state of watercourses in Switzerland

Condition of bed bottoms, banks and vicinities of watercourses (ecomorphology) divided into five categories.
percentage shares



Comments

- Watercourses categorized as "natural/seminatural" or "little impacted" are considered to be in a good ecomorphological state, while the state of those in any other category is considered to be bad.
- Roughly 22% or some 14'000 kilometers of Switzerland's watercourses are adversely affected from an ecomorphological point of view. Of these 14'000 kilometers, around 10'000 are heavily impacted or artificial. Another 4'000 kilometers have been culverted, which means they now run underground. The

remaining 78% or some 51'000 kilometers of the country's watercourses (color-coded blue or green) have been found to be in a good ecomorphological state.

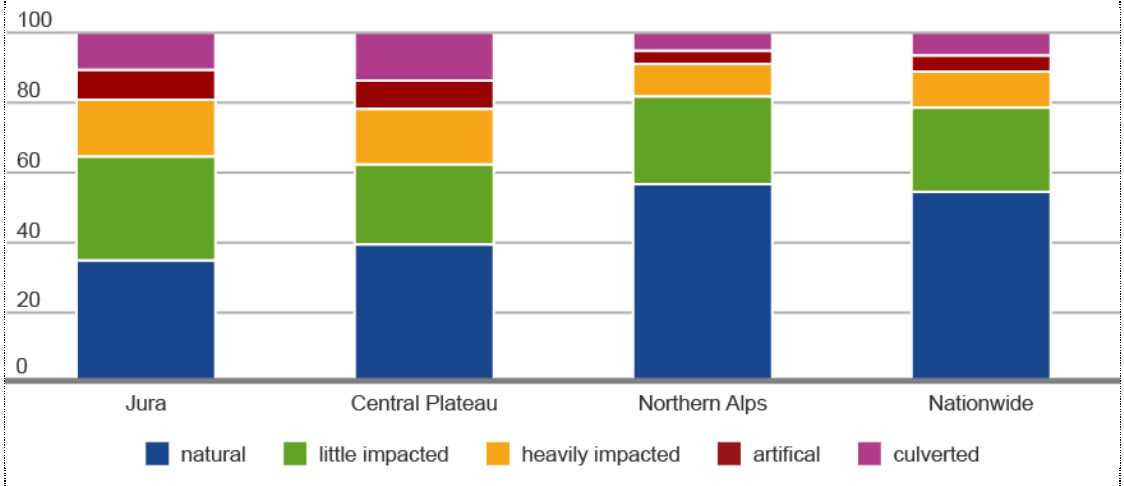
- Corresponding to 4'000 kilometers, 7% of watercourses are culverted (purple).
- In the Alps, where competing land-use pressure is low, some 40'000 kilometers of creeks are in a good ecomorphological state. As these 40'000 kilometers equal roughly 60% of the total length of Switzerland's rivers and creeks, their state has a favorable impact on the overall assessment of the country's watercourses.
- In regions located at below 600 meters above sea level and subjected to intensive land use, 46% of all watercourses are adversely affected. Compared to the situation prevailing in the Alps, that share is considerably higher.
- To reverse this long-term negative trend, efforts have increasingly been made since the 1980s to achieve renaturation of surface waters: For example by removing man-made structures, expanding their area, making obstacles open to fish migration and furnishing fish passes to dams.
- Since 2011 the Water Protection Act requires rivers and lakes to be rehabilitated. The goal is to restore 4'000 river kilometers over the next 80 years. Therefore, the trend is assumed to be moving in the right direction even though only one value currently exists.
- For complete data tables and complementary information, please go to Appendix 1.

Development in the regions

Ecomorphological impairment of watercourses by control structures varies from region to region.

Fig. 2: Ecomorphological state of watercourses in the Jura, on the Central Plateau, in the Northern Alps, and nationwide

Condition of bed bottoms, banks and vicinities of watercourses (ecomorphology) divided into five categories.
percentage shares



Comments

- Watercourses categorized as “natural/seminatural” or “little impacted” are considered to be in a good ecomorphological state, while the state of those in any other category is considered to be bad.
- At 36% and 38% respectively, the proportion of adversely affected watercourses in the Jura and on the Central Plateau is markedly higher than in the Northern Alps, where that share only reaches 18%. The Jura holds 3’000 kilometers of watercourses, the Central Plateau 15’000 kilometers, and the Northern Alps 24’000 kilometers.
- A particularly high share of watercourses (14%) has been culverted on the Central Plateau. The percentage of watercourses running underground in that region is three times as high as in the Northern Alps and two times as high as in Switzerland overall.
- With watercourses being renatured in many places (even though typically along short sections only), the proportion of adversely affected watercourses tends to decline slowly.
- For complete data tables and complementary information, please go to Appendix 2.

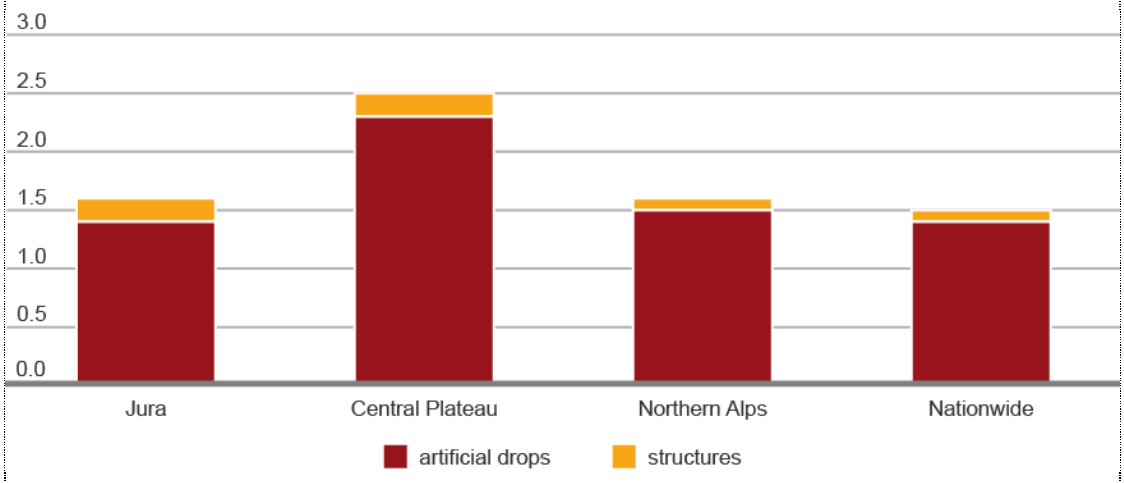
Additional findings

Density of artificial obstacles

Transverse structures such as cross-river sills, river power plants and dams segregate the habitats of fishes and other aquatic organisms, impeding their migrations. Figure 3 below illustrates the number of such artificial obstacles in watercourses per kilometer in the Jura, on the Central Plateau, in the Northern Alps and nationwide.

Fig. 3: Number of artificial obstacles in watercourses per kilometer in the Jura, on the Central Plateau, in the Northern Alps, and nationwide

Extrapolated numbers of artificial obstacles in watercourses per kilometer, considering only artificial drops and structures that are higher than 50 centimeters, as such impediments are impossible to overcome for most fish species.



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Comments

- In Switzerland, any watercourse is bound to be affected by an average 1.6 obstacles of more than 50 centimeters in height per kilometer. Of these obstacles, most are artificial drops.

- On the Central Plateau, obstacle density amounts to an average of two to three obstacles per kilometer. This average distinctly surpasses the one recorded in the Jura or the Northern Alps, where one to two obstacles are found per kilometer.
- So-called chains of check dams—which create a series of drops within a short distance of each other—have not been surveyed in a consistent manner. Some cantons did not map chains of check dams at all, others recorded the series of drops created by such chains as one single obstacle, and still others registered each drop as an individual obstacle.
- For complete data tables and complementary information, please go to Appendix 3.

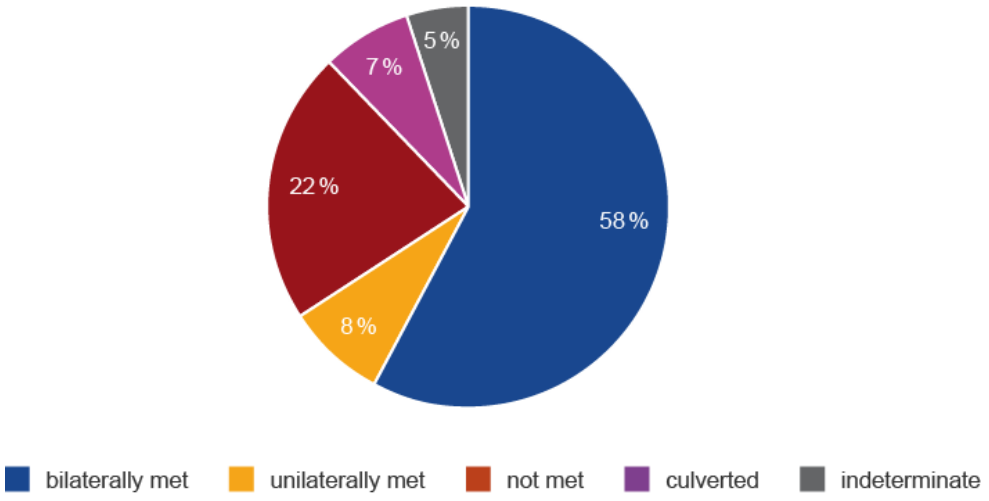
Space requirements of watercourses

Watercourses need enough space to fulfill their natural functions and not do any flood damage in times of high water. Watercourse space requirements are composed of the channel (bottom width) itself plus riparian zones on both sides. Depending on its width and ecomorphological state, a watercourse will require 5 to 15 meters of space on each side (FOEN, FOAG, ARE (eds.), 2003: *Leitbild Fliessgewässer Schweiz)*.

Fig. 4: Space requirements of watercourses in Switzerland

Space requirements of watercourses by category: "bilaterally met" (on both banks), "unilaterally met" (on one bank), "bilaterally not met", "indeterminate", or "culverted" (below ground).

category percentage shares



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Comments

- Along 38'000 kilometers or 58% of Switzerland's watercourses, space requirements are met on both sides ("bilaterally met"). While 8% of all watercourses (5'000 kilometers) have enough space on one side at least ("unilaterally met"), the riparian zones of 22% or along 14,000 kilometers are too narrow on both sides ("bilaterally not met"). For 5% or 3'000 kilometers, riparian zone sizes remained undetermined ("indeterminate"), and 7% or 4'000 kilometers of this country's watercourses are culverted.
- Riparian zones currently cover 64'000 hectares overall. However, for Switzerland's watercourses to fulfill their ecological functions, they would require a total of 86'000 hectares.
- Riparian zones in settlements are just under 4'000 hectares short, but with undeveloped land being so scarce there, it is hardly possible to give affected watercourses more space again.
- Roughly 11'000 hectares of lacking riparian zones are located in rural regions. In other words, 1% of Switzerland's agricultural land (as surveyed in 2007) is located within riparian zones. However, due to the surveying methods used, near-natural ecological compensation areas have not been taken into account. As a result, riparian zones lacking in rural regions are actually smaller by the unknown size of such ECAs.
- For complete data tables and complementary information, please go to Appendix 4.

Significance for biodiversity

Watercourses with natural beds and banks are rich in structures, offering important habitats to a large number of species, particularly fingerlings and their prey. In the past, however, many of these habitats were destroyed as watercourses have been corrected, straightened, stabilized and culverted for almost two centuries. Measures such as these were meant to allow rivers and creeks to be used as transportation routes or for energy generation, or to protect settlements and agricultural land against flooding.

Artificial river beds and banks are devoid of microhabitats needed by fishes and small animals. Furthermore, obstacles such as cross-river sills, river power plants, dams and other transverse structures obstruct or prevent the migration of aquatic organisms, above all that of many fish species needing to migrate to the upper reaches of a watercourse to spawn. Most fishes cannot overcome obstacles higher than 50 centimeters, and some species find even 20 centimeters in height to be insurmountable. Artificial habitat segregation has a considerable negative impact on nonmigratory species as well, as it prevents populations from extending their ranges and interbreeding. Isolated subsize populations, however, cannot survive in the long run.

Definition

Changes in the sum of adversely affected creek and river sections in proportion to the length of all watercourses overall.

Natural watercourses make up ecomorphological state category I as defined by the Modular Stepwise Procedure for Ecomorphology (level I, regional survey). The channel and the embankment feet of such watercourses have not been altered by control structures. Moreover, the width of their water level surface varies, and both banks are sufficiently wide, with their plant cover natural or near natural in character. The more a watercourse has been modified by control structures, the more adversely it is affected. A watercourse categorized as “little impacted”, “heavily impacted”, “not natural/artificial”, or “culverted” belongs to ecomorphological state category II, III, IV, or V respectively. Watercourses assessed to be “natural” or “little impacted” are in a good state from an ecomorphological point of view, while rivers or creeks found to be “heavily impacted”, “not natural/artificial” or “culverted” are considered to be in a bad state. A small proportion of adversely affected sections is favorable for biodiversity.

Surveying methods

Between 1997 and 2008, the ecomorphological state of Switzerland’s watercourses was surveyed in 24 cantons along just under 30’000 kilometers of rivers and creeks. However, survey density varied greatly, with mapping in the Central and Southern Alps restricted to major watercourses. Watercourses were surveyed applying the Modular Stepwise Procedure for Ecomorphology (level I, regional survey) developed by the FOEN, assessing the variability of the width of their water level surface, the width of the channel bed, bed and embankment feet control structures as well as the width and nature of the bank area. Based on these parameters, watercourses were then assigned to ecomorphological state categories. Results were subsequently transferred to the VECTOR25 network of watercourses, extrapolating mapped watercourse sections. For each watercourse section, the difference between the mapped bank width and the required bank width was determined, followed by extrapolation of this data in order to compute the size of bank areas and the size of lacking bank areas. In this extrapolation, the big Swiss rivers such as Aare, Reuss, Rhine and Rhone were disregarded because the method fails to do sufficient justice to the complex situation characterizing rivers as wide as or wider than 15 meters. Data recorded for Switzerland, the Jura and the Central Plateau has been extracted from the publication entitled

Strukturen der Fliessgewässer in der Schweiz (Zeh Weissmann et al., 2009). Data recorded for the Northern Alps has been analyzed accordingly for the E12 indicator.

Further information

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Related indicators

> E11 “Volume of Water Withdrawn from Watercourses”

> E13 “Water Quality”

Additional sources of information

> http://www.bafu.admin.ch/index.html?lang=en website of the Federal Office for the Environment FOEN. Publications mentioned in the text may be ordered in print or downloaded from the site.

> http://www.bafu.admin.ch/wasser/13465/13486/index.html?lang=en comprehensive information on water protection in Switzerland.

> http://www.modul-stufen-konzept.ch/index_EN information on the modular stepwise procedure

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> FOEN, FOAG, ARE (eds.), 2003: *Leitbild Fliessgewässer Schweiz. Für eine nachhaltige Gewässerpolitik.* Bern, Bundesamt für Umwelt. 12 S.

> Zeh Weissmann, H.; Könitzer, C.; Bertiller, A., 2009: *Strukturen der Fliessgewässer in der Schweiz. Zustand von Sohle, Ufer und Umland (Ökomorphologie), Ergebnisse der ökomorphologischen Kartierung*. Stand April 2009. BAFU-Schriftenreihe Umwelt-Zustand Nr. 0926. Bern, Bundesamt für Umwelt. 100 S.

This information is based on the German-language document 1260_E12_Basisdaten_2015_V2.docx dated September 30, 2015.