



Length of Linear Landscape Features

The E4 indicator «Length of Linear Landscape Features» registers changes in length affecting landscape features such as hedges, forest edges, and open watercourses. Representing transition zones between different habitats, linear landscape features are often particularly rich in species. As they interconnect various natural landscape units, many animal species use them for migration corridors. Declining numbers of such features result in a loss of habitat, preventing numerous animal species from moving freely about the landscape. Newly created hedges or forest edges and renatured watercourses may reconnect previously isolated habitats and increase a landscape's ecological quality.

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Contents

Development in Switzerland.....	2
Development in the regions.....	3
Significance for biodiversity.....	5
Definition.....	6
Surveying methods.....	6
Further information.....	7

Development in Switzerland

The table below lists changes registered in the length of linear landscape features nationwide (ARE/FOEN, 2007)¹. Using consecutive editions of Switzerland's National Map, signatures of individual landscape features were compared to take stock of both new and lost sections. In doing so, the indicator reveals whether linear landscape features on the whole become lengthened or shortened. Monitoring periods correspond to updating intervals of the National Map.

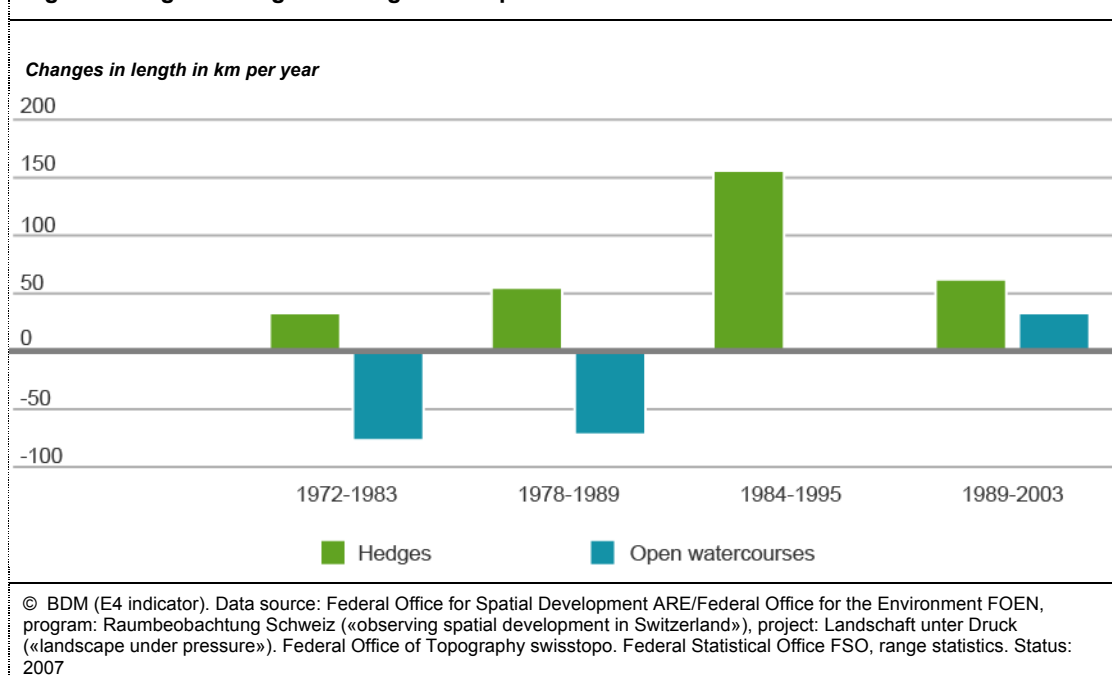
In order to put changes in length into perspective, it helps to view the bigger picture, comparing changes with the overall length of monitored landscape features: In 2009, Switzerland's National Map held 10'334 kilometers of hedges, 115'440 kilometers of forest edges, and 61'542 kilometers of watercourses. This information is based on the VECTOR25 digital dataset by swisstopo.

Tab. 1: Annual changes in length expressed in kilometers

Linear landscape features	1972–1983	1978–1989	1984–1995	1989–2003
Hedges	33	55	156	62
Forest edges	no data	no data	no data	703
Open watercourses	-77	-72	0	33

© BDM (E4 indicator). Data source: Federal Office for Spatial Development ARE/Federal Office for the Environment FOEN, program: Raumbeobachtung Schweiz («observing spatial development in Switzerland»), project: Landschaft unter Druck («landscape under pressure»). Federal Office of Topography swisstopo. Federal Statistical Office FSO, range statistics. Status: 2007

Fig. 1: Changes in length of hedges and open watercourses in Switzerland



¹ FEDERAL OFFICE FOR SPATIAL DEVELOPMENT ARE / FEDERAL OFFICE FOR THE ENVIRONMENT FOEN (EDS., 2007): LANDSCHAFT UNTER DRUCK. 3RD UPDATE 1989–2003. BERN. (NOT AVAILABLE IN ENGLISH)

Comments

- As indicated by National Map signatures, hedges increased by a net 62 kilometers per year between 1989 and 2003.
- When National Maps used to be established manually, hedge symbols were sometimes covered to make room for inscriptions. As a result, a new hedge shown in a later edition was not necessarily newly planted, but might simply have reappeared from under the inscription. While introducing the VECTOR25 digital landscape model eliminated this particular problem, data collection continues to leave considerable leeway for interpretation. However, despite these limitations, data clearly indicates hedges to increase in length.
- Forming a transition zone between forests and the open landscape, forest edges are features of great ecological importance with high species richness. The shape and surface area of forests can be changed by natural or human-made causes such as avalanches or straightening, which impacts the length of forest edges. Forest edges may also be created within a forest, for example if a storm blows down a clearing or if a road is built (ARE/FOEN, 2007)¹.
- Brooks are still being culverted (canalized in an underground pipe) in Switzerland to this day, about to the same extent as in the 1970s and 1980s (ARE/FOEN, 2007)¹. Nowadays, however, owing to infiltration swales, renaturation and natural flood dynamics, brooks returning to the surface considerably outnumber those banished underground.

Development in the regions

The table below lists changes registered in the length of linear landscape features both nationwide and in individual spatial landscape units (ARE/FOEN, 2007)¹.

Tab. 2: Annual changes in length registered in spatial landscape units* expressed in kilometers						
Linear landscape features	Monitoring period	High Alps	Mountains	Central Plateau	Conurbations	Nationwide
Hedges	1972–1983	0	9	22	3	33
	1978–1989	3	25	21	7	55
	1984–1995	0	48	67	41	156
	1989–2003	0	-2**	43	20	62
Forest edges	1989–2003	77	432	158	36	703
Open brooks	1972–1983	2	-13	-61	-5	-77
	1978–1989	3	-18	-51	-6	-72
	1984–1995	15	-15	3	-3	0
	1989–2003	20	1	10	2	33

© BDM (E4 indicator). Data source: Federal Office for Spatial Development ARE/Federal Office for the Environment FOEN, program: Raumeobachtung Schweiz («observing spatial development in Switzerland»), project: Landschaft unter Druck («landscape under pressure»). Federal Office of Topography swisstopo. Federal Statistical Office FSO, range statistics. Status: 2007

* Delimitation of spatial landscape units: high Alps: agricultural soil suitability map of Switzerland; mountains: standard borders of the agricultural land registration map; Central Plateau: region between conurbations and mountains; conurbations: national census of 1980.

** This figure is to be used with the reservation that a sampling point characterized by particular conditions might distort the overall result.

Fig. 2: Changes in length of hedges nationwide and in spatial landscape units

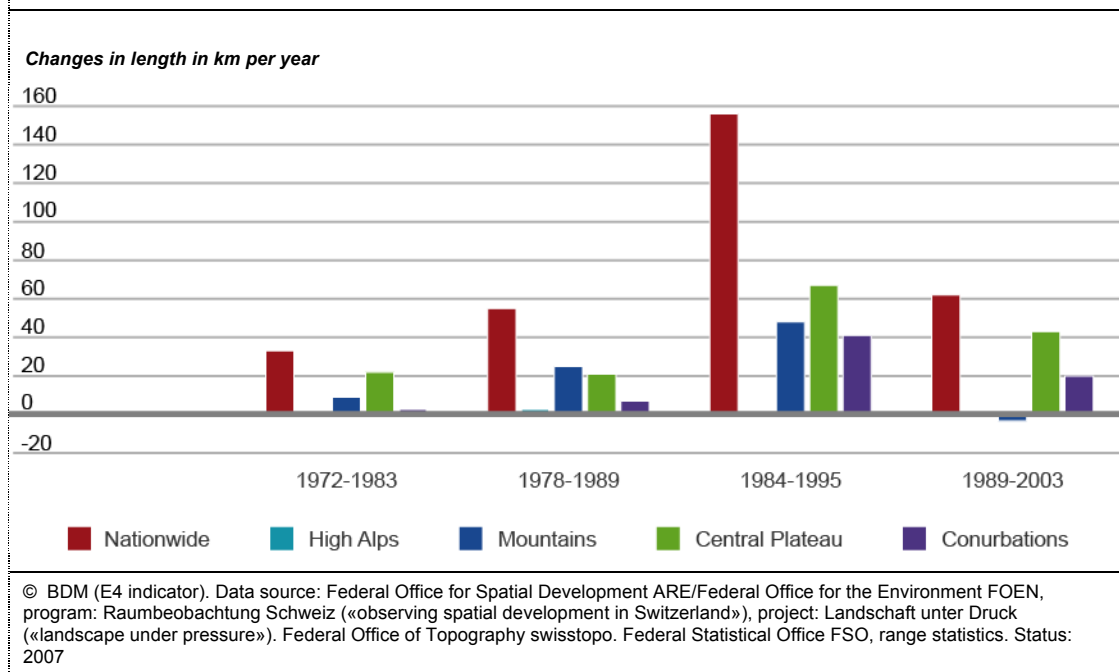
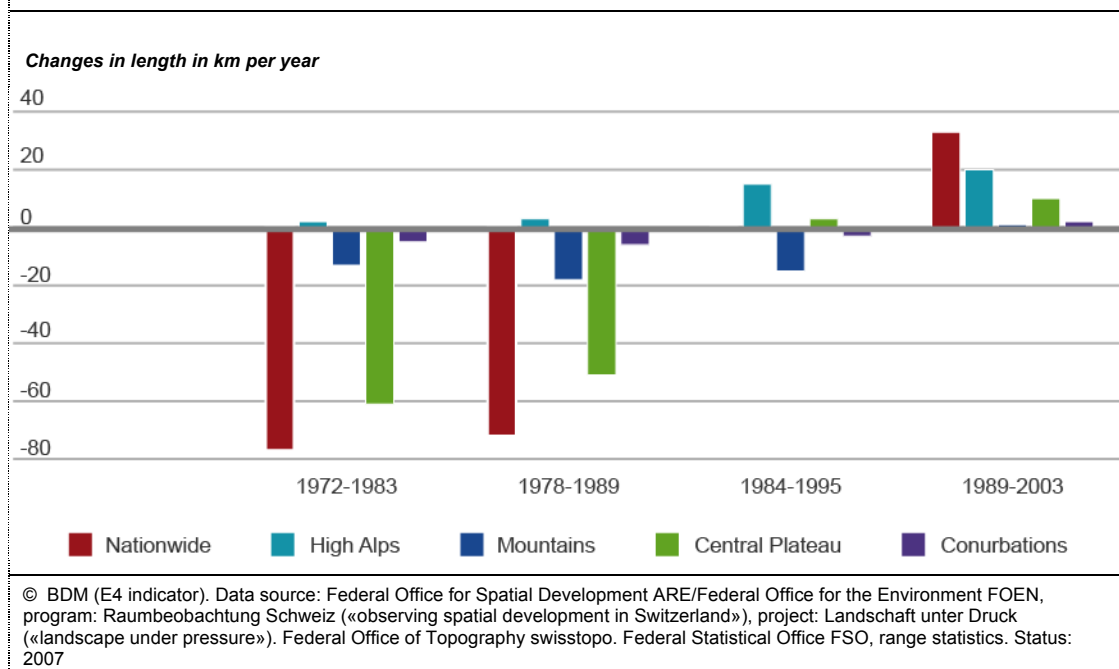


Fig. 3: Changes in length of open watercourses nationwide and in spatial landscape units



Comments

- As indicated by National Map signatures, open brooks in the high Alps increased by a net 20 kilometers per year between 1989 and 2003.
- From 1972 to 1995, hedges in the mountains displayed a net increase of up to 48 kilometers per year. During the last monitoring period (1989 to 2003), however, they did not expand anymore. At the same

time, both thickets and the length of forest edges increased at higher altitudes. In small-scale landscapes, growing hedges may end up fusing. Once a certain bulk has been reached, the National Map will not consider them to be hedges anymore, but thickets. This development indicates that marginal agricultural land is increasingly being encroached by shrub, which results in a loss of biodiversity (ARE/FOEN, 2007)¹.

- Unlike the mountains, both the Central Plateau and conurbations have been registering an increase in hedges between 1989 and 2003.
- While the mountains gained a large number of open brooks between 1989 and 2003, an almost equally large number disappeared. In part, this is caused by natural dynamics, for example if brooks change their course due to flooding. Such fluctuations are particularly marked in the high Alps, as precipitation or meltwater often change the appearance of alpine brooks. For this reason, they are not always equally well visible on the aerial photographs that the National Map is based on (ARE/FOEN, 2007)¹.

Significance for biodiversity

Providing transition zones between different habitats, linear landscape features are often particularly rich in species. Moreover, they typically interconnect various natural landscape units, turning them into migration corridors for a series of animal species. A decline of such features results not only in a loss of habitat, but usually also prevents many animal species from covering their complete potential area of expansion. Conversely, newly created hedges or forest edges as well as renatured brooks may reconnect previously isolated habitats, enhancing the landscape's value for plants and animals alike. In certain types of landscapes such as raised bogs, however, hedges, forest edges or open brooks do not occur by nature. Allowing such features to develop would have a harmful impact there.

Due to the lack of suitable data, the E4 indicator cannot evaluate the quality of the landscape features it monitors, even though a habitat's quality is crucial for its species diversity. Well-structured forest edges, for example, are of great importance both as independent habitats and as connecting features between forests and open grassland. This especially applies to the Central Plateau, where forests are divided up into countless forest islands. According to the Swiss National Forest Inventory of 2010², however, only about 40% of all forest edges on the Central Plateau and in the mountains offer high richness in species and structures.

Regardless of the fact that the ecological quality of individual linear landscape features remains unknown, the increase in hedges found on the Central Plateau and in conurbations has a favorable impact on species diversity, since every new hedge provides an additional structure in a landscape that has been «cleared out» by intensive farming and strong settlement pressure. In contrast to the Central Plateau, the length of hedges in the mountains is stagnating. At the same time, abandoning mountain areas once cultivated by extensive farming and, hence, home to many species leads to shrub encroachment, which in turn results in a loss of species richness, as many light-loving species lose their habitat.

Underground piping of brooks depletes the landscape, causing its structure and species diversity to decline. To this day, the number of watercourses disappearing from the National Map is still about the same as in previous monitoring periods. On the Central Plateau, for example, brooks are culverted when agricultural land is developed or residential and commercial buildings are constructed. On the other hand, many formerly culverted brooks are being renatured as well (ARE/FOEN, 2007)¹, which has a favorable impact on biodiversity.

² BRÄNDLI, U.-B. (RED.) 2010: RESULTS OF THE THIRD SWISS NATIONAL FOREST INVENTORY 2004-2006. BIRMENSCHEN, SWISS FEDERAL INSTITUTE FOR FOREST, SNOW AND LANDSCAPE RESEARCH WSL, FEDERAL OFFICE FOR THE ENVIRONMENT FOEN. 312 P. (ABSTRACT AVAILABLE IN ENGLISH)

Definition

Annual changes in the length of open watercourses, hedges and forest edges in kilometers, monitored both nationwide and in individual spatial landscape units.

Surveying methods

The E4 indicator «Length of Linear Landscape Features» is based on data collected for the *Landschaft unter Druck* («landscape under pressure») project of the Federal Office for Spatial Development ARE and the Federal Office for the Environment FOEN. Data used for the third project update was derived from changes registered in the differential layer of the VECTOR25 dataset that the Federal Office of Topography swisstopo draws on to establish Switzerland's National Map. Using an automated GIS process, changes in length of hedges, forest edges and open watercourses recorded in the VECTOR25 dataset were analyzed on 112 sampling areas covering 12 square kilometers each. The application computed the difference between new and missing sections of selected landscape features. In the next step, the results were extrapolated for Switzerland as a whole, and annual means were derived. As sampling areas are spread out over different spatial landscape units, it was possible to do a regional analysis as well. For the first and second updates of the *Landschaft unter Druck* project, which took place before the introduction of VECTOR25, the same analysis was done manually reviewing the entries in the differential layer recorded for the update of the National Map.

Spatial landscape units were delimited as follows:

- High Alps: agricultural soil suitability map of Switzerland (categories: «hardly fertile» and «not suitable for agricultural use»).
- Mountains: standard borders of the agricultural land registration map (montane zones I–IV).
- Central Plateau: region between conurbations and mountains.
- Conurbations: National Census of 1980, Statistical Yearbook of Switzerland 1983 (p. 64), and the «Communities of Switzerland» map.

After the third and latest update of the *Landschaft unter Druck* project, available analyses cover four monitoring periods:

- 4th monitoring period: 1989–2003.
- 3rd monitoring period: 1984–1995.
- 2nd monitoring period: 1978–1989.
- 1st monitoring period: 1972–1983.

Further information

In charge of this indicator

Barbara Schlup, schlup@hintermannweber.ch, +41 (0)31 310 13 03

Additional sources of information

> www.are.admin.ch > Topics > Spatial planning (Federal Office for Spatial Development, information on the project «landscape under pressure» not available in English)

> www.bafu.admin.ch > Topics > Landscape (Federal Office for the Environment, landscape information not available in English)

This information is based on the German-language document 875_E4_Basisdaten_2010_V1 dated March 13, 2010.