

## Finland

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**Empirical critical loads of nutrient nitrogen for Finnish Natura 2000 sites**

Empirical critical loads of nutrient nitrogen ( $CL_{empN}$ ) were first assigned for Finnish Natura 2000 sites in response to the CCE call for data 2010–2011 (Holmberg et al. 2011). In response to the CCE call for data 2014–2015, the empirical critical loads of nitrogen were updated using new information on land cover (Härmä et al. 2015). The  $CL_{empN}$  values were assigned for 25 habitat types within the Finnish Natura 2000 sites (Airaksinen and Karttunen 2001, Natura 2000, Metsähallitus 2012). The Natura 2000 GIS data set of the Finnish Environment Institute (Natura 2000 GIS) was used, in accordance with the reporting for the Habitats and Birds Directives (EC 2015). A distinction was made between sites protected within the Birds Directive (SPA), the Habitats Directive (SCI) or by both directives simultaneously (SPA and SCI). Landcover information for Finnish Natura 2000 sites was obtained from the 25 m Corine 2012 database (Härmä et al. 2015). Only area features of the Natura 2000-areas were included, not linear or point features. The landcover classes of the Corine 2012 database were interpreted to EUNIS habitats using expert judgment, in combination with indicative cross-references (Moss and Davies 2002). To distinguish between different mire habitats the mire database of Metsähallitus (Parks and Wildlife Finland) was used.

The land cover information was combined with a  $0.10^\circ \times 0.05^\circ$  longitude–latitude grid, in the WGS84 coordinate system. In this grid, there are 25,460 grid cells covering Finnish territory. Within each grid cell, the area for each protection category (SPA, SCI, SPA and SCI) was summed separately for each EUNIS habitat type. Areas smaller than 1 ha were not included. The resulting number of records is 31,245, covering a total area of 41,141 km<sup>2</sup>. The total areas of each protection category in each EUNIS habitat are given in Table FI.1. The values of

empirical critical loads of nutrient nitrogen were based on the recommendations by the 2010 meeting in Nordwijkerhout (Bobbink et al. 2011, UNECE 2010). The lower values of the suggested ranges were used to reflect the sensitivity of northern boreal ecosystems.

Table FI.1 Empirical CL N values used for Finnish Natura 2000 sites and total area per protection type.

Eunis code		CLNemp (kg ha <sup>-1</sup> yr <sup>-1</sup> )	Natura sites (km <sup>2</sup> )	SPA (km <sup>2</sup> )	SCI (km <sup>2</sup> )	SCI/SPA (km <sup>2</sup> )
A2	Littoral sediments	20	125	12	6.3	107
B1	Coastal dune and sand habitats	8	1.3	0	0.4	1.0
B1.3	Shifting coastal dunes	10	1.3	0	0.6	0.7
B1.4	Coastal stable dune grassland	8	1.6	0	0.7	0.9
B1.5	Coastal dune heaths	10	1.0	0	0.7	0.4
B1.7	Coastal dune woods	10	5.7	0	2.7	2.9
B1.8	Moist and wet dune slacks	10	0.6	0	0.03	0.6
C1	Surface standing waters	3	1 508	24	865	619
C1.1	Permanent oligotrophic lakes	3	3 546	10	2 375	1 161
C1.3	Permanent eutrophic lakes	3	29	13	5.5	11
C1.4	Permanent dystrophic lakes	3	1 562	98	1 209	255
D1	Raised and blanket bogs	5	1 729	19	575	1 134
D1.1	Raised bogs	5	1 077	0.5	548	529
D3.1	Palsa mires	5	376	0	105	271
D3.2	Aapa mires	5	6 519	11	1 954	4 554
D4.1	Rich fens	15	460	0.5	110	350
E2.2	Low and medium altitude hay meadows	10	0.2	0	0.1	0.1
E2.3	Mountain hay meadows	10	0.1	0	0.1	0.01
F2	Arctic, alpine and subalpine scrub habitats	5	6 859	0.1	1 930	4 929
G1	Broadleaved deciduous woodland	10	542	3.4	146	393
G1.9	Non-riverine woodland with <i>Betula</i>	5	3 900	0	1 533	2 367
G1.A	Meso- and eutrophic <i>Quercus</i> woodland	15	0.6	0.02	0.3	0.3
G3	Coniferous woodland	5	10 952	26	5 453	5 473
G4.1	Mixed swamp woodland	5	145	2	72	71
G4.2	Mixed taiga woodland with <i>Betula</i>	5	1 800	11	540	1 249
Total area			41 141	231	17 431	23 479

### Exceedance of empirical critical loads of nutrient nitrogen for Finnish Natura 2000 sites

Exceedances were calculated as the positive differences between the N deposition and the  $CL_{emp}N$  values. For N deposition, the sum of oxidized and reduced N deposition was used. The deposition was provided by the CCE in the 0.5° longitude by 0.25° latitude grid, calculated by the EMEP model version rv4.3beta and the scenarios according to the revised

Gothenburg Protocol (Simpson et al. 2012). In calculating exceedances for the habitats in EUNIS classes A, B and C, the grid average deposition was used, while the deposition to semi-natural vegetation was used for habitats in EUNIS classes D, E and F, and the deposition to forest was used for habitats in EUNIS classes G.

The critical loads were exceeded for the aquatic habitats (C1), raised bogs (D1.1) and aapa mires (D3.2), coniferous (G3) and mixed woodland (G4) (Table FI.2, Figure FI.1). No exceedances were projected for the other habitats. The exceedances are largest for the year 2005, and decrease considerably for the year 2020.

Table FI.2 Natura 2000 sites, area for which empirical CL N values are exceeded in 2005, 2010 and 2020.

EUNIS code	EUNIS description	Area in Natura sites (km <sup>2</sup> )	Area exceeded 2005 (km <sup>2</sup> )	Area exceeded 2010 (km <sup>2</sup> )	Area exceeded 2020 (km <sup>2</sup> )
C1	Surface standing waters	1 508	455	296	62
C1.1	Permanent oligotrophic lakes	3 546	1695	1195	178
C1.3	Permanent eutrophic lakes	29	21	19	19
C1.4	Permanent dystrophic lakes	1 562	980	471	62
D1	Raised and blanket bogs	1 729	3.3	0.6	
D1.1	Raised bogs	1 077	34	6.1	
D3.2	Aapa mires	6 519	1.1	0.4	
G3	Coniferous woodland	10 952	570	413	65
G4.1	Mixed swamp woodland	145	15	8.6	2.5
G4.2	Mixed taiga woodland with <i>Betula</i>	1 800	101	78	13
Total area		41 141	3876	2489	401

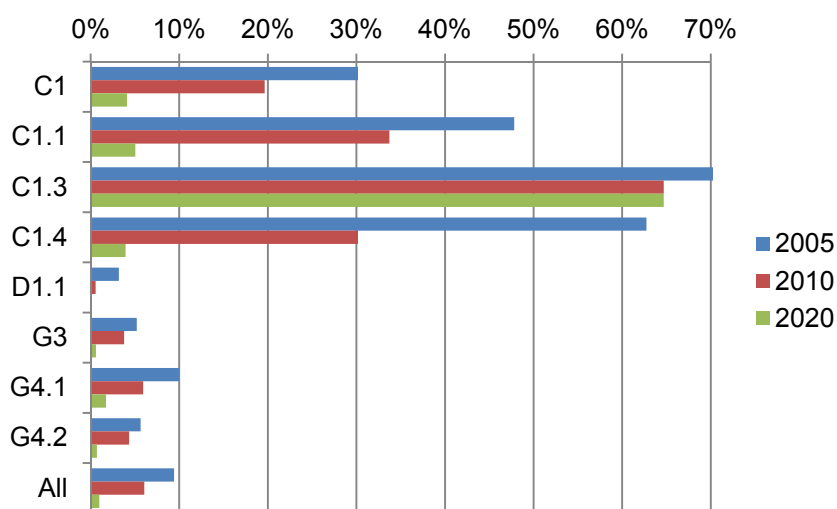


Figure FI.1 Percentage of area in each EUNIS class for which empirical  $CL_N$  are exceeded.

#### Summary

Empirical critical loads of nutrient nitrogen,  $CL_{emp}N$ , were assigned for an area covering about 41,000 km<sup>2</sup> representing 25 habitat types of Finnish Natura sites. While the  $CL_{emp}N$  values were exceeded in almost 10% of the total area, or about 4,000 km<sup>2</sup>, with the 2005 deposition, the 2020 deposition exceeds the  $CL_{emp}N$  values in only about 400 km<sup>2</sup>, or less than 1% of the area of the Finnish Natura sites. In relation to their total area, the lake habitats are proportionally more affected by  $CL_{emp}N$  exceedances than other habitats. This is because the lakes were assigned the lowest  $CL_{emp}N$  values (3 kg ha<sup>-1</sup> yr<sup>-1</sup>).

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