Finland

National Focal Centre

Finnish Environment Institute
Natural Environment Centre
Maria Holmberg, Martin Forsius
Collaborating experts:
Ari-Pekka Auvinen, Jukka-Pekka Jäppinen, Niko Leikola, Laura Mononen, Olli Ojala, Anne Raunio, Petteri Vihervaara, Jussi Vuorenmaa
P.O.Box 140
FIN-00251 Helsinki
maria.holmberg@ymparisto.fi
www.environment.fi/syke
tel: + 358 2952 51181
fax: + 358 9 5490 2390

Collaborating Institutions

Finnish Forest Research Institute
Vantaa Research Unit
Maija Salemaa
P.O. Box 18
FIN-010301 Vantaa

Summary

Finland receives comparatively low nitrogen (N) deposition and it is challenging to separate the impacts of air-borne N on vegetation and biodiversity from those of other concurrent drivers of change such as climate and land use. The long term monitoring results of the Finnish Forest Research Institute indicate that forest management is the most important factor changing forest floor vegetation. Although the development of a metric of “no net loss of biodiversity” on the European scale is important also from the Finnish perspective, Finland has not submitted data in response to this call. Finland participates, however, in the work on method development, or proof of concept, through the exercise led by ICP Integrated Monitoring to apply VSD+ and PROPS to selected IM sites in Europe. In response to an earlier call for data, empirical critical loads of nutrient N were assigned for 20 EUNIS habitat types in Finnish Natura 2000 sites, covering about 41,000 km^2. Although N deposition to Finland is considerably lower than to central or southern Europe, empirical critical loads of N were exceeded at 12% of the area of Finnish Natura 2000 sites with deposition estimates for the year 2000. The highest exceedance (AAE) values were obtained for surface water habitats. There is work in progress on updating the information in the

Finnish Natura 2000 database and after that task has been completed can the exceedance assessment be updated with new deposition scenarios.

Nitrogen effects on biological diversity in Finland

Finnish ecosystems belong primarily to the boreal biogeographical region, extending from 60° to 70° northern latitude and are characterized by comparatively low N deposition (Vuorenmaa et al. 2009) and observed and projected climate warming (Ruosteenoja et al. 2011; Tietaväinen et al. 2010). The Finnish Forest Research Institute surveyed the understorey vegetation on 443 mineral-soil sites in 1985-86, 1995 and 2006 (Tonteri et al. 2013). These sample plots are part of the 3000 permanent sample plots established in 1985-86 (Reinikainen et al. 2000) and they belong to the ICP Forests Level I network. Tonteri and co-workers conclude that the main causes of the observed vegetation changes were forest management practices and natural succession of the stands, although the accumulated N deposition and the long-term lack of forest fires may also have played a role (Tonteri et al. 2013). Although there are now detailed studies on N stocks in forest ecosystems (Merilä et al. 2014), the work in progress on assessing the role of air-borne N in vegetation changes in Finland is challenging because the comparatively low signal of N deposition is masked by concurrent climate warming, forest succession and forest management. Merilä and co-workers (Merilä et al. 2014) report N stocks in different compartments, including ground vegetation, of forest ecosystems in Finland (tree stand and soil, litter layer, ground vegetation and fine and small roots). They conclude that the understorey vegetation N stock was largest in northern spruce stands and smallest in southern spruce stands (Merilä et al. 2014).

In a recent study on the response on forest floor vegetation to N deposition in Europe, Dirnböck et al. (2014) found that the cover of plant species which prefer nutrient-poor soils decreased the more the measured N deposition exceeded the empirical critical load for eutrophication effects (CLempN). Four Finnish monitoring sites were included in the study. At these sites, the N deposition was considerably lower (0.6–1.9 kg N $ha^{-1}yr^{-1}$) than the deposition in Central Europe (10–20 kg N $ha^{-1}yr^{-1}$) or Italy (20–30 kg N $ha^{-1}yr^{-1}$). Although the N deposition levels in northern Europe are comparatively low, even a small increase in chronic N deposition may change the competitive relations of vascular plants by favouring the establishment and growth of eutrophic species or overstorey trees.

Pollution pressure reported for Habitats Directive

Air-borne N has been identified as a pressure for 18 habitat types in the reporting under Article 17 of the Habitats Directive of the EU, including many habitat types characterised by naturally low levels of N such as active raised bogs (7110), open rocky habitats and many coastal habitat types of the Baltic Sea. In most cases, air-borne N is just one component of human induced eutrophication that causes overgrowth of open habitats by saplings and bushes and changes species composition. Although air-borne N input was reported as a pressure only for one species (Pulsatilla patens), it is among the drivers of overgrowth for a number of species. The reported pressures for the Habitats Directive are primarily based on qualitative analysis. The options of utilizing quantitative indicators to support the evaluations for the reporting to the Habitats Directive have not yet been fully explored in Finland. For example the regional distribution of the exceedance of critical loads of eutrophication would contribute an additional source of information to the reporting of pressures on biodiversity.

Exceedance of empirical critical loads of N

In response to an earlier call for data, empirical critical loads of nutrient N were assigned for 20 EUNIS habitat types in Natura 2000 sites, covering about 41,000 km^2. The largest areas were covered by forest, mire and surface water habitats, extending to about 18,000, 16,000 and 6000 km^2, respectively. Empirical critical loads of N were exceeded at 12% (4776 km^2) of the area of Finnish Natura 2000 sites (Holmberg et al. 2011), with deposition estimates for the year 2000. Only the maximum feasible reductions scenario would protect all Natura 2000 sites in Finland. The highest average accumulated exceedance (AAE) (< 2 kg N ha^{-1} yr^{-1}) values were obtained for surface waters, which were assigned the lowest empirical critical loads (3 kg ha^{-1} yr^{-1}). In the Finnish Natura 2000 sites, most waters are oligothrophic (4 501 km^2), only a small number of protected lakes are naturally eutrophic (31 km^2), occurring mainly in clay soils in southern Finland. Although the naturally eutrophic lakes were not discussed by (Bobbink and Hettelingh, 2011), a low value (3 kg ha^{-1} yr^{-1}) was used for their critical load of N. This was motivated by the importance of the naturally eutrophic lakes in the nature protection areas and because of lack of evidence that they would sustain larger amounts of atmospheric N than other lakes. Of all habitat types in Finnish Natura 2000 sites, dystrophic lakes showed the highest percentage of area exceeded (82% or 1242 km^2) with deposition estimates for the year 2000 (Holmberg et al. 2011).

There is work in progress on updating the information in the Finnish Natura 2000 database, and after that task has been completed the exceedance assessment can be updated with new deposition scenarios.

Indicators of biological diversity in Finland

A recent report on metrics of ecosystem services was published in Finnish (Kniivilä et al. 2013). The authors summarize that indicators applicable for monitoring biological diversity have been developed since 2004 in Finland. The indicators have been closely related to monitoring the effects of policies of natural diversity and they have been used primarily for the evaluation of the national biodiversity strategy and the Finnish reporting to the CBD (Auvinen et al. 2010; Normander et al. 2012). The primary channel for publication of the Finnish biodiversity indicators is the website www.biodiversity.fi/en/, which provides a thematic overview of the indicators by main habitat type (forest, mires, Baltic Sea, inland waters, etc.) and with respect to climate change and invasive species.

TEEB Finland (2013–14) is a project that aims to initiate a systematic process to incorporate the value of ecosystem services into all levels of decision-making in Finland. The goal is to identify the key ecosystem services and propose methods to assess their current status and future trends. The project pays special attention to the regulating and cultural services that thus far have received limited attention. TEEB Finland is building on the TEEB Nordic scoping assessment (TEEB 2013) and it is implemented in close co-operation with a number of ongoing national projects, e.g. developing national ecosystem service indicators (FESSI) and Green Infrastructure projects (GreenFrame). Biological diversity and well-functioning ecosystems provide also essential services for human health and well-being. Within the scope of a recent project on Ecosystem Services and Human Health, the Finnish Forest Research Institute and the Finnish Environment Institute collaborate with the aim to improve multidisciplinary collaboration in the studies of ecosystem services with the focus on human health and well-being.

References

Auvinen A-P, Kemppainen E, von Weissenberg M, 2010. Fourth National Report on the Implementation of the Convention on Biological Diversity in Finland, The Finnish Environment. Ministry of the Environment, Helsinki.

Bobbink R, Hettelingh J-P, 2011. Review and revision of empirical critical loads and dose-repsonse relationships. Proceedings of an expert workshop, Noordwijkerhout, 23-25 June 2010. RIVM, Bilthoven, The Netherlands, 244 pp

Dirnböck T, Grandin U, Bernhardt-Römermann M, Beudert B, Canullo R, Forsius M, Grabner M-T, Holmberg M, Kleemola S, Lundin L, Mirtl M, Neumann M, Pompei E, Salemaa M, Starlinger F, Staszewski T, Uziębło AK, 2014. Forest floor vegetation response to nitrogen deposition in Europe. *Global Change Biology* 20, 429-440

Holmberg M, Leikola N, Forsius M, Raunio A, Mäkelä K, Vuorenmaa J, Salemaa M, 2011. National report Finland, in: Posch M, Slootweg J, Hettelingh J-P (eds): Modelling critical thresholds and temporal changes of geochemistry and vegetation diversity. CCE Status Report 2011. RIVM, Bilthoven, The Netherlands, pp. 91-97

Kniivilä M, Arovuori K, Auvinen A-P, Vihervaara P, Haltia E, Saastamoinen O, Sievänen T, 2013. Miten mitata ekosysteemipalveluita: olemassa olevat indikaattorit ja niiden kehittäminen Suomessa. (Summary in English: How to measure ecosystem services: current indicators and their further development in Finland, PTT Working Papers. Pellervon taloustutkimus PTT, 68 pp

Merilä P, Mustajärvi K, Helmisaari H-S, Hilli S, Lindroos A-J, Nieminen TM, Nöjd P, Rautio P, Salemaa M, Ukonmaanaho L, 2014. Above- and below-ground N stocks in coniferous boreal forests in Finland: Implications for sustainability of more intensive biomass utilization. *Forest Ecology and Management* 311: 17-28

Normander B, Levin G, Auvinen A-P, Bratli H, Stabbetorp O, Hedblom M, Glimskär A, Gudmundsson GA, 2012. Indicator framework for measuring quantity and quality of biodiversity—exemplified in the Nordic countries. *Ecological Indicators* 13: 104-116

Reinikainen A, Mäkipää R, Vanha-Majamaa I, Hotanen J-P, 2000. Kasvit muuttuvassa metsäluonnossa. (Summary in Englis: Changes in the frequency and abundance of forest and mire plants in Finland since 1950). Tammi, Jyväskylä, Finland, 384 pp

Ruosteenoja K, Räisänen J, Pirinen P, 2011. Projected changes in thermal seasons and the growing season in Finland. *International Journal of Climatology* 31: 1473-1487

TEEB 2013. Nordic scoping assessment; www.teebweb.org/nordic-countries/

Tietaväinen H, Tuomenvirta H, Venäläinen A, 2010. Annual and seasonal mean temperatures in Finland during the last 160 years based on gridded temperature data. *International Journal of Climatology* 30: 2247-2256

Tonteri T, Salemaa M, Rautio P, 2013. Changes of understorey vegetation in Finland in 1985-2006. In: Merilä P, Jortikka S (eds) Forest Condition Monitoring in Finland - National report. The Finnish Forest Research Institute, Helsinki

Vuorenmaa J, Kleemola S, Forsius M, 2009. Trend assessment of bulk deposition, throughfall and runoff water/ soil water chemistry at ICP IM sites, The Finnish Environment, pp. 36-63