Nitrogen Deposition and the Nature Directives

Impacts and Responses: Our shared experiences

Department for Environment Food & Rural Affairs

JNCC Joint Nature Conservation Committee

NATURA 2000

Theme 2: Working Group 7: The effectiveness of on-site (intensified) habitat management measures and restoration measures to mitigate nitrogen deposition impacts and to promote recovery

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The workshop is being organised by JNCC on behalf of the UK Government, Devolved Administrations and country nature conservation bodies, in collaboration with the Dutch Ministry of Economic Affairs and in co-operation with the Task Force on Reactive Nitrogen.

1. Summary

In cases where critical loads remain exceeded, (intensified) on-site habitat management measures may offer a means to reduce the impacts of nitrogen deposition either through removal of nitrogen from the system or through maintaining habitat structure. However, this is only the case if these measures were not (fully) performed in the past (because regular maintenance like mowing or grazing is already taken into account for setting the critical load).

Even if the most stringent air pollution control policies were to be applied, some ecosystems would not fully recover within a reasonable time period. In these cases, active restoration has to be considered as a necessary management tool to preserve habitats.

This working group aims to share knowledge and experience of using intensified habitat management to reduce nitrogen impacts and in cases of 'damaged' habitats then use restoration measures. The working group will produce recommendations to include in the workshop report.

2. Introduction

The adverse impacts of elevated inputs of reactive nitrogen on terrestrial ecosystems include decreased species diversity, changes to plant communities and habitat structure, the homogenisation of vegetation types, changes in soil chemistry, and an increased sensitivity to biotic and abiotic stresses. The most notable findings related to the threat to European terrestrial biodiversity have been identified in the European Nitrogen Assessment (Dise *et al*, 2011).

Even if the most stringent air pollution control policies are enacted some ecosystems may have been so damaged by chronic nitrogen loading that pollution reduction by itself would not lead to full recovery within a reasonable time frame. In these cases, active management could be considered as a restoration tool to accelerate the natural processes of nitrogen removal. In addition, on-site management options may also provide a valuable tool to offset or reduce the impacts of nitrogen deposition. This could include mitigation of background nitrogen inputs, or specifically from politically or economically important projects that would otherwise have detrimental impacts on biodiversity. Current management for nature conservation on sites may be partially off-setting nitrogen deposition impacts (Stevens *et al*, 2013). Note, however, that critical loads implicitly take the (positive) effects of habitat measurements into account for those habitats than can only exist as a consequence of management, such as grazing in case of grassland and heathlands. In concluding that many existing management practices will be reducing the impacts of nitrogen; Stevens *et al*, 2013, recommended that it was important to ensure that practices these were at least continued.

As the impacts of climate change take effect, habitat sensitivity to nitrogen deposition will also alter. It is therefore essential to understand how habitat management measures can be used to mitigate the impacts of nitrogen deposition and which management options are likely to be most effective.

A diagram showing the effects of nitrogen deposition and the possible recovery measures on a landscape and local (habitat/site) scale is shown in Figure 1. Nitrogen deposition impacts on two main processes, namely acidification and eutrophication, both on the local scale and the landscape scale. Eutrophication and acidification are directly influenced by factors such as drought, rigidity (loss of dynamics) and ageing (succession). It is possible to compensate for the effects of nitrogen deposition, whereby different measures can be taken at a landscape and local scale. In the diagram this is indicated by arrows, decreasing and increasing in size (restoring dynamics for example is a measure on the landscape scale and removing nutrients a measure on the local scale).

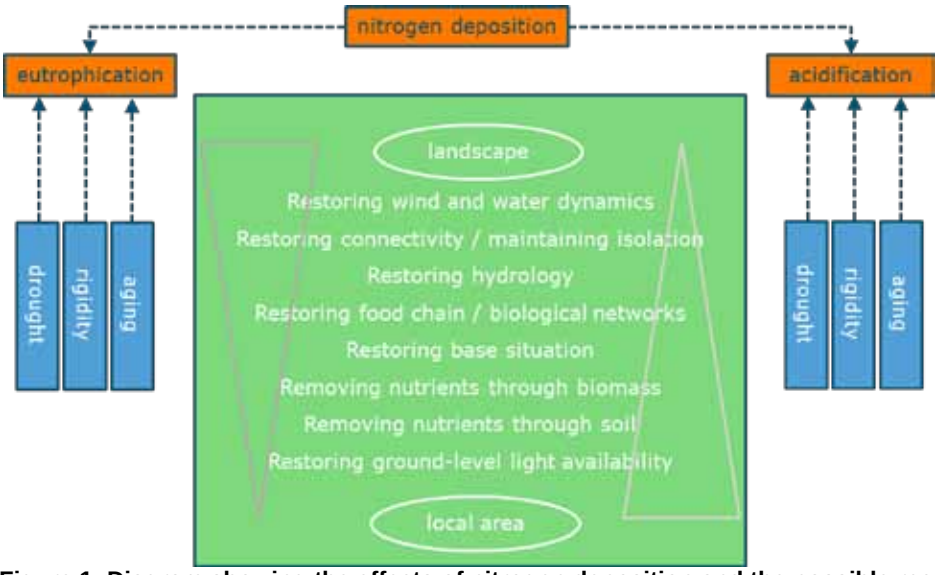

Figure 1: Diagram showing the effects of nitrogen deposition and the possible recovery measures at a landscape and local scale.

3. Objectives of the working group

The aim of this working group is:

i) To share knowledge and experience of (intensified) habitat management measures to reduce the impacts of nitrogen deposition.
ii) To share knowledge and experience of restoring nitrogen-sensitive habitats using restoration measures.
iii) To identify successful habitat management restoration measures, both at the local and landscape scale and, where possible, pull together some case studies in evidence.
iv) To discuss challenges and barriers to implementation and share solutions.

4. Discussion points

Members of this working group are asked to bring along information on and be willing to:

i) Discuss the current ability of Natura 2000 site managers/advisers to apply habitat management measures in their country to reduce or offset nitrogen impacts and/or promote recovery of habitats.
ii) Provide a critical reflection on the Dutch approach (as outlined in Appendix 1) and that of other countries on the recovery strategies for nitrogen-sensitive habitats.
iii) Discuss the practical feasibility of applying effective measures.
iv) Discuss the transfer of knowledge on successful measures to other countries.
v) Identify the most effective measures, and classify the degree of evidence supporting the considered effect in terms of proven effect, rule of thumb or hypothesis.
vi) How site managers have been supported by education and awareness of the issues.

5. How the group will operate

Members of the group are invited to provide a short presentation on habitat management measures implemented or being explored in their country, in view of the discussion points mentioned above.

A digital projector and power point will be provided. Presenters are encouraged to bring printed handouts of their presentation, so these can be circulated amongst the group. However, delegates may wish to make a more informal presentation for example, a short report, without the use of slides.

Following the presentations, we will discuss the discussion points mentioned in section 4.

Toward the end of the session, we will agree on recommendations to present to the rest of the workshop participants and collect references for (case) studies or other relevant reports to include in the published workshop report.

6. References

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Appendix 1: The Dutch Experience

Although numerous publications on ecological restoration exist, including text books on the subject (e.g. Van Andel & Aronson (Eds) 2012), to date no publication has given an *overall* view on the subject of ecological restoration and (intensified) management as a mechanism to combat the adverse effects of nitrogen deposition on (Natura 2000) habitats. The first attempt at providing such a view is the draft Dutch publication 'Herstelstrategieën stikstofgevoelige habitats' (Smits & Bal (Eds.) 2012. Part 1 has been translated to English and is published on the internet with the title 'Recovery strategies for nitrogen-sensitive habitats': http://www.natura2000communicationplatform.eu/node/69,).This publication was produced during the process of establishing the Dutch 'Programmatic Approach to Nitrogen' (PAN) to solve the problems caused by nitrogen deposition (especially in Natura 2000 sites). It provides an extensive overview of recovery strategies (restoration measures) for all nitrogen-sensitive habitats and species (included in the annexes of the Habitats and Birds Directives), based on the best available knowledge.

In this publication it has been recognised that habitat management measures can be successful in restoring nitrogen affected ecosystems by:

(i) intensifying nature management in order to preserve nitrogen-sensitive habitats as long as the critical load is exceeded (e.g. by means of introducing or intensifying grazing, mowing, sod cutting);
(ii) mitigating the adverse effects, as long as the critical load is exceeded by means of solving other problems that cause similar effects (such as eutrophication and acidification caused by lowering water tables);
(iii) restoring nitrogen-sensitive habitats when critical load are no longer being exceeded, e.g. by means of the removal of accumulated N in water, soil and/or vegetation.

The restoration measures used The Netherlands can be categorized as follows (refer to Table 3.1 in the publication): http://www.natura2000communicationplatform.eu/sites/default/files/documents/Part%20I%20Chapter%203_Nov%202012_2013-09-10.2.pdf):

- Measures against acidification by adding basic substances and/or restoration of the water cycle
- Removal of nutrients by excavation, sod cutting, chopping, dredging, (additional) mowing, burning, litter removal
- Intervening in the succession by coppice management, thinning, felling and clearing wooded heath pool banks, digging peat trenches (to initiate early stages of vegetation succession in fens)
- Measures aimed at restoring the water cycle
- Measures aimed at restoring wind and water dynamics
- Measures aimed at restoring connectivity
- Measures aimed at restoring the food chain

Some lessons that were learned include the following (see Jansen *et al*, 2012):

1. Do not focus on one threat

e.g. high nitrogen deposition, but try to solve the problem in an integrated way. Move from a one-sided emphasis on lowering the deposition to the understanding that a wide range of measures can be used for the conservation and restoration of impacted habitats. That includes the mitigation mentioned under (ii) above. Use a methodological approach, it is recommended to start for example, with solving a water problem (drought and/or acid water). This will allow an increased time frame for achieving deposition reduction and in the meantime the system becomes less sensitive to high nitrogen input. If a certain effect of nitrogen on this feature can be (temporarily) reduced by measures that are themselves not focussed on nitrogen deposition, then such a measure can be characterised as a mitigating measure.

2. Include fauna

Restoration management has mainly focussed on vegetation and abiotic processes. As plants are sessile organisms they facilitated research possibilities to a greater degree than animal species. Research on fauna is more complicated, as different species use the landscape at different spatial scales. Consequently, research on the effects of nitrogen deposition on fauna has been more limited. In recent years, however, research on faunal diversity has gained more interest. In nature management it has been noticed that a selection of faunal species have benefitted from restoration projects, however, other target species continue to show declines in abundance or even disappear from nature reserves. As an illustration Figure 2 shows the impact of nitrogen deposition on animals. Almost all effects have an indirect impact through changes in the soil, surface water, vegetation and litter. Direct impacts from the acidifying effects of nitrogen deposition almost exclusively occur through physiological problems in aquatic environments (dotted line).

The most effective restoration measures in relation to fauna are likely to be (i) restoring the food chain, (ii) restoration of landscape heterogeneity and (iii) enhancing connectivity.

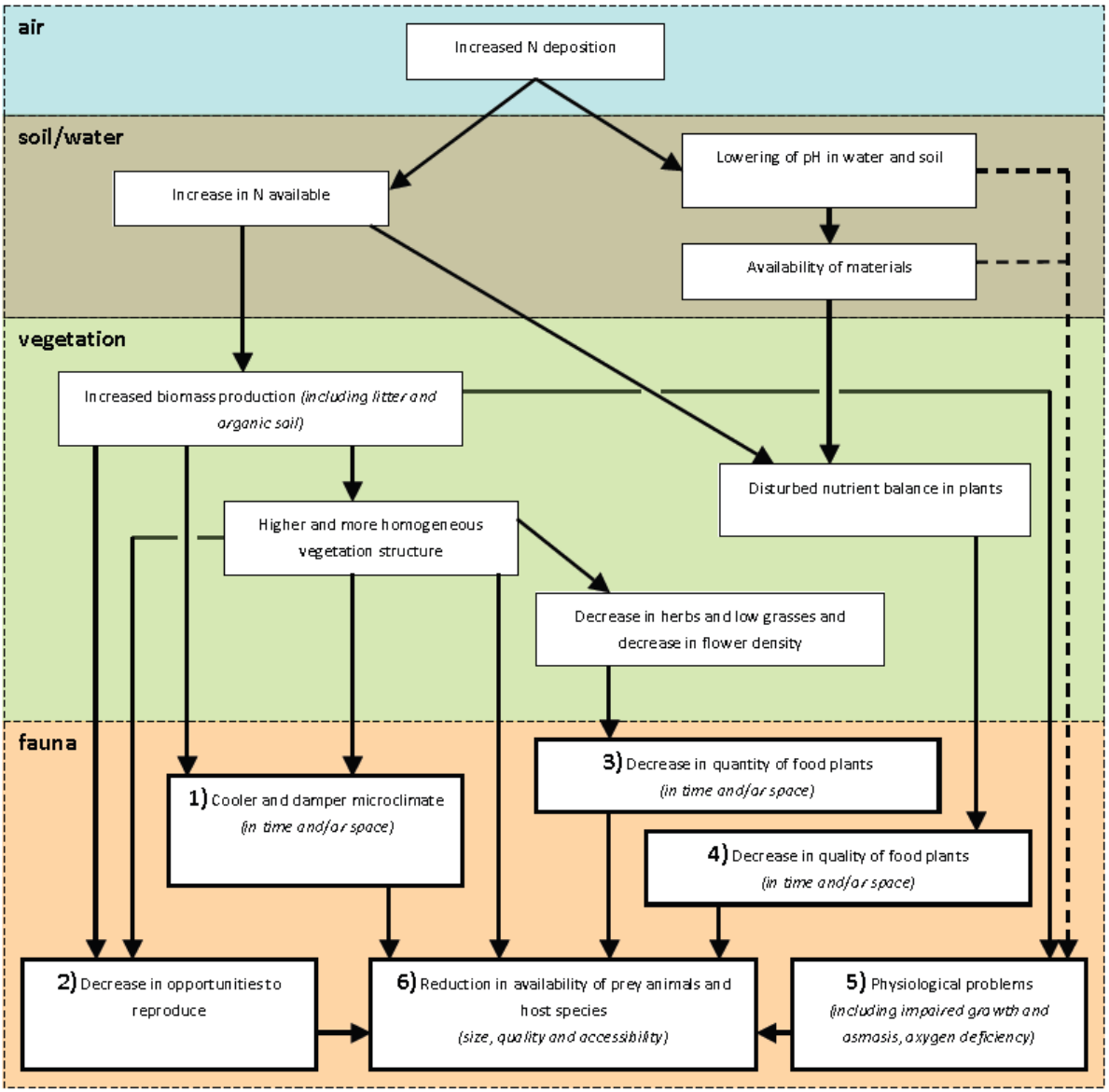

Figure 2: Simplified diagram of the impact of nitrogen deposition on animals.

3. Do not stick to the habitat scale, but also consider the landscape scale

The recovery strategies are elaborated in detail per habitat type in Part II of the publication. However, when examined at the landscape level, there appears to be a significant degree of correlation between the positions of the individual habitats. Each habitat is, as it were, embedded in a spatial gradient, the character and direction of which is determined by the landscape. As a result, recovery measures taken for one habitat often also affect other habitats, which are linked to it through landscape gradients. This influence can be positive or negative. Furthermore, improvement of the groundwater quality in the catchment area, an increase of the local groundwater level, and interventions in the landscape that contribute to sand drift can affect the environment at a landscape scale. Therefore, it is necessary to take the landscape context into consideration when planning restoration measures. It is also necessary to consider the processes and measures at the local scale in the light of the landscape gradient. This enables us to identify what measures are needed at the landscape level to recover degraded landscape gradients.

4. Pay attention to the amount of evidence

It is important to have an answer to all the effects of nitrogen deposition on all habitats. However, these answers are based on different amounts of (scientific) evidence. In order to clarify this per habitat, the measures are assigned to three categories:

Proven: The measure is certain to have the positive effect described in the text if it is implemented in the right way. As a rule, this will have to be substantiated by literature, but it may also be supported by (as yet unpublished) well-documented observations.

Rule of thumb: The measure can in many cases have the positive effect described in the text if it is implemented, but this is not certain. Reasons for this uncertainty may be that monitoring has revealed (unexplained) failures or that the conditions for successful restoration are not yet well known.

Hypothesis*:* By logical thinking, a measure has been formulated that has not, or hardly, been tested, but which would be very useful to test because it could prove very effective. The hypothesis may have been prompted by analogies (the measure is a rule of thumb or a proven measure in a closely related habitat type) or in processes we think we understand well, but which have not yet been tested in practice.