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Jones et al. Letter to Editor.docx [Cover Letter]

Jones et al._Response to Maes et al.docx [Manuscript File]

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Dear Editor,

We would like to submit this letter in reply to a response by Maes et al. on our article “Can on-site management mitigate nitrogen deposition impacts in non-wooded habitats?” in Biological Conservation.

We have run the letter by the Editor-in-chief Vincent Devictor, and he has agreed it can be submitted.

With best wishes,
Laurence Jones

Jones L., Stevens C., Rowe, E.C., Payne R., Caporn S.J.M., Evans C.D., Field, C., Dale, S.

Managing for nitrogen, the lesser of two evils. A response to Maes et al.

We thank Maes et al. for their commentary on our paper, with which we largely agree. In response we would like to explore particular issues in greater depth, and add some caveats to their recommendations.

In much of western Europe, oligotrophic habitats now represent small islands in a far larger eutrophic landscape. This is in contrast to the situation before large-scale human intervention, beginning in the Neolithic, when the rarer species were those which depended on small localised areas of high fertility arising from soil disturbance, animal dunging or bird colonies for example. Since these localities were patchy in space and time, eutrophic species are often good dispersers. Thus, while we recognise the concerns of Maes et al. about other species groups, many of the threatened invertebrates, mammals and birds are reliant on the same conditions as rare plants: shorter, open vegetation, in sites with low fertility.

Our review focused on plant species as key primary producers which support many other trophic levels but also because, as recognised by Maes et al., there are relatively few published studies of nitrogen impacts on other species groups. Yet, there is increasing evidence of clear links between eutrophication and decline of conservation priority species. For instance, in sand dune systems there is evidence that nitrogen impacts on Marram grass (*Ammophila arenaria*) in Denmark and The Netherlands cascade up to affect populations of Red-backed shrike (*Lanius collurio*), a Red List passerine bird (Dise et al. 2011). Nitrogen increases the grass cover, thereby reducing the bare sand available to large coleoptera larvae and lizards, which in turn reduces shrike populations since these are key food items. In northern USA, evidence chains link acidification from nitrogen and sulfur to reduced abundance of the snowshoe hare (*Lepus americanus*). Reduced growth rate and increased crown dieback of balsam fir (*Abies balsamea*) reduces both cover and forage available for the hare (Irvine et al. in press)

Appropriate conservation management requires assessing the balance of harm. While conservation measures to ameliorate N deposition impacts may themselves do harm to some species in the short term, this needs to be balanced against often greater harm if no action is taken. Maes et al. link detrimental management effects in heathlands to lizard populations, yet without management to open up the canopy and increase the area of bare ground, the habitat would become wholly unsuitable for those same lizards in the longer term. There is also a tension between the scale required for conservation success and a need to balance the immediate adverse impacts of restoration measures on desirable flora and fauna. Small scale interventions often revert rapidly to previous conditions, and the mismatch between the spatial and/or temporal scales of ecological processes and those adopted to conduct conservation plans is a factor which can limit success of restoration efforts (Perring et al. 2015). Retention of high nutrient islands to protect existing species can also be a source of nitrophiles which may re-invade restored areas.

We agree with Maes et al. that management should be conducted sensitively and, in the main, support their recommendations. Perhaps the aim of restoration in conservation areas should be to retain a mosaic of very low and moderate nutrient levels, to support a broad range of species. Meanwhile, the requirements of species dependent on high nutrient levels can be considered of lower priority in this context, since those conditions are so prevalent in the wider landscape. Such difficult management decisions arise because of widespread eutrophication. This reinforces the need to reduce nitrogen emissions at source and, in particular, to safeguard those areas which are, as yet, little affected by nitrogen deposition.

References

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