INTeracting effects of Abiotics and Carnivores shape herbivore Top-down effects

Rendicontazione

Informazioni relative al progetto

INTACT

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Questo progetto è apparso in...

Final Report Summary - INTACT (INTeracting effects of Abiotics and Carnivores shape herbivore Top-down effects)

I. Aims of the study:

In this project, I (Dries Kuijper) aimed at testing the interactions between herbivore top-down effects and abiotic bottom-up effects during early stages of tree regeneration in one of the last remaining natural, temperate, lowland forest systems in Europe, the Bialowieza Primeval Forest (BPF) in Poland. This area harbors native wild ungulates (red deer, European bison, roe deer, moose and wild boar) together with their natural predators (wolf and lynx). Additionally I aimed at studying how carnivores can modify herbivore-plant relationships. Below I give a detailed description on how the project results contributed to knowledge in these two ecological fields. Numbers in brackets refer to the published articles and book chapters listed at the end.

II. Interactions between herbivores and abiotic factors and their influence on tree regeneration

Together with a colleague I wrote a synthesis of the knowledge that exists on how large herbivores can influence productivity and species composition in woody plan species communities. In contrast to many other systems, our studies in the BPF show that browsing ungulates indirectly stimulate regeneration of their most important woody food plant species. We discussed the likely reasons for this, which include among others that our study system is relatively nutrient rich and has a complete assemblage of ungulate species and their natural predators (1).

In following studies I focused on the factors associated with successful oak (Quercus robur) regeneration inside the BPF. Oaks constitute an important component of most temperate lowland forests in Europe, for economic as well as ecological reasons. Hence, understanding the factors that determine recruitment of this species is relevant especially because many temperate areas across the world show reduced oak recruitment. Most studies in Europe have focussed on the regeneration of oak in woodlands grazed by livestock. There is little knowledge on how grazed woodlands develop without livestock grazing and in the

presence of only wild large herbivores. We studied which factors influenced spontaneous regeneration of oaks in an area which was abandoned from agricultural use and was directly bordering the old-growth stands of the Bialowieza National Park. In contrast to other studies, we showed that oak may successfully regenerate in grazed woodlands despite high browsing pressure by large wild ungulates. This might have been possible because of the lack of typical grazing ungulate species and the presence of only browsing wild ungulates (2).

In contrast to woodlands, regeneration of oak inside closed forest is very low. Here, browsing by ungulates is an important limiting factor for tree recruitment. Inside forest gaps which provide favourable light conditions, natural structures protecting against ungulates may be important for recruitment success. We studied oak recruitment in relation to coarse woody debris (CWD) in the BPF. Our study showed that CWD plays an essential role for the recruitment of oaks in old-growth temperate forest systems, predominantly via protection against ungulate browsing. Forestry management prevents the natural accumulation of CWD and so can be counter-productive for the recruitment of appreciated species (3). As a result of this protective function, oak saplings are often found in association with CWD. In this study we investigated whether CWD offers already a safe site during the earlier stages of oak recruitment, i.e. at the seed and seedling phase, or whether their protective role operates later during the recruitment process. Our experiment showed that acorn removal by wild boar and rodents is higher when associated with CWD. This study showed that the best place to survive as seed and seedling is on locations away from CWD, while the best place to survive as larger sapling is near CWD. Our findings explain the mechanisms behind recruitment limitation in our studied system, as well as in other forested ecosystems (4). An overview of the generated knowledge from the above-mentioned research projects has been given in a book chapter. This chapter was mainly aimed at the transfer of scientific knowledge to managers of national parks concerned with the conservation of woodlands and especially oaks (5).

Also in other ecosystems, there can be an intricate balance between bottom-up and top-down forces shaping plant communities. As part of this grant I analysed a data set from a salt marsh community that I collected during the last 10 years on an in the Danish Wadden Sea (6).

III. Influence of large carnivores on plant-herbivore interaction

Carnivores can directly and indirectly modify ungulate-plant interactions. Next to carnivores, abiotic conditions interact with herbivory by influencing forage quality and availability. Forestry activities and human hunting modify both these factors. These changes logically increase the strength of herbivore top-down effects in managed forests and increase the wildlife-forestry conflict. In a review article I discussed how forestry management can also reduce this conflict (7).

Human hunting is a second important factor which modifies many ecological relationships. Human hunting differs from predation by natural predators and also their effects on prey population dynamics and prey behavior differ largely. In the review article I discussed that current ungulate management ignores the role of non-lethal risk effects of predation and focuses on regulation of ungulate numbers only. I argued that predation risk can induce behavioral response in ungulates which can be more powerful than a reduction of their number. Incorporating risk effects in hunting practices, may offer novel opportunities to manage the increase in human-wildlife conflicts that we experience globally (8).

Finally we studied how predation risk may operate in a closed forest by testing whether wolves (Canis lupus) influence patterns of ungulate browsing and tree regeneration inside the BPF. We found that red deer avoid browsing trees close to objects which reduce escape possibilities when present inside the core area of a wolf territory. This indicates that predation risk effects of predators on prey to a large extent determine browsing patterns on red deer.

This knowledge broadens the discussion on how the impact of large predators on ecosystem functioning depends on the physical landscape, by illustrating these effects for a system which largely contrasts in this respect to the North American systems (9).

IV. Socio-economic impact of the project

Part of the published articles resulting from this ERG-grant, together with the work already carried out by Dr. D.P.J. Kuijper during his previous Marie Curie fellowship, comprised his habilitation thesis (10) or where taken into account in the habilitation process (1,2,7). I successfully defended my thesis entitled "Patterns in tree regeneration and tree stand dynamics shaped by abiotic factors and ungulates in European temperate primeval forest" on 16 April 2013 at the Jagiellonian University Krakow, Poland. This Habilitation-degree will facilitate a successful integration into the Polish scientific community as it is required to be able to continue my scientific career.

V. Published studies (as referred to in text)

1. Cromsigt, J.P.G.M. Kuijper, D.P.J. 2011. Revisiting the browsing lawn concept: evolutionary interactions or pruning herbivores? Perspectives in Plant Ecology, Evolution and Systematics 13: 207-215.
2. Bobiec, A.,Kuijper, D.P.J. Niklasson, M., Romankiewicz, A., Solecka, K. 2011. Oak (Quercus robur L.) regeneration in early successional woodlands grazed by wild ungulates in the absence of livestock. Forest Ecology and Management 262: 780-790.
3. Smit, C., Kuijper, D.P.J. Prentice, D., Wassen, M., Cromsigt, J.P.G.M. 2012. Coarse woody debris facilitates oak recruitment in Bialowieza Primeval Forest, Poland. Forest Ecology and Management 284: 133–141.
4. Van Ginkel, H.A.L. Kuijper, D.P.J. 2, Churski, M., Zub, K., Szafranska, P., Smit, C.. 2013. Safe for saplings not safe for seeds: Quercus robur recruitment in relation to coarse woody debris in Bialowieza Primeval forest, Poland. Forest Ecology and Management 304: 73–79.
5. Samojlik, T. & Kuijper, D.P.J. 2013. Grazed wood pasture versus browsed high forests: Impact of ungulates on forest landscapes from the perspective of the Bialowieza Primeval Forest. In 'Trees, forested landscapes and grazing animals- A European perspective on woodlands and grazed treescapes', I.D. Rotherham (Ed.), pp.143-162. Routledge. London/New York.
6. Kuijper, D.P.J. Bakker, J.P. 2012. Below- and above-ground vertebrate herbivory and abiotic factors alternate in shaping salt-marsh plant communities. Journal of Experimental Marine Biology and Ecology 432/433: 17–28
7. Kuijper, D.P.J. 2011. Lack of natural control mechanisms increases wildlife-forestry conflict in managed temperate European forest systems. European Journal of Forest Research 130: 895-909.
8. Cromsigt, J.P.G.M.* Kuijper, D.P.J.* Adam, M., Beschta, R.L. Churski, M., Eycott, A., Kerley, G.I.H. Mysterud, A., Schmidt, K., West, K. 2013. Hunting for fear: innovating management of human-wildlife

conflicts. Journal of Applied Ecology: 50, 544–549. (* Both authors contributed equally.)
9. Kuijper, D.P.J. de Kleine, C., Churski, M., van Hooft, P., Bubnicki, J., Jedrzejewska, B. 2013. Landscape of fear in Europe: wolves affect spatial patterns of ungulate browsing in Bialowieza Primeval Forest, Poland. Ecography 36: 001–013, in press, doi: 10.1111/j.1600-0587.2013.00266.x).
10. Kuijper, D.P.J. "Patterns in tree regeneration and tree stand dynamics shaped by abiotic factors and ungulates in European temperate primeval forest" (Wplyw czynnikow abiotycznych i ssakow kopytnych na odnowienie drzew i dynamike drzewostanow w europejskim lesie pierwotnym strefy umiarkowanej), Habilitation thesis, Jagiellonian University Krakow, Poland, date of defence 16 April 2013.

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