Competitive effect is a linear function of neighbour biomass in Kochia scoparia

Weiner, Jacob; Ramseier, D.

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ABSTRACTS

11.11.3. Population stage structure as a quick-and-dirty population viability indicator: how dirty is it ?

G. Oostermeijer;
Institute for Biodiversity and Ecosystem Dynamics, Amsterdam, The Netherlands.

In the 1980's Rabotnov published a series of papers on 'coenopopulation structures' of plants. I adopted his way of looking at populations as a method to obtain a relatively good idea of the demographic viability of populations of threatened plants within one censusing season. The basic idea is to examine the stage structure of many (sub)populations and relate them to various aspects of habitat quality, such as vegetation composition and structure and soil variables, and different types of habitat management. For our study species, *Gentiana pneumonanthe, Salvia pratensis, Veronica austriaca* and *Liparis loeselii*, the method has proven very valuable for decisions concerning optimal habitat management, although its limitations also became apparent. In my paper, I will bring together our studies with those published on other species, to investigate whether this quick-and-dirty method of assessing population viability really works and to report on its pros and cons for the practical conservation management of endangered plant species.

11.11.4. Demography of the declining grassland plant *Trifolium montanum* in central Germany: the influence of site productivity

D. Matthies[1], M. Schleuning[2];
[1]Dept. of Biology, Marburg, Germany, [2]Dept. of Biology, Marburg, Germany.

We studied the demography of the long-lived, declining plant *T. montanum* and the structure of its populations in central Germany. Intensive demographic monitoring in nine populations revealed that with increasing nutrient availability at a site the finite growth rate of populations (λ) decreased. The decrease in λ was the result of reduced growth and increased mortality of non-reproductive plants. In a clipping experiment λ increased significantly from 0.91 in unmanaged to 1.13 in managed plots, indicating that the detrimental effects of high nutrient availability were due to increased light competition. The removal of 25% of the vegetation was enough to release light competition and to considerably reduce the mortality of non-reproductive plants. Nutrient availability also influenced the structure of populations. The density of immature plants strongly decreased with increasing productivity in 20 populations of *T. montanum*, indicating reduced recruitment at high productivity sites. Our results suggest that nutrient enrichment is the major cause of the decline of *T. montanum* and that many of the remnant populations are strongly threatened.

11.11.5. On the relationship between longevity and population dynamics: the demographic component of life history evolution in plants

M. B. García[1], **F. X. Picó**[2], J. Ehrlén[3];
[1]Instituto Pirenaico de Ecología CSIC, Zaragoza, Spain, [2]Center for Ecological Research and Forestry Applications (CREAF), Barcelona, Spain, [3]University of Stockholm, Stockholm, Sweden.

Theory predicted the evolution of life histories towards short or long lived life spans through life history trade-offs. The goal of this paper is to reveal that life span and demographic behavior are intricately related, emphasizing the demographic component of life history evolution. To this end, we investigated the relationship between longevity and population growth rate, a surrogate of global fitness. Our study included 24 demographic datasets of herbs using population matrix models. For each dataset of study, we computed longevity, mean and temporal variance in population growth rate, and demographic importance of life history traits (based on elasticity and variance contribution analyses). Results clearly indicate that long-lived plants exhibit more stable and less variable population behavior than short-lived plants. The relative importance of fecundity decreased with increasing longevity whereas that of survivorship showed the opposite pattern. We conclude that longevities are a good predictor of population dynamical trends in plants. Results are presented and discussed on the basis of the evolution of plant life histories.

11.11.6. Competitive effect is a linear function of neighbour biomass in *Kochia scoparia*

J. Weiner[1], D. Ramseier[2];
[1]Royal Veterinary and Agricultural University, Frederiksberg, Denmark, [2]ETH, Zürich, Switzerland.

To investigate the effects of neighbour size on competitive effect, we grew target Kochia scoparia individuals surrounded six equidistant, even-aged, conspecific neighbours. We varied neighbour size by sowing neighbours at different times, and we varied the sowing time for the target plants to generate variation in both neighbour and subject size. We analyzed the growth of focal plants over two time intervals as a function of their own size and the size of their neighbours at the beginning of the interval.
When competition was intense, the relative growth rate of target plants was primarily determined by the size of their neighbours. There was a negative linear relationship between the relative growth rate of target plants over and the biomass of their neighbours at the beginning of the interval. The size of the target plant itself did not make a significant additional contribution to predicating its growth rate.
There was no evidence of size-asymmetric competition. Neighbours larger than the target plant had more of an effect than smaller neighbours, but the per unit effect of neighbour biomass was the same for neighbours larger and those smaller than the target plant.

11.11.7. Effects of multiple herbivores on the population dynamics of a perennial herb

R. Leimu[1], K. Lehtilä[2];
[1]University of Turku, Turku, Finland, [2]Södertörn University College, Huddinge, Sweden.

We present a modelling approach to be used in estimating simultaneously the long-term fitness effects of multiple herbivores on perennial plants. We examined the effects of two specialist herbivores, a pre-dispersal seed predator and a leaf-feeding moth, on the population dynamics and long-term fitness of their shared host plant. We compared the relative roles of seed predation and leaf herbivory in determining plant population dynamics. Demographic data were collected during three years and this data was combined with the effects of natural levels of herbivory. Both seed predation and leaf herbivory reduced population growth of their host plant, but only very high damage levels changed the growth trend of the vigorously growing populations from positive to negative. Seed predation was more important in determining plant population growth than leaf herbivory. Moreover, the impact of leaf herbivory was insignificant in a situation where seed predation intensity was very high.

11.12.1. Leaf canopy as a dynamic system: ecophysiology and optimality in leaf turnover

K. Hikosaka, S. Oikawa, N. Osada, T. Hirose;
Tohoku University, Sendai, Japan.

Leaf canopy is a dynamic system, where leaves are produced and fall with time. We developed a model of leaf turnover in a canopy (Hikosaka 2003 Am Nat). In the model, the rate of leaf production is a function of the canopy photosynthetic rate and leaf loss results from the leaf area that exceeds the optimal leaf area index. The model predicted environmental response of leaf area index and canopy photosynthesis. We further developed a model in which an indivudual has two canopies (e.g. two branches on a tree). When the two canopies are exposed to different light environment from each other, development of the two canopies depended on the degree of physiological integration between the canopies (i.e. reallocation of photosynthates and nitrogen). Using monospecific stands of an annual, we analysed leaf turnover and its environmental dependence. Both light environment in the canopy and nitrogen availability were shown to affect leaf production and shedding (Oikawa et al. 2005 Oecol).

11.12.2. Nitrogen-use efficiency in canopy and understory species in a beech forest

Y. Yasumura, K. Hikosaka, T. Hirose;
Tohoku University, Sendai, Japan.

We studied nitrogen (N) use in coexisting species in a mature beech forest. Leaf-level nitrogen use efficiency (NUE_L), defined as the amount of leaf produced per unit N taken up into leaves, was