CO_2 increase and biodiversity – a vulnerability problem
Christian Körner

In a recent article Christian Körner stated: "Global change has many facettes of which land use and the change of atmospheric chemistry are primary agents […]. The largest single contribution to the compositional change of the atmosphere, CO_2 enrichment, has (besides its influence on climate) immediate and direct effects on plants. Quantitatively, CO_2 is the plant food number one, and the rate of photosynthetic CO_2 uptake by leaves is not yet CO_2 saturated. This abrupt change in the biosphere's diet does and will affect all aspects of live including our food. However, the plant and ecosystem responses are more subtile than had been assumed from the results of responses of isolated, well-fertilized and well-watered plants in greenhouses during the early days of CO_2 enrichment research." (C. Körner, Phil. Trans. R. Soc. Lond. A (2003) 361, 2023-2041)

In his talk Christian Körner elaborated on the complex responses of natural ecosystems to rising CO_2 concentration in the atmosphere, giving examples from the literature and his personal research.

1. Grassland

Species rich grasslands respond to increased CO_2 concentration with an increase in biomass production. However, while some species showed no or little response, others dramatically increased productivity. Species specific responses to elevated CO_2 will thus change the current competition regime and in the long run lead to changes in species composition of the ecosystem. Körner also showed by the example of legumes, that CO_2 effects can only be observed if other resources such as nutrients (e.g. phosphorus) are not limiting plant growth.

2. Earthworms

CO_2 effects can also be observed in higher trophic levels, for example in earthworm communities. In a CO_2 enriched world, plants don't only show increased productivity, but also exhibit a greater water use efficiency. This leads on one hand to more carbon input into the soil and on the other hand to higher soil moisture levels. As a consequence, earthworm activity increases.

3. Tree seedlings

CO_2 effects on tree seedling are strongly species dependent. In a low light regime, as typically observed in mature temperate forests, beech seedlings (*Fagus sylvatica*) show a strong growth response to elevated CO_2. Contrary, fir seedlings (*Abies alba*) show no response to elevated CO_2 in a low light regime, but increase in growth under better light conditions as found in canopy gaps.

4. Lianas

Lianas, as beech seedlings, also show a dramatic increase in biomass to elevated CO_2 under low light conditions. Körner's experimental findings well explain the oberserved increase in liana biomass in tropical rainforests. In tropical forests, lianas are considered to determine the turnover (lifespan) of trees. Increased liana growth under elevated CO_2 is expected to accelerate forest dynamics and thus to decrease carbon storage in these ecosystems.

5. Forest (Web-FACE, Swiss canopy crane project)

In an attempt to investigate the effects of CO_2 enrichment on an entire natural forest ecosystem, Christian Körner initiated a project, where 14 mature broad-leaf trees were fumigated directly at the leaves with CO_2 (Web-FACE). Although the project started only three years ago, it has already produced numberous results. For example, Körner was able to show that CO_2 enrichment led to an overall reduction (7%) in canopy transpiration, which again caused an overall increase in soil moisture. However, Körner was also able to show, that not all tree species behavied equally. Similar species specific effects were observed in changing food quality of the herbivory catarpilar *Lymantria dispar*. Under ambient CO_2 concentrations, *Lymantria* prefered oak trees as main food source, while under elevated CO_2 hornbeam trees were prefered. Both studies suggest, as observed in the grassland studies mentioned at the beginning of the talk, that species in the forest reacted differently to elevated CO_2, which is expected to change species compostition in the future.

Körner's talk can be summarized into four points:

a.) Responses to elevated CO_2 are species specific, suggesting changes in future species composition of ecosystems.
b.) Response intensity also depends on other environmental factors, such as nutrient and light.
c.) Elevated CO_2 not only has a direct effect on plant physiology, but can also change ecosystem properties such as soil moisture.
d.) Effect of elevated CO_2 can not only be observed in plants, but can also lead to effects at higher trophic levels (insect, earthworms).

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