More biodiversity for better climate – The interdependence of climate change and biodiversity

The Intergovernmental Panel on Climate Change (IPCC), set up in 1988 by the United Nations Environment Programme and the World Meteorological Organization, has the task to assess the risks of global warming on the basis of scientific principles. Various emission scenarios drafted by the IPCC show some possible developments of climate in the future. Based on each scenario (from complete cessation of greenhouse gas emissions to “business as usual”) a global temperature increase ranging between 1.1 and 6.4°C is expected by the end of the century. From a global perspective, we must therefore count on an average increase of 3-4°C by 2100.

The most recent studies even suspect a significantly higher warming. As to local developments, it turns out that climate warming will be particularly marked in the Alps. The increase is almost twice as much compared to the global trend. In the history of the earth, climate has always changed, and nature in its wake. However, the speed and size of the current climate warming are extraordinarily high and are thus divergent from previous climate changes.

Changes in climate conditions are reflected on species and ecosystems. Due to climate change, distribution areas move along climate zones, height and moisture gradients. If there is an average global warming of 3°C in the next 100 years, a horizontal shift of around 600 km from the south to the north or a vertical shift of around 600 meters in height will be expected in the northern hemisphere. Experts assume that some species cannot manage such migrations with respect to the speed of the current climate change. Most woods expand at a speed of around 100 km in 100 years, many Alpine species grow 50 meters further up in 100 years and some grass species in the Alps reposition themselves by a mere 4 metres in 100 years (www.gloria.ac.at). In addition to this spatial shift, it is expected that species will change their genes, aspect or behaviour. Reactions of biodiversity to climate change will be very different and are hard to foresee at the moment.

Climate change will produce winners and losers among plant and wildlife species. Mountain areas are particularly sensitive and will incur the highest losses in biodiversity. Species and ecosystems in mountain areas, especially in the higher areas of the Alps, are often durable and have special requirements and no chance of escaping (as per above). The way flora changes as a consequence of climate change has been examined by international projects such as GLORIA (Global Observation Research Initia-
tive in Alpine environments). GLORIA is a project for the establishment of a worldwide network in which long-term data on plants and temperature are gathered, in order to estimate future trends in species' variety and temperature. According to GLORIA, it has already been determined that some plant species have moved around 15 meters higher.

The “Flora Alpina“ features 4491 plant species in the Alps, 501 of which are endemic. Therefore the Alps are the richest floral region in Central Europe. At the same time, they are most strongly impacted by climate change. According to current models, 45% of the Alpine plant species are threatened with extinction by 2100. Because of global warming, also well-known animal species such as the Alpine ibex, the snow grouse and the mountain hare will experience far worse living conditions in the Alps.

![Extreme high altitude species, like Androsace alpina, according to the results of the research project Gloria are already displaying a retreat today.](image)

If, in the near future, there is no expansion and connection between currently existing protected areas, and if the variety of species outside these areas is not protected, a large number of species from certain regions will disappear or even be globally threatened with extinction.

Climate change also affects ecosystems: for the last 150 years, glaciers have been retreating in the Alps (according to Bund Naturschutz Bayern: 52% in surface area and 60% of the mass). This endangers, for example, the ow of Alpine rivers. Low water levels and further hydrological changes lead to serious changes in the ecosystems of watercourses. Fish species in the head waters are increasingly endangered. OcCC/ProClim (2007) predicts that by 2050 watercourses in the Swiss Alps will have warmed by 2°C compared to 1990. This means that the habitats of cold water fish may shrink by 20-25%. Also the situation of meadows and wetlands and their ecosystems changes along with that of rivers.

Climate change requires quick action since ecosystems are slow to react. Scientific bases are sufficient, there is no reason to wait any longer to take actions for protecting biodiversity.
Protection of biodiversity means climate protection

Against the backdrop of climate change, the role of ecosystems with high biodiversity is more significant than ever in the past, since they react more flexibly and dynamically to climate changes and, as reducers of organic carbon, they can improve the balance of greenhouse gases. As a consequence, high biodiversity can contribute at the same time to climate protection. Growing marshland and forests can store carbon dioxide (CO₂), and an agriculture compatible with nature releases essentially less CO₂ than intensive agriculture.

Renaturation and reactivation of rivers, meadows and wetlands as well as the improvement of the hydrologic balance of the landscape can soften the negative consequence of increased rainfall extremes also for people. The forest has always offered protection from natural hazards such as landslides, landslips and high waters. With climate change these dangers increase, so that well-functioning protection forests become increasingly significant.

Adapting to the shift of climate zones

Climate change can have unpredictable and surprising effects on individual species and ecosystems because of the complex ecological interactions. Distribution areas move clearly along climate areas, as well as height or moisture gradients. Different strategies of networking of habitats from global to local level must make these shifts possible as biodiversity has been already experiencing changes due to climate change.

Against this background, the concepts of classic nature protection are no longer sufficient, since, up to now, it has focused on protected areas as "Islands" for the conservation of biologic variety. Future-oriented nature protection must strive for a functional networking of large and small protected areas and complex habitats, while a complexity of biotopes is protected or even created.
Landscape elements such as corridors or stepping stones, which can support the networking of habitats, play a decisive role in the protection of biodiversity. It is recommended that large connection areas be created instead of narrow corridors, since migration paths can change according to the various species. If conditions inside the protected areas are no longer appropriate, UNESCO in its “Man and Biosphere” Programme recommends the creation of buffer zones, which can accept migrating populations. For this strategy to work, the buffer area must be sufficiently large.

Based on local situations, measures in various sectors are necessary in order to improve the ecological networking of protected areas and complex habitats with the goal to protect biodiversity. Alongside nature protection, significant fields of action are for example agriculture, forestry, hunting, tourism, spatial planning, transport, water management and environmental education (see Kohler and Heinrichs, 2009 : Catalogue of measures on www.alpine-ecological-network.org).

In addition to measures in protected areas, land users outside protected areas should be offered incentives for judicious use. This increases the chance for species to find adequate conditions extensively and to move their habitats in response to climate change.

Protected areas can only contribute in the long term to the conservation of biodiversity if they are configured in such a way that the consequences of climate change as well as of “Global Change“ in the widest sense are sufficiently taken into consideration. In nature protection institutions there are accumulated needs, when strategies are sketched, nature protection plans are newly drafted or management tasks are defined for protected areas. Even though it is not yet possible to foresee all the consequences of climate change, the data base is good enough to act now in a prescient manner.

Large buffer areas which surround large protected areas could be able to absorb future changes. However, in large parts of Europe, protected areas are on the one hand too small, and on the other hand their surroundings are too much utilized by man. New protected areas should also be established in low traffic and non-fragmented spaces. Static protection of individual species is, however, an obsolete concept.
Climate change : a challenge for biodiversity

Not only does climate change have an impact on species and ecosystems, but also climate measures in the various fields of activity. Conflicts between climate protection and the conservation of biodiversity exist above all in the field of renewable energies. The boom of biogenous fuels and the connected increase in areas that are used for the cultivation of energy plants, must be assessed as particularly critical, first of all with respect to the hunger issue — in particular in southern countries. The rocketing expansion of areas also has negative consequences on biodiversity: intensification of agricultural production, loss of green areas and the expansion of cultivated areas. Biogenous fuels deserve support only if they are not in competition with the production of food and when they can be produced in an ecologically sustainable way. Corresponding certification systems on the basis of life cycle assessments are currently being developed.

Also, a possible increase in electricity production from water power can have significant consequences for the ecosystems affected if, because of this, residual water quantities are further reduced or hitherto near-natural watercourses are dismantled. Furthermore, the production of wind energy represents an ecological conflict, since pumped storage hydro power stations must be constructed in order to store the electricity from wind power stations which is not constantly available.

Since high water events become more frequent as a consequence of climate change, more extensive adaptation measures are necessary. If hydraulic engineering measures are taken, which considerably change the natural water flow (straightening, riparian control structures, channeling projects), there are conflicts with the protection of the ecosystems of the watercourses. For a sustainable high water protection – particularly as regards climate changes – restraint spaces must be preserved and the necessary space along rivers must be ensured which also has a positive effects on biodiversity.