

# Initiatives

## Biodiversity and Climate Change Research Programme of the Snow and Mountain Research Centre of Andorra (CENMA)

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Andorra is located in the heart of the Pyrenees, where the rocks are the oldest in the mountain chain. Although it is a small country, it has plenty of biodiversity. The flattest areas of the valley floors have traditionally been the areas where human occupation has been concentrated. It is where the majority of the population centres are, but it is also where we mainly find agriculture and in the wettest places, meadows. As a consequence of this, the river bank vegetation in Andorra has greatly diminished, especially fragments of river forests (*Fraxinus excelsior*, *Salix* sp, etc). The low parts of the southern, sunny sides are the warmest slopes of the country and are the northern limit in the distribution area for some Mediterranean species. The vegetation that occupies the slopes between 1,800 and 2,200 metres are mainly mountain pine forests (*Pinus uncinata*), a habitat which occupies 20 percent of the country. Over 2,200 metres there are clear alpine affinities. It is the domain of high mountain pastures, although we can find some scrub as a consequence of the reduction in stockbreeding. These pastures occupy approximately 25 percent of Andorra.

The Snow and Mountain Research Centre of Andorra (CENMA) is a centre that studies and researches different but connected mountain subjects (geology, nivology, biodiversity, climatology, etc.). We have a variety of studies and proposals in relation to climate change, global change and biodiversity. Below we explain some of the studies related to climate change and biodiversity.

One of the most important projects taken on at CENMA over the last two years has been the creation of an automatic weather station (AWS) network over Andorra, mainly at high elevations (1,600 - 2,700 metres). Variables such as temperature, precipitation, humidity, solar radiation, snow depth, snow and soil temperature, pressure, wind speed and direction are registered following the World Meteorological Organization recommendations as the "10 minutes resolution". Improving awareness about the Andorran climate and meteorology and the creation of a high quality climatological database for biotic studies are the main objectives that are considered by CENMA.

Climate variability through climatological series analysis is also studied at CENMA. Three long continuous series since the 1930's are being homogenised and added to international databases (participation at the COST ES0601 European action and the WMO-MEDARE community, Esteban et al., 2008). Homogenised temperature and precipitation trends will be derived from these studies, one of the main steps for evaluating climate change in a certain region or country. Future work plans are related to the use of downscaling applications for deriving future climate scenarios over the Andorran area on the basis of GCM models.

Studies that are currently being conducted at CENMA related to biodiversity and global change are as follows:

### Monitoring of butterflies in Andorra (Butterfly Monitoring Scheme)

This project is based on the methodology developed by Pollard and Yates (1993) and permits a precise recognition of changes



*Aglais urticae*. A threatened specie by global warming. This specie is one of the 156 that lives in Andorra. Photo: Montse Mases.

in butterfly abundance by following itineraries to observe butterflies in their environment and later relate these observations to various environmental variables. The role of the butterfly as a biodiversity indicator is well-known for climate change in particular (Stefanescu et al., 2003; Parmesan et al., 1999). Butterfly abundance data is gathered over 30 weeks in seven locations in Andorra. Each location represents a microhabitat. By the end of the year, an abundance index per species is obtained which allows the population variations between years and over the year to be compared. This index is also used to determine environment preferences and possible variations due to the management carried out in the area of study. In general, the information obtained is very varied: fauna composition, phenological information, environmental preferences, population fluctuations, migrations, influence of the management of an area, introductions, colonisations and extinctions.

### Study of changes in soil use in Andorra in 1948, 1972 and the present day

The evolution of Andorran soil cover over the last 50 years is being studied through aerial geo-referenced photos. Over recent years Andorra has experienced a dramatic change in soil use, passing from being a society nourished basically from the primary sector (stockbreeding and agriculture) to one almost exclusively dependent on the tertiary sector (tourism and commerce). These changes have a marked influence on the territory which needs to be evaluated.

### Monitoring and studying of snowbeds in Andorra

In this study, snowbeds are regarded as a plant unit model for investigation on the consequences of climate change on high mountain vegetation. Snowbed species (called *chinophiles*) have narrow ecological niches and are highly vulnerable to environmental changes.

The development of snowbeds over the last 50 years is evaluated and a physical typology of these is produced. Tracking and monitoring stations for snowbeds are also set up through measuring meteorological data and monitoring vegetation. The main aim of these tracking stations is to study the relationship between the phenology of *chinophila* vegetation, the climate and other environmental variables. The monitoring of these variables will allow changes in the

composition and diversity of vegetation to be detected on an inter-annual basis and over the years. The processing of all the data in the long term will permit the adaptation of vegetation in these habitats to be assessed in the context of climatic change.

## Study and monitoring of the production and diversity of fungus in experimental plots

An evaluation is made on the influence of climatic variables on the production or diversity of fungus carpophores in the forest habitats of Andorra close to an altitude of 2,000 metres.

## References

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## Climate Change and Biodiversity in the European Union Overseas Entities

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Stretching from the Arctic to the South Pacific through the Atlantic, Amazonia, Antarctica and Indian Ocean, the 28 European Overseas Territories present both a remarkable and vulnerable biodiversity. Typically tropical islands, they are generally small in size with limited resources; they are often isolated and exposed to tropical cyclones and sea level rise.

These insular ecosystems are particularly rich, with significant endemism rates, but they are also extremely fragile and often highly deteriorated. Therefore, their resilience to new aggressions is limited. Furthermore, island economies strongly rely on the quality of their natural environment. Notably through tourism, fishing and subsistence farming, a degradation of their environment could deeply affect local communities. Mountain areas do not represent a significant proportion of these territories but some of them shelter unique and threatened biodiversity: sub-Alpine forests in French Polynesia (the only ones in the South Pacific region), high altitude rainforests and mountain forest on Reunion Island, laurel forests in Macaronesia, etc.

The range of environments, from polar to tropical, encompasses a wide range of exposure to climate change. Indeed, this project was the first attempt to capture the diversity of the seven Outermost Regions (OR) and 21 Overseas Countries and Territories (OCT) belonging to six European Union Member States.

The OR include: Guadeloupe and Martinique (France) in the Caribbean, French Guiana in South America and Reunion Island (France) in the Indian Ocean; the Azores, Madeira (Portugal) and the Canary Islands (Spain) in Macaronesia.

The OCT include: the Netherlands Antilles, Aruba (Netherlands), the Cayman Islands, the British Virgin Islands, Turks and Caicos, Bermuda, Anguilla and Montserrat (United Kingdom) in the Caribbean; Mayotte (France) and the Chagos Archipelago (United Kingdom) in the Indian Ocean; French Polynesia, New Caledonia, Wallis and Futuna (France) and Pitcairn (United Kingdom) in the south Pacific; Saint-Helena and dependencies (United Kingdom) in the south Atlantic; Greenland (Denmark), Saint-Pierre-and-Miquelon (France); the Falkland Islands (United Kingdom), the French Southern and Antarctic Territories (TAFF - France), South Georgia and the South Sandwich Islands (United Kingdom), and the British Antarctic Territory in the Polar Regions.

In 2007-2008, the International Union for the Conservation of Nature (IUCN) and the Observatoire National sur les Effets du Réchauffement Climatique (ONERC) prepared a report on the impacts of climate change in the European Overseas Entities. The territories were grouped into main regions: Caribbean, Macaronesia, Amazonia, South Atlantic, Indian Ocean, South Pacific and Polar Regions. The main characteristics and biodiversity of each OR and OCT were presented, as well as the key climate trends identified for these territories, the expected impacts and some ideas toward an adaptation process. An Editorial Board of 22 members was set up to help



Heard Coquille IPF. Photo: Guilluame Prudent.