



CASCADE

Catastrophic shifts in drylands:
How can we prevent
ecosystem degradation?

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<http://www.cascade-project.eu/>

Reporting on our recent Plenary meeting in Paphos, Cyprus



One of the most challenging themes in ecology over the last decades is the quest for the understanding of discontinuous changes in ecosystems. Some of these *discontinuous shifts* imply undesired and irreversible changes. **CASCADE** will investigate and analyze a range of dryland ecosystems in southern Europe to obtain a better understanding of sudden shifts in drylands that may lead to major *losses in biodiversity* and concomitant ecosystem services. Based on these analyses, **CASCADE** will develop ways to predict the proximity of the **CASCADE's** dryland ecosystems to *thresholds* in such a way that these predictions can be used by policymakers and land users for more sustainable management of drylands worldwide.

In the CASCADE Project, researchers are looking closely at the ecology of drylands in parts of Portugal, Spain, Italy, Crete and Cyprus to find a better understanding of discontinuous shifts, or tipping points, in ecosystems. Read more about the aims and work plan in the CASCADE flyer,

(downloadable from <http://www.cascade-project.eu/index.php/downloads/category/1-public-documents>
in 5 languages)

By Rudi Hessel and Nicky Geeson

Making movies, - CASCADE promotional films

Cyprus was the ideal setting to record a new interview with one of the researchers in the CASCADE project. Next to the 'official' CASCADE movie that was recently issued, the 'home-made' interviews with CASCADE researchers try to give an insight in the specific field certain researchers are looking into during the execution of the project. Interviews that are already recorded deal with: **the importance of drylands** (Jan Jacob Keizer – UAVR), the explanation of **what sudden ecosystem shifts are** (Ramon Vallejo – UB), **what processes occur during a catastrophic shift** (Susana Bautista, UA) and **how drylands can be managed better** (Gudrun Schwilch – UNIBE). Violette Geissen had given a video interview about the general scope of the project.



See the CASCADE movie and all interviews at:
<http://vimeo.com/channels/drylandshifts>

The Cyprus setting gives a good insight in the process of overgrazing and what this process can do with the landscape. Violette illustrates these aspects during the interview by showing degradation features found near a goat farm in the middle of the Cyprus study area. The technical experimental setups used in the Cyprus study area are also demonstrated.



Photo by R Hessel

Choosing a location for the interview

The original quality of the interview with Violette was not quite satisfactory, so a new version of that interview was made during the field trip in Cyprus. In the newly-recorded interview, Violette talks about the background of the project and what different aspects we are actually looking into.



Photo by J Brandt

Filming the interview with Violette

The series of researcher interviews will be expanded in the future by also interviewing researchers involved in plant modelling, stakeholder involvement and socio-economic up-scaling.

By Erik van den Elsen and Jane Brandt

The CASCADE visit to the Randi Forest field site near Paphos, Cyprus - an impressive encounter with drivers and consequences of land degradation

It was quite exciting to meet the CASCADE project team again, including researchers from England, the Netherlands, France, Switzerland, Portugal, Spain, Italy, Greece and of course Cyprus.

Here, very close to Paphos, we have one of the six field sites set up. It is particularly interesting, because it is the field site with the highest intensity of grazing, and overgrazing is one of the key drivers of land degradation here. Goats are free to walk around the entire area, and evidence of their grazing habits are everywhere.

Associational resistance to grazing

Now, in spring, many fast growing annuals are covering the ground, plus some fleshy herbs that are known to be indigestible or poisonous to herbivores. Over the years of grazing, some shrubs grow into weird shapes.

Most shrubs have thorns and form spiked cushions that are pressed firmly to the ground, though some are towering high and are surrounded by a natural fence of half-dead branches nibbled down to the woody parts. Often, plants of the same or different species are growing next to each other to form an associated patch. This effect is often referred to as Associational Resistance, the protection against external pressures by local aggregation.



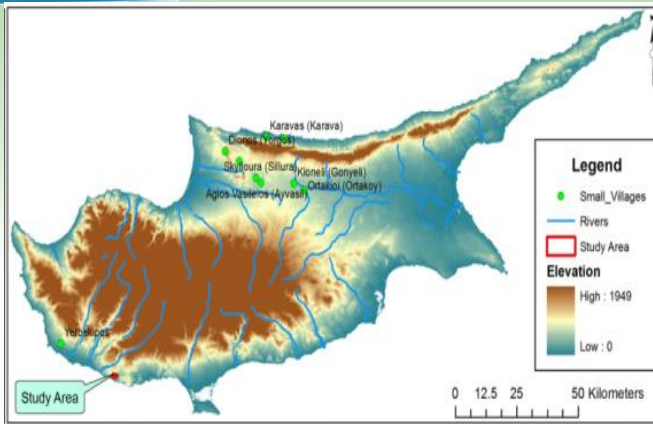
Photo by N Geeson

The Randi forest site, overgrazed by goats and suffering erosion



Photo by N Geeson

Researchers examine a shrub with thorns to protect itself from overgrazing. More vulnerable plants may grow within and below it



A map of Cyprus showing the location of the Randi forest study area

Nurse and protégé

Building protective structures such as thorns, against grazing requires a lot of effort for plants. Some plants are therefore free-riders on the protection provided by others.

The plant providing the protection is called the nurse, and the one benefiting is the protégé. It is however unclear if the nurse plant gains from hosting the protégé, or whether it suffers from competition or increased attraction to grazers. In Cyprus in March we found at least one flowering plant growing inside almost every other shrub. In the fenced sites without goats, we also found the vulnerable, soft plants climbing dead wood, or growing widely, whereas in strongly degraded sites these plants were hardly found.



Photo by FD Schneider

Shrubs are grazed into weird shapes by the goats



Photo by FD Schneider



Photo by FD Schneider

Left: Prickly "Nurse" shrubs protect other more vulnerable plants growing within them. Above: degradation to bare soil



Photo by FD Schneider

Surface runoff erodes the soils and exposes roots where vegetation no longer protects it



Photo by N Geeson

Deep gullies are carved out through sediment accumulated at the base of slopes

Erosion

We found strongly eroded areas, usually in the valleys between two facing slopes. It is hard to say what started this process: water runoff or grazing. In the first place, the valleys receive a larger share of the available water in the landscape, which is good for the plants growing there. However, the grazing activity and the trampling of the goats reduces herbs and grasses and erodes the top soil. The emerging goat tracks on the surrounding slopes concentrate the water runoff. From a certain point, water does more harm than good. It washes away all nutrients and seeds. This makes it difficult for shrubs and other plants to hold their ground. Now, exceptional rainfall events can cause severe damage and expose the roots of shrubs and carve deep gullies in the soil.



Photo by N Geeson

The grazing goats have removed nearly all the vegetation on this slope, leaving it highly-degraded

Aerial approach

We begin to understand the processes that shape the plant individuals, the vegetation patches, and the entire landscape. In CASCADE we investigate the interplay of all the mechanisms and how they might turn a formerly vegetated and productive landscape into a barren desert. A good way to describe changes on the landscape scale, like the spatial structure of the vegetation, is to look on it from above. That is why we have people of the Technical University of Cyprus in Limassol on board who are experts on mapping aerial imagery. They investigate changes over time from historical time series of satellite images and provide us with high resolution, air-borne images from all kinds of drones.



Photo by M Jucker Riva

Preparing to launch the drone to map vegetation from the air



Photo by FD Schneider

The drone in flight, with camera



Photo by N Geeson

Rainfall exclusion roof

Experiments

We also need a better understanding on what is going on at the scale of a single plant. Therefore, rainfall exclusion roofs and other experiments are investigating how the plants and soils respond to the additional pressure of drought. The results will give us a clue about tipping points between healthy vegetation and degraded land.

As you can see, the CASCADE project is combining approaches on a wide range of scales, from the individual plant to the view from space, to solve practical issues. The knowledge will help land users and policy makers to avoid degradation and to look after the land in a more sustainable way.

By Florian D. Schneider

Drought Simulation with Rainfall Exclusion Experiments in Crete

At plant level, CASCADE experiments include the simulation of drought, or prolonged dry summers, through rainfall exclusion experiments. In the Messara Valley site, Crete, prototype roofs were constructed using polycarbonate sheets fitted in hydro-jet cut sea plywood. The design ensures a sturdy but light structure that can sustain strong winds.



Photo by the Hydromech lab

Setting up a rainfall exclusion experiment in Messara, Crete

Many solutions are bound to come through a combination of innovative technologies and traditional practices. For example, flora biodiversity can be fully restored with the application of rational grazing, fertilization or exclusion of degraded areas, and sustainable irrigation and land management practices can be applied to promote water conservation. The results of the Project will provide insight to the causes and characteristics of tipping points in the Mediterranean drylands, thus leading to meaningful natural resource management recommendations for preventive and restorative best practices.

By Yannis Daliakopoulos and Manolis Grillakis

Talking to local people in Pissouri, Cyprus

My main objective was to discover and understand the main problems related to land use and land degradation in the area, and what management options the locals are using to solve them. As always, in order to identify the land management, I had also to gain some knowledge about the land use, the history of the place, and how the stakeholders perceive their environment. It all began, with a wonderful dinner in Pissouri with about 18 people that ranged from farmers to local administrators, from the wildlife conservation to the fire brigade.

It was also a good occasion to introduce ourselves and CASCADE and as you can see from the pictures, the atmosphere was definitely welcoming!! Special thanks to Michalis Christoforou who managed to organize all this in such a short time. Although I wish I had had more time to widen the circle of stakeholders and to really understand the different land uses, I gathered some interesting information that I think can be of interest for the CASCADE project.



Photo by M Jucker R

Researchers and stakeholders get to know one another

More structured and detailed information will come in the future, but below are some comments and opinions.

"If the farmers leave, and the grazing stops, there is a very high risk of fire..."



Photo by HP Liniger

A Pissouri farmer

"I will always be a farmer, but I don't think my sons will continue if the environment is like that"

"Goats are really machines of destruction: they will not simply eat a plant, they will stomp and brake and graze a whole area before they move to another place..."

By speaking to the farmers and by observing the goats, I realized we often forget about adaptation capacity of both humans and animals. If the environment is degraded and provides less nourishment, the animals will eat even the unpalatable plants, will produce less milk, and will lose weight before definitely abandoning an area.



Photo by M Jucker Riva

A friendly goat

Similarly, farmers will provide fodder, will sell less milk or milk of a lower quality, and might economize before they radically change the way they use their land.

By Matteo Jucker Riva

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