Endangered Landscapes & Seascapes Programme | Cambridge Conservation Initiative

Terrestrial Arthropods

Objective: Increase diversity of terrestrial arthropods

Carpathian Mountains

status: no change observed

Problem: Many habitats across the Fagăraș Mountains have become ecologically degraded. This is partly due to forestry practices which include clear-felling, planting with spruce monocultures instead of diverse native tree assemblages, and clearing vegetation in alpine habitats. In riparian habitats, ecological degradation is due to the combined effects of logging in riparian areas and neighbouring forests, grazing near rivers, and decreasing soil moisture due to climate change. This has reduced the occurrence of native tree species and characteristic understory vegetation, being replaced by invasive alien species. Degradation across habitats has led to a shift in arthropod communities, which can be used as an indicator of habitat type and condition.

Morimus funereus, an indicator species for forests. Photo: Oliviu Pop.

Action: In clear-cut forest areas, Foundation Conservation Carpathia is planting saplings of native trees that occur naturally in mixed intact forests in the area. In spruce monocultures, Foundation Conservation Carpathia is cutting down some spruce specimens to thin out the dense monocultures and allow natural regeneration of native species, as well as planting saplings. In alpine and sub-alpine habitats, Foundation Conservation Carpathia is replanting dwarf pine and juniper and in riparian areas invasive plant species are being cleared and native alder saplings planted.

Indicator: Changes in the composition and diversity of terrestrial arthropod communities indicate changing vegetation characteristics of degraded forest, alpine and riparian habitats as they undergo restoration.

Methods

Arthropod surveys were conducted across four degraded habitat types: spruce monocultures, clear-cut forests, riparian habitats, and alpine and subalpine meadows. In all habitats, surveys took place across both areas undergoing restoration, and control areas not undergoing restoration. Baseline surveys were completed in 2019 and 2020, while follow-up surveys were conducted in 2021, 2022 and 2023. In addition, mixed deciduous forests (with no interventions) were surveyed to provide references for intact native forest. These sites were surveyed only once, in 2019-2020, since they represented ecologically stable, intact habitats and were not expected to change significantly over the monitoring period. Restoration at sites had not started at the time of baseline surveys, and started at varying times at different sites in the period between 2019 and 2023.

A spruce monoculture. Photo: Foundation Conservation Carpathia.

Arthropod monitoring in clear-cut habitat. Photo: Foundation Conservation Carpathia.

Riparian habitat. Photo: Foundation Conservation Carpathia.

Subalpine-alpine habitat. Photo: Foundation Conservation Carpathia.

Different survey methods were used in the forest habitats compared to other habitats (Fig. 1). In all habitats, ground-dwelling arthropods were sampled at each sampling site using three pitfall traps, separated by 2 m. To sample arthropods from herbaceous vegetation, in mixed forest habitats a Winkler sample was taken at each site, in which leaf litter was collected from a 1 m^2 area and passed through a mesh bag, so that arthropods were separated out. In riparian, clear-cut and alpine areas, arthropods from herbaceous vegetation were sampled using vegetation sweeping over a 10 m transect. There is no significant herbaceous vegetation layer present in spruce monocultures, so no herbaceous layer samples were collected in those areas.

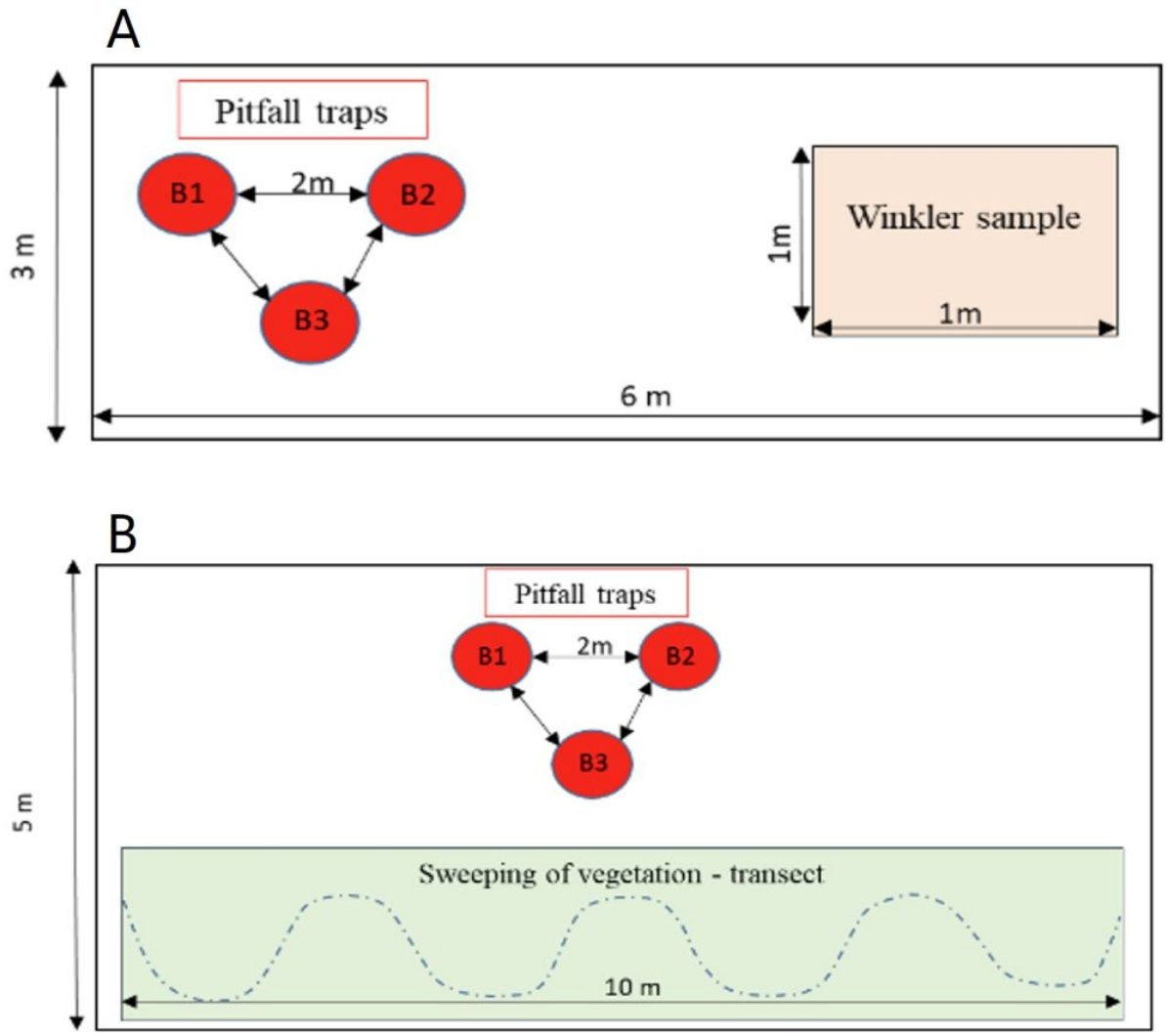


Figure 1: Sampling design for (A) spruce monocultures and mixed forests, and (B) clear-cut areas, riparian and alpine meadow habitats. Created by Foundation Conservation Carpathia.

Sample numbers for each habitat type in baseline surveys are listed in Table 1. Additional sampling points were added in subsequent years as further plots of land were acquired by Foundation Conservation Carpathia.

	Mixed forest		Spruce monoculture		Riparian habitat		Alpine habitat		Clear-cut	
Year	Control	Restored	Control	Restored	Control	Restored	Control	Restored	Control	Restored
2019	9	N/A	0	43	10	5	8	0	0	0
2020	12	N/A	7	18	10	5	14	0	0	14
2021	2	N/A	10	20	7	2	4	4	6	6
2022	0	N/A	10	10	10	10	10	10	10	10
2023	0	N/A	10	10	10	10	10	10	10	10

Table 1: Number of sampling plots for each habitat type in each year. Due to the process of acquiring land and initiating restoration, restoration activities began at different times in the restored plots.

Sampled arthropods were identified to order level. To assess taxonomic diversity, Shannon Index was calculated for each sample.

Results

There were no statistically significant changes in Shannon diversity of arthropod communities over time in any habitat (Fig. 2). No significant differences in diversity emerged between control and restored sites.

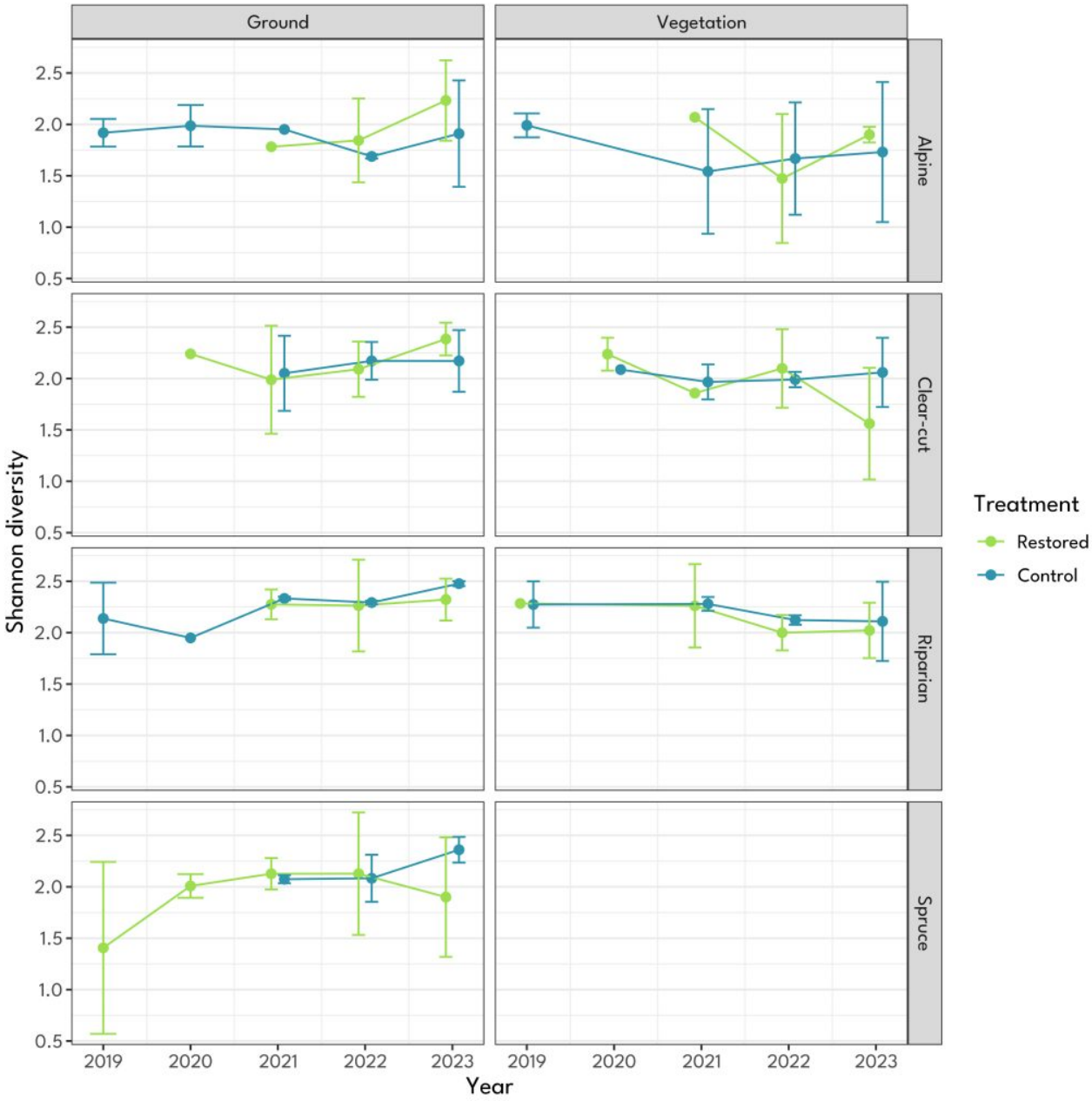
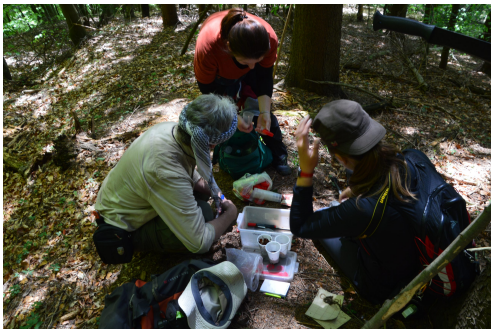


Figure 2: Change over time in Shannon diversity of ground- and vegetation-dwelling arthropod communities across different sampled habitats, comparing between control sites and sites undergoing restoration. Note that intact mixed forests were included as a reference, and therefore there are no restored sites in this habitat. Control and restored points are slightly offset for ease of viewing.

Interpretation

Significant changes in vegetation structure will need to take place in habitats undergoing restoration before significant

shifts in arthropod communities would be expected. In addition, recovery of arthropod communities is unlikely to be a linear process, since it will follow ecological succession. This is a long-term process – for example, in the case of spruce monocultures, such changes will only become apparent once the planted beech seedlings reach an age of 20 – 30 years. In clear-cut areas, the time needed to detect changes in arthropod communities is expected to be shorter, but will still depend on the development and closure of the tree canopy, a multi-year process. In riparian habitats, changes in arthropod community structure are contingent upon the planted alder trees reaching approximately 3 meters in height, at which point canopy closure will shade the soil and induce further ecological shifts. For all habitats therefore, this dataset will provide a valuable baseline to compare against future survey data, in order to monitor long-term effects of restoration.



Checking arthropod pitfall traps. Photo: Oliviu Pop.

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