

Biodiversity study

The species, habitats, ecosystem dynamics and ecological relationships in the hodăia cultural landscape around Brădetu, Argeş.

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As part of the project “Hodaia - nod rural pentru reabilitarea peisajelor culturale”

Summary

This report synthesises an ecological inventory compiled from surveys across five distinct taxonomic groups within a 3km² area of sub-montane landscape in Argeş, Romania, characterised by hodăia and a traditional pastoral system. The surveyed site represents a pristine, functional habitat mosaic of conservation significance, including dry calcareous grassland, riparian forest and meadows, mature orchards and ancient deciduous forest. The data reveals an extraordinary co-occurrence of nine orchid species, critical high-nature-value flora, large carnivores, protected birds, important herpetofauna, and endangered invertebrates.

The site currently sits at an ecological crossroads: historically sustained by low-intensity, traditional seasonal grazing and haymaking, it is now threatened by acute abandonment on one side and intensification of sheep grazing on the other. It is a crucial moment in the life of this cultural landscape, which trajectory to take and how to balance necessary ecological protection with social, cultural and political challenges. This report establishes a scientific foundation to build upon in the future and to use as a baseline to identify changes in biodiversity over time. It also puts forward suggestions and recommendations that would help maintain the ecological integrity of the site and its biodiversity.



A fairly typical view within the study area

Introduction

The cultural landscape of hodăia was always centred around haymaking and summer grazing for livestock. A simple, wooden cottage was the shelter for the family and their animals, whilst the surrounding parcel of grassland shifted between pasture and hay-meadow. Hedges were planted as protective boundaries and orchards maintained to provide shade and fruit. The mosaic of land-uses, in combination with patches of forest and intertwining streams, created a wonderful, blended ecological gradient between the village and the 'wilderness' of the mature woodland and mountains beyond. Over time the identity of this landscape has been stamped with a unique cultural and natural richness. However, the land-uses that created this landscape are changing and with it, the fragile ecosystem that is so finely balanced. The biodiversity is highly vulnerable to two opposing external landscape pressures: increasingly intensive sheep grazing and complete land abandonment. This study is just a temporal and spatial snapshot, looking to document the presence of important species and shed light on the ecological relationships.

Study Area

The study area is the region of hodăia to the northwest of Brădetu, Argeş. It is a 3km² polygon which aimed to include the majority of the hodăia landscape belonging to the village and excluding large grazing and forest areas (see figure 1). This study area falls almost entirely within the Valea Vâlsanului protected area, designated under Natura 2000 as a Site of Community Importance, covering an area of 9582.7ha of the Vâlsan river and its watershed. It is the only place in the world where a fish, the aspretele (*Romanichthys valsanicola*), has been recorded. This of course has meant much of the conservation efforts have been aimed at the freshwater habitats and ecosystem to ensure the survival of this incredibly range-restricted species, but has perhaps neglected the traditional, small scale agricultural landscape and its associated flora and fauna. This area was largely dictated by the scope and scale of the project to which this study is a part of, rather than any ecological boundary. Not all the study area was equally surveyed, one forested area in the centre of the study area was not visited due to access and the fact it was forest.

Methodology

Fieldwork was split between two visits, 3rd to 5th May and 9th to 11th June, totalling six days of data collection. During both visits, data was collected on mammals, birds, herpetofauna, butterflies and plants. The methodology was simple and opportunistic, using multiple random transects to cover as much of the study area as possible whilst constantly recording any observations from any taxonomic group. Mammals were detected visually, from tracks or signs or by camera traps (eight setup over a period of four weeks) (Figure 2), each observation was recorded on Ornitodata, including GPS location (a phone application created by Societatea Ornitologică Română). Birds were detected both visually and audibly, with some incidental records coming from the camera traps, every observation was recorded on Ornitodata and GPS location logged. Herpetofauna (amphibians and reptiles) and butterflies were detected visually and recorded on Ornitodata, with GPS location. Vascular plants were recorded and shared on PlantNet (a phone application). The identification of many plants was also done using PlantNet and so determination to species-level may not always be completely accurate. Not all plants were recorded due to limited time and resources. Instead, the study was focused on identifying specialised botanical indicators and representative species to identify the various plant communities and associations.



Figure 1. A map showing the study area and Natura 2000 site Valea Vâlsanului in relation to the village of Brădetu, Argeș.



Figure 2. A map showing the locations of the eight camera traps in the study area.

A particular focus was given to orchids, which were mapped to show their distribution across the study area, whilst other plants were simply recorded as present. Not every individual orchid was mapped, instead it was measured per parcel (one record equals one parcel that the orchid was present in, regardless of abundance).

The complete spectrum of habitats that make up the hodăia landscape were surveyed to get the most comprehensive idea of the biodiversity in such a short time frame. The first visit concentrated mainly on documenting birds and mammals, with the later visit focused more on recording butterflies and plants, this was due to the respective presence and detectability of those groups at that time of year. It was a challenge to accurately determine the abundance of mammals from tracks and signs, in general I tried to only count a new individual when it was clear from the size, form, direction/ time of travel or distance from the previous track.



The tracks of *Rattus norvegicus*

Historical Management

The traditional balance between grazing and hay making in the hodăia landscape was governed by a strict pastoral calendar rooted in Orthodox Christian beliefs. These spiritual milestones doubled as social and ecological boundary dates, determining when animals must be confined, when meadows were allowed to rest, and when fields were opened for community grazing.

Sângiorz – April 23rd – This milestone opened the pastoral year and marked the official end of winter indoor feeding. Livestock were driven out of the main village up to the hodăia. In early spring, animals were allowed to graze the meadows briefly to eat the first rough shoots and trample the soil. The heavy trampling by cattle breaks up the dense, dead thatch layer left over from winter. This process creates pockets of bare, exposed earth, giving delicate species, such as orchids, the open soil and direct sunlight they need to germinate.

Sânziene – June 24th – This was the meadow closure deadline. Livestock were strictly banned from entering the dedicated hay-meadows, which were often marked with coloured ribbons to signal a temporary ban. Animals were pushed upward onto other pastures, often the higher, steeper slopes or peripheral communal pastures to allow the grass near the hodăia to grow uninterrupted, ready for cutting for winter fodder. The strict prohibition of livestock entry between June 24th and late

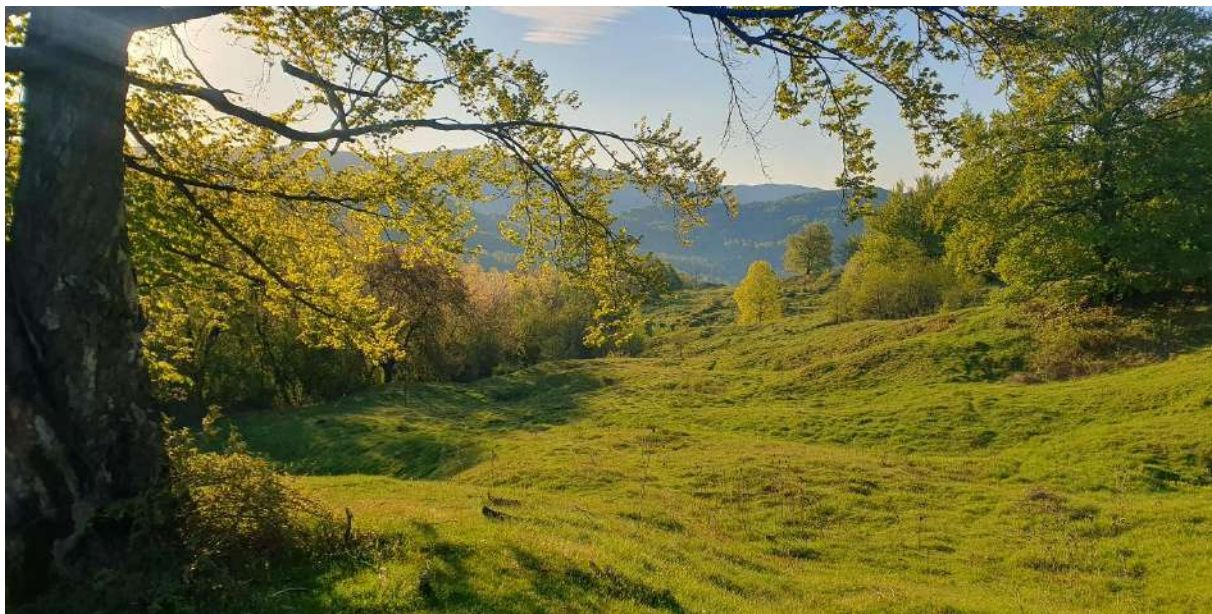
July acts as a vital reproductive window. Because cutting should not begin until after July 20th, slow-maturing, rare species have an uninterrupted, month-long period to complete their life cycles.

Sfântul Ilie – July 20th – The traditional kick-off for the hay harvesting season. Local families stayed in their *hodăia* to scythe, dry, and stack the hay. Working with hay was strictly forbidden on the feast day itself out of fear that lightning or sudden summer winds would destroy the haystacks. The use of hand scythes rather than heavy, motorized machinery was critical to preserve the botanical diversity. Scythes cut the grass relatively high above the ground, completely sparing the base leaves and leaving root systems undisturbed. The traditional practice of leaving the cut grass to dry on the field for several days allows any late-maturing seed pods to dry, split open, and fall directly back into the meadow, giving the best chance for reproduction.

Sântămăria Mare – August 15th – The deadline for completing the first major hay cut and the start of the second growing period. Livestock were selectively allowed back onto the cleared fields to graze the secondary growth allowing some amount of fertilisation to put removed nutrients back into the soil. Reopening the meadows to grazing in the late summer and autumn regulates the nutrient profile of the soil, ensuring it remains naturally balanced. Livestock consume the aggressive secondary growth, preventing fast-growing, nitrogen-loving competitive grasses from choking out rare, delicate specialists.

Sâmedru – October 26th – This milestone closed the pastoral year. Herds that were higher up returned from the pastures down to the foothills. The strict boundaries between pasture and hay meadows dissolved entirely. Livestock were allowed to roam the wider landscape for late-autumn feeding until the first heavy snows forced them into the winter shelters in and around the village.

Although some elements of this traditional management continue and may loosely follow these dates, the strict boundaries and balance between haymaking and grazing have been lost. New land uses, such as sheep grazing are now becoming dominant in some parts.



An area in the southeast of the study area grazed extensively by cattle

Mammals

A total of 18 species of mammal were recorded during the survey period (see table 1 & figure 3) five of which are strictly protected under EU and national law (*Ursus arctos*, *Canis lupus*, *Felis silvestris*, *Bison bonasus* and *Lutra lutra*). The number of observations of these mammals is not completely indicative of their abundance, as each species has a significantly different level of detectability when it comes to their tracks and signs and it is hard to accurately determine the number of individuals in an area from tracks alone. Better estimates could be calculated from more standardised, prolonged camera trapping. Regardless, there is certainly a high population of *Ursus arctos* in the study area and with the additional record of *Canis lupus* (both Annex II & IV strict protection species) this indicates a healthy, functioning ecosystem and ecological corridor between the Făgăraş mountains and the lowlands to the south, for these apex predators to feed and roam. The presence of *Felis silvestris* (Annex IV) is a very good indicator for not only healthy, mature woodland but also connected, rich grasslands for hunting. Likewise, *Lutra lutra* (Annex II & IV) is an indicator for a healthy freshwater system and undisturbed riparian corridors where they can move and disperse. Another key species is *Bison bonasus* (Annex II), an ecosystem engineer that provides structural landscape diversity through its browsing. As selective grazers they reduce scrub encroachment and create a patchwork in the grasslands, some areas are cropped very short leaving areas for nesting birds and reptiles, whilst other areas remain in taller stands, providing cover for small mammals and insects. Their wallowing behaviour also creates shallow depressions in the soil which can become important sunning areas or sometimes form small wetlands or seasonal ponds. This species has expanded from the rewilding zones closer to the Făgăraş mountains and ecologically speaking is a very welcome addition to this landscape.

The habitat mosaic of mature woodland, hay meadows, orchards, riparian corridors and the village itself, offer plentiful opportunities for refuge and food throughout the year. It is particularly the combination of rich hay meadows and mature patches of forest that support the high numbers of *Sus scrofa*, *Ursus arctos*, *Capreolus capreolus*, *Vulpes vulpes* and *Meles meles*, all species that find shelter in forest but utilise healthy grasslands for much of their foraging. Although the presence of enigmatic, protected species usually steals the headlines, it is in fact the balance of species seen here that is one of the most important characteristics of this landscape. There are substantial populations of carnivores, herbivorous grazers and omnivores, some arboreal, some aquatic and some subterranean. This equality and balance are the key to ecosystem functionality and maintaining a high biodiversity. I am certain that more concentrated small mammal and bat surveying would vastly increase the mammal list and likely add some important, protected species to the study area.

Mammals	
Species	Observations
<i>Sus scrofa</i>	88
<i>Ursus arctos</i> *+	70
<i>Capreolus capreolus</i>	52
<i>Vulpes vulpes</i>	34
<i>Meles meles</i>	15
<i>Martes foina</i>	7
<i>Sciurus vulgaris</i>	6
<i>Felis silvestris</i> *+	4
<i>Erinaceus roumanicus</i>	3
<i>Bison bonasus</i> *+	2
<i>Cervus elaphus</i>	2
<i>Martes martes</i>	2
<i>Talpa europaea</i>	1
<i>Lutra lutra</i> *+	1
<i>Apodemus sylvaticus</i>	1
<i>Lepus europaeus</i>	1
<i>Canis lupus</i> *+	1
<i>Rattus norvegicus</i>	1
18	291

Table 1. A table showing the mammal species identified and the number of times observed (* indicates EU protection, + indicates national protection)

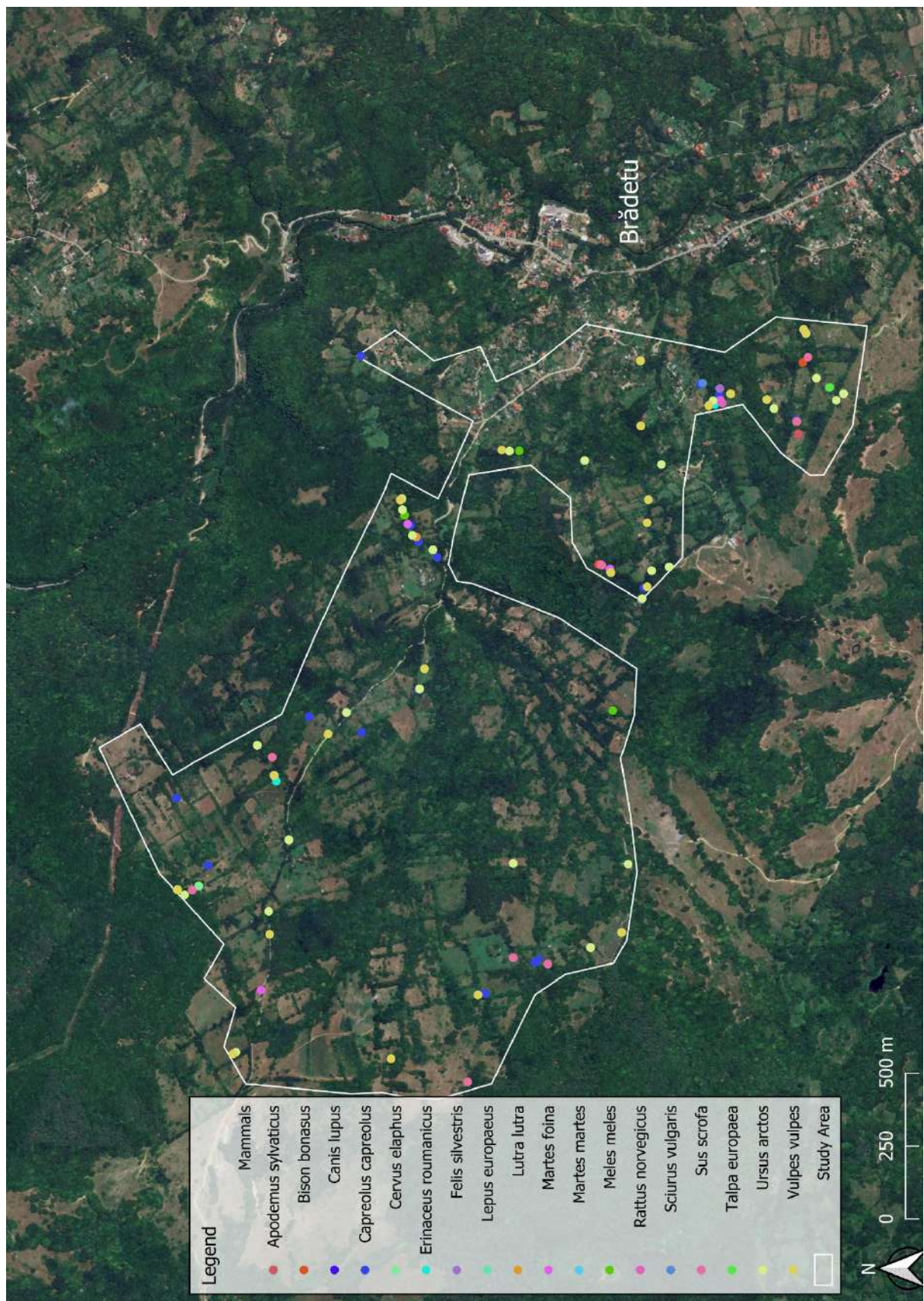


Figure 3. A map showing every mammal observation



Top: *Canis lupus* caught on a camera trap

Middle: *Vulpes vulpes* in the village

Bottom: *Lutra lutra* tracks along the main stream running through the study area



Top: Three *Ursus arctos* cubs following their mother on a camera trap Left: A *Canis lupus* track
 Right top: *Sciurus vulgaris* in a tree Right bottom: Teeth marks from *Bison bonasus*

Birds

The avian diversity was found to be very rich considering the size of the study area and the short window in which surveying took place. A total of 64 species were recorded of which nine are strictly protected under EU law and 19 under Romanian law (see table 2 & figure 4). Many of these species are specialised around this semi-open landscape that is typical of the *hodăia*; rich meadows with abundant old fruit trees and connecting forest fragments. *Ficedula albicollis* (Annex I), *Oriolus orioles* (Annex I), *Picus canus* (Annex I), *Jynx torquilla*, *Dryobates minor*, *Anthus trivialis* all thrive in this semi-open ecotone and make them very good indicators of both grassland and forest quality. The fact that seven species of woodpeckers were recorded, confirms a vast abundance of old cavity trees and standing deadwood. The many orchards are a perfect habitat for many woodpeckers; mature fruit trees hold many natural nest holes, whilst the meadows beneath hold many invertebrates including one of their favourite food resources, ants. *Lanius collurio* (Annex I), *Merops apiaster* (Annex I), *Saxicola rubetra* and *Emberiza citrinella* are all declining species across Europe and in Romania due to agricultural intensification and a consequent loss of field structure and reduced insect populations. The presence of these birds highlights the existence of a subtly more open habitat, particularly around the edges of the study area. Here the *hodăia* mosaic meets the surrounding larger parcels, where more sheep grazing offers favourable habitat to these more open-country birds.

Another habitat that is also somewhat peripheral, yet vital to the wider context of the *hodăia* landscape are the surrounding swathes of mature forest. Birds of prey, in a similar way to large mammalian carnivores, are one of the best indicators for environmental health and quality at landscape level, relying on the forest for nesting and shelter but utilising other habitats nearby for feeding. As apex predators, they have low reproductive rates and are especially susceptible to habitat disturbance, making them strictly protected at national level. The fact that *Pernis apivorus* (Annex I), *Buteo buteo*, *Accipiter gentilis*, *Accipiter nisus*, *Falco peregrinus*, *Strix uralensis* (Annex I), *Strix aluco*, and *Asio otus* all share this 3km² area, emphasises the quality of the various habitats and rich food availability at a broader scale. The additional diversity of woodpeckers and particularly the presence of *Dryocopus martius* (Annex I) is a further testament to the quality of the woodland around the study area. A habitat that is often forgotten is that of the village. Many modernised villages, towns and cities are almost devoid of birds apart from the most adaptive, opportunistic species. However, rural villages that have retained traditional architecture and horticulture can be one of the richest habitats and transition effortlessly into the surrounding landscape, making the extent of the village impossible to demarcate. *Hirundo rustica*, *Motacilla alba*, *Phoenicurus ochruros*, *Passer domesticus*, *Apus apus*, *Serinus serinus* and *Delichon urbicum* all specialise around settlements, with many more species occupying gardens and infrastructure associated with humans.

The decline of old orchards, mature forest and small-scale, traditional agriculture has put many birds on the national red list due to worrying local population trends. The fact that many protected or endangered species have been recorded and in reasonable abundance, is a good sign that these habitats are still present and functioning within the study area. The absence of *Otus scops* was surprising given the profusion of old orchards and seemingly good habitat, but it is also possible that it just was not detected during the short survey periods. Equally strange but less worrying was the absence of *Pica pica*, *Streptopelia decaocto* and *Falco tinnunculus*.

Birds	
Species	Observations
Turdus merula	87
Parus major	66
Sylvia atricapilla	63
Fringilla coelebs	62
Phylloscopus collybita	56
Dendrocopos major +	34
Cyanistes caeruleus	31
Sitta europaea	26
Erithacus rubecula	24
Passer domesticus	22
Poecile palustris	21
Aegithalos caudatus	21
Ficedula albicollis *+	20
Garrulus glandarius	20
Cuculus canorus	15
Turdus philomelos	15
Hirundo rustica	13
Phoenicurus phoenicurus	13
Buteo buteo +	12
Corvus corax	12
Emberiza citrinella	10
Certhia familiaris	9
Lanius collurio *+	9
Sturnus vulgaris	8
Motacilla alba	7
Phylloscopus sibilatrix	7
Picus viridis +	6
Coccothraustes coccothraustes	6
Picus canus *+	6
Carduelis carduelis	6
Merops apiaster *+	6
Columba palumbus	5
Turdus viscivorus	5
Oriolus oriolus *+	5
Jynx torquilla +	4
Pyrrhula pyrrhula	4
Muscicapa striata	4
Leiopicus medius *+	4
Phoenicurus ochruros	4
Phylloscopus trochilus	4
Troglodytes troglodytes	3
Apus apus	3
Oenanthe oenanthe	3
Falco peregrinus +	2
Nucifraga caryocatactes	2
Serinus serinus	2
Chloris chloris	2
Sylvia borin	2
Corvus corone cornix	2
Dryocopus martius *+	2
Luscinia megarhynchos	2
Delichon urbicum	1
Strix uralensis *+	1
Phasianus colchicus	1
Saxicola rubetra	1
Dryobates minor +	1
Accipiter gentilis +	1
Anthus trivialis	1
Asio otus +	1
Pernis apivorus *+	1
Strix aluco +	1
Prunella modularis	1
Motacilla cinerea	1
Accipiter nisus +	1
64	790

Table 2. Table showing the bird species identified and the number of times observed (* indicates EU protection, + indicates national protection)



Top: *Sitta europaea* close to its nest hole

Bottom: *Certhia familiaris* finding a caterpillar

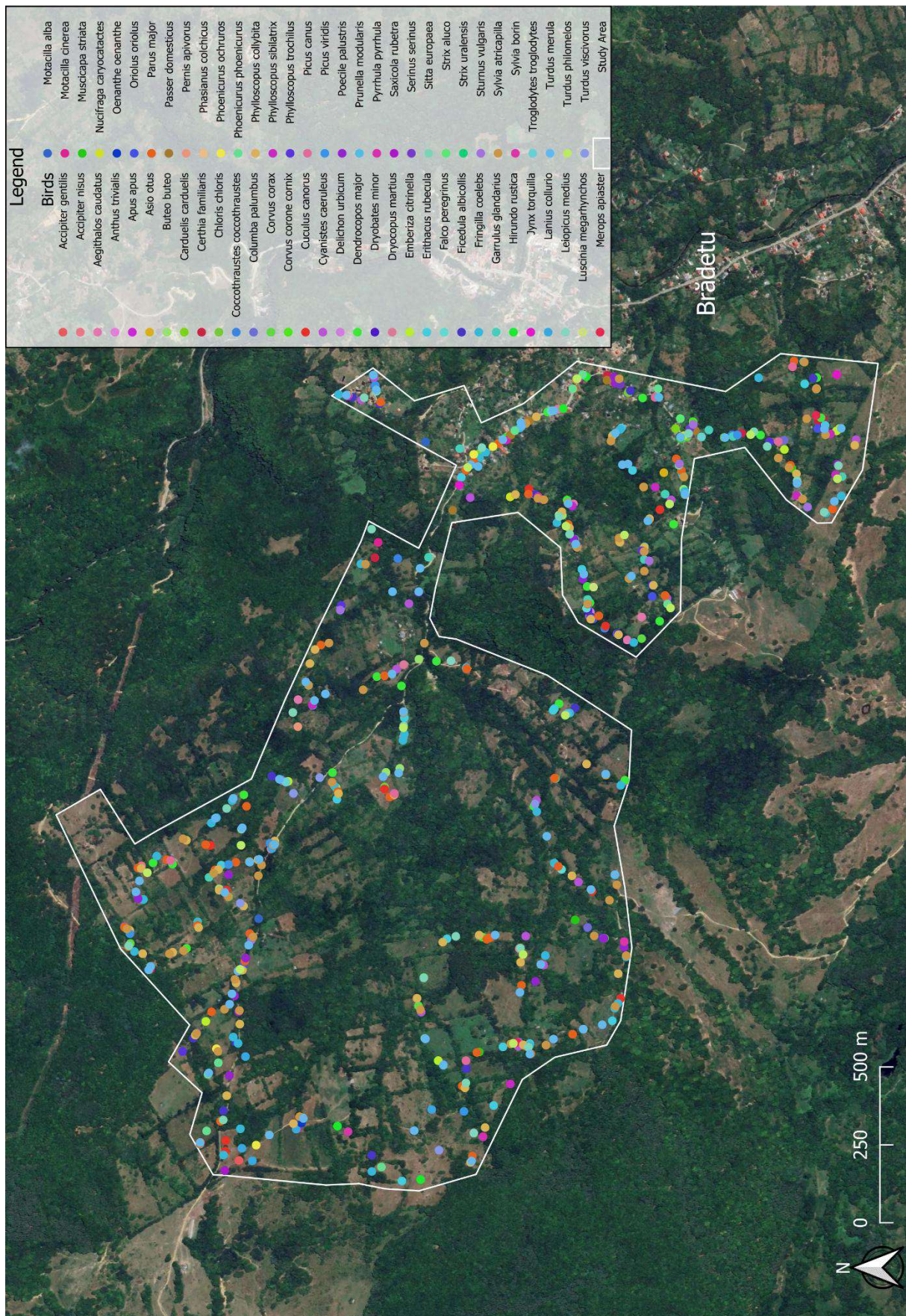


Figure 4. A map showing every bird observation



Top left: *Pernis apivorus* circling above the forest Top right: Female *Ficedula albicollis*
 Bottom left: *Buteo buteo* hunting in a meadow Bottom right: Male *Dendrocopos major* leaving its nest



Top left: *Picus canus* camouflaged in an old orchard
Bottom left: Male *Phoenicurus phoenicurus*

Top right: Pair of *Lanius collurio*
Bottom right: Female *Saxicola rubetra*

Herpetofauna

Eight species of reptile and amphibian were recorded, four of which are strictly protected under EU law but with the remaining species also receiving some degree of protection under the EU Bern Convention and Romanian national law (see table 3 & figure 5). The presence of *Bombina variegata* (Annex II & IV), *Triturus cristatus* (Annex II & IV) and *Rana dalmatina* (Annex IV) gives a very solid basis for the protection of these species' habitats and the wider hydrology. Deterioration or destruction of breeding sites or resting places is strictly illegal even if the damage is accidental or a result of negligence. In the context of this landscape, this means all the ponds, temporary pools and wetland should be protected from eutrophication, draining, pollution and trampling by domestic animals. Protection of *Bombina variegata* is a little unusual and can seem somehow contrary to these laws regarding 'disturbance' as they require a certain level of disturbance from large vehicles to create the temporary pools they need. As a pioneer species they rely on shallow puddles and waterfilled vehicle tracks in sun exposed areas. Of course, the criss-crossing of dirt tracks through this landscape, where tractors and 4x4's constantly establish new puddles, is the perfect means to maintain the presence of these temporary waterbodies and therefore this protected species.

Many of the hodăia include a spring, well or pond that was created for water access during the months livestock and villagers were present. Not only do these directly create habitat for many amphibians, but they also cause water runoff through the surrounding meadows, leading to further habitat in the form of wet meadows and small streams. Unfortunately, the disuse of these wells and ponds risks them drying out or succumbing into vegetation. Ideally, they require some use and gentle maintenance to ensure they remain ecologically functional. The other risk is the pollution and trampling caused by an overabundance of livestock and for this reason these water sources need to be somehow protected to minimise disturbance. The presence of *Lacerta agilis* (Annex IV) is an excellent indicator for a healthy vegetation mosaic, from bare open areas to dense, tall grass and an abundance of insects for feeding. Their survival depends on very specific microhabitat conditions with low human disturbance. The hodăia huts themselves were also found to be a wonderful habitat for the reptiles recorded. They were seen basking on the exposed verandas or foundation stones but were able to quickly dive under the building or through crevices in the wood to find cover. Although a shame to see so many of the hodăia in a state of collapse, the piles of material are amazing, semi-natural hibernacula or breeding sites. Once again, the mosaic of habitats and microhabitats in close proximity to each other are what has given rise the rich assemblage of herpetofauna in the study area. Historically, human activity has added diversity to this landscape with the addition of water bodies, refugia and small levels of 'disturbance'. More reptile and amphibian species could certainly be added to the list with more focused surveying and acoustic recording.

Herpetofauna	
Species	Observations
<i>Bombina variegata</i> *+	16
<i>Triturus cristatus</i> *+	6
<i>Zootoca vivipara</i> +	3
<i>Anguis colchica</i> +	2
<i>Natrix natrix</i> +	2
<i>Pelophylax ridibundus</i> +	2
<i>Rana dalmatina</i> *+	1
<i>Lacerta agilis</i> *+	1
8	33

Table 3. A table showing the species of herpetofauna identified and number of times observed (* indicates EU protection, + indicates national protection)



Figure 5. A map showing every herpetofauna observation



Top left: *Triturus cristatus* in a small pond

Top right: *Zootoca vivipara*

Bottom: *Lacerta agilis* basking in the remains of a collapsed hodăia



Top: A young *Natrix natrix* gives a lift to *Aglais io*
Bottom left: *Pelophylax ridibundus* in a small pool

Bottom right: *Bombina variegata*

Plants

Nine species of orchid were recorded in the study area, all of which are protected at EU and national level (see table 4 and figure 6). An additional four species of plants are on the Romanian red list due to declining or threatened populations and therefore have some form of national protection (see table 5). There were also a whole host of high nature value grassland indicators that dominated the hay meadows; *Rhinanthus minor*, *Rhinanthus alectorolophus*, *Leucanthemum vulgare*, *Knautia arvensis*, *Lotus corniculatus*, *Campanula glomerata*, *Filipendula vulgaris*, *Gentiana cruciate*, *Briza media* and *Dianthus carthusianorum*. The abundance of *Rhinanthus minor* and *alectorolophus* is especially important as they are hemi-parasitic, taking nutrients away from aggressive, dominant grass species, making space for other wildflowers. In combination with the orchids *Neotinea ustulata*, *Anacamptis coriophora* and *Gymnadenia conopsea*, it becomes clear that the study area holds some near pristine, dry calcareous grassland with minimal historical disturbance or improvement. The traditional hay cutting and seasonal grazing is the perfect management of these grasslands to maintain the diversity. The absence of these indicator species was visible in some of the sheep grazed and abandoned parcels within the study area. A shift away from the rotational hay cutting and cattle grazing to more constant sheep grazing poses a risk to the current, rich floral diversity of the grasslands. If areas that were previously cut for hay are now grazed by sheep, then many species sensitive to grazing pressure will disappear. On the other hand, grasslands that are falling into disuse are gradually being shaded out by more aggressive herbaceous plants and shrubs.

There are also a number of high-quality wetland and damp meadow indicator species; *Lychnis flos-cuculi*, *Filipendula ulmaria*, *Cirsium oleraceum*, *Petasites hybridus* and *Myosotis scorpioides*. Which in addition to the presence of the orchid, *Dactylorhiza incarnata*, shows hydrological stability, unpolluted water and damp, lime-rich soils. A plant community that has certainly been assisted by the creation of wells and pools in the otherwise dry grassland. To complete the picture, *Lilium martagon* and *Allium ursinum* are indicator species for forest quality, suggesting undisturbed, nutrient rich, mature forest. Altogether, the floral diversity is outstanding, particularly with the richness of orchid species and abundance of indicator species for the various habitats that comprise the hodăia landscape. One specific 20-hectare area was identified in the south-eastern part of the study area, that held six of the nine orchid species and was particularly diverse floristically. A complete botanical survey across spring and summer, especially for the hay meadows, would be very useful to fully document the diversity of the flora and identify more important plant species.

Orchids	
Species	Observations
Anacamptis coriophora +*	21
Neottia ovata +*	9
Neotinea ustulata +*	5
Dactylorhiza fuchsii +*	3
Dactylorhiza maculata +*	3
Dactylorhiza incarnata +*	2
Neottia nidus-avis +*	1
Gymnadenia conopsea +*	1
Platanthera bifolia +*	1
9	46

Table 4. A table showing the orchid species identified and the number of times observed (* indicates EU protection, + indicates national protection)

Vascular Plants	
Species	
Lilium martagon +	Knautia arvensis
Betonica officinalis	Luzula campestris
Campanula glomerata	Vicia tenuifolia
Gentiana cruciata	Aethusa cynapium
Valeriana officinalis	Silene dichotoma
Equisetum telmateia	Gymnadenia conopsea
Salvia verticillata	Veronica chamaedrys
Allium ursinum	Trollius europaeus +
Ornithogalum pyrenaicum	Tragopogon pratensis
Vicia cracca	Rorippa amphibia
Rhinanthus minor	Helleborus viridis +
Polygala alpestris	Hieracium spp.
Astrantia major	Stachys sylvatica
Colchicum autumnale	Plantago media
Lotus corniculatus	Trifolium pannonicum
Ajuga reptans	Veronica teucrium
Pimpinella saxifraga	Thymus pulegioides
Vicia sepium	Lotus pedunculatus
Petasites hybridus	Stellaria graminea
Cirsium oleraceum	Ranunculus acris
Carum carvi	Trifolium montanum
Dianthus carthusianorum	Silene nutans
Hypochaeris radicata	Leucanthemum vulgare
Cichorium intybus	Campanula persicifolia
Symphytum officinale	Asperula cynanchica
Erigeron philadelphicus	Briza media
Scrophularia nodosa	Silene flos-cuculi
Polygala vulgaris	Trifolium pratense
Rumex acetosa	Lamium maculatum
Vicia sativa	Campanula patula
Rorippa sylvestris	Pulmonaria visianii
Cruciata laevipes	Impatiens noli-tangere
Narcissus pseudonarcissus	Polygala comosa
Succisa pratensis	Myosotis scorpioides
Filipendula vulgaris	Galium album
Geranium phaeum	Genista sagittalis
Genista tinctoria	Geum urbanum
Chaerophyllum aromaticum	Melampyrum nemorosum
Gladiolus italicus +	Rhinanthus alectorolophus
Viola arvensis	Pilosella aurantiaca subsp. carpathicola
	40

Table 5. A table showing the vascular plant species identified (+ indicates national protection)

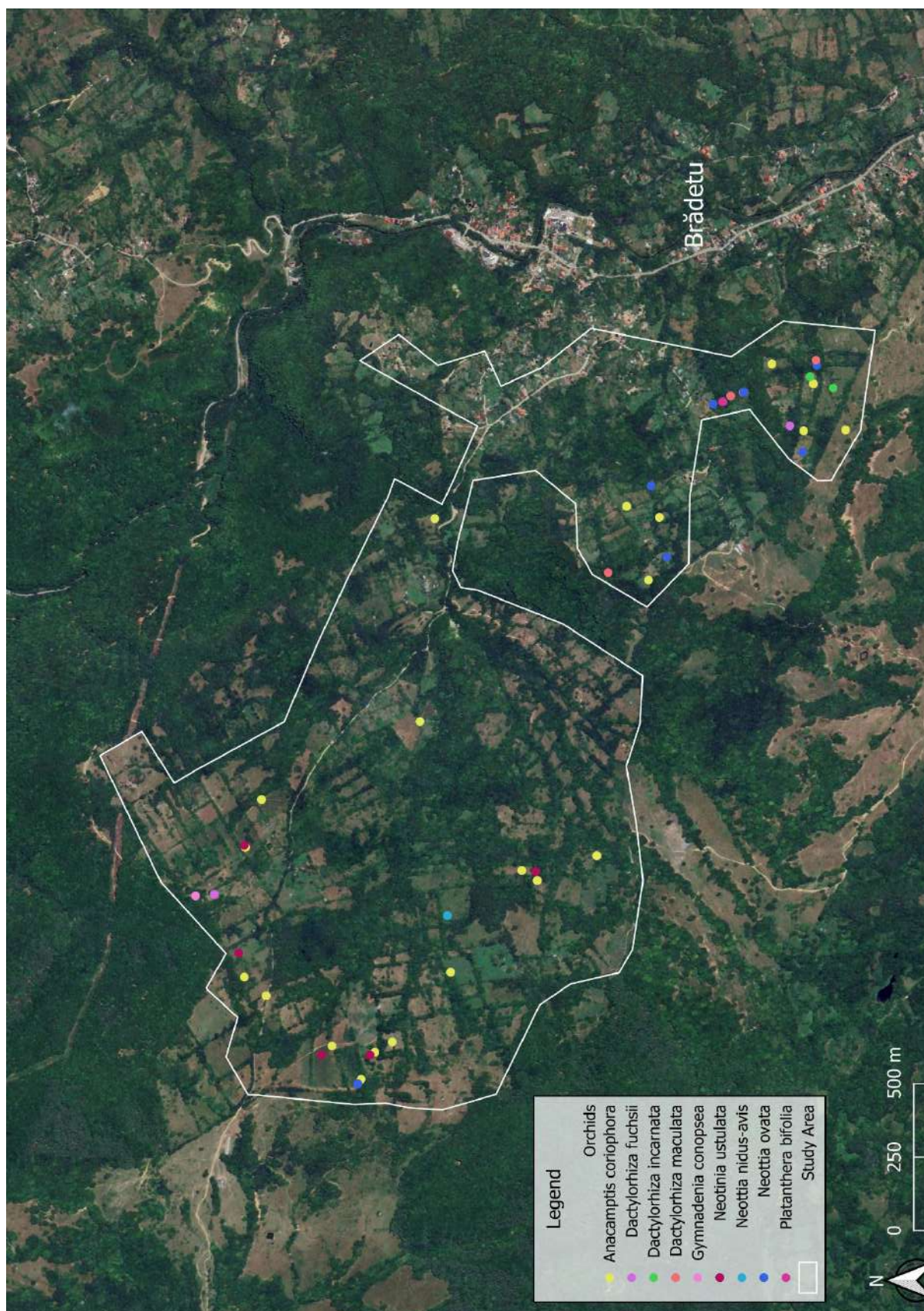


Figure 6. A map showing every orchid per parcel observation



Top left: *Lilium martagon*
Bottom left: *Gentiana cruciata*

Top right: *Rhinanthus alectorolophus* and *Plantago media*
Bottom right: *Trollius europaeus*



Top left: *Dactylorhiza maculata*

Middle left: *Platanthera bifolia*

Bottom left: *Dactylorhiza fuchsia*

Top centre: *Dactylorhiza incarnata*

Middle centre: *Neotinea ustulata*

Bottom centre: *Neottia nidus-avis*

Top right: *Anacamptis coriophora*

Middle right: *Gymnadenia conopsea*

Bottom right: *Neottia ovata*

Butterflies

A total of 36 species were identified in the study area, with three being protected at EU or national level (see table 6 & figure 7). *Lycaena dispar* is protected under Annex II and IV of the EU Habitats Directive, a wetland specialist tied to *Rumex* species, that has suffered severe declines across western Europe. The damp, unpolluted, wetland edges resulting from the ponds and springs setup around the hodăia have produced a suitable habitat for this declining butterfly. The nationally protected *Phengaris alcon* is an extraordinary biological indicator, globally threatened due to its hyper-specialised, parasitic life cycle. It requires *Gentiana cruciata* plants to lay its eggs, with the caterpillars after a few weeks of feeding, dropping to the ground and mimicking the scent and sound of *Myrmica* ant larvae. The ants adopt the caterpillar, carry it into their underground nest, actively feeding and protecting it for over a year before it forms a chrysalis and later emerges as an adult butterfly. When it hatches suddenly the ants attack, but the butterfly has even evolved a layer of loose, powdery scales that shed when the ant bites. A remarkable symbiotic evolution that requires the butterfly, the specific plant and specific ant colony to exist in the same localised area and the same time. If any of these elements decline, then the butterfly population can completely collapse. The presence of *Phengaris alcon* is a sign that the ecosystem is still fully functional and holding highly specialised microhabitats. Current land-uses should be maintained to ensure the fragile life cycle of this butterfly can take place. Grazing or cutting must take place to keep the soil warm for the *Myrmica* ants, but not too early to allow the *Gentiana* plants to grow. If pastures are abandoned, then scrub will choke out the *Gentiana* plants and *Myrmica* ants.

Other species are further indication of high nature value, structurally diverse grassland mosaics; *Papilio machon* and *Iphiclides podalirius* require large nectar sources from meadows but need umbellifers or fruit trees for reproduction, whilst the trio of *Coenonympha* butterflies confirms a highly complex meadow structure, ranging from short, sun-exposed patches to tall, un-mown or ungrazed swards. The mature woodland and its ecotone have yet another community of butterflies; *Nymphalis antiopa* live along damp riverine forests where they feed on willow and birch, *Parage aegeria* patrols sun dappled forests, and *Hamaeris lucina* is a very sensitive specialist of shady, scrubby woodland margins. The main track running through the study area proved to be one of the best areas to find some of these shade loving species, it also offered puddles and numerous faeces from cows and horses, all of which attracted butterflies. The diversity of butterflies is testament to both the range of habitats included in the hodăia mosaic and the huge floral richness of the meadows. The highly specialised life cycles and microhabitat features required by some butterflies, highlights both the diversity in the study area, but also underlines the complexity in correctly managing such an area with its range of contiguous habitats. Unfortunately, *Leptidea sinapsis* was unable to be documented on Ornitodata due to a technical issue, however this species was observed in high numbers along treed meadow edges and orchards. More concentrated surveying, with capturing of individuals, across a wider time frame would yield more species of butterflies within the study area.

Butterflies		
Species	🇪🇺	Observations
Coenonympha glycerion		82
Pieris brassicae		51
Vanessa cardui		38
Polyommatus icarus		33
Melitaea athalia		21
Pieris rapae		21
Issoria lathonia		18
Iphiclides podalirius		17
Hamearis lucina		14
Cyaniris semiargus		11
Coenonympha pamphilus		10
Coenonympha arcania		9
Cupido minimus		9
Pontia edusa		9
Anthocharis cardamines		8
Araschnia levana		8
Aglais io		7
Pararge aegeria		4
Polygonia c-album		3
Boloria selene		3
Speyeria aglaja		3
Thymelicus lineola		3
Cupido alcetas +		3
Papilo machaon		2
Erynnis tages		2
Vanessa atalanta		2
Phengaris alcon +		2
Pyrgus malvae		1
Maniola jurtina		1
Ochlodes sylvanus		1
Colias croceus		1
Nymphalis antiopa		1
Boloria dia		1
Lycaena dispar *+		1
Lysandra bellargus		1
Leptidea sinapsis		~
	36	401

Table 6. A table showing the species of butterfly identified and number of times observed (* indicates EU protection, + indicates national protection)



Top: *Melitaea athalia*

Bottom: *Pyrgus malvae*

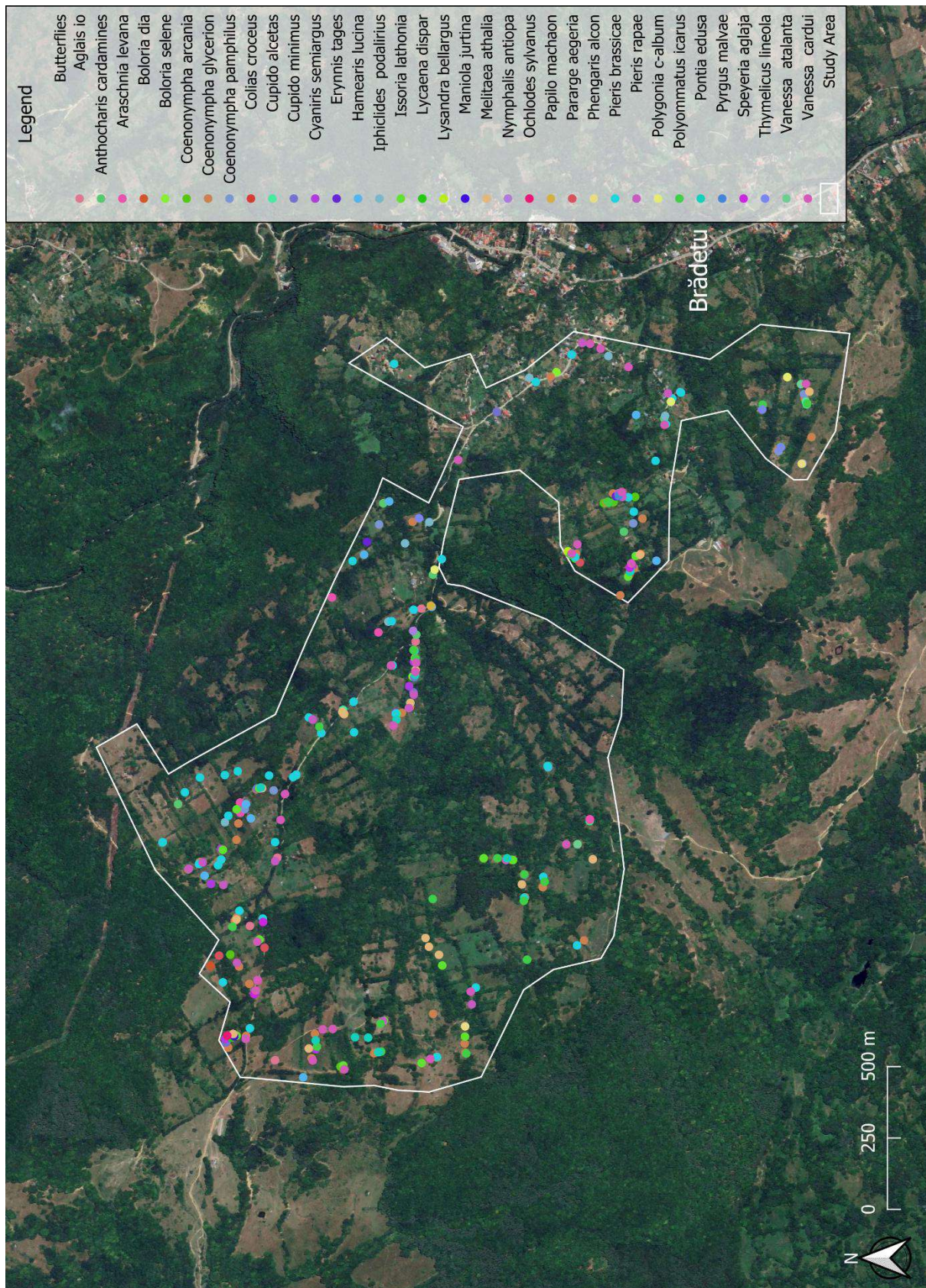


Figure 7. A map showing every butterfly observation



Top: Lycaena dispar

Bottom left: Phengaris alcon

Bottom right: Vanessa cardui



Top left: *Coenonympha pamphilus*

Middle left: *Hamearis Lucina*

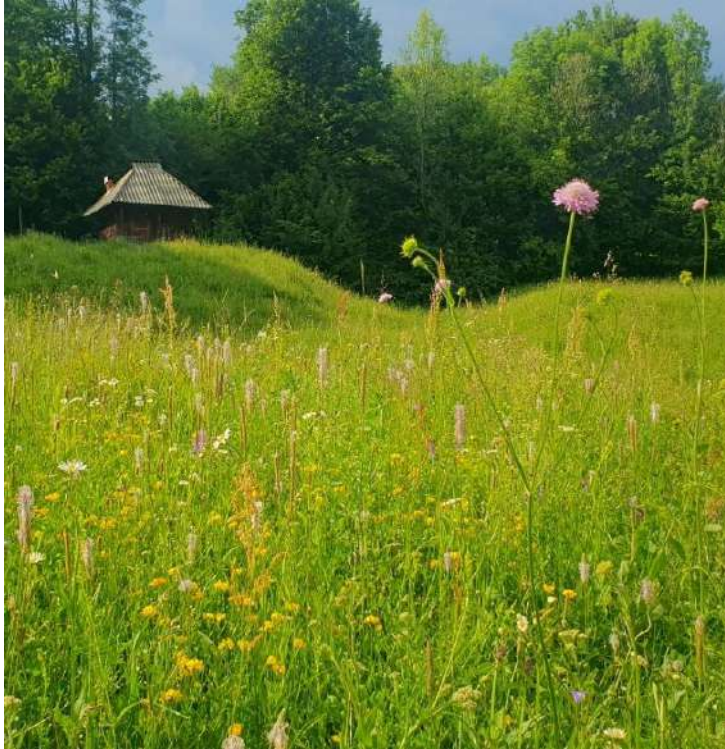
Bottom: *Pontia edusa* taking flight

Top right: *Iphiclides podalirius*

Middle right: *Leptidea sinapsis* mating, plus one

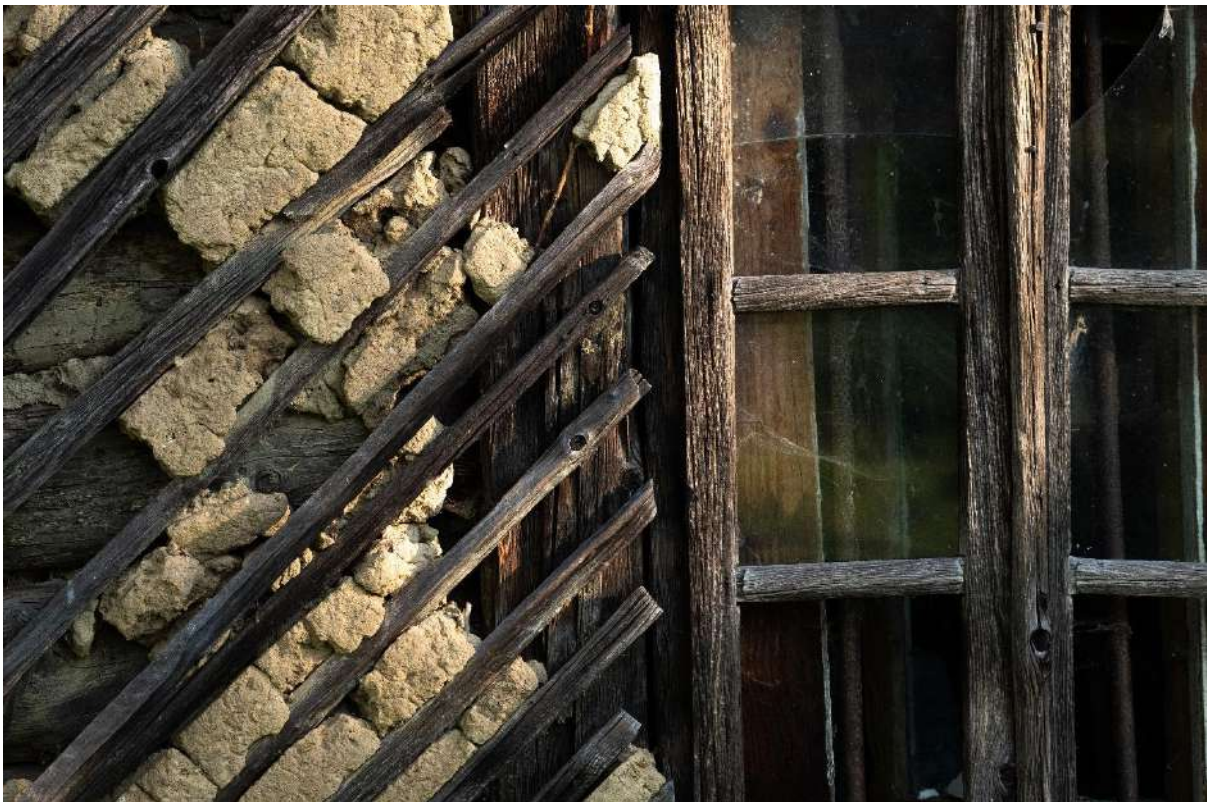
Other Observations

Over the course of the surveying, other observations were made that help complete the understanding of the ecology and functioning of the hodăia landscape. Many species from other taxonomic groups were seen that were not identified, remarkable trees were found and patterns started to emerge. Thoughts and theories were formed from these observations, many of which were photographed to help tell the story.



Left: Considering each hodăia had the same historical purpose, each one has its own identity. The hodăia themselves, the meadows, the orchards, the water sources and the general layout of each parcel have its own characteristics and charm, despite following the same blueprint.

Below: The hodăia are built out of completely natural materials, most of which were collected from the surrounding landscape. Not only does this mean they 'fit' seamlessly into the environment, but that if they collapse, there is no waste, they will slowly fade back into the landscape they came from.





Left: The hodăia are fully incorporated into the landscape, with nature allowed to take back space and use elements of the structure. There is kind of symbiosis between these human-made buildings and their surroundings. It adds to the idea that the hodăia mosaic is, in itself, an ecotone between the village and the 'wilderness', a transition from human impacted environments to undisturbed ones. In this transition zone, both are allowed to coexist.

Below: One of many hodăia in a state of collapse. Although a sign of abandonment, dying tradition and cultural loss, ecologically speaking these buildings still offer an excellent habitat in all forms of decomposition.





Above: A violet carpenter bee (*Xylocopa violacea*) resting on a hodăia, where it presumably has its nest drilled into one of the large beams. Another benefit from the natural building materials is they provide a shelter not just for humans, but also a habitat for many animals, especially now that many have been abandoned. Many species of mammal, invertebrate, reptile and bird were seen using the hodăia in some way.



Above: Two examples of bird nests found in hodăia, a swallow (*Hirundo rustica*) and a probable blackbird (*Turdus merula*). Well hidden and protected from rain, wind, sun and predators.



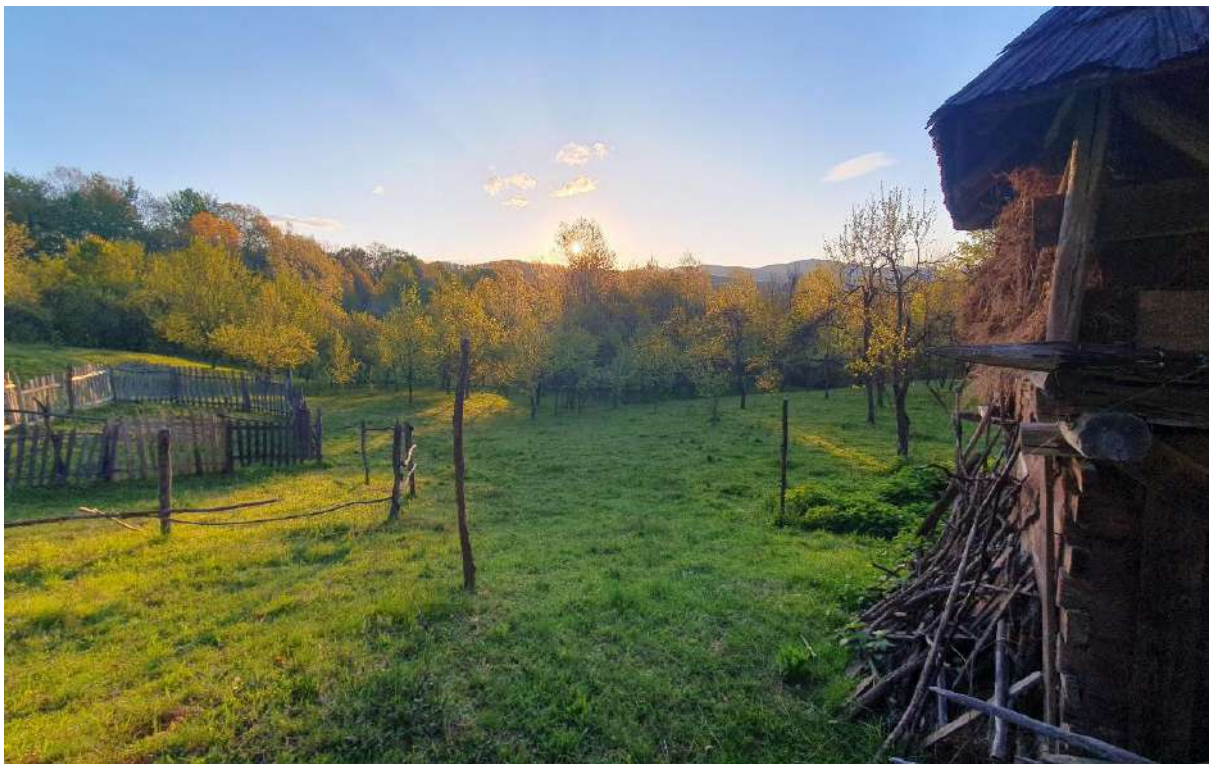
Top left: Many hodăia had signs of digging and burrowing under the foundations of the building. Super places for *Vulpes vulpes*, *Meles meles*, *Martes foina* and smaller mammals to make a den for sleeping or raising young.

Top right and below: The remains of a chicken found on the edge of a large, flattened area of grass next to a hodăia. Evidence left behind by a family of foxes (*Vulpes vulpes*) that had clearly made there den somewhere nearby.





Above: Large, isolated trees and hodăia offer structural diversity to the meadows, increasing the biodiversity hugely. They also provide shade to the meadow, allowing for different plant species to thrive.



Above: Alongside the hodăia there were often other structures, for example fences to protect haystacks or to keep livestock at night. Another sign of gentle coexistence with wild mammals, but additionally creating diversity in the meadow by altering grazing intensity and introducing structure.



Top left and right: Traditional style fences and gates used to demarcate boundaries are often seen broken, a sign of wild and domestic animals passing through the hodăia. Many of these holes seemed to have been accepted as passageways, allowing a certain permeability for wildlife across the wider landscape. This permeability is crucial to a functioning ecological corridor, especially where *Ursus arctos* and *Canis lupus* are present.

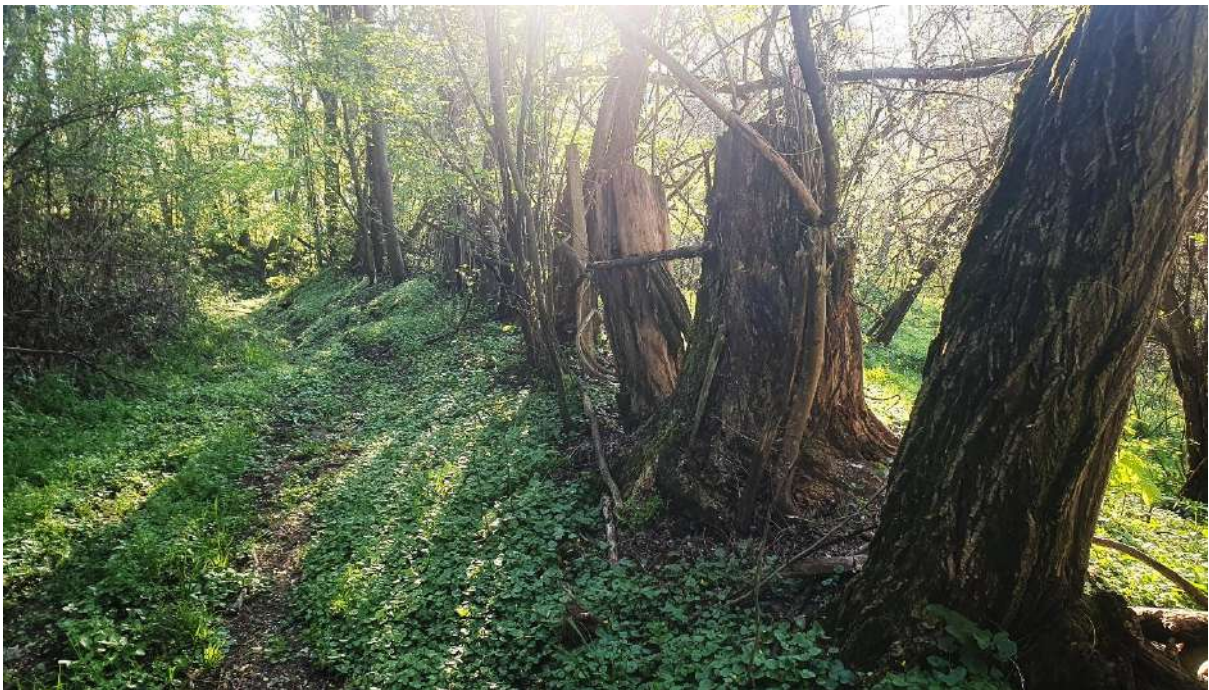


Left: Barbed wire with fur from *Ursus arctos* caught in it. Around some of the hodăia that are still used, especially those that have been 'modernised', there is the increasing use of barbed wire, electric fencing or high mesh wire to demarcate boundaries. If these become widely used, particularly by shepherds or around some of the larger parcels it will significantly affect the functionality of the corridor.



Left: Across the study area is a network of tracks, many of which are sunken and clearly historical, traditional routes used for generations. These tracks are important for many species, including the strictly protected *Bombina variegata* and the large carnivores that use these ways to easily move through the landscape.

Below: *Ursus arctos* and other mammal tracks were abundant on these ways.



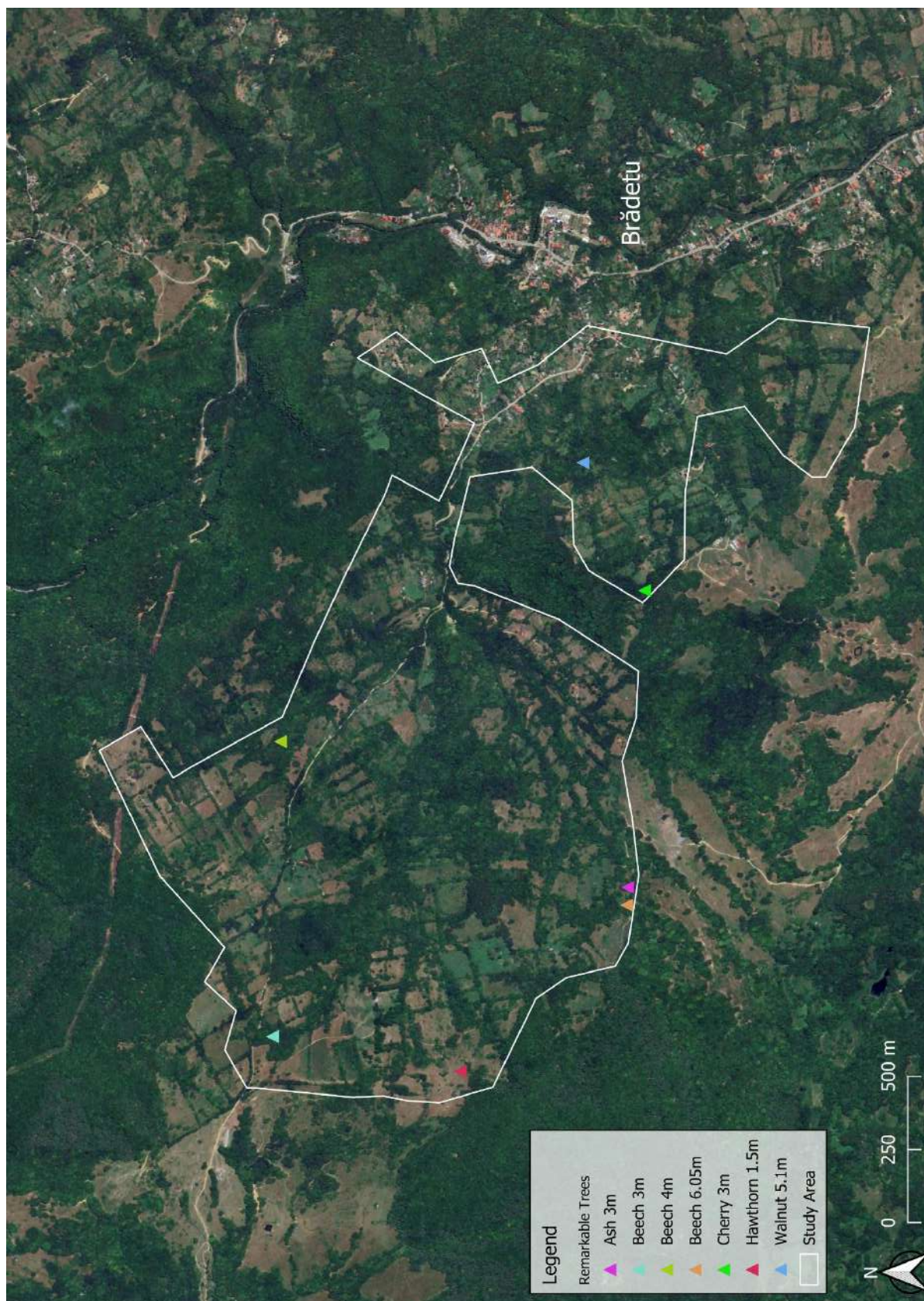
Above: Another indication these ways are very old, are the trees planted alongside them as markers. Often willows are planted and pollarded to line these tracks and create natural boundaries, whilst also being used for their wood.



Above: Where hodăia parcels meet the forest there are also very old, large trees demarcating the edge. Some of these important boundaries have clearly been unchanged for centuries.



Above: A 6.05m beech tree next to a historical way. Some of these trees are often left and allowed to become very old, as they mark important geographical, cultural or even spiritual locations.



Above: Map showing some of the remarkable trees within the study area, there were many more large trees in the forest that were not mapped. Many of the remarkable trees lie on the edge of the study area, perhaps indicating the same geographical and environmental boundaries that were followed and used for the surveying process.



Top left: An old hawthorn.



Top right: A large cherry tree seemingly marking the corner of one section of hodăia.



Above: A large beech tree in one of the fragments of forest following the waterway.



Above: In the patches of forest or hedgerows separating areas of *hodăia* hazel is often planted and coppiced. The wooden poles are used to make the *căprițe*, fences or gates.



Left: Wells, ponds or springs were created, willows planted and fences usually built around it to protect these water sources from domestic and wild animals. This willow was then pollarded and used for weaving, fencing or in this case for small functional details and repairs. Almost everything in the landscape is intentional and used for something. The result is not just beneficial for people, but also for the biodiversity. Introducing all these features into the landscape adds many more microhabitats.



Top left: The middle of a hollow, dead tree, where clearly a small mammal has been feeding on plum stones.

Top right: Dead wood is hugely important to the life cycle of many invertebrates, especially to saproxylic beetles. Various mammals and woodpeckers then rip apart this dead wood in search of insects and their larvae. Here it looks like a brown bear (*Ursus arctos*) has torn apart this standing dead tree trunk.

Left: A dead fruit tree stands as a hollowed-out structure. An incredibly important feature for cavity nesting birds.

Dead trees in many ways are just as valuable as when they are alive. There were a good number of dead trees in the study area that provided food and shelter for a wide array of species.



Left: Three such saproxylic beetles were identified in the study area, including two protected under EU law, *Rosalia alpina* (Annex II & IV), *Lucanus cervus* (Annex II), plus the non-protected *Oryctes nasicornis*. The presence of these protected species in a forest fragment identifies it as a critical habitat and severely restricts forestry actions.

Bottom left: Orchards are not just important for cavity nesting birds but also for birds such as *Turdus philomelos*.

Bottom right: Nest of *Turdus merula* in an old orchard.

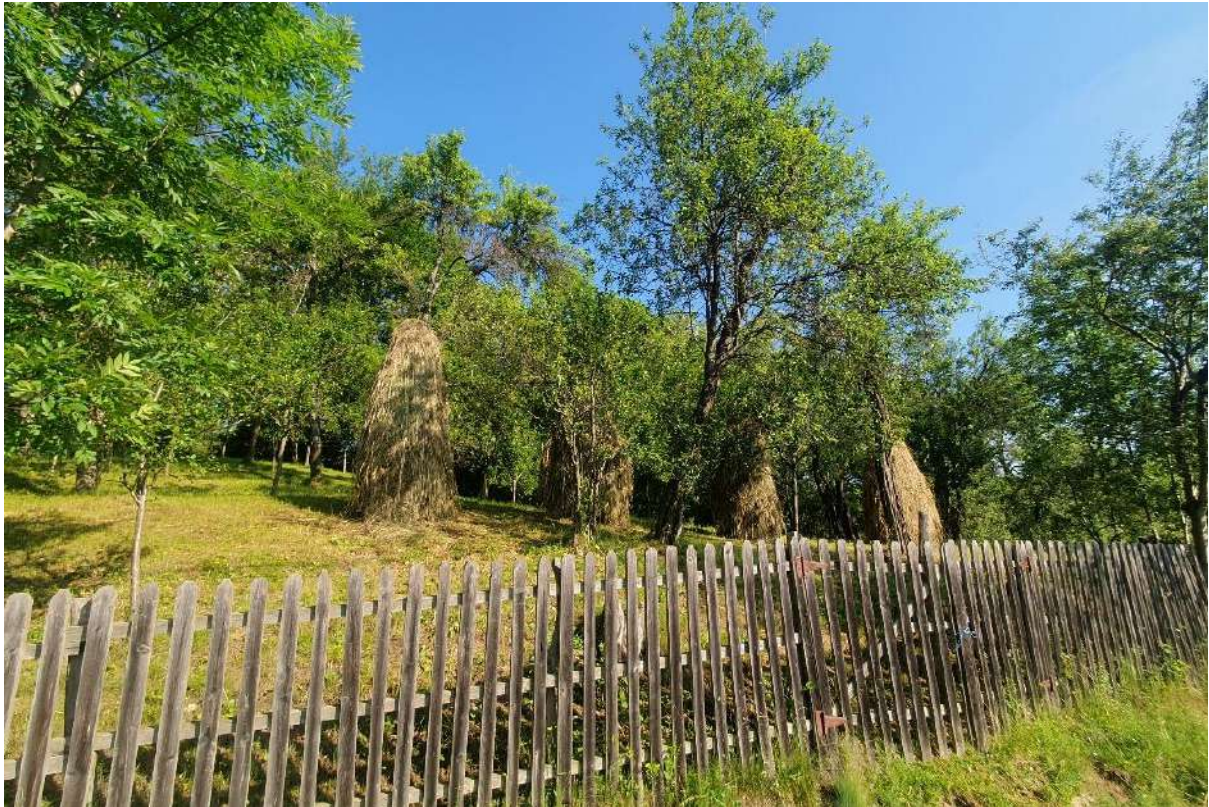




Above: The combination of orchard and hay meadow is ideal for many species of bird. When hay is cut it opens the grassland for ground-feeding birds such as *Turdus merula*, *Picus viridis* and *Picus canus*. It also suddenly exposes small mammals and reptiles for birds of prey to feed on. The disturbance also throws up many insects for flycatchers, redstarts and warblers to catch.



Above: Whilst planting of fruit trees is generally beneficial to these meadows, ideally, they should be tall-stem rather than more modern half-stem trees to not shade out certain plant species, allow easy hay cutting beneath and make bigger trees with more nesting potential for birds.



Above: In the centre of the village, old mature orchards thrive and hay cutting continues. The ease of access means a much lower rate of abandonment.



Above: Dwellings and farmsteads on the edge of the village have essentially the same features as the *hodăia*, just on a slightly larger scale and usually more active. They are perhaps the areas with highest bird diversity, holding many of key species that typify this landscape; *Phoenicurus phoenicurus*, *Jynx torquilla*, *Ficedula albicollis*, *Picus canus*, *Leiopicus medius*, *Dryobates minor* and *Serinus serinus*. Tall, mature fruit trees, livestock, hay meadows, structures and water sources all come together to create little hotspots.



Above: Activity and use of the hodăia varies hugely across the landscape, from semi-permanent inhabitancy to complete abandonment and dis-use. Very few were inhabited for the summer months, and the only ones that were, were for the shepherds moving with the sheep. If the parcels were managed on a small-scale it usually meant higher levels of plant, butterfly and bird diversity than those lacking any management. None were visibly functioning in the traditional way, with a balance between small-scale grazing and hay cutting, and people living in the hodăia.



Above: A well-managed parcel with orchard, rotational hay cutting and a maintained hodăia. Hay cutting in small sections like this is ecologically very good practice. It ensures the presence of flowers for pollinators, allows time for plants to go to seed in certain patches and ensures cover for herpetofauna and mammals at all times. Another key feature of the landscape is the extreme fragmentation of land ownership. One family may own 5 hectares, but that land may be split between 5 isolated plots, scattered across different areas with different environmental features. This division acts as an ecological insurance policy: if the grass on an open slope is destroyed from drought, then a field in a more sheltered shady area may be okay. It also creates rotation on a larger scale and more of an ebb and flow to activity on individual parcels, letting them rest between cuts or grazing.



Above: One of the best indicators for high-quality grassland was the presence of căprițe. If they were present, then it generally implied that the grass was cut for hay and therefore maintained and managed. Where căprițe were absent, it often coincided with the parcel being improved, with more herbaceous vegetation and sometimes shrub encroachment.



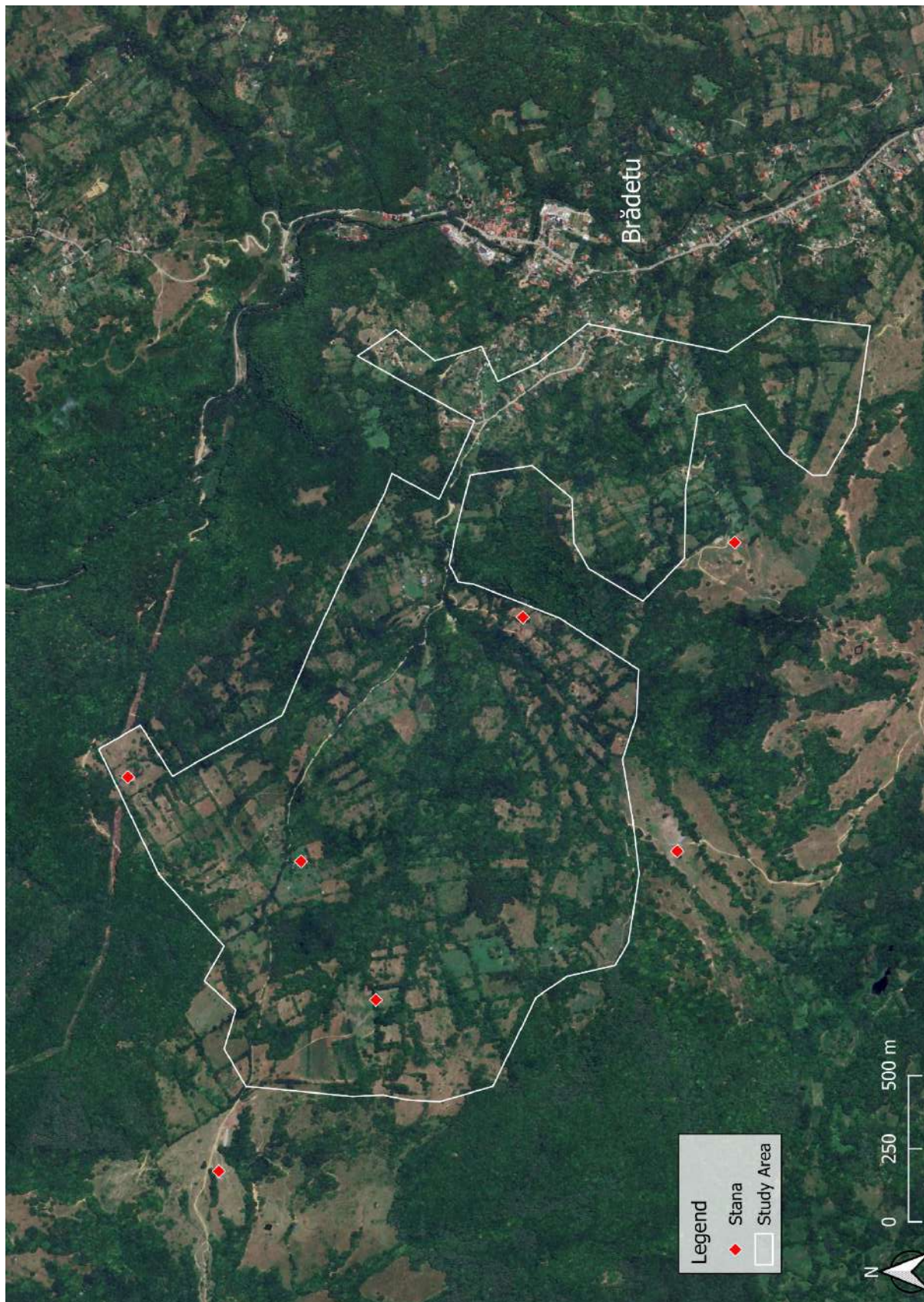
Above: *Anacamptis coriophora* was the most abundant orchid across the study area, identified in 21 separate parcels. The abundance of these in the meadows was a good gauge for the quality of the grassland. *Neotinea ustulata* was also a good indicator but was less abundant.



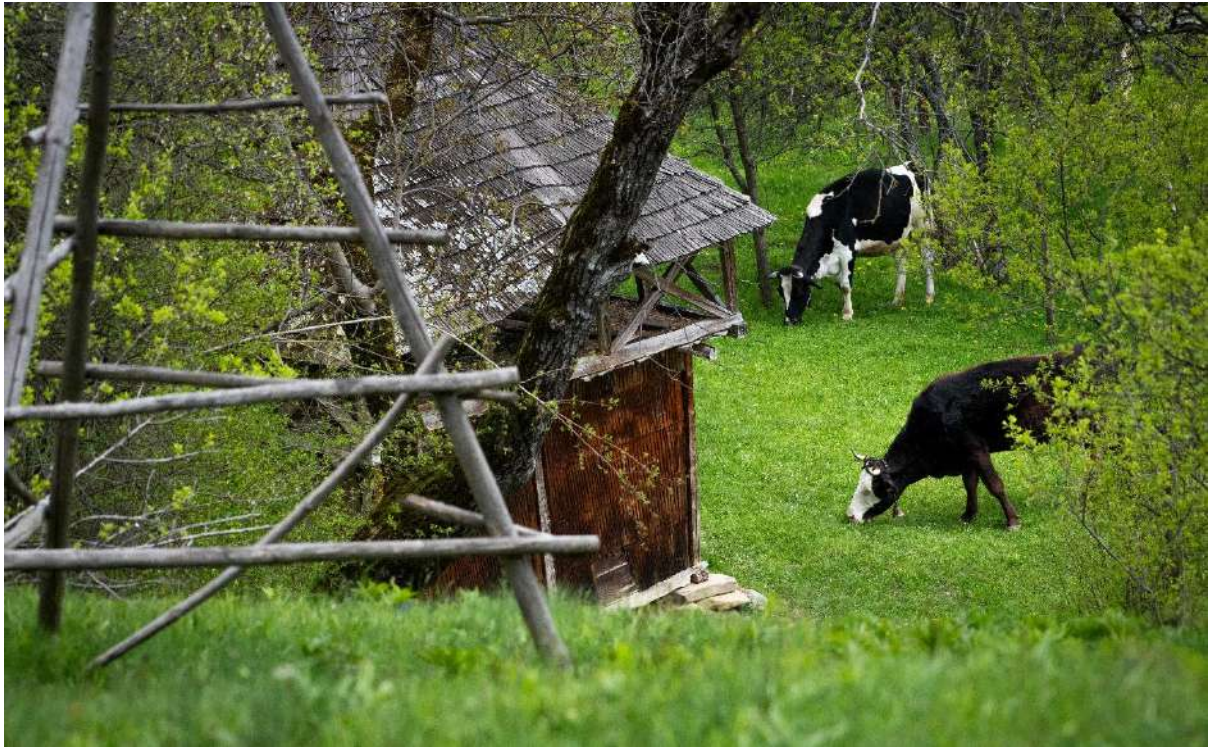
Above: This area had a stark contrast between sheep grazed areas on one side of a fence and hay meadow on the other. Where it was grazed the floral diversity was much lower and where there was hay cutting, there were orchids, *Rhinanthus* species and other high-nature-value indicators. Sheep grazing seems to be spreading into the hodăia and threatening these fragile meadow ecosystems.



Above: A grazed meadow, with visibly less flowering plants, dominated by grasses and clovers. Although regularly grazed, the presence of certain species, such as *Trifolium pratense* and *Ranunculus acris*, suggests a fairly extensive grazing system. The grass is fairly high, shrubs are present and there are no signs of excessive trampling. The only signs of overgrazing were in the areas immediately surrounding the stana. Whilst this sheep grazing may not maximise plant diversity, it is a different form of land management that creates a slightly different habitat and therefore adds value to the landscape mosaic. These areas were important for multiple species of butterfly and bird that enjoy a slightly more open vegetation structure.



Above: A map showing identified locations of stana, some looked permanent, others more temporary and may move annually. Some of these areas were not surveyed or less surveyed so as not to disturb the sheep flock and protection dogs. However, enough of the grassland around was observed to judge the grazing intensity.



Above: There was not a great deal of cattle in the study area considering the historical management of this landscape. Those that were present, were mainly on small parcels close to the village. There were some small herds that were being moved regularly up to areas of the hodăia, and there was one high-quality area in the southeast that was extensively grazed by cattle.



Above: There is a certain level of grazing from wild ungulates, particularly *Capreolus capreolus* that helps against succession and shrub encroachment. A significant increase in *Bison bonasus* would be beneficial to the hodăia landscape. It does not replace the traditional, regular forms of grazing, however.



Above: Each parcel is floristically unique and different, sometimes surprisingly so. The composition of flowering plants tells the story of its past and present management going back decades. But management is not the only consideration, the flora is also determined by slight variations in environmental factors: slope, aspect, soil, drainage, light etc. If these parcels are abandoned or more intensively grazed, they slowly will shift towards a more homogenous composition and the unique identity of each meadow will be lost.



Above: An abandoned parcel that is becoming overgrown with more herbaceous, taller vegetation and woody plants taking over the edges. Once this process starts it can take a long time to return to good quality pasture or meadow. If nothing changes, this parcel will slowly but surely become shrubby woodland and completely shade out the grassland.



Top left: Many meadows had trails of mammals woven across them. If you followed these paths and looked closely they were dotted with various other signs of activity.

Top right: A common sight along the mammal trails were opened ant nests. *Ursus arctos* are very fond of ants and ant larvae, an easy and abundant meal in these meadows. *Meles meles* and *Vulpes vulpes* also will opportunistically forage for ants.



Left: The meadows and forest edges are also filled with tasty treats, such as *Fragaria vesca*. Many herbs and medicinal plants in the meadow offer wild animals the same benefits we use them for; natural parasite control, immune stimulation, respiratory support and anti-inflammation. Fruits and mushrooms are also abundant, providing food at times when other things may be in scarcity.



Top left: A few small waterways and this larger feeder stream for the Vâlsan flow through the study area and offer a vital resource year-round for all faunae. It is also a direct habitat for fish, freshwater invertebrates and amphibians. Freshwater surveys have been conducted extensively along the Vâlsan due to the presence of *Romanichthys valsanicola* and so were not the focus of this study but would of course introduce new taxonomic groups and increase the species list.



Top right: Man-made freshwater wells, ponds and springs often drain down through the meadows creating a visibly different vegetation and floral composition.

Right: In dry periods water can become scarce and pose threats to species reliant on waterbodies for their life cycle. Here you can see a group of *Bombina variegata* tadpoles surviving in the last bit of water sitting in the old track of a cow or horse.





Above: Two male *Nemophora metallica* stake their claim for a *Knautia arvensis* flower, their strict host plant. Invertebrates and their wonderful symbiotic relationships are plentiful in the rich hay meadows across the study area. To understand each one makes you realise the fragile balance of the ecosystem, that is constantly teetering on the edge.



Left: A group of *Zygaena purpuralis*. Another moth that has a specialised relationship with its host, *Thymus* plants. From the whole invertebrate group, only butterflies were surveyed, as they are good indicators, reasonably detectable and identifiable. A more extensive invertebrate study, looking at Orthoptera, Coleoptera or more completely at Lepidoptera would help identify key species, microhabitats, ecological relationships and landscape level diversity.

Threats

Perhaps the most apparent and serious threat to this landscape is the abandonment of the *hodăia*. As previously mentioned, the historical, small-scale management of the land has created the biodiversity that we have documented in this study. Without this management, the landscape will gradually become forest, resulting in a more homogenous and less rich flora and fauna. The abandonment of land is a common problem across much of Romania. Fragmented small plots on difficult terrain makes farming economically inefficient or unproductive, depopulation of rural areas due to urban and European migration and an ageing population due to this loss of working-age people all contribute to this problem. Around Brădetu, the hilly topography, difficult access to many of the parcels and the very small size of each plot has surely contributed to the abandonment. Large machinery that has made farming easier and more efficient in the lowlands, is not so practical in the study area. People also do not own the number of animals that they once did and so do not require the pasture or hay. It is visible that some of the *hodăia* are no longer used and shrub encroachment has already started, closing the canopy, suffocating vulnerable flora and reducing populations of sun loving reptiles, ants or butterflies.

Seasonal grazing was always a part of the traditional management of this landscape but in a very extensive, small-scale way. Traditionally, the *hodăia* were primarily grazed by cattle rather than sheep. Sheep were generally grazed on the larger, communal pastures higher up during the summer, only rarely integrated into the *hodăia* system in early spring or autumn. These grazing systems have changed over time, more and more cattle are kept on permanent pastures, often close to the village, whilst sheep no longer move huge distances up into the mountains and are instead grazing the larger parcels in and around the edges of the *hodăia*, with semi-permanent *stana* dotted around. This shift in the dynamics of the pastoral system is threatening certain habitats and flora. Sheep are highly selective in their grazing, targeting high-nutrient plant parts and delicate wildflowers, nibbling close to the root and creating minimal soil disturbance. Cows are much less selective, usually knocking back tall, dominant, aggressive grass species allowing space and light for wildflowers, whilst also creating significant patches of soil disturbance for seeds. All in all, cows are generally considered to lead to a higher floral abundance and diversity. The other thing to be considered is the intensity of the grazing. Historically, this was very low, with very low stocking rates and high levels of rotation between various small parcels. Now, there are much larger flocks of sheep, more permanently grazed in the same areas over the whole season. This change is also detrimental to the floral diversity. Another habitat that is particularly vulnerable to increased pressure from livestock are the wetlands. If livestock become too abundant then water sources can quickly suffer pollution, eutrophication and eventually run dry. Given the presence of protected amphibians, butterflies and plants that rely on these freshwater systems, an increase in livestock could pose a significant threat to these populations. It is important to point out that the current level of sheep grazing (not so intensive) around the perimeters of the study area has created a slightly different habitat and allowed the presence of certain species of butterfly and bird, and can therefore be considered beneficial to the overall diversity of the site. Whether overall landscape diversity or specialised meadow species compositions are more important is something to be argued, however what is clear is that this sheep grazing should be carefully managed, so that it doesn't push too much into the *hodăia* (which was observed in some areas) and that the intensity doesn't increase too much in the areas it already exists.

Whilst changes in grazing practice pose a threat to the landscape, there are other, more dramatic changes happening to some hodăia. As many families do not have the same needs from the plots, they are developing them into recreational areas, holiday houses and permanent residencies. Although these developments could be achieved whilst still managing the land to maintain the diversity, of course this is not incentive enough to go to the effort of cutting the hay or pruning the fruit trees. Instead, modern constructions using artificial materials are popping up, with increasing use of high mesh or electric fences and non-native plants. These plots and their structures no longer blend into the natural surroundings. These changes are not only aesthetic, but they also pose ecological problems too. Fencing in particular is something that could threaten the functionality of the area as a corridor for large mammals if it becomes widely used and accepted.

One threat that was not directly observed, but is always a lingering issue across Romania, is the logging of the mature forests. As discussed in many parts of this study, the forest is a vital part of the hodăia mosaic for all taxonomic groups, but also just to maintain many of the ecosystem functions. Should heavy logging activity take place in any of the neighbouring forests it would certainly affect many of the important, protected species identified in this study. It would also threaten the existence of many of the incredibly old, important trees that are individually recognised and protected as remarkable.

Conclusions

This 3km² area is a wonderful, irreplaceable haven for European biodiversity. Its richness and value stems from the historical small-scale management and fragmentation of the hodăia, which has created a mosaic of habitats ranging from riverbanks, to dry open slopes and shaded mature forests. This spectrum allows specialists from all taxonomic groups to find their niche. Not only does it feel like each plot has its own ecotone, between meadow, orchard, forest or wetland, but the whole area of the hodăia acts as an ecotone between the village and undisturbed wilderness. Protecting the biodiversity means protecting the diversity of land-uses and the structural transition between them.

The site holds a wide range of protected species across all taxonomic groups: 9 species of orchid, 7 species of woodpecker, *Lanius collurio*, *Ficedula albicollis*, *Pernis apivorus*, *Lycaena dispar*, *Phengaris alcon*, *Rosalia alpina*, *Lucanus cervus*, *Bombina variegata*, *Triturus cristatus*, *Ursus arctos*, *Canis lupus*, *Lutra lutra*, and *Bison bonasus*, to name just a few. The documentation of these species in the same area gives immense leverage for conservation measures to be facilitated and requires the Romanian authorities to enforce the maximum statutory protection already existing under the Natura 2000 site designation.

Given the richness of orchids across the study area, it could qualify as an 'important orchid site' (6210* priority habitat under Natura 2000). The observations trigger two official qualifiers for this designation:

1. Exceptional species richness – nine species within a single 3km² area represents an extremely high density.
2. A stronghold for vulnerable species – the presence of *Neotinea ustulata* and *Anacamptis coriophora* serves as a direct indicator. Though widely distributed across suitable pristine habitats in Romania, these orchids are rapidly declining. A localised population of this scale fulfils the criteria of hosting highly important regional populations.

This designation could be given to the whole area or could be limited to the smaller 20 hectare area in the southeast of the study area where six of the nine orchid species were recorded (see figure 8). This area was particularly special, not only for orchids but for all taxonomic groups. It held both *Phengaris alcon* and its host plant *Gentiana cruciata*, making it a key area to try and implement very focused management. This designation would give this area the highest tier of priority protection and give access to special agro-environment schemes which financially compensate landowners who accept the strict autumn-only mowing and grazing restrictions.

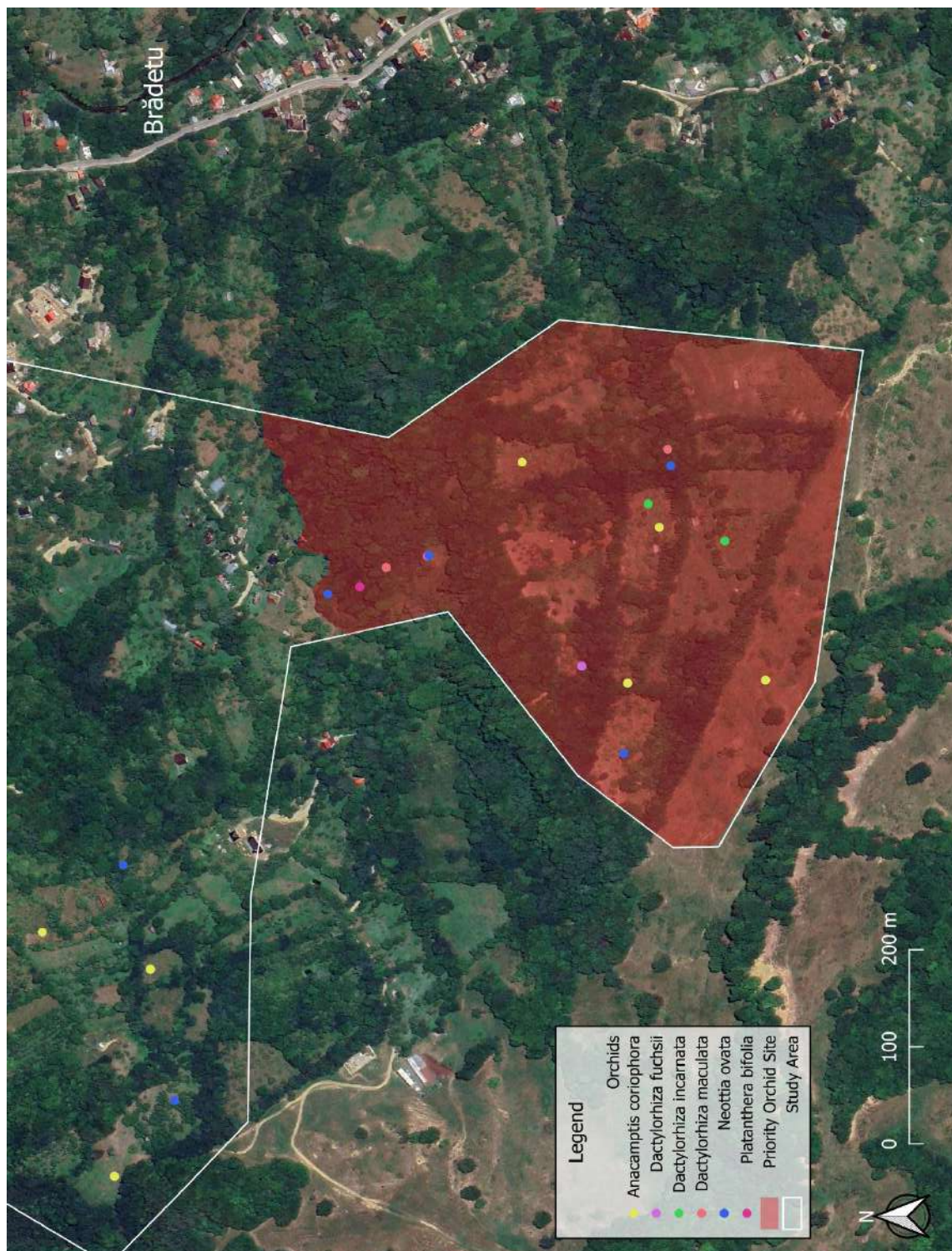


Figure 8. A map showing the proposed priority orchid site and the locations of orchid species

Recommendations

Based on the findings from the study there are some recommendations to make regarding the best practices going forward to try and maintain the sites remarkable biodiversity. I understand that many of these may seem impossible or require vast amounts of work and funding, but I include them as 'best practices' to give an idea of what would be the ideal solution and perhaps more manageable aims or goals can be developed from these recommendations. In general, the best recommendation is to somehow follow or replicate the traditional activities that have been carried out for decades across this cultural landscape.

- Propose additional priority orchid site in the smaller 20 hectare area with official micro zoning update to the Natura 2000 site and management plan.
- The traditional balance between grazing and hay making created the biodiversity recorded in the study area and so current management should aim to replicate or mimic these historical practices. Maximise extensive cattle grazing in early spring and late autumn, exclude livestock from key hay meadows during the growing season and cut hay as late as possible, ideally not until august. At least in the core area.
- Manual shrub clearance from abandoned parcels will reset the succession and allow grazing and hay cutting to restart and maintain the grassland.
- Build awareness of agro-environment schemes, especially for high nature value grasslands and important orchid sites. Encourage landowners to adhere to the restrictions to receive financial compensation.
- If hay is no longer needed for winter fodder, identify projects or uses for the grassland that incentivise maintaining the biodiversity and give value back to the management of grasslands.
- Preserve and maintain old orchards with winter pruning and clearance of the grassland beneath. Encourage the planting of new orchards, with tall stem, traditional varieties.
- As was done traditionally, install wildlife-permeable wooden fences around ponds and springs. This will exclude sheep and cattle from directly trampling and polluting water sources, while allowing natural grazers access.
- Regulate the construction of new modern buildings within the study area, as well as high metal fences and the use of electrical wire. A single line is enough to contain cattle where necessary and temporary night sheepfolds are not an issue.
- Maintain the wide array of land-uses and encourage different forms of land-use as long as they do not deteriorate existing habitat and are at an appropriate scale for the landscape.
- Mapping the usage and management of plots could be a very useful tool to visualise areas that are well managed and those that need intervention. It would also be interesting to overlap with biodiversity values and the presence and absence of certain species.
- Identify and map more remarkable trees. Build stories or trails based on these natural landmarks for people to visit and become aware.
- More in-depth, focused studies over a longer period (including all seasons) are needed to achieve a more comprehensive and complete understanding of the biodiversity of the area. A fuller inventory of invertebrates, plants and small mammals (including bats) would massively increase the species list, whilst probably adding crucial protected or endangered species.