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I-SWAMP

Deliverable 1.3.1: Biodiversity report

TESAF

Zavod Republike Slovenije za varstvo narave

GEOPARK KARAWANKEN KARAVANKE

unesco Global Geopark

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E.C.O.

This document represents the **Deliverable 1.3.1: Biodiversity Report** of the project I-SWAMP (Integrated Small Wetlands of the Alps Monitoring and Protection). This project is co-funded by the European Union in the frame of Interreg Alpine Space.

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Cover photo: La Zopa wetland (San Vito di Cadore, Italy; photo by Giulio Menegus, 2023).

Completed in February 2024.

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1. Austrian sites

1.1 Introduction

1.1.1 Selection of sites in the Austrian Part of Geopark Karawanken/Karavanke

In the frame of the Interreg Alpine Space project with the acronym I-SWAMP the project partner EGTC Geopark Karawanken/Karavanke, supported by E.C.O. Institute for Ecology, was able to implement ecological monitoring at all the six selected ecological valuable sites in the area. The monitoring took place from May to August 2023.

Beginning with the start of the project, a selection process started. E.C.O. consulted with the project observer Arge NATURSCHUTZ, the organisation which is responsible for the wetland management strategy in Carinthia.

Target sites were visited, the chance for implementation measures was discussed, and suitable sites for monitoring finally selected. The aim was to pick diverse sites, from ecological point of view and with regards to public access and frequency of visitation by visitors, who was the target group for the sensitization. At the end of the selection process 6 sites were selected for monitoring. Out of them three sites were identified to be important sites for sensitization, and on two to four sites, pilot restoration measures with volunteers were implemented in the frame of the project.

Two of the sites were already mentioned in the preparation phase of the project, Wildensteiner marsh and Sonnegg Fen, both quite big areas with a huge number of single landowners, mixed public and private.

Figure 1.1: Sonnegg Fen, overgrown by reed and bushes

1.1.2 The role of E.C.O. Institute for Ecology

E.C.O. is a consulting company for nature conservation and protected area management, and therefore actively involved in wetland protection in the federal state of Carinthia and all-around Europe. The role in the project is to advice the geopark in ecological matters. The first step was the selection of suitable sites.
The second step was the ecological monitoring on the sites. Based on the monitoring results measures were elaborated.

The next step was to consult with the administration and to present the measures to the respective landowners. The last step was to support the implementation measures on site.
The monitoring activities started in March 2023 on the six sites and went on until August 2023.

Figure 1.2: Monitoring Plot in Sonnegg Fen

1.1.3 Aim of the monitoring

The aim was, to get some base data on the sites on vegetation, amphibia, dragonflies and other relevant species. The second aim was to sensitize landowners and the public on the importance of wetland conservation. The third aim was to provide a scientific base for measures.

1.1.4 Monitoring activities

In May 2023 the vegetation monitoring started. On all the six sites, vegetation plots were made, and additionally a plant list was recorded. The biotope type was allocated (according to the Austrian biotope list), the information documented in ARC GIS. Small habitat maps were prepared as a base for measure decision. The vegetation was documented by Susanne Glatz-Jorde and Daniel Wuttej of E.C.O. - Institute for Ecology

based on the simplified protocol elaborated in the project. The analysis was based on the Carinthian Red list of vascular plants (Franz et al., 2023).

Figure 1.3: Monitoring vegetation and birds in Wildenstein in May 2023.

Figure 1.4: Monitoring Plot at Kleinzapfen, May 2023

Additionally, the sites were visited several times and the relevant species for wetlands like amphibia, birds and dragonflies were recorded between March and August 2023. The

birds were recorded by Daniel Wuttej, MSc. of E.C.O. The dragonflies were detected by Doris Gitschthaler, MSc. Data on amphibians were organized and from the observer Arge NATURSCHUTZ, Mag. Karina Smole-Wiener elaborated the data and proposed measures. Unfortunately, the expert for water snails, who was meant to look for *Anisus vorticulus* was not available in 2023. Measures for each site were proposed based on the monitoring results.

1.2 Wildensteiner Moor

Wildenstein marsh is a fen located in the Community of Galizien, KG Enzelsdorf and encompasses several plots. They are basically privately owned; one plot belongs to the NABU – Nature conservation association of Carinthia.

The ecological monitoring was done according to the simplified protocol developed in this project. The monitoring activities started in March 2023 with Amphibia, followed by the Vegetation in May 2023. Dragonflies were observed from May to August.

1.2.1 Vegetation

The vegetation of the wetland turned out to be a uniform sedge reed. Only the eastern part is a little bit dryer. The Vegetation plots were made in May 2023. Due to the uniform vegetation, only one plot was made in the marshland. Additionally, the surrounding vegetation was recorded.

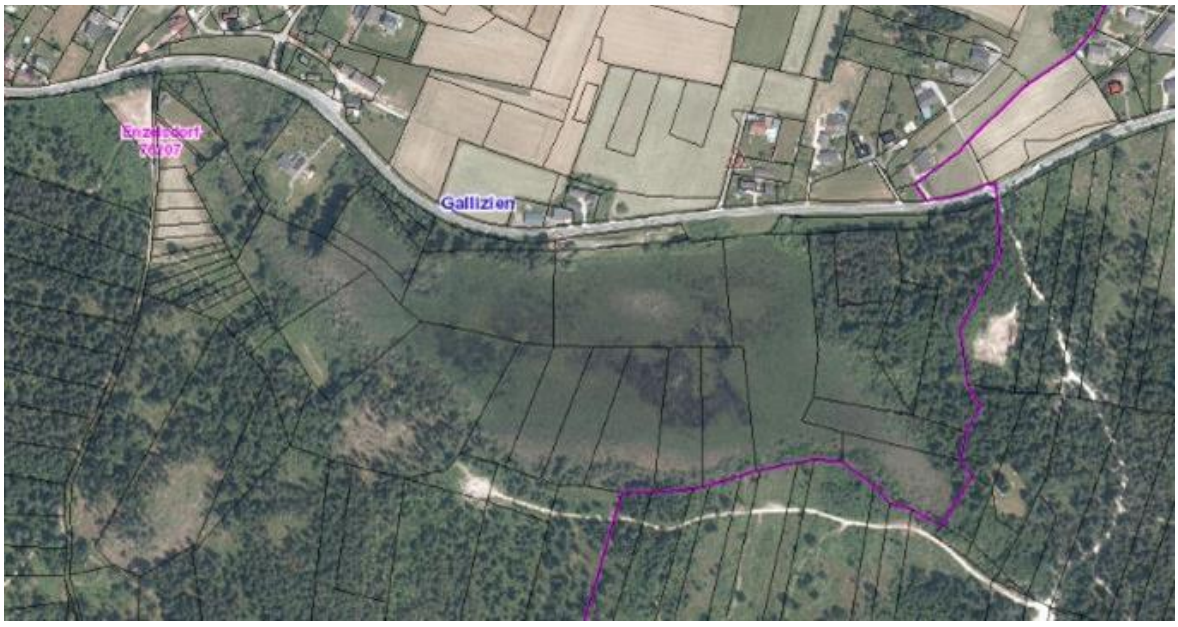

Figure 1.5: Location of plots on areal image of the site

The 9-ha sized Wildenstein marsh is covered basically by one species of sedge – the *Carex elata* and additionally *Phragmites australis* (Plot 1). This is typical for the first succession of open water bodies, which can be found only between the *Carex*- humps and in the central parts of the wetland. Landowners reported that the marshland was very wet and more open in former times, and they could go for skating during wintertime there.

Within the last ten years it was observed that the wetland turned to get dryer. The sedge area does not need measures to keep the vegetation. The southern part, which is dryer, starts to overgrow with willows. In the surrounding of Plot 1 also other plants can be found, like *Frangula alnus*, *Salix purpurea*, *Lysimachia vulgaris* and *Alnus glutinosa* (surrounding of Plot 1).

Figure 1.6: Eastern part of Wildenstein marsh 07.06.2023, Karina Smole-Wiener

Figure 1.7: Vegetation at Southern Part

Figure 1.8: Humpy sedge vegetation dominates

In the eastern part, the vegetation is drier and there is a small part which can be classified as calcareous fen. It contains species like *Schoenus ferrugineus* and *Primula farinosa*, which are rather rare according to the red list of Carinthian vascular plants (Franz et al., 2023). The presence of *Molinia caerulea* shows that it might be maintained by mowing in former times. Nowadays it is getting overgrown by phragmites and bushes like *Frangula alnus* and *Pinus sylvestris*.

Figure 1.9: Overview of Wildensteiner Marsh, 25.5.2023, northern part

Figure 1.10: *Primula farinosa* and *Eriophorum latifolium* in the Wildenstein fen

The following species could be found:

Table 1.1. Vegetation Plot in Wildenstein. WI1 and WI2 are the plots, () describes the species of surrounding area. Coverage according to Braun Blanquet 1964. RL -C

Plot Number	**WI 1**	**WI 2**	**Rl-C**
Latitude °	465 414 765		
Longitude °	145 321 224		
Elevation (m)	469	469	
Country	Austria	Austria	Austria
Plot Shape	3x3	3x3	
Date	23.05.2023	08.06.2023	
Plant cover:			
Live plants (%)	40	70	
Bare Ground (%)	30	0	
Litter (%)	40	50	
Remarks	Characteristics of sedges and open water, difficult to access no maintenance, water frogs audible	Small belt of willows around	
Observers	Susanne Glatz Dani Wuttej	Susanne Glatz	
Cover Trees (%)	0		
Cover Shrubs (%)	0	20 %	
Cover Field Layer (vascular) (%)	70	80	
Plant species:	**WI 1**	**WI 2**	**Rl-C**
Alnus glutinosa	(+)		
Carex elata	4	-	
Carex flava		1	LC
Carex hostiana		**+**	**VU**
Carex nigra		+	
Crucoata laevipes		+	
Cirsium palustre		2	
Equisetum palustre		+	

Plant species:	WI 1	WI 2	Rl-C
Eriophorum latifolium		**+**	**VU**
Frangula alnus	(1)	1	
Galium palustre		+	
Lysimachia vulgaris	(1)	1	
Lythrum salicaria		+	
Molinia caerulea		2m	
Parnassia palustris		**+**	**LC**
Phragmites australis	1	1	
Poa trivialis		+	
Picea abies		+	
Pinus sylvestris		+	+
Primula farinosa		**1**	**VU**
Salix purpurea	(1)		
Schoenus ferrugineus		**3**	**VU**
Succisa pratensis		**+**	**VU**
Thalictrum lucidum		1	
Valeriana dioica		1	

1.1.1 Birds

Birds were observed on the 23rd and the 27th of May 2023 on two short visits. The vegetation, mostly *Carex elata*, does not provide many structures and is therefore not a good habitat for nesting birds. However, it is a good hunting ground for insectivore birds. The birds recorded are quite common and occur frequently in Carinthia. They are mostly birds from the neighboring woods and cultural landscape. The occurrence of one grey heron (listed as NT - near threatened in the Austrian red list of Birds, Dvorak et al., 2017) searching for food in a shallow pond in the middle of the fen shows the high potential for water birds of the area. In order to improve the quality of the site for birds, open water areas could be created or enlarged.

Table 1.2: Birds spotted at Wildensteiner marsh in May 2023 (RL: A Austrian Red list of Birds, Dvorak et al. 2017; BCD: Birds of conservation Concern, Dvorak et al. 2017, EUBD: European Birds Directive; State: rB: regular breeding bird)

English Name	Scientific name	German name	RL A	BCB	EUBD	State
Common Blackbird	*Turdus merula*	Amsel	LC	green	-	rB
Common Chaffinch	*Fringilla coelebs*	Buchfink	LC	green	-	rB
Common Chiffchaff	*Phylloscopus collybita*	Zilpzalp	LC	green	-	rB
Common Wood Pigeon	*Columba palumbus*	Ringeltaube	LC	green	-	rB
Eurasian Blackcap	*Sylvia atricapilla*	Mönchsgrasmücke	LC	green	-	rB
Eurasian Jay	*Garrulus glandarius*	Eichelhäher	LC	green	-	rB
Eurasian Tree Sparrow	*Passer montanus*	Feldsperling	LC	green	-	rB
European Goldfinch	*Carduelis carduelis*	Stieglitz	LC	green	-	rB
European Robin	*Erithacus rubecula*	Rotkehlchen	LC	green	-	rB
Great Tit	*Parus major*	Kohlmeise	LC	green	-	rB
Grey Heron	*Ardea cinerea*	Graureiher	NT	green	-	rB

English Name	Scientific name	German name	RL A	BCB	EUBD	State
Hooded Crow	*Corvus cornix*	Nebelkrähe	LC	green	-	rB
Song Thrush	*Turdus philomelos*	Singdrossel	LC	green	-	rB
Yellowhammer	*Emberiza citrinella*	Goldammer	LC	green	-	rB

1.1.2 Amphibians

Amphibians were recorded by Mag. Karina Smole Wiener of Arge NATURSCHUTZ. Along the B85 Rosental road in the Wildensteiner marsh area, amphibian migration in the spring has been controlled and protected since 1992 using the so-called fence-bucket method according to the observer, Arge NATURSCHUTZ. Therefore, it is well known as important spawning ground amphibians.
A total of at least nine species of amphibians were found on the protective fence (**Table 1.3**), all of which are in accordance with the Carinthian Animal Species Protection Ordinance, the completely protected animal species and additionally are listed on the Austrian red list. Some are of European importance and mentioned in the FFH (Flora Fauna Habitat Directive. The range of species of the detected amphibians thus includes both widespread and less demanding species such as common toad, common frog and smooth newt, as well as rare species with more specific habitat requirements such as Balkan moor frog, Alpine crested newt and tree frog.

Figure 1.11: Tree frog (07.06.2023, Karina Smole-Wiener)

In the year 2023 the Wildensteiner marsh was monitored on March 14th. (during the day), on 30.03 (at night), on 12.05 (at night) and on 07.06.2023 (during the day). On March 30, 2023, an evening excursion was carried out with 7 participants, during which the fence-bucket method and the amphibians encountered were explained. Overall, the Wildensteiner marsh is one of the most important spawning grounds for amphibians out

of the known migration routes in Carinthia, due to its species richness and the remarkable number of individuals passing the fence.

The following **Table 1.3** shows the amphibians recorded during the monitoring:

Table 1.3: Amphibian species recorded at Wildensteiner marsh, their conservation status according to the red list RL C (GOLLMANN 2007), and their listings in the annexes of the habitats directive (FFH). VU = vulnerable, NT = nearly threatened * The waterfrogs were not determined down to species level

English Name	Scientific name	RL C	FFH-Directive
Smooth newt	*Lissotriton vulgaris*	NT	
Alpine newt	*Ichthyosaura alpestris*	NT	
Alpine crested newt	*Triturus carnifex*	VU	Annex II and IV
Tree frog	*Hyla arborea*	VU	Annex IV
Common toad	*Bufo bufo*	NT	
Common frog	*Rana temporaria*	NT	Annex V
Agile frog	*Rana dalmatina*	NT	Annex IV
Balkan Moor frog	*Rana arvalis wolterstorffi*	VU	Annex IV
Water frog*	*Pelophylax sp.*	VU	Annex IV or V

1.1.3 Dragonflies

The dragonflies were recorded by Doris Gitschthaler MSc., an external odonatan expert. Due to the wet conditions of the site and the limited accessibility, mapping could only be done from the northern edge of the marsh (see **Figure 1.12**). During the second inspection at the end of August, there was a significantly higher water level and accordingly more open water areas, which are necessary for a successful life cycle for dragonflies. **Table 1.4** lists all Odonata species sighted at Wildensteiner marsh.
On following pages there are some photos of dragonflies present at the study site.

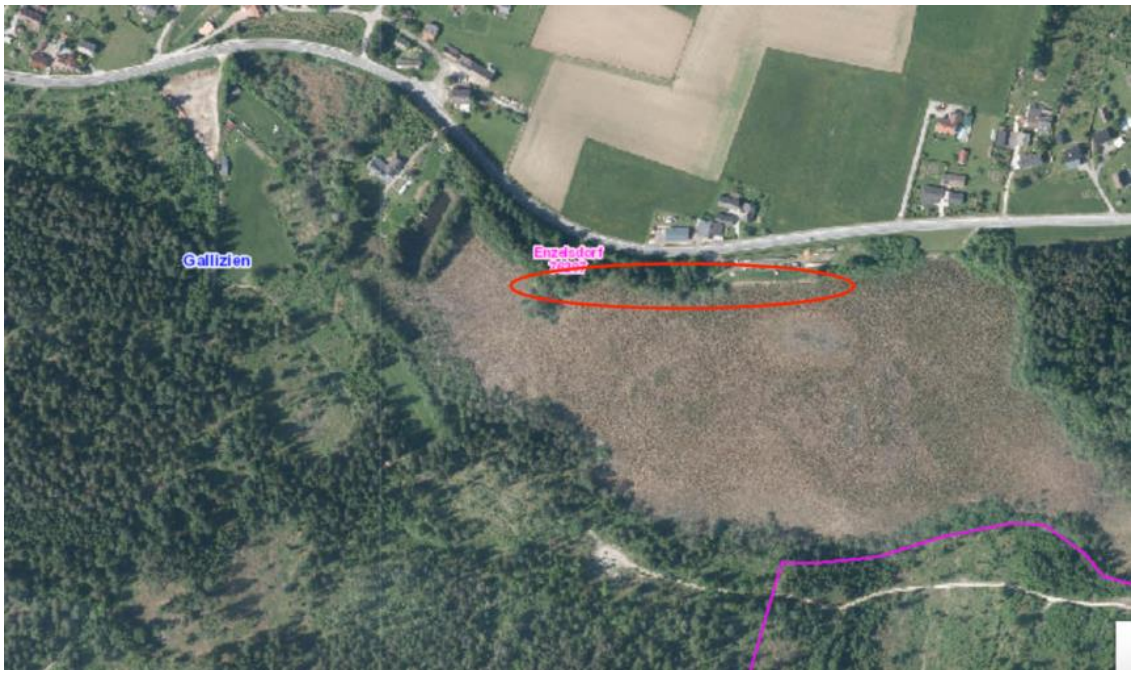

Figure 1.12: Study area in the Wildensteiner marsh circled in red, source: KAGIS, modified by Doris Gitschthaler (on 28.08.23)

Table 1.4: Proven dragonfly species at the Wildensteiner marsh incl. red list status in Austria and in Carinthia (systematic ranking according to Wildermuth & Martens, 2019); RL-A - Red List Austria (Raab, 2006), RL-C - Red List Carinthia (Holzinger & Komposch, 2012), LC - Least Concern (not endangered)

Scientific Name	RL-A	RL-C	Wildensteiner marsh	
			12.06.23	25.08.23
Coenagrion puella	LC	LC	x	
Pyrrhosoma nymphula	LC	LC	x	
Aeshna mixta	LC	LC		x
Libellula depressa	LC	LC	x	
Sympetrum sanguineum	LC	LC		x
Total number of species			3	2

Figure 1.14: *Libellula depressa* at Wildensteiner marsh, Photo: DG

Figure 1.13: *Aeshna mixta* at Wildensteiner marsh, Photo: DG

1.1.4 Ecological threats

The greatest ecological threats are the slowly drying out of the water level in the moor areas especially in springtime. However, due to the heavy rainfall in 2023 over the season, the situation improved at that time. Along the road, invasive species start to grow close to the fen. If it gets dryer, they might be able to grow into the fen as well.
Additionally, the increasing bush encroachment at the eastern site is a threat for the calcareous fen, which exists on a small part of the big marsh area.

Overgrowth can restrict or even destroy the natural habitat of native species. Especially amphibians and dragonflies rely on open water surfaces to reproduce or find food.
The drying out of the wetlands is a concerning phenomenon not only in the geopark. Wetlands as swamps, marshes are vital ecosystems that serves a variety of functions and support rich biodiversity. Climate change is a significant factor, which lead to altered precipitation patterns. Irregular rainfalls and more frequent and intense drought periods have an intense effect on the water balance in these areas. The consequences are highly significant. The main problem is the loss of habitats of plant and animal species that are adapted to these environments. Wetlands also play a crucial role in water filtration and regulation. They are storing significant amounts of water and release it during floods and dry periods.

For years, the moor area was increasingly drying up prematurely. In some years there was hardly any water in the moor when the amphibians spawned, so that the amphibians could only spawn in the north-western part, where artificially created ponds are available (residents, verbal communication). In March 2023, the Wildensteiner marsh was largely dry again, but filled up due to the precipitation in April and May and was mostly water-bearing during the inspections on May 12 and June 7.

The south- eastern part of the Wildersteiner marsh is characterized by calcareous fens. In this area, encroaching shrub growth poses a significant concern.

1.1.5 Proposed measures

The measures are mapped on **Figure 1.15**.
In order to counteract the increasing drying out of the fen and to ensure that the amphibians have spawning waters even in years with little rainfall, several ponds of at least 100 m² should be created in several places in the fen by dredging and removing emerging woody plants if necessary. Possible locations for this could be, for example, the wetland in the north-west of the moor (site A, **Figure 1.15**), the northern edge of the moor (site B, **Figure 1.15**) and silting-up areas in the south-east of the moor (sites C and D, Figure. 1.15). The area in the southeast was largely dry even with high water levels on June 7 and bushes are appearing. A male tree frog was spotted right here (**Figure 1.11**). The locations in the south-east would have the advantage of being farther away from the B85 Rosental road, which means there is less risk of roadkill for the amphibians spawning here and especially the migrating young animals.

Figure 1.15: Establishment of spawning ponds for amphibians. Place options: A, B, C and D, removal of trees and bushes and removal of bushes

Due to the difficult accessibility, the measures could be implemented in wintertime when it is frozen. For implementation it is necessary to contact and sensitize the landowners first, then to prepare permission documents for the administration and to set up a follow up project.
In the southern part of the area, the fir and spruces that are causing increasing overgrowth should be removed. The overgrowth leads to shading areas, which can significantly impact the flora and fauna. The bushes should be removed regularly. If possible and wanted by the landowner, part of the area should be maintained by regular mowing.

1.2 Sonnegger Moor, Tichoja, Sittersdorf

Sonnegg Fen is a fen located in the Community of Sittersdorf, KG Sonnegg and encompasses several very small plots. They are basically privately owned; one plot belongs to the church and one plot on the other site of the fen to the community of Sittersdorf.
The ecological monitoring was done according to the simplified protocol developed in this project. Additionally, the surrounding vegetation was recorded. The monitoring activities started in March 2023 with amphibians (by Karina Smole-Wiener), followed by the Vegetation and birds in May 2023. Dragonflies were observed from May to August 2023 by Doris Gitschthaler. Two vegetation plots were explored by vegetation ecologists of E.C.O. - Institute for Ökologie in May 2023.

1.2.1 Vegetation

Figure 1.16: Location of plots on areal image of the site

The vegetation of the wetland changed a lot since the last vegetation monitoring in 2010 (see also Keusch et al, 2010). The former Molinia meadow turned out to be developed towards a sedge reed, due to the stopping of maintenance within the last 15 years. Especially the southeastern part was very wet, and now it is not possible to mow it by machine. Landowners reported that the fen was dryer and more open in former times, and they could mow it regularly. Nowadays, bigger parts are overgrown by pine forest, willow bushland and reed belts, depending on the level of ground water.

Figure 1.17: The orchid species *Dactylorhiza* cf. *majalis* within Sonnegg Fen

Figure 1.18: *Menyanthes trifoliata* in Sonnegg Fen

Figure 1.19: The orchid species *Dactilorhiza incarnata* in a wet part of the Sonnegg Fen.

Only the part in the middle is a little bit dryer. From the southern plot, plants like *Filipendula ulmaria* and *Eupatorium canabinum* start to overgrow the wetland. Additionally, invasive species like Canadian goldenrod (Solidago gigantea) starts to grow into the middle of the former Molinia meadows.

The 1-ha sized remaining open part of Sonnegg Fen is covered by a species rich and valuable vegetation including orchids and typical calcareous fen vegetation. Some of the plants like *Dactylorhiza majalis* and *Dactylorhiza incarnata* as well as *Eriophorum latifolium*, *Menyanthes trifoliata* and *Salix repens ssp. Rosmarinifolia* and *Sucissa pratensis* are rather rare according to the Carinthian red list of plant species (see also Franz et al., 2023).

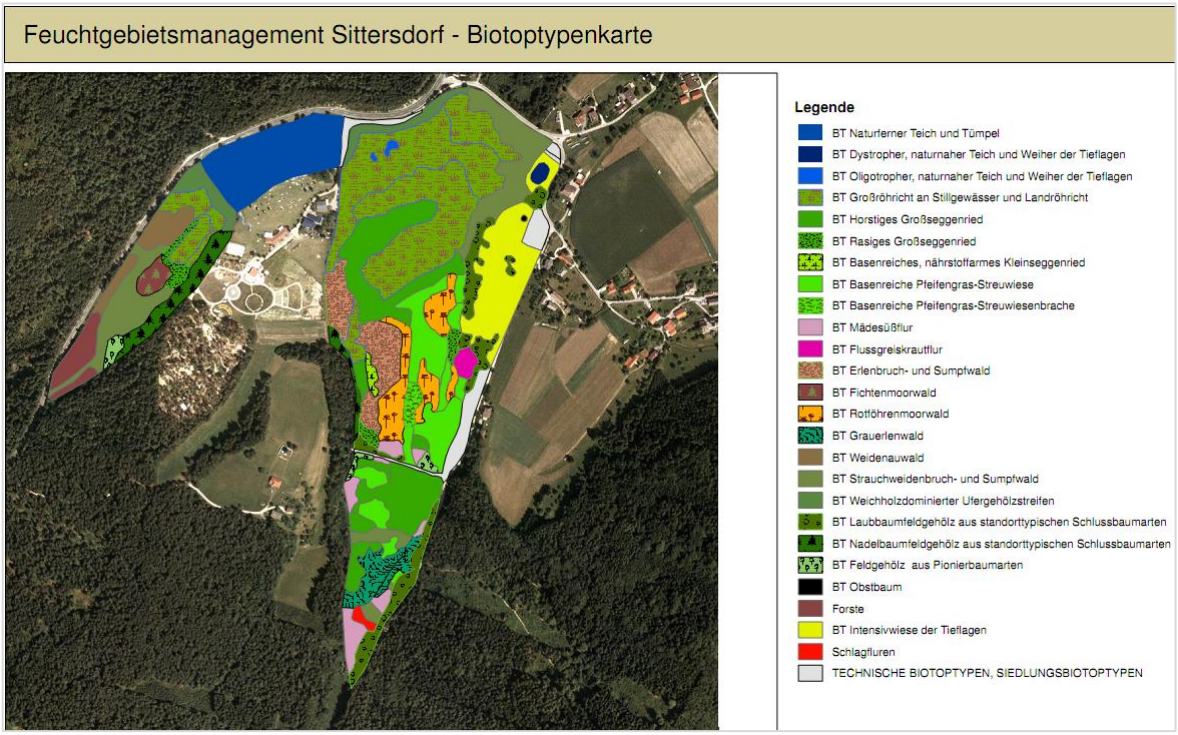

Figure 1.20: Habitats Sonnegg Feb 2012. The vegetation has basically changed from *Molinia* meadow to a mosaic of sedge areas and bushland. Invasive species cover some areas.

The following species were found within the plots:

Table 1.5: Vegetation Plots (So 1 VA, So 2 VA) in Sonnegg Fen. Status Carinthian Red List (Franz et al., 2023)

Plot		So 1 VA	So 2 VA	RL C
Latitude °		465 491 631	465 491 645	
Longitude °		146 302 858	146 302 832	
Elevation (m)		463	463	
Country		AT	AT	
Plot Shape		3 x 3	3 x 3	
Plot Size (m^2)		9	9	
Date		23.05.2023	23.05.2023	
Live plants (%)		60	75	
Bare Ground (%)		0	0	
Litter (%)		40	30	

Plot		**So 1 VA**	**So 2 VA**	**RL C**
Remarks		Goldenrod close to plot	Prior bushes removed	
Observers		Susanne Glatz-Jorde , Daniel Wuttej	Susanne Glatz Jorde, Daniel Wuttej	
Cover Trees (%)		0	0	
Cover Shrubs (%)		0	0	
Cover Field Layer (vascular) (%)		60	70	
Plant species		**So 1 VA**	**So 2 VA**	**RL C**
Frangula alnus	s	.	r	
Salix cinerea	s	.	r	
Acer pseudoplatanus	hl	.	r	
Ajuga reptans	hl	1	1	
Angelica sylvestris	hl	+	2a	
Caltha palustris	hl	.	+	
Carex panicea	hl	.	1	
Carex nigra	hl	r	+	
Carex acutiformis	hl	2b	.	
Carex davalliana	hl	.	+	
Carex rostrata	hl	.	r	
Cirsium oleraceum	hl	1	.	
Cirsium palustre	hl	.	r	
Crepis paludosa	hl	.r	2b	
Dactylorhiza maculata	**hl**	+		**LC**
Dactylorhiza majalis	**hl**	**.**	**+**	**NT**
Dactylorhiza incarnata	**hl**	**.**	**r**	**VU**
Epilobium cf. hirsutum	hl	.	r	
Equisetum fluviatile	hl	2m	2m	
Equisetum palustre	hl	+	+	
Eriophorum latifolium	**hl**	**.**	**r**	**VU**
Eupatorium canabinum	hl	.	+	
Filipendula ulmaria	hl	2a	.	
Galium cf. album	hl	.	r	
Holcus lanatus	hl	.	+	
Hypericum tetrapterum	hl	.	+	
Lychnis flos-cuculi	hl	+	+	
Lysimachia vulgaris	hl	+	r	
Lythrum salicaria	hl	+	.	
Mentha aquatica	hl	1	+	
Menyanthes trifoliata	**hl**	**.**	**r**	**VU**
Molinia caerulea	hl	1	2a	
Myosotis scorpioides	hl	+	.	
Poa cf. pratensis	hl	+	.	
Potentilla erecta	hl	.	+	
Ranunculus acris	hl	.	+	
Ranunculus repens	hl	.	r	
Rumex acetosa	hl	+	.	
Solidago canadensis	hl	.	r	
Succisa pratensis	**hl**	**.**	**+**	**NT**

Plant species		So 1 VA	So 2 VA	RL C
Valeriana dioica	hl	1	2a	
Salix repens ssp. rosmarinifolia	**hl**	**.**	**r**	**VU**
Solidago gigantea	hl	+	.	

Compared to the vegetation of 2012 (Köstl, 2012), the *Molinia* meadow has turned to a sedge area, and perennial plants like *Angelica sylvestris*, *Eupatorium canabinum*, *Filipendula ulmaria* and even *Solidago canadensis* increased in the area, whereas some of the typical *Molinia* meadow plants disappeared.

1.2.2 Birds

Birds were observed on 23rd of May 2023 around midday and on the 8th of June 2023 in the morning. The vegetation mosaic with grassland, reed vegetation, shrubs and solitaire trees with surrounding woods provide very attractive structures for birds. The Reed warbler and the March warbler, both observed singing on 8th of June, are typical birds of wetlands. Although both species are neither threatened nor occurring on the Austrian List of "Birds of conservation Concern" (Dvorak et al. 2017), measures should take in account these two species. The Reed warbler was singing in the reed area (typical breeding habitat) south of the forest road some meters outside of the area, while the March warbler was observed directly inside the area singing out of bushes (typical breeding habitat). The Red-backed shrike was observed on both days. This bird species is listed in Annex I EU Birds Directive and qualified for the "amber" category in the Austrian List of "Birds of conservation Concern", which means that short- or medium-term conservation action should be taken. The area with open wet grassland and bushes (used as perches) is a very suitable hunting and nesting habitat for the Red-backed shrike. The Black woodpecker (also Annex I EU Birds Directive and amber" category in the Austrian List of "Birds of conservation Concern") is a breeding bird from the surrounding woods, mostly just flying over the area. Most of the other bird species recorded are common and occur frequently in Carinthia. They are mostly birds from the neighboring woods, using the wetland area as foraging habitat. In order to keep the high quality of the habitat for bird species, at least some of the bushes and trees should be kept in the site.

Table 1.6: Birds spotted at Sonnegg Fen in May 2023 (RL A: Austrian Red list of Birds, Dvorak et al. 2017; BCD: Birds of conservation Concern, Dvorak et al. 2017, EUBD: European Birds Directive; State: rB: regular breeding bird)

English name	Scientific name	German name	RL A	BCB	EUBD	State
Black Woodpecker	***Dryocopus martius***	**Schwarzspecht**	**LC**	**amber**	**Annex I**	**rB**
Coal Tit	*Periparus ater*	Tannenmeise	LC	green	-	rB
Common Blackbird	*Turdus merula*	Amsel	LC	green	-	rB
Common Buzzard	*Buteo buteo*	Mäusebussard	LC	green	-	rB
Common Chaffinch	*Fringilla coelebs*	Buchfink	LC	green	-	rB
Common Chiffchaff	*Phylloscopus collybita*	Zilpzalp	LC	green	-	rB
Common Cuckoo	*Cuculus canorus*	Kuckuck	LC	green	-	rB
Common Firecrest	*Regulus ignicapilla*	Sommergoldhähnchen	LC	green	-	rB
Common Wood Pigeon	*Columba palumbus*	Ringeltaube	LC	green	-	rB

English name	Scientific name	German name	RL A	BCB	EUBD	State
Eurasian Blackcap	*Sylvia atricapilla*	Mönchsgrasmücke	LC	green	-	rB
Eurasian Blue Tit	*Cyanistes caeruleus*	Blaumeise	LC	green	-	rB
Eurasian Golden Oriole	*Oriolus oriolus*	Pirol	LC	green	-	rB
Eurasian Jay	*Garrulus glandarius*	Eichelhäher	LC	green	-	rB
Eurasian Nuthatch	*Sitta europaea*	Kleiber	LC	green	-	rB
Eurasian Reed Warbler	*Acrocephalus scirpaceus*	Teichrohrsänger	LC	green	-	rB
Eurasian Tree Sparrow	*Passer montanus*	Feldsperling	LC	green	-	rB
Eurasian Wren	*Troglodytes troglodytes*	Zaunkönig	LC	green	-	rB
European Robin	*Erithacus rubecula*	Rotkehlchen	LC	green	-	rB
Great Spotted Woodpecker	*Dendrocopos major*	Buntspecht	LC	green	-	rB
Great Tit	*Parus major*	Kohlmeise	LC	green	-	rB
Marsh Warbler	*Acrocephalus palustris*	Sumpfrohrsänger	LC	green	-	rB
Mistle Thrush	*Turdus viscivorus*	Misteldrossel	LC	green	-	rB
Red-backed Shrike	***Lanius collurio***	**Neuntöter**	**LC**	**amber**	**Annex I**	**rB**
Song Thrush	*Turdus philomelos*	Singdrossel	LC	green	-	rB
Spotted Flycatcher	*Muscicapa striata*	Grauschnäpper	LC	green	-	rB
Stock Dove	*Columba oenas*	Hohltaube	LC	green	-	rB

1.2.3 Amphibians

Figure 1.21: The Balkan moorfrog is one of the species occurring in Sonnegg Moor.

Amphibians were recorded by Mag. Karina Smole Wiener of Arge NATURSCHUTZ. Along the B81 Bleiburger road next to Sonnegg lake amphibian migration in the spring has been controlled and protected for several years using the so-called fence-bucket method. Therefore, the area is well known as important spawning ground amphibians.
There are several habitats within the big fen and reed belt as well as directly at the lake. Nine amphibian species are regularly found in the area. The rather vegetation free Sonnegg Lake itself is also habitat for several fish species. Therefore, it is not a perfect

habitat for some of the species. Within the fen, there are open parts, which amphibian species can use for spawning.

Table 1.7: Amphibian species recorded at Sonnegg Fen, their conservation status according to the red list RL A (Gollmann 2007), and their listings in the annexes of the habitats directive (FFH). VU = vulnerable, NT = nearly theatend

English Name	Scientific name	RL A	FFH-Directive
Smooth newt	*Lissotriton vulgaris*	NT	
Alpine newt	*Ichthyosaura alpestris*	NT	
Alpine crested newt	***Triturus carnifex***	**VU**	**Annex II and IV**
Tree frog	***Hyla arborea***	**VU**	**Annex IV**
Common toad	*Bufo bufo*	NT	
Common frog	*Rana temporaria*	NT	Annex V
Agile frog	***Rana dalmatina***	**NT**	**Annex IV**
Balkan Moor frog	***Rana arvalis wolterstorffi***	**VU**	**Annex IV**
Waterfrog*	***Pelophylax sp.***	**VU**	**Annex IV or V**

1.2.4 Dragonflies

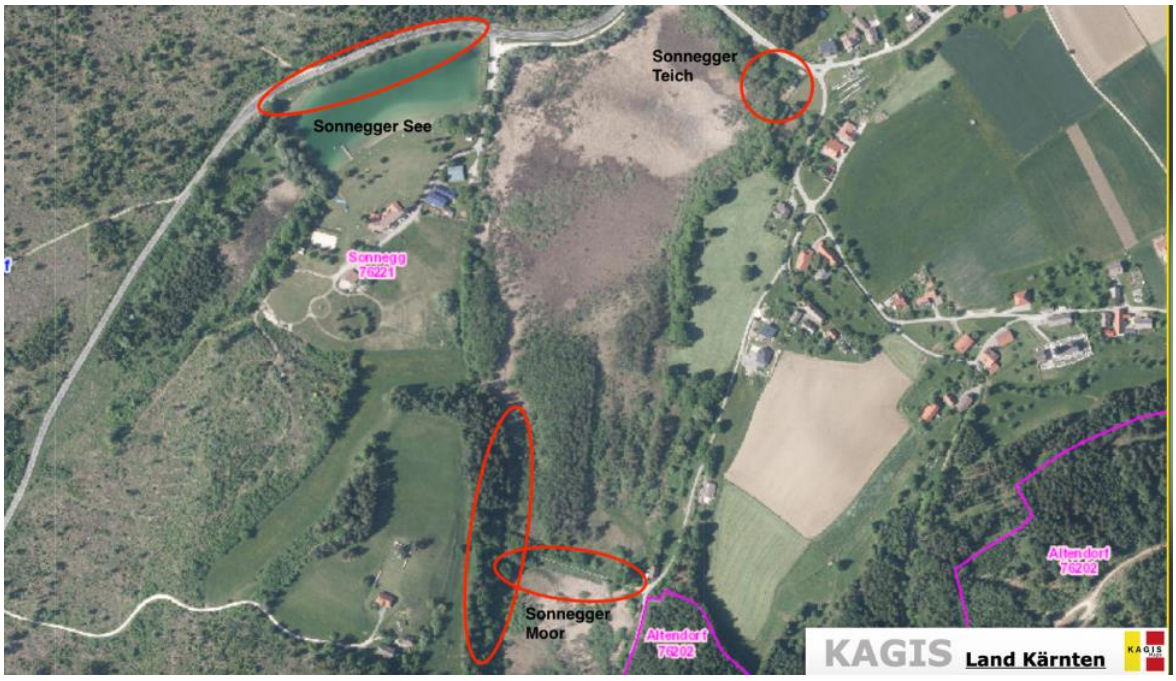

Figure 1.22: Study sites for the dragonflies

The Sonnegg Fen study area was divided into three sites. Sonnegg Lake, Sonnegg Fen, and Sonnegg pond (see **Figure 1.22**).
The following **Table 1.8** lists the observed dragonfly species at the three study sites.

Table 1.8: Dragonfly species recorded at Sonnegg Fen divided into three study sites incl. Endangerment status in Austria and Carinthia (systematic ranking according to Wildermuth & Martens, 2019); RL-A - Red List Austria (raab, 2006), RL-K - Red List Carinthia (Holzinger & Komposch, 2012), LC - Least Concern (not endangered), NT - Near Threatened (potentially endangered), EN - Endangered (strongly endangered).

Scientific name	RL-A	RL-K	Sonnegg Lake		Sonnegg Fen		Sonnegg Pond	
			12.06.23	25.08.23	12.06.23	25.08.23	12.06.23	25.08.23
Sympecma fusca	LC	LC				x		
Calopteryx virgo	**NT**	**NT**		**x**				

Scientific name	RL-A	RL-K	Sonnegg Lake		Sonnegg Fen		Sonnegg Pond	
Platycnemis pennipes	LC	LC	x	x			x	
Coenagrion puella	LC	LC	x				x	x
Coenagrion pulchellum	LC	LC	x				x	
Ischnura elegans	LC	LC	x	x				
Pyrrhosoma nymphula	LC	LC			x		x	
Aeshna cyanea	LC	LC				x		x
Aeshna mixta	LC	LC				x		
Anax imperator	LC	LC					x	x
Cordulia aenea	LC	LC		x				
Somatochlora flavomaculata	**EN**	**NT**			**x**	**x**		
Orthetrum cancellatum	LC	LC	x					
Sympetrum striolatum	LC	LC						x
Sympetrum vulgatum	LC	LC				x		x
Total number of species			**5**	**4**	**2**	**5**	**5**	**5**

According to Holzinger & Komposch (2012, p. 185), there are records of *Brachytron pratense* at Lake Sonnegg. Furthermore, Holzinger & Komposch (2012, p. 141) describe an individual-rich population of *Sympecma fusca* at Lake Sonnegg. A female *of Sympecma fusca* could be detected on 25.8.2023 at the Sonnegg Fen. Some photos of the occurring dragonflies are found below (see **Figure 1.23** to **Figure 1.25**)

Figure 1.23: *Calopteryx virgo* at the Sonnegg Lake, photo: DG

Figure 1.24: *Sympetrum striolatum* at Sonnegg Pond, Photo: DG

Figure 1.25: Egg deposition of *Anax imperator* at Sonnegg Teich, photo: DG

1.2.5 Ecological threats

The monitoring has shown valuable results but also some problems. Sonnegg lake is used mainly for leisure activities. The habitat quality is limited. The surrounding ponds and wetland are mainly overgrown by large reed belts. Parts of the fen are drying out, part are getting wetter, so that maintenance is difficult with nowadays equipment and manpower.
A widespread problem of the overgrowth in this area is caused by bushes and goldenrod *Solidago canadensis* due their aggressive and extensive growth at the edge of the fen. When the fen is getting dryer, goldenrod has the change to take over the former Molinia meadow.

1.2.6 Proposed measures

Figure 1.26: Site plan with landowners

The Sonnegg Fen is habitat for rare plant and amphibian and dragonfly species. Cutting bushes and mowing Solidago are essential management practices to maintain the biodiversity and ecological balance of natural habitats. By regularly cutting back overgrown bushes, we create open spaces that encourage the growth of diverse plant species and provide suitable habitats for various wildlife. The areas should be partially cleared, taking into account the presence of *Salix angustifolia*. Also, dragonflies need open areas. Especially the occurrence of *Somatochlora flavomaculata* in Sonnegg Fen is an important monitoring result. Important for the survival of this species is a regular

maintenance of wet meadows by mowing of parts of the vegetation and to hinder the spreading of bushland. Additionally, small open waterbodies should be maintained.
Also constructing and establishing of new amphibian ponds on reed areas are vital for the protection of the local biodiversity, especially amphibian species but also for dragonflies and should be taken into consideration.
A big challenge for implementation is the landownerships: several small plots belong to many different landowners; also, the community of Sittersdorf in an important stakeholder. The maintenance of the wet meadows was given up on purpose and with the aim of getting at least timer in future.

Figure 1.27: Proposal for establishment of spawning ponds for amphibians. Construction of amphibian ponds, place options A, B, C and D. Source Smole-Wiener

Figure 1.29: Part of the former *Molinia* meadow was maintained until 2005 and turned to a sedge area in 2023

Figure 1.28: Part of the fen next to the dam, which is falling dry and starts getting overgrown with bushes and invasive species

There are various opportunities to restore parts of the Sonneger Fen. As a first step, sensitization of the community to share the value of the local wetlands should be taken up.
A follow up project should be planned for the integrated implementation of the measures in the Sonnegger moor.

1.3 Kleinzapfen, Sittersdorf

Near to Kleinzapfen on bottom of a hill is a former *Molinia* meadow located in the Community of Sittersdorf. It encompasses some plots which are partly maintained by mowing and partly already overgrown. They are basically privately owned; one plot belongs to the church and was maintained by Arge NATURSCHUTZ in a prior project. The site was proposed by the observer for monitoring.
The ecological monitoring was done according to the simplified protocol developed in this project. The monitoring activities started in May 2023 with vegetation and birds. Two vegetation plots were done and the surrounding species also recorded. It was planned to observe also butterflies, but according to the wet and rainy summer the results would be compromised. Therefore, it is planned to continue with the activities in the following year together with NWV.

1.3.1 Vegetation

The Vegetation is made by a more or less overgrown and humpy *Molinia* meadow close to the forest. Part of the plot is heavily overgrown by Canadian goldenrod and by *Phragmites australis*. There are no rare species left within the dense vegetation and litter layer. *Schoenus ferrugineus* is a typical plant for calcareous fens, also *Carex panicea* and *Carex nigra* can be found often.

Table 1.9: Vegetation Plot in Kleinzapfen, Sittersdorf, Plot Kl 1 VA, Red List status Carinthian red list of vascular plants, Franz et al., 2023

Plot	**Kl 1 VA**	**Red List Status**
Latitude °	4.655.471	
Longitude °	1.457.848	
Date	22.05.2023	
Live plants (%)	50	
Bare Ground (%)	20	
Litter (%)	90	
Remarks	SO Corner point is 5 m north of the spruce tree, bulbous moor grass fallow with some old reeds; bulrushes up to 40cm high, wasp nests on reeds	
Observers	Susanne Glatz Jorde , Daniel Wuttej	
Cover Trees (%)	0	
Cover Shrubs (%)	0	
Cover Field Layer (vascular) (%)	50	
Cover Juvenile (%)	10	
Cover Seedling (%)	5	
Plant	**Kl 1 VA**	**Red List Status**
Brachpodium cf. rupestris	x	
Carex nigra	x	
Carex panicea	x	

Plant	Kl 1 VA	Red List Status
Cirsium palustre	x	
Galium boreale	x	
Lysimachia vulgaris	x	
Lythrum salicaria	**x**	
Mentha aquatica	x	
Molinia caerulea	x	
Phragmites australis	x	
Picea abies	x	
Schoenus ferrugineus	x	

Figure 1.30: *Schoenus ferrugineus* as typical plant for calcareous fens and abandoned *Molinia* meadows.

1.3.2 Birds

Birds were observed on 23rd May 2023 in the morning and on the 22nd June 2023 for a short visit before midday. The vegetation mosaic with reed vegetation, shrubs and solitaire trees with surrounding woods, fields and extensive grassland provide very attractive structures for birds. The Red-backed shrike was observed on both days. This bird species is listed in Annex I EU Birds Directive and qualified for the “amber” category in the Austrian List of “Birds of conservation Concern”, which means that short- or medium-term conservation action should be taken. The area with open extensive grass- and wetlands as well as bushes (used as perches) is a very suitable hunting and nesting habitat for the Red-backed shrike. The European Green Woodpecker and the Yellowhammer are two not that common species worth mentioning, although not directly dependent on wetlands. They are mostly birds from the neighboring cultural landscape, using the wetland area as foraging habitat. Generally, the habitat with bushes and reed vegetation would be suitable for the March warbler, which could not be spotted. In order to keep the high quality of the habitat for bird species, at least some of the bushes and trees should be kept at the site.

Table 1.10: Birds spotted at the Kleinzapfen in May 2023 (RL: Austrian Red list of Birds, Dvorak et al. 2017; BCD: Birds of conservation Concern, Dvorak et al. 2017, EUBD: European Birds Directive; State: rB: regular breeding bird)

English name	Scientific name	German name	RL	BCB	EUBD	State
Coal Tit	*Periparus ater*	Tannenmeise	LC	green	-	rB
Common Blackbird	*Turdus merula*	Amsel	LC	green	-	rB
Common Buzzard	*Buteo buteo*	Mäusebussard	LC	green	-	rB
Common Chaffinch	*Fringilla coelebs*	Buchfink	LC	green	-	rB
Common Chiffchaff	*Phylloscopus collybita*	Zilpzalp	LC	green	-	rB
Common Cuckoo	*Cuculus canorus*	Kuckuck	LC	green	-	rB
Common Firecrest	*Regulus ignicapilla*	Sommergoldhähnchen	LC	green	-	rB
Common Wood Pigeon	*Columba palumbus*	Ringeltaube	LC	green	-	rB
Eurasian Blackcap	*Sylvia atricapilla*	Mönchsgrasmücke	LC	green	-	rB
Eurasian Blue Tit	*Cyanistes caeruleus*	Blaumeise	LC	green	-	rB
Eurasian Golden Oriole	*Oriolus oriolus*	Pirol	LC	green	-	rB
Eurasian Jay	*Garrulus glandarius*	Eichelhäher	LC	green	-	rB
Eurasian Nuthatch	*Sitta europaea*	Kleiber	LC	green	-	rB
European Green Woodpecker	*Picus viridis*	Grünspecht	LC	green	-	rB
European Robin	*Erithacus rubecula*	Rotkehlchen	LC	green	-	rB
Great Spotted Woodpecker	*Dendrocopos major*	Buntspecht	LC	green	-	rB
Great Tit	*Parus major*	Kohlmeise	LC	green	-	rB
Marsh Tit	*Poecile palustris*	Sumpfmeise	LC	green	-	rB
Red-backed Shrike	***Lanius collurio***	**Neuntöter**	**LC**	**amber**	**Annex I**	**rB**
Yellowhammer	*Emberiza citrinella*	Goldammer	LC	green	-	rB

Figure 1.31: The plot next to the abandoned meadow is overgrown with goldenrod and *Phragmites*.

Figure 1.32: Humpy abandoned *Molinia* meadow

1.3.3 Ecological threats

The most significant threat in Kleinzapfen is the proliferation of bushes, which inhibit the undergrowth and overgrow the former *Molinia* meadows. Rare species like orchids are not able to grow anymore in such environment. Another threat is the extensive stands of *Solidago gigantea* next to the site, which causes impairments to site specific species.

1.3.4 Proposed measures

The main measures include mowing *Solidago gigantea*, the *Molinia* meadow. The emerging bushes should be removed to prevent the inhibition of site-specific species. Arge NATURSCHUTZ had a project to try out machines for removal of Canadian Goldenrod. Unfortunately, it turned not out to be feasible.

The heavy load of seeds of goldenrod makes it impossible to open up the soil next to the site. The removal of this invasive species at that site would need intensive maintenance like mowing three or four times a year over a minimum of decade of time.
The landowner shall be addressed to clarify the next steps and the willingness to invest in this area.

Figure 1.33: Snails (*Helicidae*) climb the dry reed stems in dry periods

Figure 1.34: *Polistes dominula* in its nest on pine seedling

1.4 Pirkdorfersee

1.4.1 Vegetation

Lake Pirkdorf is an artificial swimming lake which was dug in a former wetland several decades ago. There is also a dam keeping the water level. The surrounding is used as a campground and the lake is also full of fish. The area is mowed several during the vegetation period. At the western corner there is an island with a meadow and some bushes. Limited access is given there. Part of the island is overgrown by goldenrod. Next to it reed belt exists of several meters' extension. Due to the linear extension of the shoreline vegetation no plot was made, but a species list war elaborated.

It contains several wetland plants but also hay meadow species. Typical for wetland are various carex species like *Carex versicaria, Carex acutiformis, Carex elata, Carex nigra, Carex pallescens*. and *Iris pseudacorus* are mentionable, as well as *Typha latifolium*. *Eleocharis palustris* and *Schoenoplecus lacustris* are listed as vulnerable in the Carinthian Red list of vascular plants (see also Franz et al., 2023).

Figure 1.35: Lake Pirkdorf with a small stretch of natural vegetation

Table 1.11: Vegetation Plot at the Pirkdorfer Lake, Plant list PI A, Red List: Carinthian red list of vascular plants, Franz et al., 2023.

Plot	**Pi A**	**Red List status**
Latitude °	465.581.808	
Longitude °	147.514.654	
Date	26.05.2023	
Observers	Susanne Glatz Jorde , Daniel Wuttej	
Plant species	**Pi A**	**Red List status**
Acer pseudoplatanus	X	
Agromonia eupatoria	X	
Agrostis stolonifera	X	
Ajuga reptans	X	
Alnus glutinosa	X	
Artemisia vulgaris	X	
Avenula pubescens	X	
Betula pendula	X	
Campanula patula	X	
Carex versicaria	**X**	**VU**
Carex acutiformis	**X**	**LC**
Carex elata	X	
Carex nigra	X	
Carex pallescens	X	
Carex hirta	X	
Cerastium holosteoides	X	
Cirsium vulgare	X	
Cirsium oleraceum	X	
Cirsium arvense	X	
Cornus sanguniea	X	
Crataegus monogyna	X	
Deschampsia cespisota	X	
Eleocharis palustris	**X**	**VU**
Epliobium hirsutum	X	
Equisteum fluviatile	X	

Plant species	Pi A	Red List status
Equisteum arvense	X	
Euonymus europaeus	X	
Festuca rubra	X	
Fragaria vesca	X	
Frangula alnus	X	
Fraxinus excelsior	X	
Heracleum sphondylium	X	
Holcus lanatus	X	
Hypericum tetrapterum	X	
Iris pseudacorus	**X**	**LC**
Juglans regia	X	
Juncus effusus	X	
Ligustrum vulgare	X	
Lotus corniculatus	X	
Luzula campestris	X	
Lychnis flos-cuculi	X	
Lythrum salicaria	X	
Myosotis scorpioides	X	
Phragmites australis	X	
Picea abies	X	
Poa trivialis	X	
Pinus sylvestris	X	
Poa annua	X	
Prunus avium	X	
Ranunculus repens	X	
Rumex crispus	X	
Rumex acetosa	X	
Salix cinera	X	
Salix caprea	X	
Sambucus nigra	X	
Sanguisorba officinalis	X	
Schoenoplectus lacustris	**X**	**LC**
Solidago canadensis	X	
Solidago gigantea	X	
Sorbus aucorparia	X	
Taraxacum officinale agg. = Taraxacum sect. Ruderalia	X	
Trifolium repens	X	
Typha latifolia	**X**	**LC**
Valeriana officinalis	X	
Viburnum opulus	X	
Viburnum lantana	X	
Vicia sepium	X	

Figure 1.36: The island in the north-western corner offers habitat for different birds

1.4.2 Birds

Birds were observed at lake Pirkdorf two times for about one hour on 26th of May 2023 in the afternoon and on the 8th of June 2023 in the morning. The lake with the island covered which bushes, solitaire trees and abandoned grassland offers many structures for birds. The reed belt the NW part of the lake is a highly suitable habitat for the Reed warbler. On 8th of June there could be observed at least three singing males in the reed areas on the edge of the lake and the island. This is a very high density for such a small area. There are around 300-500 breeding couples of the Reed warbler in whole Carinthia (Feldner et al, 2006). Although this species is neither threatened nor occurring on the Austrian List of "Birds of conservation Concern" (Dvorak et al. 2017), measures at Pirkdorfer Lake should take in account this species. If the management would mow the grass not to the water's edge in some parts of the lake, the reed would extend rapidly and the habitat for the Reed warbler could be enlarged. This warbler could also be used as flag ship species on information boards to show the camping guests what is done for the avifauna.
Two Mallard where swimming in the lake, which could be a suitable breeding habitat for this species. The huge anthills in the abandoned meadow on the island could be rich feeding habitat for woodpeckers. The Great Spotted Woodpecker was observed on the visit in June. The surrounding camp side attracts many species of cultural landscapes and villages. The Common House Martin (NT and "amber" category in the Austrian List of "Birds of conservation Concern") was observed hunting for insects above the lake, using the nearby buildings as nesting habitat. The European Greenfinch was observed building a nest in the nearby hedge, the Eurasian Tree Sparrow was visiting a nest site and the White Wagtail was feeding the young. Also, the European Goldfinch and the Yellowhammer as typical species of cultural landscape were observed singing around the lake.

Table 1.12: Birds spotted at Pirkdorf Lake in May 2023 (RL: Austrian Red list of Birds, DVORAK et al. 2017; BCD: Birds of conservation Concern, DVORAK et al. 2017, EUBD: European Birds Directive; State: rB: regular breeding bird)

English name	Scientific name	German name	RL	BCB	EUBD	State
Barn Swallow	*Hirundo rustica*	Rauchschwalbe	LC	green	-	rB
Black Redstart	*Phoenicurus ochruros*	Hausrotschwanz	LC	green	-	rB
Common Blackbird	*Turdus merula*	Amsel	LC	green	-	rB
Common Chaffinch	*Fringilla coelebs*	Buchfink	LC	green	-	rB
Common Chiffchaff	*Phylloscopus collybita*	Zilpzalp	LC	green	-	rB
Common Cuckoo	*Cuculus canorus*	Kuckuck	LC	green	-	rB
Common House Martin	***Delichon urbicum***	**Mehlschwalbe**	**NT**	**amber**	**-**	**rB**
Common Starling	*Sturnus vulgaris*	Star	LC	green	-	rB
Common Wood Pigeon	*Columba palumbus*	Ringeltaube	LC	green	-	rB
Eurasian Blackcap	*Sylvia atricapilla*	Mönchsgrasmücke	LC	green	-	rB
Eurasian Collared Dove	*Streptopelia decaocto*	Türkentaube	LC	green	-	rB
Eurasian Golden Oriole	*Oriolus oriolus*	Pirol	LC	green	-	rB
Eurasian Jay	*Garrulus glandarius*	Eichelhäher	LC	green	-	rB
Eurasian Reed Warbler	*Acrocephalus scirpaceus*	Teichrohrsänger	LC	green	-	rB
Eurasian Tree Sparrow	*Passer montanus*	Feldsperling	LC	green	-	rB
Eurasian Wren	*Troglodytes troglodytes*	Zaunkönig	LC	green	-	rB

English name	Scientific name	German name	RL	BCB	EUBD	State
European Goldfinch	*Carduelis carduelis*	Stieglitz	LC	green	-	rB
European Greenfinch	*Chloris chloris*	Grünling	LC	green	-	rB
European Robin	*Erithacus rubecula*	Rotkehlchen	LC	green	-	rB
Great Spotted Woodpecker	*Dendrocopos major*	Buntspecht	LC	green	-	rB
Great Tit	*Parus major*	Kohlmeise	LC	green	-	rB
Hooded Crow	*Corvus cornix*	Nebelkrähe	LC	green	-	rB
House Sparrow	*Passer domesticus*	Haussperling	LC	green	-	rB
Mallard	*Anas platyrhynchos*	Stockente	LC	green	-	rB
Mistle Thrush	*Turdus viscivorus*	Misteldrossel	LC	green	-	rB
Song Thrush	*Turdus philomelos*	Singdrossel	LC	green	-	rB
White Wagtail	*Motacilla alba*	Bachstelze	LC	green	-	rB
Yellowhammer	*Emberiza citrinella*	Goldammer	LC	green	-	rB
Great Spotted Woodpecker	*Dendrocopos major*	Buntspecht	LC	green	-	rB

Figure 1.37: A very small part of the shore remains natural and offers hiding places for animals

1.4.3 Amphibians

Amphibians were recorded in March and in April 2023 by Karina Smole-Wiener and by E.C.O. Institute for Ecology. The lake is not yet known as spawning ground for amphibians, due to its artificial surrounding.

In March a big number of common toads were swimming at the lake. However, due to the presence of a numerous fish population and due to the lack of vegetation in the lake the habitat is not optimal for amphibians.

Table 1.13: Amphibian species recorded at Pirkdorf Lake, their conservation status according to the red list of Carinthia RL C (GOLLMANN 2007), and their listings in the annexes of the habitats directive (FFH). NT = nearly theatend

English Name	Scientific name	RL C	FFH-Directive
Tree frog	***Hyla arborea***		**Anhang IV**
Common toad	***Bufo bufo***	**NT (Gefährdung droht)**	
Common frog	***Rana temporaria***	**NT (Gefährdung droht)**	**Anhang V**

Figure 1.38: Common toads at Pirkdorfer Lake like the sunny spawning ground

1.4.4 Dragonflies

Figure 1.39: *Cordulia aenea* at Lake Pirkdorf, photo: DG

Figure 1.40: *Libellula quadrimaculata* at Lake Pirkdorf, photo: DG

Dragonflies were observed and documented by Doris Gitschthaler, and external expert. **Table 1.14** lists all Odonata species sighted at Lake Pirkdorf.

Table 1.14: Detected dragonfly species at Lake Pirkdorf incl. endangerment status in Austria and Carinthia (systematic ranking according to Wildermuth & Martens, 2019); RL-A - Red List Austria (Raab, 2006), RL-C - Red List Carinthia (Holzinger & Komposch, 2012), LC - Least Concern (not endangered), NT - Near Threatened (potentially endangered).

Scientific Name	RL-A	RL-C	Lake Pirkdorf	
			12.06.23	25.08.23
Calopteryx virgo	**NT**	**NT**	**x**	**x**
Platycnemis pennipes	LC	LC	x	
Coenagrion puella	LC	LC	x	x
Enallagma cyathigerum	LC	LC		x
Ischnura elegans	LC	LC		x
Aeshna cyanea	LC	LC		x
Aeshna grandis	LC	LC		x
Anax imperator	LC	LC	x	x
Cordulia aenea	LC	LC	x	
Libellula quadrimaculata	LC	LC	x	
Orthetrum albistylum	LC	LC		x
Sympetrum sanguineum	LC	LC		x
Sympetrum striolatum	LC	LC		x
Sympetrum vulgatum	LC	LC		x
TOTAL			**6**	**11**

Figure 1.41: Study areas Lake Pirkdorf circled in red, source: KAGIS, modified by Doris Gitschthaler (on 28.08.23)

The study sites are located on the northern and northwestern shore areas, as well as on the lake outlet, which runs parallel to the northern shoreline.
Holzinger & Komposch (2012, p. 141) describe an individual-rich population of *Sympecma fusca* at Lake Pirkdorf. The Common Winter Damselfly could not be detected on the two survey dates.

14 Odonata species were detected at Lake Pirkdorf, most of them common species. *Calyopterix virgo* is listed as vulnerable.
Though Lake Pirkdorf is intensively used, it shows that a small structure like the small island provides structures and habitat for many species.

1.4.5 Ecological threats

The area is heavily influenced by tourism. The mowing at the camp site is carried out intensively, so that very little natural vegetation remains as habitat for typical species. The fish population is hindering the development of a species rich amphibian fauna. On the island, is an extensive spread of goldenrod *Solidago gigantea*, which inhibits the natural vegetation.

1.4.6 Proposed measures

The main measure in this area should be raising awareness and visitor management. The frequency of mowing should be changed at the shoreline, or some sub-areas with valuable species should be fenced. Another measure is the abandonment of some areas to allow for natural regeneration of the shoreline. Regular mowing of *Solidago gigantea* on the island is highly desirable. To protect the amphibians, the establishment of two ponds (**Figure 1.42**) is desirable. These should remain mostly fish-free.

Figure 1.42: Site plan of the proposed measures. Establishment of amphibian breeding ponds at location A and B

The establishment of amphibian ponds need the agreement with the landowner, the preparation of documents for the authorities. The implementation of the pond also extends the status of pilot measures and needs proper planning and financing.

However, the sensitization of the campground owner and the tourists can be done as a pilot restoration measures. Interpretation panels shall be established on the site.

1.5 Lavamünder Badesee

The swimming lake of Lavamünd was established in the former alluvial forest of Drava River, close the power plant of Lavamünd. It consists of a bigger swimming lake with surrounding lawn on three sites. The western part is left naturally, there is also a small reed belt and water plants. In the northwest of the lake two small ponds were placed, surrounded by willow bushes. The lake is owned by the Community of Lavamünd, the Swimming part is rented out. The natural part in the north west was developed for natura conservation.

1.5.1 Vegetation

The vegetation on the three ponds is different. The swimming lake has a natural shore at the northern part. It consists of *Phragmites australis* and *Typha latiifolia*, followed by *Carex acutiformis*. The water itself shows partly a vegetation of *Potamogetum nudosus a*n endangered species in Carinthia.
The first small pond behind the swimming lake is surrounded by younger trees of the species *Willows*, ash. *Populus* and *Quercus*. Half of the pond is covered by phragmites australis. The shore is overgrown by a dense willow vegetation. The third pond is covered by *Lemna triscula.* The shore is also covered by a dense tree vegetation, also the invasive *Solidago canadensis* and a quite remarkable bamboo can be found.

Table 1.15: Plant species around swimming lake Lavamünd natural zone, LA 1 A

Plant list		**LA1 A**	**Red List Status**
Latitude °		466 490 241	
Longitude °		149 306 311	
Date		26.05.2023	
Observers		N/A	
Live plants (%)		80	
Bare Ground (%)		20	
Litter (%)		10	
Remarks	Area next to Swimming like, between the two ponds. Bamboo in the northern part.		
Observers		Susanne Glatz Jorde , Daniel Wuttej	
Acer campestre	hl	x	
Acer campestre	s	x	
Acer pseudoplatanus	hl	x	
Acer pseudoplatanus	s	x	
Alnus glutinosa	t	x	
Alopecurus pratensis	hl	x	
Anthoxanthum odoratum	hl	x	
Arrhenatherum elatius	hl	x	
Avenula cf. pubescens	hl	x	
Berberis vulgaris	s	x	
Carex acutiformis	hl	x	
Cornus sanguinea	s	x	
Crataegus monogyna	s	x	
Cruciata laevipes	hl	x	
Equisetum arvense	hl	x	
Erigeron annuus	hl	x	

Plant list		LA1 A	Red List Status
Euonymus europaeus	s	x	
Festuca rubra	hl	x	
Filipendula ulmaria	hl	x	
Fragaria vesca	hl	x	
Fraxinus excelsior	t	x	
Fraxinus excelsior	hl	x	
Galium album	hl	x	
Galium aparine	hl	x	
Glyceria cf. fluitans	hl	x	
Hedera helix	hl	x	
Hibiscus sp.	s	x	
Holcus lanatus	hl	x	
Humulus lupulus	s	x	
Lemna cf. minor	hl	x	
Ligustrum vulgare	s	x	
Lonicera xylosteum	s	x	
Medicago lupulina	hl	x	
Medicago sativa	hl	x	
Phragmites australis	hl	x	
Plantago lanceolata	hl	x	
Poa trivialis	hl	x	
Populus alba	s	x	
Potamogeton nodosus	**hl**	**x**	**EN**
Potentilla erecta	hl	x	
Quercus robur	t	x	
Quercus robur	hl	x	
Ranunculus acris	hl	x	
Ranunculus repens	hl	x	
Rhamnus cathartica	s	x	
Rubus caesius	s	x	
Rubus idaeus	s	x	
Salix caprea	t	x	
Salix cf. purpurea	s	x	
Salix fragilis	t	x	
Scirpus sylvaticus	hl	x	
Solidago canadensis	hl	x	
Sorbus aucuparia	s	x	
Taraxacum officinale agg. = Taraxacum sect. Ruderalia	hl	x	
Trifolium pratense	hl	x	
Tussilago farfara	hl	x	
Typha latifolia	hl	x	
Ulmus glabra	t	x	
Urtica dioica	hl	x	
Valeriana officinalis	hl	x	
Viburnum lantana	s	x	
Viburnum opulus	s	x	
Vicia sepium	hl	x	
Bambus sp.	s	x	

1.5.2 Birds

Birds were observed on 26th of May 2023 from 7:30 till 10:00 in the morning. The small ponds, the riparian forest, the surrounding grassland and the Drava River offer rich habitats for different bird species. In the direct surrounding of the ponds the Spotted Flycatcher is worth mentioning. One male was singing in the bushes around the ponds. Other common species observed there were Common Chiffchaff, Eurasian Blackcap, Eurasian Blue Tit and Marsh Tit. A Eurasian Sparrowhawk was spotted while hunting singing birds between the bushes and trees.

The surrounding bathing area attracts species of the villages. White Wagtail and Black Redstart are common in this area. The reed next to the swimming lake was used as

feeding habitat by Eurasian Tree Sparrows, but no warblers could be observed. However, the habitat with bushes and reed vegetation could also be suitable for the March warbler. The Common Kingfisher (NT -near threatened, Annex I EU Birds Directive and amber" category in the Austrian List of "Birds of conservation Concern") was observed at the Drava River, the common species Mallard and Mute Swan were swimming there. The Eurasian Hobby was observed hunting above the Drava River. The endangered Whinchat ("red" category in the Austrian List of "Birds of conservation Concern") was observed in the meadow north of the ponds. The Black woodpecker (Annex I EU Birds Directive and amber" category in the Austrian List of "Birds of conservation Concern") is a breeding bird from the surrounding woods, mostly just flying over the area. In May 2023 a group of Eurasian Sparrowhawks hunting over Drava River could be observed.

Table 1.16: Birds spotted at swimming lake Lavamünd in May 2023 (RL: Austrian Red list of Birds, Dvorak et al. 2017; BCD: Birds of conservation Concern, Dvorak et al. 2017, EUBD: European Birds Directive; State: rB: regular breeding bird)

English name	Scientific name	German name	RL	BCB	EUBD	State
Barn Swallow	*Hirundo rustica*	Rauchschwalbe	LC	green	-	rB
Black Redstart	*Phoenicurus ochruros*	Hausrotschwanz	LC	green	-	rB
Black Woodpecker	*Dryocopus martius*	Schwarzspecht	LC	amber	Annex I	rB
Coal Tit	*Periparus ater*	Tannenmeise	LC	green	-	rB
Common Blackbird	*Turdus merula*	Amsel	LC	green	-	rB
Common Buzzard	*Buteo buteo*	Mäusebussard	LC	green	-	rB
Common Chaffinch	*Fringilla coelebs*	Buchfink	LC	green	-	rB
Common Chiffchaff	*Phylloscopus collybita*	Zilpzalp	LC	green	-	rB
Common Cuckoo	*Cuculus canorus*	Kuckuck	LC	green	-	rB
Common Kingfisher	***Alcedo atthis***	**Eisvogel**	**NT**	**amber**	**Annex I**	**rB**
Common Wood Pigeon	*Columba palumbus*	Ringeltaube	LC	green	-	rB
Eurasian Blackcap	*Sylvia atricapilla*	Mönchsgrasmücke	LC	green	-	rB
Eurasian Blue Tit	*Cyanistes caeruleus*	Blaumeise	LC	green	-	rB
Eurasian Golden Oriole	*Oriolus oriolus*	Pirol	LC	green	-	rB
Eurasian Hobby	*Falco subbuteo*	Baumfalke	LC	green	-	rB
Eurasian Nuthatch	*Sitta europaea*	Kleiber	LC	green	-	rB
Eurasian Sparrowhawk	*Accipiter nisus*	Sperber	LC	green	-	rB
Eurasian Tree Sparrow	*Passer montanus*	Feldsperling	LC	green	-	rB
European Crested Tit	*Lophophanes cristatus*	Haubenmeise	LC	green	-	rB
European Goldfinch	*Carduelis carduelis*	Stieglitz	LC	green	-	rB
Great Spotted Woodpecker	*Dendrocopos major*	Buntspecht	LC	green	-	rB
Great Tit	*Parus major*	Kohlmeise	LC	green	-	rB
Hooded Crow	*Corvus cornix*	Nebelkrähe	LC	green	-	rB
Mallard	*Anas platyrhynchos*	Stockente	LC	green	-	rB
Marsh Tit	*Poecile palustris*	Sumpfmeise	LC	green	-	rB
Mute Swan	*Cygnus olor*	Höckerschwan	-	-	-	rB
Spotted Flycatcher	*Muscicapa striata*	Grauschnäpper	LC	green	-	rB
Whinchat	***Saxicola rubetra***	**Braunkehlchen**	**EN**	**red**	**SPA Trigger**	**rB**
White Wagtail	*Motacilla alba*	Bachstelze	LC	green	-	rB
Yellow-legged Gull	***Larus michahellis***	**Mittelmeermöwe**	**VU**	**green**	**-**	**rB**

1.5.3 Amphibians

Amphibia in the area were counted via roadkill protection measures in the area. There is an ongoing project by Arge NATURSCHUTZ. The lake and the ponds are full of fish, that's why only the amphibian species occur. Only common toads and common frogs as well as water frogs were found. The ponds are quite shady, that's why they do not prefer them. Due to fish the reproduction success is limited.

Table 1.17: Amphibia detected at swimming lake Lavamünd: Proven amphibian species at the swimming lake, their endangerment according to the Austrian Red List Rl A(Gollmann, 2007) and their mention in the appendices of the Habitats Directive. VU = endangered, NT = nearly threatened.

English Name	Scientific name	RL A	FFH Directive
Common toad	*Bufo bufo*	NT	
Common frog	***Rana temporaria***	**NT**	**Annex V**
Water frog*	***Pelophylax sp.***	**VU**	**Annex IV, V**

*water frogs were not identified at species level.

1.5.4 Dragonflies

The main focus of the investigation was on the southern, western and northwestern shore areas (see **Figure 1.43**).
Table 1.18 lists all dragonfly species sighted at the swimming lake Lavamünd. Two of the species are listed as near threatened in the Carinthian red list. Seven exuviae were found during the survey on 12.06.2023. Of these, five exuviae can be assigned to *Anax imperator*. Furthermore, one exuvium each could be assigned to *Orthetrum cancellatum* and *Coenagrion* sp. Some of the species are represented in **Figure 1.45** to **Figure 1.46**.

Figure 1.43: Study areas of bathing lake Lavamünd circled in red, source: KAGIS, modified by Doris Gitschthaler (on 28.08.23).

Table 1.18: Detected dragonfly species at Lake Lavamünd incl. endangerment status in Austria and Carinthia (systematic ranking according to Wildermuth & Martens, 2019); RL-A - Red List Austria (Raab, 2006), RL-K - Red List Carinthia (Holzinger & Komposch, 2012), LC - Least Concern (not endangered), NT - Near Threatened (potentially endangered), VU - Vulnerable (endangered).

Scientific Name	RL-A	RL-C	Swimming Lake Lavamünd	
			12.06.23	25.08.23
Calopteryx virgo	**NT**	**NT**		**x**
Platycnemis pennipes	LC	LC	x	x
Coenagrion puella	LC	LC	x	
Enallagma cyathigerum	LC	LC	x	x
Ischnura elegans	LC	LC	x	x
Aeshna isoceles	**VU**	**NT**	**x**	
Anax imperator	LC	LC	x	x
Cordulia aenea	LC	LC	x	
Crocothemis erythraea	LC	LC		x
Libellula quadrimaculata	LC	LC	x	
Orthetrum cancellatum	LC	LC	x	
Total			**9**	**6**

Figure 1.44: *Orthetrum cancellatum* at lake Lavamünd, Photo: DG

Figure 1.47: *Aeshna isoceles* at lake Lavamünd, Photo: DG

Figure 1.46: *Ischnura elegans* at lake Lavamünd, Photo: DG

Figure 1.45: *Crocothemis erythraea* at lake Lavamünd, Photo: DG

1.5.5 Other species

As a part of an excursion during the Lavamünder summer school, a small zoological monitoring was conducted. Following species were found:

Table 1.19: Other species detected at Swimming lake Lavamünd.

Name	Species	Redlist Austria	FFH Directive
Four spotted leaf beetle	*Clytra quadripunctata*		
Glassworms	*Chaoborus sp.*		
Great silver water beetle	*Hydrophilus piceus*		
Peach blossom jellyfish	*Craspedacusta sowerbii*		
Peardrop beetle	*Cybister lateralimarginalis*		
Piratenspinne	*Pirata sp.*		
Pond skater	*Gerridae*		
Water scorpion	*Nepa cinerea*		
peach blossom jellyfish	*Craspedacusta sowerbii*		

1.5.6 Ecological threats

The widespread occurrence of invasive plants (e.g., *Bambusoideae*, *Solidago canadensis)* in the area poses the greatest threat. The plants were dumped there by garden owners. Also, the trees tend to overgrow the ponds. The shading of the pond leads to an absorption of the sunlight. Overgrowth can restrict or even destroy the natural habitat of native species. Especially amphibians and dragonflies rely on open sunny water surfaces to reproduce or find food. The presence of fish in the pond negatively impacts the fauna.

Figure 1.48: View of the bamboo vegetation

1.5.7 Proposed measures

One priority measure is to sensitize the community on the value of such habitat for natura and also for the people. It is now used as a learning site for the primary and secondary school of Lavamünd and as natural recreation site along the Drava River. Visitor management should be done to avoid disturbance especially in springtime, during the breeding season of the birds.
A second important measure is to improve the maintenance regime.

It is important to control the invasive species, especially goldenrod and bamboo, which overgrow the northern part. Garten cuttings are dumped illegally into the wetland, so there is a need to sensitize the community on the results of such behavior. Measure three is the removal of bushes and trees next to the northern ponds to allow mor sunlight. However, it needs to take into account not to open up the area for more visitors.

Figure 1.49: Proposed measures. Removing dense vegetation and invasive species control.

As a part of the summer camp of the Lavamünd school, the participants of the excursion were introduced to the threats of invasive plants. Bamboo and *Solidago canadensis* were largely removed and taken out of the area. In the classroom, using the collected materials (bamboo tubes), insect hotels were built.
To preserve this habitat, regular measures are required, such as the removal of invasive plants and shrubs. Willow and ashes are hanging above the Water, which causes shading. These and the invasive species (bamboo tubes, *Solidago canadensis*) should be removed in recurring interventions.

1.6 Bleiburg / Einersdorf

The pond in Einersdorf is situated next to the forest on the lowest part of the Kömmel mountain. There was a former clay quarry for bricks, and there are several ponds left. The respective pond is in the shadow of big ash and spruce trees. The monitoring was done by Susanne Glatz-Jorde and Daniel Wuttej of E.C.O. – Institute for Ökologie.

Figure 1.50: Pond in Einersdorf, May 2023

1.6.1 Vegetation

There is a grass vegetation inside, which reflects the temporarily drying out. At the shore there is *Iris pseudacorus* and *Carex versicaria*, the latter has the red list state vulnerable in Carinthia. At the northern side the presence of Spirea sp. shows the effect of dumping garden cut into the wetland. The pond is quite dark, because it is surrounded by trees like *Alnus glutinosa, Quercus robur, Acer pseudoplatanus, Prunus avium* and *Picea abies.*

Table 1.20: Plant species around Einersdorf

Plant List	**Ei 1 A**	**Red LIst**
Date	26.05.2023	
Remarks	Pond, Beech forest, *Spirea*, Water level fluctuates	
Observers	Susanne Glatz Jorde , Daniel Wuttej	
Cover Trees (%)	N/A	
Cover Shrubs (%)	N/A	
Cover Field Layer (vascular) (%)	N/A	
Cover Juvenile (%)	N/A	
Cover Seedling (%)	N/A	
Cover Field Layer (non-vascular) (%)	N/A	
Agrimonia eupatoria	x	
Alnus glutinosa	x	
Alopecurus pratensis	x	
Caltha palustris	x	
Cardamine amara	x	
Carex briziodes	x	
Carex versicaria	**x**	**VU**
Deschampsia cespitosa	x	

Plant List	Ei 1 A	Red LIst
Dryopteris filix-mas	x	
Equistetum fluviatile	x	
Ficaria verna	x	
Filipendula excelsior	x	
Fraxinus excelsior	x	
Galium aparine	x	
Impatiens parviflora	x	
Iris pseudacorus	x	LC
Lamium hybridum	x	
Lycopus europaeus	x	
Lythrum salicaria	x	
Picea abies	x	
Poa trivialis	x	
Prunus padus	x	
Rubis idaeus	x	
Salix fragilis	x	
Sambucus nigra	x	
Spirea alba	x	

1.6.2 Birds

Birds were observed on 23rd of May 2023 for an hour around midday. The pond with surrounding broad leaf trees is a good habitat for mostly common species of singing birds. Common Blackbird, Common Chaffinch, Common Chiffchaff, Eurasian Blackcap, Eurasian Nuthatch, European Greenfinch, European Robin, Eurasian Blue Tit, Great Tit and Marsh Tit were spotted around the pond. The Great Spotted Woodpecker also used this habitat, as well as the Spotted Flycatcher, one of the not that common species. Three male Mallards was swimming in the pond, that could also be a suitable breeding habitat for this species. The Common Kestrel was hunting on the neighboring fields.

In order to maintain the quality of the area for bird species, measures should be taken to keep water in the pond.

Table 1.21: Birds spotted in Einersdorf in May 2023 (RL: Austrian Red list of Birds, Dvorak et al. 2017; BCD: Birds of conservation Concern, Dvorak et al. 2017, EUBD: European Birds Directive; State: rB: regular breeding bird).

English name	Scientific name	German name	RL	BCB	EUBD	State
Common Blackbird	*Turdus merula*	Amsel	LC	green	-	rB
Common Chaffinch	*Fringilla coelebs*	Buchfink	LC	green	-	rB
Common Chiffchaff	*Phylloscopus collybita*	Zilpzalp	LC	green	-	rB
Common Kestrel	*Falco tinnunculus*	Turmfalke	LC	green	-	rB
Eurasian Blackcap	*Sylvia atricapilla*	Mönchsgrasmücke	LC	green	-	rB
Eurasian Blue Tit	*Cyanistes caeruleus*	Blaumeise	LC	green	-	rB
Eurasian Nuthatch	*Sitta europaea*	Kleiber	LC	green	-	rB
European Greenfinch	*Chloris chloris*	Grünling	LC	green	-	rB
European Robin	*Erithacus rubecula*	Rotkehlchen	LC	green	-	rB
Great Spotted Woodpecker	*Dendrocopos major*	Buntspecht	LC	green	-	rB
Great Tit	*Parus major*	Kohlmeise	LC	green	-	rB
Mallard	*Anas platyrhynchos*	Stockente	LC	green	-	rB
Marsh Tit	*Poecile palustris*	Sumpfmeise	LC	green	-	rB
Spotted Flycatcher	*Muscicapa striata*	Grauschnäpper	LC	green	-	rB

1.6.3 Amphibians

Amphibians were recognized in March and in May 2023. There are also fishponds next to the site. It could be observed that the pond was fallen dry during March, when it is an important time for spawning.

Table 1.22: Amphibian species recorded in Einersdorf.

English name	Scientific name	Red List Austria	FFH-Status
Common toad	*Bufo bufo*	NT	
Common frog	*Rana temporaria*	NT	Annex V

Figure 1.51: In March 2023 the pond was filled with water offering a spawning ground for amphibians

1.6.4 Ecological threats

Figure 1.52: The Vegetation shows temporary flooding.

The water level dries up prematurely, during the breeding season, throughout the year. This Conditions promote a decline especially in the amphibian population. The introduction of garden compost (e.g., S*pirea* sp.) in some areas is a main problem for a natural habitat.

Figure 1.53: The pond was fallen dry in June 2023

1.6.5 Proposed measures

To avoid further issues, it is essential to create a restoration plan. This plan should include the key measures for preserving valuable nature.
The former clay pond was disturbed by digging measures in the past. There is a need to find out where exactly it is losing water and to fill it up with clay again. Due to the existing constraints and resources, unfortunately, it is not possible to implement the measures in the frame of this project as it is too large and complex. To enable and carry out these implementations, it is necessary to develop a follow-up project.

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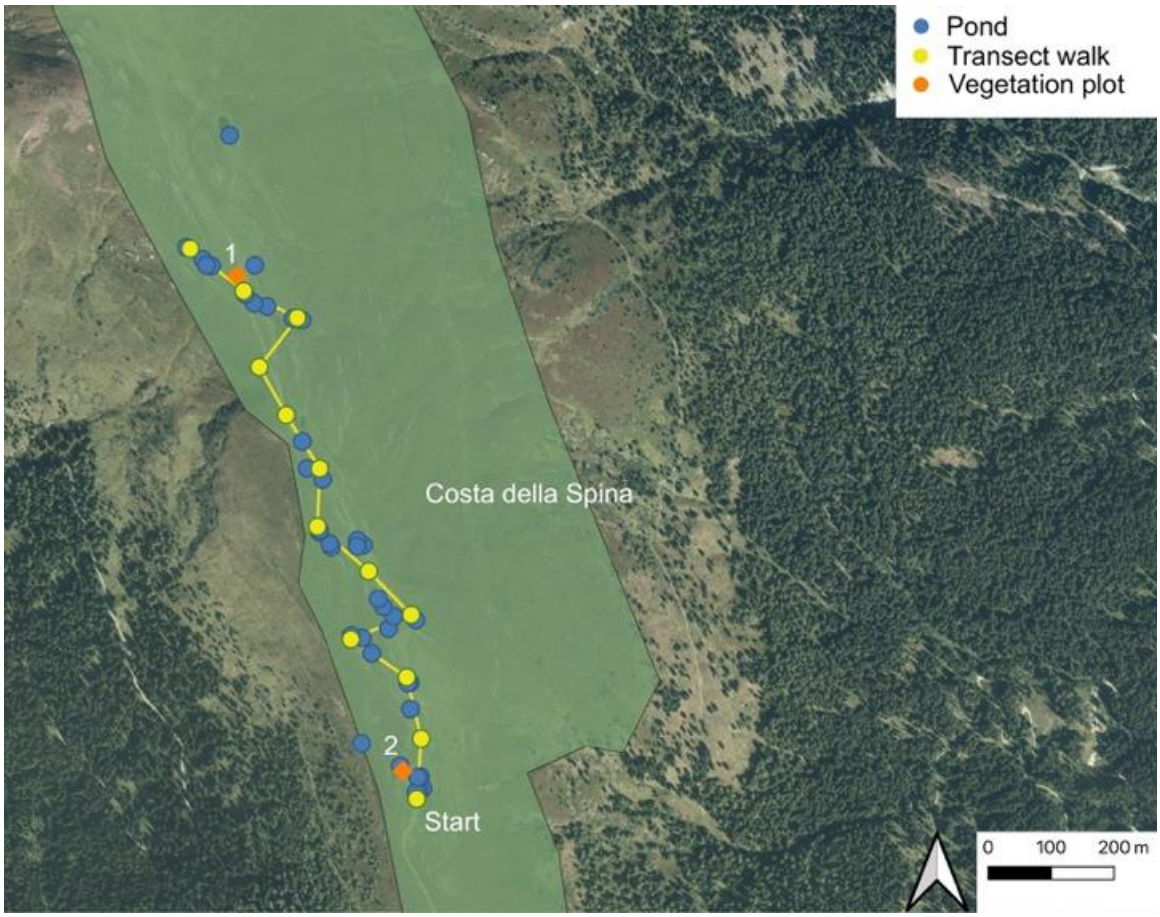
2. Italian sites

2.1 Pozze di Costa della Spina

Figure 2.1: Ponds in Costa della Spina (Comelico Superiore, Italy, 7.7.2023; photo by G. Menegus)

Costa della Spina (**Figure 2.1**) is a mountain ridge located in the municipality of Comelico Superiore, situated between the peaks of Monte Spina and Col Rosson, at an elevation ranging from 1950 to 2150 m above sea level (46.631484 N, 12.501868 E approx.). This area is just above the upper tree line, and it is characterised by Alpine heath (habitat type 4060) and siliceous grassland (6150), with small patches of siliceous scree (8110). 44 ponds are scattered through the site, many of which originated from bombings during World War I. They often have elongated shapes, while some occur naturally, with a significant number being temporary. The entire area is owned by the Regola Comunione Familiare di Dosoledo and is utilised as pasture for cattle and horses.

The ponds were mapped on June 20, 2023 (refer to **Map 2.1**), and a unique code was assigned to each pond site. Surveys were organized following the simplified protocol developed by the I-SWAMP collaboration. Two vegetation plots were chosen along the banks of plots 6 and 28 and were sampled. A Pollard transect walk for butterfly monitoring (Pollard & Yates, 1993; Sevilleja et al., 2019) was established and sampled twice, with additional observations conducted outside the transect walk. Point count surveys (PS) (Pearce-Higgins & Chandler, 2020, Smallshire & Beynon, 2010) and Visual Encounter Surveys (VES) (Scott et al., 1994) for dragonflies and amphibians were repeated three times for the majority of ponds.



Map 2.1: The area of Costa della Spina (Comelico Superiore, Italy). Green: project area; blue: ponds; yellow: transect for butterfly monitoring; orange: vegetation plots.

2.1.1 Vegetation

Most ponds exhibit signs of eutrophication, with murky water commonly observed, particularly in the latter part of the season. This condition is attributed to the prolonged use of the area as a pasture for cattle and horses. The majority of ponds display similar vegetation patterns; hence, we opted to focus on two plots located on the banks of ponds 6 and 28 (see **Map 2.1**), situated in areas prone to periodic flooding. **Table 2.1** provides a comprehensive list of species, along with their cover and conservation status (method similar to Braun-Blanquet, 1964).

As anticipated, we identified a wet prairie vegetation dominated by *Deschampsia cespitosa* and several sedges (*Carex canescens*, *Carex leporina*, *Carex nigra*) (see **Figure 2.2**), with limited diversity in other species. No species of conservation interest were noted. This vegetation pattern is characteristic of disturbed, trampled, and eutrophicated high-altitude pond banks, primarily on acidic soil. Interestingly, there is no significant variation between the two plots, despite the ponds being located at opposite ends of the ridge. The overall condition of the pond vegetation is suboptimal, particularly when compared to the vegetation found in areas outside the ponds, featuring notable examples of Alpine heath and siliceous grasslands.

Table 2.1: Vegetation plots in Costa della Spina (the cover of each species is reported for both plots; Plot 1-28: banks of pond 28; Plot 2-6: banks of pond 6; RL-BL and RL-V: conservation status in the red-list of Belluno province and Veneto Region, Buffa et al., 2016).

Species	Plot 1-Pond 28	Plot 2-Pond	RL-BL	RL-V
Bellardiochloa variegata (Lam.) Kerguélen	R	+	LC	LC
Carex canescens L.	1	2		
Carex leporina L.	+	2		
Carex nigra (L.) Reichard	R	2		
Deschampsia cespitosa (L.) P. Beauv.	3	5	LC	LC
Festuca rubra aggr.		+		
Juncus filiformis L.	R		LC	LC
Nardus stricta L.	R	R		
Phleum pratense L.		R		
Trifolium repens L.		R		
Veronica serpyllifolia L.		R		

2.1.2 Butterflies

Butterflies were observed on three occasions (20.6, 7.7 and 24.8.2023). A 1.2 km-long transect was designed (refer to **Map 2.1**), covering various areas of the ridges and diverse habitat types. The transect walk was repeated twice. Individual butterflies were identified on sight or after capture using a butterfly net. However, unfavourable weather conditions during most observations resulted in a limited number of species being recorded (refer to **Table 2.1** and **Table 2.3**).

The monitoring revealed a butterfly community comprising at least 11 species. Among them, *Coenonympha gardetta*, *Colias palaeno*, and *Erebia epiphron* are associated with wetlands, while many others are generalist species. This diverse community was expected given the mosaic of different habitat types in the area. The only species of conservation interest appears to be *Colias palaeno* (see **Figure 2.3**), which is becoming increasingly rare in northeast Italy (Paolucci, 2010). Its presence on Costa della Spina is likely linked to the presence of *Vaccinium* sp. and was previously documented (Bonato et al., 2014).

Table 2.2: Butterflies observed during transect walks in Costa della Spina in the 12 sections of the transect (Columns 1 to 12 show the number of adults observed for each species on 7.7 / 24.8.2023 in each section of the transect; - = no individuals observed; RL-I: conservation status in the Italian red list, Balletto et al. 2015; RL-NE: conservation status in northeast Italy according to Paolucci, Paolucci, 2010).

Species	RL-I	RL-NE	1	2	3	4	5	6	7	8	9	10	11	12
Aglais urticae	LC	Common	1/-	1/-	1/-			1/-	1/-					
Coenonympha gardetta	LC	LC					1/-							
Colias palaeno	LC	VU	1/-											
Erebia cassioides	LC	LC		-/1										
Erebia epiphron	LC	LC											-/1	
Erebia cf. *epiphron*	LC	LC								-/1				
Erebia pandrose/cassioides	LC/LC	LC/LC							1/-					
Erebia pronoe	LC	LC								-/1		-/1	-/1	
Erebia cf. *pronoe*	LC	LC								-/1		-/1		
Erebia sp.	–	–	1/-	1/-	1/-	-/2				1/1				

Species	RL-I	RL-NE	1	2	3	4	5	6	7	8	9	10	11	12
Pieris sp.	–	–	1/-											
Pyrgus armoricanus/serratulae	LC/LC	NT/LC	1/-											
Vanessa atalanta	LC	Common								1/-				

Table 2.3: Butterflies observed outside transect walks in Costa della Spina (number of adults observed for each species on 20.6 and 7.7.2023; RL-I: conservation status in the Italian red list, Balletto et al. 2015; RL-NE: conservation status in northeast Italy according to Paolucci, Paolucci, 2010).

Species	RL-I	RL-NE	20.6	7.7
Aglais urticae	LC	Common	1	
Erebia medusa	LC	LC-NT		2
Vanessa cardui	LC	Common	1	

Figure 2.2: Immature *Aeshna juncea* grappling on *Carex leporina* (Costa della Spina, 7.7.2023, photo by G. Menegus)

Figure 2.3: *Colias palaeno* (Costa della Spina, 7.7.2023, photo by G. Menegus)

2.1.3 Dragonflies

Dragonflies were surveyed on 20.6, 7.7 and 24.8.2023. The primary method of observation involved conducting repeated short point count surveys (PS) for each pond. All individuals were documented, and their sex was determined when feasible. Additionally, dead individuals, juveniles, and exuviae were observed. The survey results are detailed in **Table 2.4** (part 1 to 4), with most ponds being surveyed three times.

The dragonfly community comprised 6 species, with only *Cordulia aenea* and *Coenagrion hastulatum* considered of conservation interest. The former is classified as NT (Near Threatened) in the Italian red list (Riservato et al., 2014), while the latter is considered to be in decline in the Alps (Bonometto, 2020). Notably, the monitoring results are significant, as only *Aeshna juncea* and *Libellula quadrimaculata* were previously observed in the site (Bonometto, 2020). *A. juncea* and *Aeshna cyanea* are among the most common species in Cadore and are well-adapted to eutrophicated ponds. *Somatochlora alpestris* was known in nearby sites (Bonometto, 2020). The presence of *Libellula depressa* was anticipated, given its adaptation to eutrophicated ponds, although its occurrence in Cadore is somewhat limited.

Numerous *A. juncea* juveniles were observed on vegetation along the banks of several ponds (see **Figure 2.2**), suggesting that fencing the ponds to reduce the risk of trampling could have a significant impact in minimizing damage to emerging dragonflies in this delicate stage. *A. juncea* and *S. alpestris* were the most frequently observed species. Despite signs of disturbance, the area hosts an intriguing dragonfly community, particularly considering its high altitude.

Table 2.4: dragonflies observed in Costa della Spina (Columns 1 to 34 report the individuals observed at different ponds on 20.6 / 7.7 / 24.8.2023; m= males; f= females; ?= sex unknown; C=mating behaviour observed; - = no individuals observed; Outside: individuals observed outside the PS; RL-I: conservation status in the Italian red list, Riservato et al., 2014).

Table 2.4-Part 1

Species	RL-I	Outside	1	2	3	4	5	6	7	8	9	10	11
Aeshna cyanea	LC	-/-/1m											-/-/1m
Aeshna juncea	LC							-/-/3m					-/-/1m 1f C
A. juncea juveniles	LC												
A. juncea dead	LC												
A. juncea exuviae	LC												
Coenagrion hastulatum	LC												
Coenagrionidae	–												
Cordulia aenea	NT							1m/-/-					
Libellula depressa	LC											-/1m/-	
Somatochlora alpestris	LC							-/2m/-	-/1m 1?/-				
S. alpestris exuviae	LC												

Table 2.4-Part 2

Species	RL-I	12	13	13b	14	15	16	17	18	19	20	21a
Aeshna cyanea	LC											
Aeshna juncea	LC	-/-/1m	-/-/2m 1f C			-/-/2m 1f C		-/-/1m				
A. juncea juveniles	LC											
A. juncea dead	LC		-/-/2									
A. juncea exuviae	LC											
Coenagrion hastulatum	LC											
Coenagrionidae	–					-/-/1f						
Cordulia aenea	NT											
Libellula depressa	LC											
Somatochlora alpestris	LC	-/1f/-								-/1m/-		
S. alpestris exuviae	LC											

Table 2.4-Part 3

Species	RL-I	21b	21c	21d	21e	22	23	24	24a	24b	25a	25b
Aeshna cyanea	LC											
Aeshna juncea	LC	-/-/1m	-/-/1m 1f						-/-/1m 1f C	-/-/1m		
A. juncea juveniles	LC							-/-/1m				
A. juncea dead	LC							-/-/2				
A. juncea exuviae	LC											
Coenagrion hastulatum	LC											
Coenagrionidae	–											
Cordulia aenea	NT											
Libellula depressa	LC											
Somatochlora alpestris	LC		-/2m 1f C/-					1f/-/-				
S. alpestris exuviae	LC							1/-/-				

Table 2.4-Part 4

Species	RL-I	25c	25d	26	27	28	29	30	31	32	33	34
Aeshna cyanea	LC											
Aeshna juncea	LC	-/-/1m 1f C	-/-/1m 1f C	-/-/1m		-/-/1m 1f C			-/-/1m			
A. juncea juveniles	LC	-/10/-				-/2/-						
A. juncea dead	LC			-/-/1								
A. juncea exuviae	LC	-/15/-				-/7/-						
Coenagrion hastulatum	LC					-/1m 1f C/-						
Coenagrionidae	–											
Cordulia aenea	NT											
Libellula depressa	LC	-/1m/-										
Somatochlora alpestris	LC	-/1m/-		-/1/-								
S. alpestris exuviae	LC											

2.1.4 Amphibians

Amphibian species were surveyed on June 20.6, 7.7 and 24.8.2023. The survey primarily employed VES, where individuals were counted and observed walking along a designated path on the banks of a pond. VES were repeated three times for most ponds, although some were not surveyed on August 24. The survey results are detailed in **Table 2.5** (part 1 to 4).

Due to the high altitude, expectations were that the amphibian community would be relatively small, and this aligns with our observations. However, the survey provided valuable insights, demonstrating that Costa della Spina is abundant in breeding sites for two characteristic amphibians, *Bufo bufo* and *Ichthyosaura alpestris*. We observed *B. bufo* in at least 15 ponds (reproducing in 13) and *I. alpestris* in at least 31 ponds (reproducing in 11) out of the total 44 ponds. Adults, tadpoles, and larvae were observed in both temporary and permanent ponds scattered throughout the ridge. *Rana temporaria* was less common and observed only on one occasion. All these species are relatively common in Cadore, although *B. bufo* is considered at risk (vulnerable, VU) according to the Italian red list (Rondinini et al., 2022).

Table 2.5: Amphibians observed during VES in *Costa della Spina* (Columns 1 to 34: number of individuals observed in the different ponds on 20.6 / 7.7 / 24.8.2023; X= tadpoles observed; - = no individuals observed; RL-I: conservation status in the Italian red list Rondinini et al., 2022).

Table 2.5-Part 1

Species	RL-I	1	2	3	4	5	6	7	8	9	10	11
Bufo bufo dead	VU						-/1/-			-/1/-		
B. bufo tadpoles	VU		X/X/-	X/X/-		X/X/-	X/X/-			X/X/-	-/X/-	X/X/-
Ichthyosaura alpestris adults	LC			8/6/-	1/-/-		8+/4/-	1/4/-	10/-/-	2/-/-	4/3/-	14/8/-
I. alpestris larvae	LC											
Rana temporaria adults	LC											

Table 2.5-Part 2

Species	RL-I	12	13	13b	14	15	16	17	18	19	20	21a
Bufo bufo dead	VU											
B. bufo tadpoles	VU					X/X/-						
Ichthyosaura alpestris adults	LC	2/5/-	10/1/-	2/1/-		50+/-/-			1/-/-		3/-/-	1/-/-
I. alpestris larvae	LC	-/-/2	-/-/15+			-/-/100+						
Rana temporaria adults	LC					-/-/1						

Table 2.5-Part 3

Species	RL-I	21b	21c	21d	21e	22	23	24	24a	24b	25a	25b
Bufo bufo dead	VU										-/1/-	
B. bufo tadpoles	VU											
Ichthyosaura alpestris adults	LC	2/4/-	5/2/-	1/1/-	1/-/-			54/139/1			10/2/-	10/-/-
I. alpestris larvae	LC	-/-/8	-/-/2	-/-/1				-/-/40	-/-/37			
Rana temporaria adults	LC											

Table 2.5-Part 4

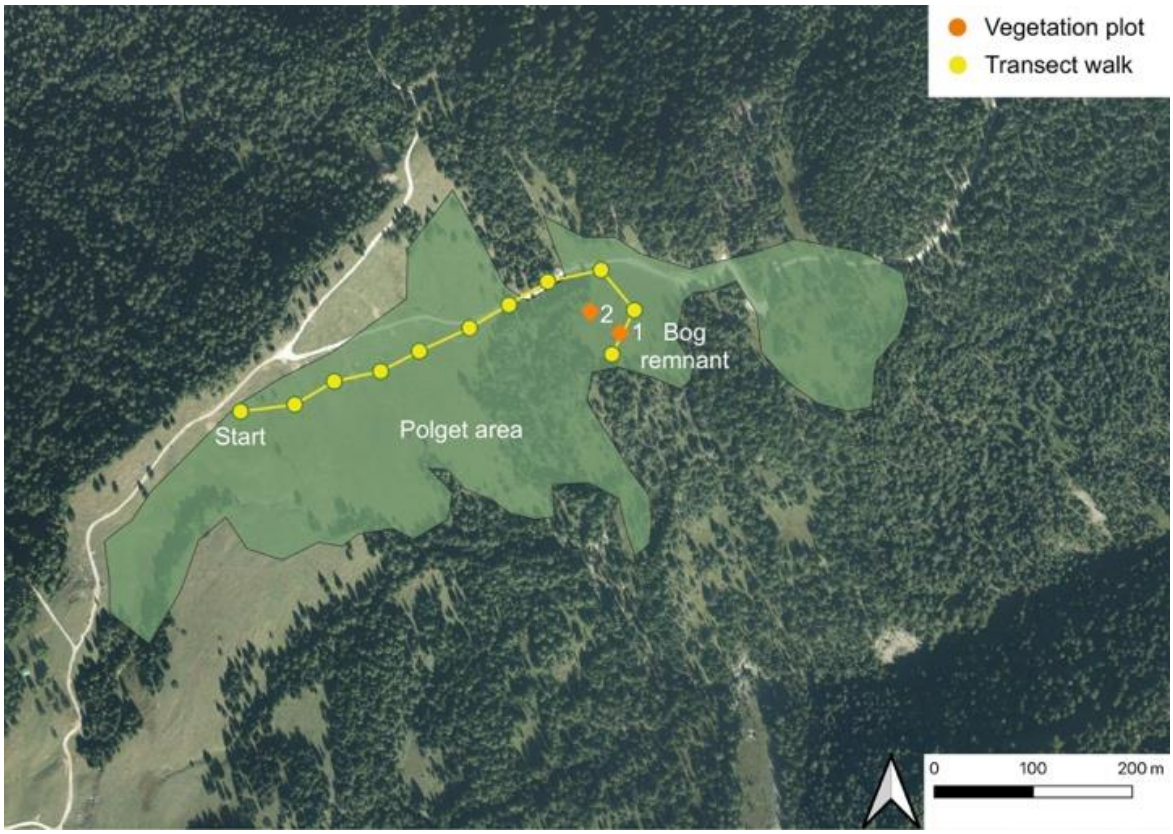
Species	RL-I	25c	25d	26	27	28	29	30	31	32	33	34
Bufo bufo dead	VU	1/1/-										
B. bufo tadpoles	VU			X/X/-		X/X/X			X/X/-	X/X/-		X/-
Ichthyosaura alpestris adults	LC	5/-/2		170/8/2	1/-/-	64/6/-			51/58/-	-/8/-	2/9/-	88/75
I. alpestris larvae	LC	-/-/13		-/-/100+		-/-/10						
Rana temporaria adults	LC											

2.2 Torbiera di Polget-Fontanabona

Figure 2.4: *Eriophorum angustifolium* blooming in a bog remnant in Polget-Fontanabona (Lozzo di Cadore, Italy, 13.06.2023; photo by G. Menegus)

Torbiera di Polget-Fontanabona (**Figure 2.4**) is a peatland situated in Pian dei Buoi plateau (municipality of Lozzo di Cadore), at an altitude of approximately 1725 m above sea level (46.516935 N, 12.413070 E approx.). This wetland is characterised by a mosaic of bogs, fens, and wet prairies. The majority of the area is owned by the municipality itself and has been utilized as pasture for cattle and horses for an extended period. Extensive drainage efforts have been implemented, involving the excavation of ditches, and certain sections have undergone modifications for the construction of roads and paths.

In the context of this project, our focus was on the conservation of a specific bog area of the peatland exhibiting significant signs of drainage. Despite the alterations, this area retained noteworthy bog vegetation. Our survey encompassed the vegetation of this preserved bog remnant, as well as the butterfly community within the bog and its surrounding environs, following a standard protocol.



Map 2.2: The area of Polget-Fontanabona peatland (Lozzo di Cadore, Italy). Green: project area; yellow: transect for butterfly monitoring; orange: vegetation plots.

2.2.1 Vegetation

The bog remnant at Polget-Fontanabona underwent modification through the implementation of a system of ditches designed to facilitate water discharge from the peaty soil on the western part of the wetland. Two distinct plots were selected for study (refer to Map 2.2): Plot 1, situated in the most preserved section of the bog, where *Sphagnum* mosses formed a system of hollows and hummocks, and plot 2, located within the largest ditch. Sampling was conducted on 11.7 and 3.8.2023, with the results documented in **Table 2.6**.

While not particularly species-rich (21 in total), the plant community in Polget is noteworthy and harbours three species of conservation interest for the Province of Belluno and the Veneto Region: *Carex pauciflora*, *Drosera rotundifolia* (**Figure 2.5**) and *Menyanthes trifoliata*. In the best-preserved part, the community reflects the characteristics of a degraded bog, evident in the presence of *Calluna vulgaris*, *C. pauciflora*, *D. rotundifolia*, and the dominance of *Sphagnum* mosses. This degradation is

expected, given the discernible signs of trampling by livestock on the hummocks/hollows structure. Conversely, Plot 2 exhibits a different form of degradation typical of drained bogs, with a significant presence of *Carex rostrata*. However, the occurrence of species typical of bogs, particularly *D. rotundifolia* (which is relatively rare in the area), suggests that habitat restoration may be achievable through measures such as reducing trampling and damming the ditches.

Table 2.6: Vegetation plots in Polget bog (the cover of each species is reported for both plots; Plot 1: *Sphagnum* hummocks/hollows, Plot 2: drainage ditch; Outside: species observed outside the plots; X: species present; RL-BL and RL-V: conservation status in the red lists of the Province of Belluno and Veneto Region, Buffa et al., 2016)

Specie	Plot 1	Plot 2	Outside	RL-BL	RL-V
Agrostis capillaris L.		3			
Bartsia alpina L.	R	R			
Calluna vulgaris (L.) Hull	+				
Carex echinata Murray	2			LC	LC
Carex flacca Schreb.		R			
Carex flava aggr.		1		LC	LC
Carex pauciflora Lightf.	2			VU	VU
Carex rostrata Stokes		3			
Drosera rotundifolia L.	1	R		VU	VU
Equisetum arvense/pratense	R			(VU)	(VU)
Equisetum sp.		1		–	–
Eriophorum angustifolium Honck.	R	R			
Juncus articulatus L.	4	1			
Juncus effusus L.		2			
Luzula aggr. *multiflora*	R				
Menyanthes trifoliata L.		3		NT	NT
Molinia caerulea (L.) Moech	R	1		LC	LC
Potentilla erecta (L.) Raeusch.	R				
Prunella vulgaris L.		R			
Selaginella selaginoides (L.) P.Beauv. Ex Schrank & Mart.			X		
Sphagnum sp.	5			–	–
Trichophorum cespitosum (L.) Hartm.	R				
Valeriana officinalis aggr.		R			

Figure 2.5: *Drosera rotundifolia* in Polget-Fontanabona (3.8.2023, photo by A. Fitsios)

Figure 2.6: Male *Polyommatus icarus* in Polget-Fontanabona (21.6.2023, photo by G. Menegus)

2.2.2 Butterflies

Butterflies were surveyed on multiple occasions using a 0.5 km-long transect walk, divided into ten 50 m-long sections, covering different areas and habitats (refer to **Map 2.2**). The transect was traversed twice (on 21.6 and 8.8.2023), and the results are presented in **Table 2.7**. Additionally, observations of butterflies outside transect walks on 13.6, 21.6 and 8.8.2023, are detailed in **Table 2.8**. Inclement weather prevented the repetition of observations on 6.7, 11.7 and 3.8.2023. Despite these challenges, the survey yielded results similar to a previous study conducted in 2022.

Twelve species were observed, and the community in the area is predominantly composed of common generalist species, such as *Pieris brassicae* and *Polyommatus icarus* (Figure 2.6), with *Erebia epiphron* being the sole species associated with wetlands. Notably, species such as *Coenonympha pamphilus*, *Colias croceus*, *Gonepteryx rhamni*, *Pieris napi*/*bryoniae*, and *Vanessa* atalanta, *observed* in 2022, were not found again. Similarly, *Erebia* sp., *Pyrgus* sp., and *Pieris brassicae* were not observed in 2022.

The observed results align somewhat with expectations, considering the high level of modification and the use of the area as pasture. Surprisingly, few forest or forest-edge species were found, even though such habitats are prevalent in the surrounding area. Considering past observations of *Euphydryas aurinia*, *Euphydryas intermedia*, and *Phengaris arion* in Pian dei Buoi, it appears plausible that proper management of the site could facilitate the expansion of these species to this area of the plateau.

Table 2.7: Butterflies observed during transect walks in Polget-Fontanabona in the 10 sections of the transect (Columns 1 to 10 show the number of adults observed for each species on 21.6 / on 8.8 in each section of the transect; m=male; - = no individuals observed; RL-I: conservation status in the Italian red list, Balletto et al. 2015; RL-NE: conservation status in northeast Italy according Paolucci, Paolucci, 2010).

Species	RL-I	RL-NE	1	2	3	4	5	6	7	8	9	10
Aglais urticae	LC	Common			2/-		2/-			1/-		
Erebia cf. *epiphron*	LC	LC							-/1			
Erebia euryale/ligea	LC/LC	LC/LC-NT						-/1	-/1			
Erebia medusa	LC	LC-NT	2/-		2/-		1/-	2/-		3/-		
Erebia sp.	–	–										-/1
Pieridae	–	–					1/-	1/-				
Pieris brassicae	LC	Common						1/-				
Polyommatus icarus	LC	Common					1m/-					
Pyrgus armoricanus/alveus/serratulae	LC/LC/LC	NT/LC/LC							-/1			
Pyrgus malvae/malvoides	LC/LC	DD-LC/LC-NT									1/-	

Table 2.8: Butterflies observed outside transect walks in Polget.Fontanabona (number of adults observed for each species on 13.6, 21.6 and on 8.8.2023; m= male; RL-I: conservation status in the Italian red list, Balletto et al. 2015; RL-NE: conservation status in northeast Italy according Paolucci, Paolucci, 2010).

Species	RL-I	RL-NE	13.6	21.6	8.8
Aglais urticae	LC			1	
Cyaniris semiargus	LC	LC		1m	

Species	RL-I	RL-NE	13.6	21.6	8.8
Erebia euryale/ligea	LC/LC	LC/LC-NT			1
Erebia medusa	LC	LC-NT		1	
Erynnis tages	LC			1	
Vanessa atalanta	LC		1		
Vanessa cardui	LC		1		

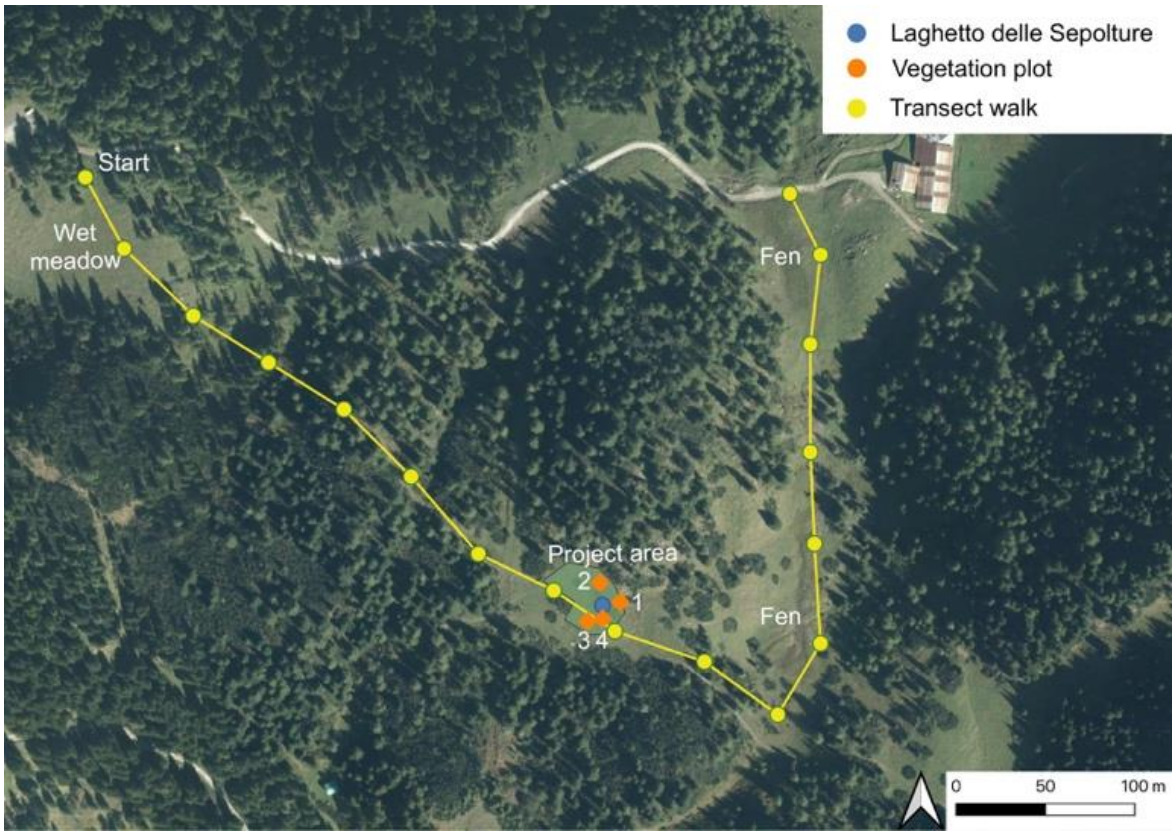
2.3 Laghetto delle Sepolture

Figure 2.7: Laghetto delle Sepolture (Lozzo di Cadore, Italy, 13.6.2023, photo by G. Menegus)

Laghetto delle Sepolture (**Figure 2.7**) is a small pond situated on the plateau of Pian dei Buoi, within the municipality of Lozzo di Cadore, at an elevation of 1824 m above sea level (46.507967 N, 12.414573 E). The area is owned by the municipality and serves as pasture for cattle. The pond is encircled by a pasture dominated by *Deschampsia cespitosa* and is bordered by a sparse stand of *Picea abies* woodland. This modest water body typically experiences dry periods during at least part of the summer, primarily relying on precipitation as its main water source (Menegus et al., 2021).

In the past, notably in 2018, the site suffered significant damage to its vegetation and pond bed due to heavy cattle trampling (Bonometto, 2020). Subsequently, the site underwent protective measures as part of a small Interreg V-A I-A project titled "Zone umide nel territorio DL" (DL-Biotop). Implemented interventions in 2021 and 2022 included measures such as fencing around the pond and a portion of the surrounding wet meadow, mowing the meadow, and removing sections of the sedges.

The immediate vicinity of the pond features a diverse mosaic of wetland habitats, including wet meadows, fens, degraded ponds, alongside mostly degraded *Nardus* pastures, two streams, and *P. abies* woodland.



Map 2.3: The area of Sepolture (Lozzo di Cadore, Italy). Green: project area; blue: Laghetto delle Sepolture; yellow: transect for butterfly monitoring; orange: vegetation plots

2.3.1 Vegetation

The area underwent intense trampling and eutrophication by cattle, but management and fencing efforts around the pond and its surroundings have been ongoing for some years. As a result, there is a noticeable difference in the plant community between the wet meadow inside and outside the fence. In the aquatic environment, *Eleocharis palustris* dominates, with *Carex nigra* along the banks, and the surrounding meadow is primarily dominated by *D. cespitosa*. Four plots, were selected for sampling on 6.7.2023, with results presented in **Table 2.9**: Plot 1 included the sedge bed along the pond's banks, while Plots 2 and 3 were meant to sample aquatic vegetation; Plot 4 was placed in the wet meadow on the northern side of the pond (refer to **Map 2.3**). The aquatic vegetation community is characterized by only four species, with *Glyceria notata* marginally present. *E. palustris* dominates the waterbody, while the southern part of the pond also exhibits significant presence of *Callitriche palustris* and *Alopecurus aequalis*. These species, along with *G. notata*, suggest the impact of eutrophication and frequent desiccation of the pond. Proper management, particularly targeting these species, could benefit the community.

The pond banks are dominated by sedges (*Carex* sp.) and other species adapted to frequent flooding and waterlogged soil, such as *Juncus filiformis*. The community

sampled in Plot 4 appears typical of slightly drier soil, with minor differences in the species list compared to Plot 1. Currently, no plants of conservation interest have been observed. The absence of *D. cespitosa* in these two plots suggests that the management efforts are yielding some positive results. Repeating the fencing and mowing annually or every two years could further contribute to the soil returning to a more mesotrophic condition, promoting a more diverse plant community.

Table 2.9: Vegetation plots in Sepolture (the cover of each species is reported for all plots; Plot 1: pond banks, Plot 2: aquatic environment; Plot 3: aquatic environment; Plot 4: wet meadow; Outside: species observed outside the plots; X= species present; RL-BL and RL-V: conservation status in the red lists of the Province of Belluno and Veneto Region, Buffa et al., 2016).

Specie	Plot 1	Plot 2	Plot 3	Plot 4	Outside	RL-BL	RL-V
Alchemilla sp.				1			
Alopecurus aequalis Sobol.		R	4			LC	LC
Callitriche palustris L.		R	2			LC	LC
Carex canescens L.	R						
Carex echinata Murray	R			+		LC	LC
Carex leporina L.				1			
Carex nigra (L.) Reichard	4			+			
Carex pallescens L.				+			
Crepis cf. *aurea* (L.) Cass.	+						
Eleocharis palustris (L.) Roem. & Schult.		4	3			LC	LC
Festuca rubra aggr.	R			2			
Geum montanum L.				R			
Glyceria notata Chevall.					X		
Juncus effusus L.					X		
Juncus filiformis L.	R			R		LC	LC
Lolium pratense (Huds.) Darbysh.	3			2			
Luzula multiflora aggr.	R						
Nardus stricta L.	R						
Phleum pratense L.	1		3				
Poa cf. *pratensis* L.	R						
Potentilla erecta (L.) Raeusch.	R						
Ranunculus breyninus Crantz	+			4			
Trifolium pratense L.				+			
Trifolium repens L.	+			1			
Veronica chamaedrys L.				R			

Figure 2.8: *Boloria thore* in Sepolture (11.7.2023, photo by G. Menegus)

Figure 2.9: Male *Libellula* quadrimaculata in Sepolture (8.8.2023, photo by G. *Menegus*)

2.3.2 Butterflies

Butterflies were observed on multiple occasions from May to August. A 1.6 km-long transect walk was carefully designed, covering various 100 m-long sections and habitats within the Sepolture area, with a focus on wet meadows, fens, and the pond (refer to **Map 2.3**). The transect was sampled three times on 21.6, 11.7 and 8.8.2023, with results detailed in **Table 2.10** (part 1 and 2). Additional observations outside the transect walks were recorded on 29.5, 13.6, 21.6, 6.7, 11.7, 3.8 and 8.8.2023, and are reported in **Table 2.11**.

In total, 18 butterfly species were observed, with only *Boloria thore*, *Coenonympha gardetta*, and *Erebia epiphron* being well-adapted to wetlands. *B. thore* (**Figure 2.8**) is also the only species of conservation interest observed in 2023, classified as NT (Near Threatened) in northeast Italy (Paolucci, 2010). It is relatively scarce in Veneto and in the Venetian Dolomites (Bonato et al., 2014). In 2022, a slightly different community was observed with 19 species (28 in the entire Pian dei Buoi area), including *Erebia pharte*, *E. intermedia* (species linked to wetland habitats), and *P. arion* (a protected butterfly listed in Annex IV of the "Habitats" Directive 92/43/CEE).

Despite presenting a mixed community with species adapted to various habitats, such as forests, forest edges, dry or disturbed pastures, the butterfly community in Pian dei Buoi exhibits some interesting wetland species. Proper management of the area, coupled with restoration efforts aimed at fostering a more diverse landscape and vegetation, could have significant positive effects on the butterfly community.

Table 2.10: Butterflies observed during transect walks in Sepolture in the 16 sections of the transect (Columns 1 to 16 show the number of adults observed for each species on 21.6 / 11.7 / 8.8.2023 in each section of the transect; m=male; f= female; ?= sex unknown; - = no individuals observed; RL-I: conservation status in the Italian red list, Balletto et al. 2015; RL-NE: conservation status in northeast Italy according to Paolucci, Paolucci, 2010)

Table 2.10-part 1

Species	RL-I	RL-NE	1	2	3	4	5	6	7	8
Aglais urticae	LC	Common	-/-/-	-/-/-	-/-/-	-/-/-	-/-/-	-/-/-	-/-/-	-/-/-
Boloria euphrosyne	LC	LC			-/1/-	-/2/-	-/2/-	-/2/-		
Boloria thore	LC	NT			-/1/-	-/1/-		-/1/-		
Callophrys rubi	LC	LC					1/-/-			
Coenonympha gardetta	LC	LC	-/1/-	-/1/-				-/1/-		
Cupido cf. *minimus*	LC	Common								
Cyaniris semiargus	LC	LC	-/4/-	-/4/-				-/1/-	-/3m/-	-/1/-
Erebia epiphron	LC	LC			-/-/3					
Erebia euryale/ligea	LC/LC	LC/NT	-/-/2	-/-/1	-/-/3	-/-/3		-/-/3		
Erebia medusa	LC	LC-NT	-/3/-	-/6/-	-/4/-		2/3/-	-/3/-	-/1/-	-/-/-
Erebia cf. *medusa*	LC	LC-NT			-/-/3					
Pieridae	LC	-								
Pyrgus malvae/malvoides	LC/LC	DD-LC/NT						1/-/-		
Vanessa atalanta	LC	Common						1/-/-	1/-/-	

Table 2.10-part 2

Species	RL-I	RL-NE	9	10	11	12	13	14	15	16
Aglais urticae	LC	Common						1/-/-		
Boloria euphrosyne	LC	LC	-/1/-				1/-/-	-/1/-		
Boloria thore	LC	NT		-/1/-	-/1/-	-/1/-				
Callophrys rubi	LC	LC								
Coenonympha gardetta	LC	LC		-/1/-	-/1/-	-/2/-	-/1/-			
Cupido cf. *minimus*	LC	Common				1/-/-				
Cyaniris semiargus	LC	LC	-/1m 1f/-	-/1f/-	-/2/-	1m 1f/1f 2?/-	-/1/-	-/1m/-		
Erebia epiphron	LC	LC		-/-/1						
Erebia euryale/ligea	LC/LC	LC/NT		-/-/3	-/-/4				-/-/1	
Erebia medusa	LC	LC-NT	-/2/-	1/-/-	1/4/-	4/1/-	1/3/-	1/-/-	1/-/-	
Erebia cf. *medusa*	LC	LC-NT								
Pieridae	LC	-				1/-/-			1/-/-	
Pyrgus malvae/malvoides	LC/LC	DD-LC/NT								
Vanessa atalanta	LC	Common							1/-/-	

Table 2.11: Butterflies observed outside transect walks in Sepolture (number of adults observed for each species on 29.5, 13.6, 21.6, 6.7, 11.7, 3.8 and on 8.8.2023; m = male; + = several individuals; numbers in brackets show the individuals observed in the wet meadow surrounding Laghetto delle Sepolture; RL-I: conservation status in the Italian red list, Balletto et al. 2015; RL-NE: conservation status in northeast Italy according to Paolucci, Paolucci, 2010).

Species	RL-I	RL-NE	29.5	13.6	21.6	6.7	11.7	3.8	8.8
Aglais urticae	LC		1 (4)						
Aporia crataegi	LC	LC					(+)		
Coenonympha gardetta	LC	LC				(1)	(+)		
Cyaniris semiargus	LC	LC					(+)		
Erebia cf. *melampus*	LC	LC						1	
Erebia cf. *epiphron*	LC	LC						1	
Erebia euryale/ligea	LC/LC	LC/LC-NT							1
Erebia medusa	LC	LC-NT			1(1)	3			
Erebia cf. *medusa*	LC	LC-NT						1	1
Leptidea sinapis/juvernica	LC/LC				1				
Pieridae	LC				1(1)				
Pieris rapae	LC		1						
Pyrgus sp.						1			
Cf. *Speyeria aglaja*	LC							1	
Vanessa atalanta	LC		2						

2.3.3 Dragonflies

Dragonflies were observed through repeated PS at Laghetto delle Sepolture on 21.6, 11.7, 8.8.2023. On 6.7 and 3.8.2023, suboptimal weather conditions prevented the completion of a point count survey, but one individual was observed. The results are detailed in **Table 2.12**. The pond appears to serve as a breeding site for five species: *A. juncea*, the most frequent species in Cadore, and *L. depressa*, which is adapted to eutrophicated water bodies. The presence of *C. hastulatum*, *Coenagrion puella*, and *Libellula quadrimaculata* (**Figure 2.9**) is of particular interest. The presence of *L. quadrimaculata* suggests lower eutrophication than in the past, *C. puella*'s limited mobility indicates a stable population, and the occurrence of *C. hastulatum*, not previously observed in the area, is noteworthy given its decline in the Alps (Bonometto, 2020).

In previous years, *Pyrrhosoma nymphula* and *Somatochlora arctica* were also observed in the area (Bonometto, 2020; Menegus et al., 2021). The dragonfly community in this small isolated pond is quite interesting. Protecting this breeding site and managing it in line

with the needs of these species is crucial. Additionally, restoring nearby ponds could provide several other reproductive sites for these dragonfly species.

Table 2.12: Dragonflies observed during PS at Laghetto delle Sepolture on 21.6, 6.7, 11.7, 8.8.2023 (m= males; f= females; ?= sex unknown; C=mating behaviour observed; numbers in brackets indicate the individuals observed in other parts of Sepolture area; RL-I: conservation status in the Italian red list, Riservato et al., 2014).

Species	RL-I	21.6	6.7	11.7	8.8
Aeshna juncea	LC	1m		2m (3m)	
Coenagrion hastulatum	LC		1m	1m	
Coenagrion puella	LC	1m		2m	
Libellula depressa	LC	2m 1f C (2m)		2m	
Libellula quadrimaculata	LC	1m 1?		3	1m

2.3.4 Amphibians

Amphibian species were observed on multiple occasions, primarily during VES. The VES was repeated five times on 29.5, 13.6, 21.6, 11.7 and 8.8.2023. Weather conditions were suboptimal on 6.7 and 3.8.2023, affecting the results reported in **Table 2.13**.

As expected, the amphibian community is relatively small, with the most frequent species being *B. bufo* and *I. alpestris*, the latter exhibiting a thriving population. This pond serves as the last known reproductive site for the Alpine newt in the area (Bonometto, 2020). *R. temporaria* has a reproductive site in the nearby Palù Gran fen but is otherwise quite rare. This composition represents a typical community for high-altitude wetlands. However, given that Laghetto delle Sepolture is the last pond in the area, it is imperative to manage and protect it to prevent further degradation.

Table 2.13: Amphibians observed during VES in Sepolture on 29.5, 13.6, 21.6, 6.7, 11.7, 3.8, 8.8.2023 (number of individuals observed; X= tadpoles or larvae observed; numbers in brackets indicate observations outside Laghetto delle Sepolture and its surroundings; RL-I: conservation status in the Italian red list Rondinini et al., 2022).

Species	RL-I	29.5	13.6	21.6	6.7	11.7	3.8	8.8
Bufo bufo adults	VU	1						
B. bufo tadpoles	VU		X	X	X	X	X	X
Ichthyosaura alpestris adults	LC	30	5	82				
I. alpestris larvae	LC						X	X
Rana temporaria juveniles	LC			(X)				(1)
R. temporaria tadpoles	LC							

2.4 Laghetto di Vedorcia

Laghetto di Vedorcia (**Figure 2.10**) is a small pond situated on the Vedorcia plateau in the municipality of Pieve di Cadore, at an elevation of 1821 m above sea level (46.407793 N, 12.421410 E approx.). The area is owned by the municipality itself. The pond is characterized by sedge vegetation along its banks and is surrounded by a sparse stand of *P. abies* woodland and a small pasture. The same clearing also hosts an Alpine hut known as "Rifugio Tita Barba". While the pond was once fenced, it is currently often utilized by cattle, and tourists have access to it.

A survey was conducted to assess the vegetation of the pond banks, along with the dragonfly and butterfly communities of the pond, following a common protocol. The start of the monitoring was postponed to July due to the closure of one of the access roads for road rehabilitation in June. However, given the high altitude, small size, and isolated nature of the site, it was deemed that a shorter monitoring period would have minimal impact on the overall study.

Figure 2.10: Laghetto di Vedorcia (Pieve di Cadore, Italy, 8.7.2023, photo by G. Menegus)

Map 2.4: The clearing encircling Laghetto di Vedorcia (Pieve di Cadore, Italy). Green: project area; blue: Laghetto di Vedorcia; orange: vegetation plots.

2.4.1 Vegetation

The pond is consistently flooded, with its banks characterized by dense sedge vegetation. Two plots were selected for sampling: Plot 1 was placed on the regularly flooded northern banks of the pond, and Plot 2 was located in the surrounding marshy area (refer to **Map 2.4**). The plots were sampled on 8.7.203, and the results are presented in **Table 2.14**.

The findings indicate that the plant community is relatively poor, with *C. nigra* dominating in both plots. Other wetland plants, including *Carex flava* aggr., *J. articulatus*, *Poa trivialis*, and *Potentilla erecta*, were observed, but the overall community lacked diversity and did not include species of conservation interest. Fencing the site to reduce trampling and eutrophication could potentially lead to the development of a more diverse vegetation community.

Table 2.14: Vegetation plots in Vedorcia (the cover of each species is reported for both plots; Plot 1: banks of the pond; Plot 2: surrounding marshy area; Outside: species observed outside of the plots; X= species present; RL-BL and RL-V: conservation status in the red-list of Belluno province and Veneto Region, Buffa et al., 2016).

Specie	Plot 1	Plot 2	Outside	RL-BL	RL-V
Carex flava aggr.		R		LC	LC
Carex nigra (L.) Reichard	5	5			
Cerastium holosteoides Fr.		R			
Festuca rubra aggr.		2			
Juncus articulatus L.			X		
Luzula multiflora aggr.		+			
Poa alpina L.		R			
Poa trivialis L.		R			
Potentilla erecta (L.) Raeusch.		+			

2.4.2 Dragonflies

We conducted surveys of dragonfly species on two occasions during PS on 8.7 and 10.8.2023. The results are detailed in **Table 2.15**. The pond was confirmed as a breeding site for *A. juncea* and *A. cyanea*. Additionally, two more species, *L. depressa* and the regionally declining *C. hastulatum*, were observed. This suggests that the site is ecologically interesting, and implementing fencing measures could help reduce the risk of trampling on immature juveniles.
On August 10, 2023, we also surveyed a small pond at a lower altitude (46.4242667 N, 12.4186667 E) where we observed *A. cyanea* and *L. depressa*. For the latter, we documented mating and oviposition behaviour.

Table 2.15: Dragonflies observed in Vedorcia during point count surveys on 8.7, 10.8.2023 (m= males; f= females; C=mating behaviour observed; D=oviposition observed; numbers in brackets indicate observation at a lower pond site; RL-I: conservation status in the Italian red list, Riservato et al., 2014).

Species	RL-I	8.7	10.8
Aeshna cyanea adults	LC		(1m)
A. cyanea juveniles	LC	1	
A. cyanea exuviae	LC	1	

Species	RL-I	8.7	10.8
Aeshna juncea adults	LC		4m 1f C
A. juncea juveniles	LC	5	
A. juncea exuviae	LC	8	
Coenagrion hastulatum	LC	1m	
Libellula depressa	LC	2m	(1m 1f C D)

Figure 2.11: *Bufo bufo* in Vedorcia (8.7.2023, photo by G. Menegus)

Figure 2.12: *Ichthyosaura alpestris* in Vedorcia (8.7.2023, photo by G. Menegus)

2.4.3 Amphibians

Amphibians were monitored during VES on 8.7 and 10.8.2023. The results are documented in **Table 2.16**. As anticipated, the amphibian community is relatively small, primarily composed of *B. bufo* (**Figure 2.11**) and a thriving population of *I. alpestris* (**Figure 2.12**). *R. temporaria* was observed only on August 10, 2023, at a lower pond (46.4242667 N, 12.4186667 E).

Table 2.16: Amphibians observed during VES in Vedorcia on 8.7 and 10.8.2023 (number of individuals observed; X: tadpoles observed; numbers in brackets indicate observations at a lower pond; RL-I: conservation status in the Italian red list Rondinini et al., 2022).

Species	RL-I	8.7	10.8
Bufo bufo adults	VU	1	
B. bufo juveniles	VU		(1)
B. bufo tadpoles	VU	X	
Ichthyosaura alpestris adults	LC	55	33 (1)
I. alpestris larvae	LC	1	>200
Rana temporaria juveniles	LC		(>100)

2.5 Risorgive di Mosigo

Downstream of Lago di Mosigo, a lake in the municipality of San Vito di Cadore, there is a small system of ponds and streams encircled by a fringe of hydrophilous tall herbs, constituting a wet meadow (**Figure 2.13**). The site, partially artificialized and situated near a highly frequented tourist spot, is municipal property. Despite its location on the valley floor (975 m above sea level, 46.465463 N, 12.421410 E) and its proximity to the town of San Vito, the area displays some intriguing ecological characteristics.

The stream and ponds are bordered by a sparse wood of *Fagus sylvatica*, while the banks in certain areas are characterized by tree species such as *Acer pseudoplatanus*, *Acer platanoides*, *Salix caprea*, *Salix purpurea*, and others. We conducted monitoring of its vegetation, amphibians, as well as the butterfly and dragonfly communities, adhering to the I-SWAMP protocol.

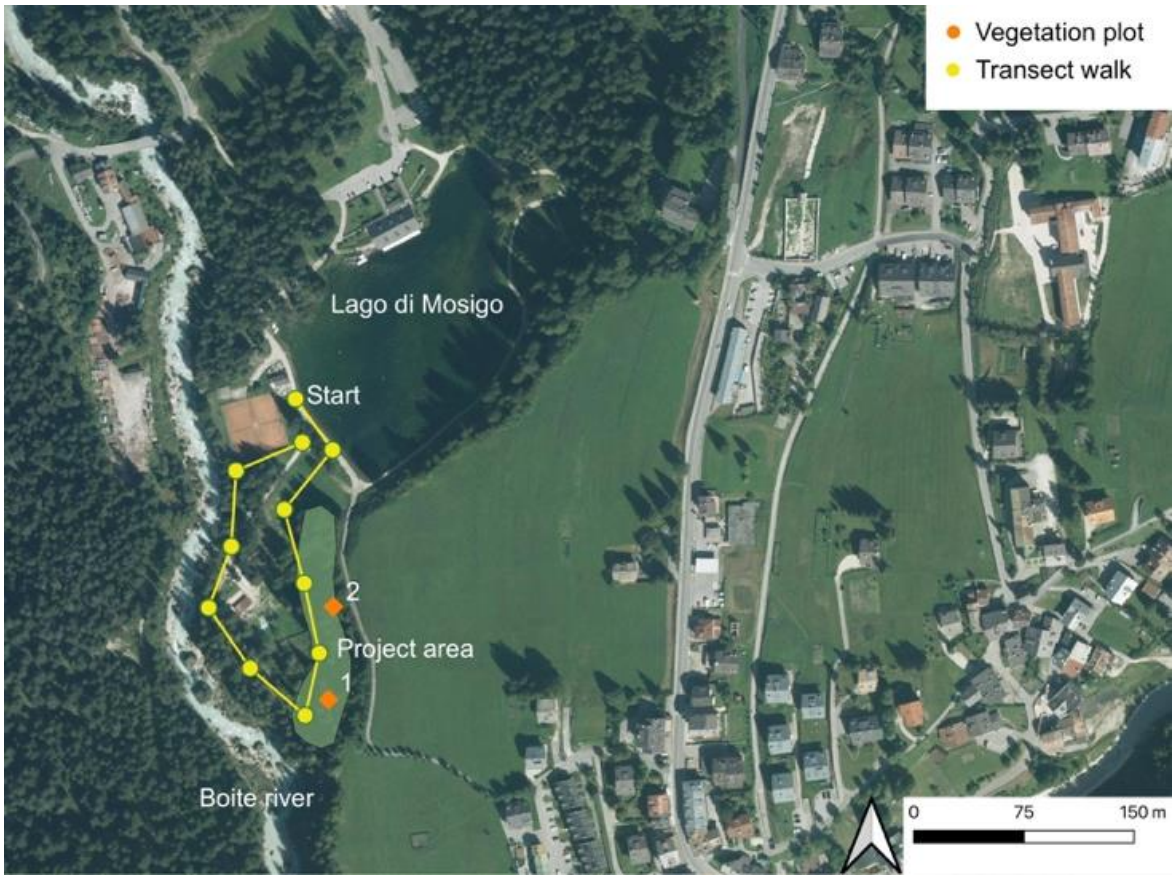
Figure 2.13: Pond and wet meadow in Mosigo (San Vito di Cadore, Italy, 19.5.2023, photo by G. Menegus)

2.5.1 Vegetation

Despite its location, the area exhibits an interesting vegetation of tall herbs fringe (Lasen & Scariot, 2006). However, certain areas are dominated by bushes and trees, others by stands of *Urtica dioica*. We selected two plots for analysis: Plot 1 was positioned on the banks of the final pond in a sedge-rich area, while Plot 2 was located on the banks of the stream (refer to **Map 2.5**). The plots were sampled on 27.6 and 5.7.2023, and the results are detailed in **Table 2.17**.

Both plots display the presence of wetland plants, including species such as *Agrostis stolonifera*, *Caltha palustris*, various *Carex* sp., *Filipendula ulmaria*, *Geranium robertianum*, *Juncus inflexus*, *Ranunculus repens*, etc. *Cardamine amara* and *Veronica beccabunga* were observed in the stream. Plot 2 can be classified as a degraded hydrophilous tall herbs community (habitat type 6430, indicated by the presence of *F. ulmaria*, *G. robertianum*, *R. repens*), while Plot 1, dominated by *Carex flacca* (**Figure 2.14**),

indicates signs of a drier soil. The survey suggests that appropriate management could facilitate the evolution of such a habitat into a well-preserved tall herbs fringe.



Map 2.5: The area of Mosigo (San Vito di Cadore, Italy). Green: project area; yellow: transect for butterfly monitoring; orange: vegetation plots.

Table 2.17: Vegetation plots in Mosigo (the cover of each species is reported for both plots; Plot 1: banks of the pond; Plot 2: banks of the stream; Outside: species observed outside the plots; X= species present; RL-BL and RL-V: conservation status in the red-list of Belluno province and Veneto Region, Buffa et al., 2016).

Species	Plot 1	Plot 2	Outside	BL	RDV
Agrostis stolonifera L.		R			
Caltha palustris L.	3	3		LC	LC
Cardamine amara L.		+		LC	LC
Carex acutiformis Ehrh.	R				
Carex flacca Schreb.	5				
Cirsium palustre (L.) Scop.			X		
Deschampsia cespitosa (L.) P. Beauv.		2		LC	LC
Equisetum fluviatile L.	2	R			
Filipendula ulmaria (L.) Maxim.	1	R		LC	LC
Fragaria vesca L.		1			
Fraxinus excelsior L.		2		LC	LC
Geranium robertianum L.		R			
Glyceria sp.			X		
Juncus inflexus L.	R				
Lathyrus pratensis L.	R				
Lotus corniculatus L.					
Myosotis scorpioides L.			X		
Neottia nidus-avis (L.) Rich.			X	LC	LC
Potentilla erecta (L.) Raeusch.			X		
Prunus sp.		R			
Ranunculus repens L.		2			

Species	Plot 1	Plot 2	Outside	BL	RDV
Ranunculus sp.		R			
Scirpus sylvaticus L.	2				
Stachys sylvatica L.		2			
Urtica dioica L.		R			
Valeriana compl. *officinalis* L.	R				
Veronica beccabunga L.			X		

Figure 2.14: *Carex flacca* in Mosigo (19.5.2023, photo by G. Menegus)

Figure 2.15: *Lopinga achine* in Mosigo (24.6.2023, photo by G. Menegus)

2.5.2 Butterflies

We conducted sampling of the butterfly community on several occasions, structured as a 0.5 km-long transect walk divided into ten 50 m-long sections, covering the entire habitat (refer to Map 2.5). The sampling was repeated three times on 24.6, 5.7 and 27.7.2023, with results reported in **Table 2.18**. Additionally, butterflies were observed outside the transect walks on several occasions (6.4, 29.4, 31.5, 19.6, 24.6, 5.7 and 27.7.2023), and these observations are detailed in **Table 2.19**.

A total of at least 19 species were observed, an interesting outcome for such a disturbed and small area. The community includes generalist species like *Aglais urticae* and *P. icarus*, forest edge species such as *Callophrys rubi* and *Lopinga achine* (**Figure 2.15**), and several species typically found along streams and rivers, including *Brenthis ino* and *Limenitis camilla*. Three of these species are of conservation interest: *Brenthis ino*, considered vulnerable in northeast Italy (Paolucci, 2010); *Limenitis camilla*, considered nearly threatened in northeast Italy (Paolucci, 2010); *L. achine*, a significant observation as it was not previously recorded in the site and is under strict protection according to the "Habitats" Directive 92/43/CEE.

As the area is a popular tourist spot, with meadows usually mown in July, potential negative effects on these species may arise. *L. achine* is considered nearly threatened in Italy and vulnerable in the northeast (Balletto et al., 2015; Paolucci, 2010). These results suggest the need for measures to ensure the conservation of clearings and forest edges

in the area, maintaining existing meadows, and avoiding actions in the summer to prevent potential damage to *L. achine*.

Table 2.18: Butterflies observed during transect walks in Mosigo in the 10 sections of the transect (number of adults observed for each species on 24.6 / 5.7 / 27.7.2023 in each section of the transect; - = no individuals observed; * = species protected under "Habitats" directive; RL-I: conservation status in the Italian red list, Balletto et al. 2015; RL-NE: conservation status in northeast Italy according to Paolucci, Paolucci, 2010).

Species	RL-I	RL-NE	1	2	3	4	5	6	7	8	9	10
Brenthis ino	LC	VU							-/1/-			
Erebia aethiops/stiria/styx	LC/LC/LC	LC/DD/LC					-/-/1			-/-/1		
Erebia euryale/ligea	LC/LC	LC/LC-NT		-/1/-	-/1/1	1/-/-	1/2/-	-2/1	-/1/-			-/1/-
Erebia sp.	–	–		-/-/1		-/-/1		-/-/1	-/-/1		-/-/1	
Leptidea sinapis/juvernica	LC/LC	Common						1/-/-				
Limenitis camilla	LC	NT			1							
*Lopinga achine**	NT	VU			2/-/-		1/-/-	-/1/-				
Melanargia galathea	LC	LC				-/-/1						
Pieris brassicae	LC	Common				1/-/-						
Pieris napi/bryoniae	LC/LC	Common		1/-/-	1/-/-	-/-/1						
Pieris sp.	–	–			-/-/1							
Vanessa atalanta	LC	Common				1/-/-						

Table 2.19: Butterflies observed outside transect walks in Mosigo (number of adults observed for each species on 6.4, 29.4, 19.5, 31.5, 19.6, 24.6, 5.7 and 27.7.2023; + = several individuals; * = species protected under the "Habitats" directive; RL-I: conservation status in the Italian red list, Balletto et al. 2015; RL-NE: conservation status in northeast Italy according to Paolucci, Paolucci, 2010).

Species	RL-I	RL-NE	6.4	29.4	31.5	19.6	24.6	5.7	27.7
Aglais urticae	LC	Common	1	1					
Callophrys rubi	LC	LC		1					
Coenonympha pamphilus	LC	LC							1
Colias sp.	–	–					1		
Erebia aethiops/stiria/styx	LC/LC/LC	LC/DD/LC							2
Erebia euryale/ligea	LC/LC	LC/LC-NT						1	6
Erebia sp.	–	–							+
Leptidea sinapis/juvernica	LC/LC	Common			1	1			
Lopinga achine*	NT	VU						1	
Maniola jurtina	LC	Common						1	
Cf. Ochlodes sylvanus	LC	LC						1	
Pararge aegeria	LC	Common				1	1		
Pieridae	LC	–					1		
Pieris napi/bryoniae	LC/LC	Common							1
Pieris rapae	LC	Common		1	1	1		1	
Pieris sp.	–	–							1
Polyommatus icarus	LC	Common			1				
Satyrinae	–	–							1

2.5.3 Dragonflies

Despite several repetitions of the transect walk in Mosigo, and despite Lago di Mosigo being known as the habitat for at least seven dragonfly species, we observed only *A. cyanea* mating in the last part of the season (13.10.2023, see **Table 2.20**). The dragonfly community of the resurgence streams and ponds appeared to be very limited.

Table 2.20: Dragonflies observed in *Mosigo* in summer 2023 (m= males; f= females; C=mating behaviour observed; RL-I: conservation status in the Italian red list, Riservato et al., 2014).

Species	RL-I	24.6	5.7	27.7	13.10
Aeshna cyanea	LC				3m 1f C

2.5.4 Amphibians

We conducted surveys of amphibians on several occasions from April to late June during repeated VES on 6.4, 29.4, 19.5, 31.5, 19.6, 24.6, 5.7 and 27.7.2023). On two occasions, we also carried out a VES along the banks of Lago di Mosigo, and our observations are reported in **Table 2.21**. Both habitats host breeding populations of *B. bufo* and *R. temporaria*. Given the proximity of the town and a high-traffic road to the site, there may be limited opportunities to increase the number of species that inhabit the area.

Table 2.21: Amphibians observed during VES in Mosigo on 6.4, 29.4, 19.5, 31.5, 19.6, 24.6, 5.7 and 27.7.2023 (number of individuals observed; L: observations from Lago di Mosigo; X= tadpoles observed; C= mating behaviour observed; RL-I: conservation status in the Italian red list Rondinini et al., 2022).

Species	RL-I	6.4	29.4	6.4L	29.4L	19.5	31.5	19.6	24.6	5.7	27.7
Bufo bufo egg-strands	VU			3	5						
B. bufo tadpoles	VU					X		X		X	
B. bufo adults	VU			>6C							
Rana temporaria spawns	LC	>70	>30	>500	>150						
R. temporaria tadpoles	LC		X		X	X					
R. temporaria adults	LC			>4							
R. temporaria dead	LC	3	2			1					

2.6 Biotopo umido di La Zopa

Figure 2.16: A pond in Biotopo umido di La Zopa (San Vito di Cadore,Italy, 31.5.2023, photo by G. Menegus)

Biotopo umido di La Zopa (**Figure 2.16**) is a wetland biotope in the municipality of San Vito di Cadore. The site is situated at an elevation of 975 m above sea level, downstream of the town of San Vito (46.461472 N, 12.200932 E). The entire area is owned by the Regola di Vallesella-Resinego-Serdes and is in close proximity to houses and schools. Nevertheless, it exhibits some interesting characteristics. The area is a clearing within a sparse *F. sylvatica* and *Fraxinus excelsior* wood. It is characterized by wet conditions and features a system of artificialized streams and three ponds. Many areas are occupied by a wet meadow. A short distance away is the river Boite. The site has a historical aspect, as evidenced by an ancient wooden washing basin. Recently, a nature trail has been constructed. In the summer of 2023, we conducted monitoring of the wetland's vegetation and studied the amphibian, butterfly, and dragonfly communities.

Map 2.6: The area of Biotopo umido di La Zopa (San Vito di Cadore, Italy). Green: project area; blue: ponds; orange: vegetation plots.

2.6.1 Vegetation

The clearing is surrounded by a sparse *F. sylvatica* wood; hay meadows and the town of San Vito are at a short distance upstream, while downstream is the river Boite. The wetland includes a meadow that is clearly divided into two parts: the northern and northwest parts of the wet meadow, surrounding Pond 1, are dominated by *Petasites hybridus*, while the central part, surrounding Ponds 2 and 3, is dominated by *F. ulmaria*. Pond 1 has no aquatic vegetation, while Ponds 2 and 3 are mostly occupied by *C. rostrata*, though some parts of Pond 3 are invaded by *Elodea canadensis*. We selected three plots (refer to **Map 2.6**): Plot 1 was placed in the *F. ulmaria* meadow; Plot 2 was placed inside

the aquatic habitat of Pond 2; Plot 3 was placed inside the P. hybridus meadow. We sampled the plots on July 5, 2023, and our observations are summarized in **Table 2.22**. Plot 1 and Plot 3 show that the wet meadow can be classified as habitat type 6430 (hydrophilous tall herb fringe), as indicated by the presence of *F. ulmaria* and *P. hybridus*. Pond 2 shows a monospecific stand of *C. rostrata*, which is a typical species in stagnant and slow-flowing freshwater habitats. Though no species of conservation interest are present, the site could benefit from regular mowing to maximize the number of species and to maintain the meadow, preventing the growth of trees. *Impatiens glandulifera* was observed on the margins of the clearing: this is an invasive alien species that should be monitored and managed, in order to preserve the interesting wet meadow habitats.

Table 2.22: Vegetation plots in La Zopa (the cover of each species is reported for all plots; Plot 1: *F. ulmaria* meadow; Plot 2: aquatic vegetation of Pond 2; Plot 3: *P. hybridus* meadow; Outside: species observed outside the plots; X = species present; RL-BL and RL-V: conservation status in the red-list of Belluno province and Veneto Region, Buffa et al., 2016).

Species	Plot 1	Plot 2	Plot 3	Outside	RL-BL	RL-V
Agrostis stolonifera L.	R					
Astragalus glycyphyllos L.			R			
Brachypodium rupestre (Host) Roem. & Schult.	1		3			
Calamagrostis epigejos (L.) Roth.				X		
Carex flacca Schreb.	R					
Carex hirta L.	R					
Carex cf. *paniculata* L.	R				LC	LC
Carex rostrata Stokes		5				
Centaurea nigrescens Wild.			R			
Chaerophyllum cf. *hirsutum* L.			R			
Dactylis glomerata L.			R	X		
Dactylorhiza maculata (L.) Soó subsp. *fuchsii* (Druce) Hyl.			R		LC	LC
Deschampsia cespitosa (L.) P. Beauv.	R				LC	LC
Equisetum cf. *arvense* L.	4					
Equisetum sp.			1			
Filipendula ulmaria (L.) Maxim.	4				LC	LC
Fraxinus excelsior L.			R		LC	LC
Gallium mollugo L.				X		
Impatiens glandulifera Royle				X		
Juncus articulatus L.				X		
Lathyrus pratensis L.	R		R			
Neottia nidus-avis (L.) Rich.			R		LC	LC
Petasytes hybridus (L.) G. Gaertn., B.Mey. & Scherb.			5			
Phleum pratense L.			R			
Pimpinella cf. *saxifraga* L.			R			
Poa alpina L.	R					
Valeriana officinalis aggr..	R					

2.6.2 Butterflies

To study butterflies in La Zopa, we decided not to design a transect walk but to collect observations during our other activities in the area because the area is not suitable for designing a transect of at least 500 m. Nonetheless, we observed butterflies on 6.4, 29.4, 30.5, 19.6, 24.6, 5.7 and 27.7.2023. One additional observation on 22.6 was also sent to us. The observations are summarized in **Table 2.23**. The observation resulted in a community of at least 24 species, including many species adapted to *F. sylvatica* woods, such as *Boloria euphrosyne*, to forest edges, such as *Coenonympha arcania* and *Cyaniris semiargus*, and to the banks of streams and rivers, such as *B. ino*, *Carterocephalus*

palaemon, and *L. camilla*. Three species of conservation interest were recorded: *B. ino*, *L. camilla*, and *L. achine* (**Figure 2.18**). All the species are discussed in the Mosigo chapter. In this case too, the presence of *L. achine* is of particular interest and should inform the management of the site to maintain the bush edges where it lays its eggs.

Table 2.23: Butterflies observed in La Zopa (number of adults observed for each species on 6.4, 29.4, 30.5, 19.6, 24.6, 27.6, 5.7 and 27.7.2023; (22.6): observation sent to us; m= male; f= female; ?= sex unknown; + = several individuals; C=mating behaviour observed; * = species protected under the "Habitats" directive; RL-I: conservation status in the Italian red list, Balletto et al. 2015; RL-NE: conservation status in northeast Italy according to Paolucci, Paolucci, 2010).

Species	RL-I	RL-NE	6.4	29.4	30.5	19.6	(22.6)	24.6	27.6	5.7	27.7
Aglais urticae	LC	Common	1								
Anthocharis cardamines	LC	Common		1m							
Aporia crataegi	LC	LC								2	
Boloria euphrosyne	LC	LC			1						
Brenthis ino	LC	VU								3	1
Brenthis cf. *ino*	LC	VU						3			
Carterocephalus palaemon	LC	NT						1			
Coenonympha arcania	LC	LC-NT						1		1	
Coenonympha pamphilus	LC	LC						1		1	
Cyaniris semiargus	LC	LC				1m		1m			
Erebia aethiops/stiria/styx	LC/LC/LC	LC/DD/LC									3m
Erebia euryale/ligea	LC/LC	LC/LC-NT							1m1fC	1	2
Erebia sp.		–									+
Gonepteryx rhamni	LC	Common		1	1			1f		1	
Lasiommata maera/petropolitana	LC/LC	Common/LC				1					
Leptidea sinapis/juvernica	LC/LC	Common				2		1		2	
Limenitis camilla	LC	NT									2
*Lopinga achine**	NT	VU						1		2	
Maniola jurtina	LC	–					1f	2m		1m1f	2m1f
Melanargia galathea	LC	LC								4	1
Ochlodes sylvanus	LC	LC						1			
Cf. *Ochlodes sylvanus*	LC	LC				1m					1f 1?
Pieris napi/bryoniae	LC/LC	Common		2		1					
Pieris rapae	LC	Common						1			
Pieris cf. *rapae*	LC	Common								2	
Pieris sp.		–	1								1
Polygonia c-album	LC	NT			1						
Thymelicus lineola	LC	LC								2	
Thymelicus lineola/sylvestris	LC/LC	LC/LC									1
Vanessa atalanta	LC	Common									1

2.6.3 Dragonflies

Despite the repetition of point count surveys on several occasions (24.6, 5.7, 27.7 and 7.10.2023), only a few dragonflies were observed in La Zopa, all of them were seen during point count surveys at Pond 3. An additional observation on 9.9 was sent to us (Fitsios, pers. com.). All results are summarized in **Table 2.24**. We found four species (*A. cyanea*, *C. puella*, *P. nymphula*, *Sympetrum vulgatum*) (see **Figure 2.17**), all of which are quite common in the area (Bonometto, 2020). Mating behavior was observed for three of them (*A. cyanea*, *P. nymphula*, *Sympetrum vulgatum*).

Table 2.24: Dragonflies observed during point count surveys in La Zopa (individuals observed for each species on 24.6, 5.7, 27.7, 7.10.2023; m= males; f= females; C=mating behaviour observed; + = several individuals; RL-I: conservation status in the Italian red list, Riservato et al., 2014).

Species	RL-I	24.6	5.7	27.7	(9.9)	7.10
Aeshna cyanea	LC				+m	+m +f C
Aeshnidae	–	1				
Coenagrion puella	LC	1				
Pyrrhosoma nymphula	LC	1m 1f C				
Sympetrum vulgatum	LC				3m 3f C	+

Figure 2.17: Male *Coenagrion puella* in La Zopa (24.6.2023, photo by G. Menegus)

Figure 2.18: *Lopinga achine* in La Zopa (24.6.2023, photo by G. Menegus)

2.6.4 Amphibians

We monitored amphibian species with repeated VES on 6.4, 29.4, 19.5, 30.5, 31.5, 19.6, 24.6, 5.7 and 27.7.2023. One additional observation was made outside VES on 7.10.2023. The only amphibian species observed is *R. temporaria* (see **Table 2.25**).

Table 2.25: Amphibians observed during VES in La Zopa on 6.4, 29.4, 19.5, 30.5, 31.5, 19.6, 24.6, 5.7 and 27.7.2023 (number of individuals observed; X= tadpoles observed; RL-I: conservation status in the Italian red list Rondinini et al., 2022).

Species	RL-I	6.4	29.4	19.5	30.5	31.5	19.6	24.6	5.7	27.7	(7.10)
Rana temporaria spawns		25	6								
R. temporaria tadpoles			X	X	X	X	X	X	X	X	
R. temporaria adults					1						1

Notes and aknowledgements

The surveys were carried out in 2023 by employees of TESAF department. Most monitoring and identification were done by Giulio Menegus, with the help of Samuele Pellizzari, Raffaella Dibona and Vinicio Carraro. The sampling, disturbance and manipulation or collection of protected species was authorised by the Italian Ministry of Environment (Ministero dell'Ambiente e della Sicurezza Energetica, Direzione Generale Patrimonio Naturale e Mare, ex DM 357/97) and by Veneto Region (Regione del Veneto,

Area Tutela e Sicurezza del Territorio, Direzione Uffici Territoriali per il Dissesto Idrogeologico, U.O. Servizi Forestali – Sede di Belluno, ex LR 53/74). Photos taken by the students of CFP Bauer (Milan) and Athanasios Fitsios proved helpful in completing our data. We would like to thank the Servizio forestale di Belluno and U.O. Strategia regionale della biodiversità e dei Parchi – Regione del Veneto. We would like to thank Cesare Lasen for his help in the identification of vascular plants (especially, but not restricted to, *Poaceae*). We would like to thank CFP Bauer, A. Fitsios for their help, and WWF and Gruppo Promotore del Parco delle Marmarole-Antelao-Sorapiss for their collaboration.

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3. Slovenian sites

Monitoring was carried out by the Center za kartografijo favne in flore, Antoličičeva 1, SI-2204 Miklavž na Dravskem polju (CKFF) in the year 2023 from April to November. Three project areas were included in biodiversity monitoring: Dolga Brda, Zadnji travnik, Helena Stream spring (upper part) and Helena Stream spring (lower part). All four areas are small alpine wetlands and have a status of Natural values of national importance (Rules on the designation and protection of natural values, Official Gazette of the Republic of Slovenia, no. 111/04, 70/06, 58/09, 93/10, 23/15, 7/19 and 53/23) and are placed within the EZTS area of the Karavanke Geopark.

The objective of monitoring was to verify the presence of protected species of selected taxonomic groups and to provide guidelines for the management of areas according to target groups or species.

Additional surveys of biodiversity were conducted by the IRSNC and the volunteer work of Students of biology at the sites of Smrekovec and Šumc, and the results are presented at the end of the report.

Table 3.1: Areas of biodiversity monitoring

Project area	Natural value	Identification number of natural value	Monitoring
Helenski potok - lower part	Helenski potok - povirje	7216	Marsh fritillary
Helenski potok - upper part	Helenski potok - povirje	7216	Marsh fritillary
Zadnji travnik	Zadnji travnik - Olševa	3773	Flora
Dolga Brda	Dolga Brda	7144	Dragonflies, amphibians, flora, habitat types

The field work was carried out in accordance with the permits of the RS Environment Agency number 35601-56/2016-2 and 35601-52/2016-24 and were obtained by a contractor.
According to contract of public procurement CKFF delivered report of monitoring "*Popis vrst in habitatnih tipov, prisotnih v malih alpskih mokriščih znotraj projektnih območij projekta "Integrated small wetlands of the Alps monitoring and protection*" (Monitoring of species and habitat types present in small alpine wetlands in project area of *"Integrated small wetlands of the Alps monitoring and protection"*) on which this document is based unless stated otherwise.

3.1 Dolga Brda

3.1.1 Vegetation

METHODS

Flora was monitored twice in Dolga Brda, on 29 May and 16 July 2023. Determination of ferns and spermatophytes was carried out on the field, the rest were collected and later determined with the help of a stereoscope and identification keys (Martinčič et al. 2007, Fischer et al. 2005). In the field, recognizable species of mosses were recorded, but most of them were collected in marked plastic bags and the samples were carefully examined in the laboratory using a stereoscope and a microscope. Mosses were determined with the help of the following literature: Casas et al. (2006, 2009), Frey et al. (2006), Holyoak (2021), Lüth (2019), Paton (1999), Smith (2004) and Schumacker and Váňa (2005). Žan Lobnik Cimerman also participated in determining the mosses.

As a nomenclature source for mosses European List of Mosses (Hodgetts et al. 2020) was used. For data on the distribution of moss species in Slovenia, we used the sources Martinčič (2003, Bryopsida) and Martinčič (2011, hornworts and liverworts), and for Europe, the European list of mosses by country (Hodgetts & Lockhart 2020). We used the Slovenian Red List (Martinčič 2016) to check the data on endangered species in Slovenia, and the European Red List (Hodgetts et al. 2019) for Europe.
We used the following as the nature conservation basis for the flora threat assessment:

- Rules on the inclusion of endangered plant and animal species in the Red List (Official Gazette of the RS, no. 82/02 and 42/10)
- Decree on protected wild plant species (Official Gazette of the Republic of Slovenia, no. 46/04, 110/04, 115/07, 36/09 and 15/14)

Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (Official Journal L 206 of 22 July 1992), last amended by Council Directive 2013/17/EU with of 13 May 2013 (Official Gazette L 158 of 10 June 2013) (Habitats Directive).

RESULTS: VASCULAR PLANTS

A total of 269 species of vascular plants (ferns and seed plants) were recorded in the area of Dolga Brda during two visits on 16 plots. Plots included both habitat types *Ash-alder woods of slow rivers* (Physis 44.33) and *Acidophilic fir forests with greater whipwort* (Physis 42.135), a strip by the railway, various types of meadows and tall stalks throughout the area, around the existing pond at the entrance and an area of a former pond that is becoming overgrown.

In addition to black alder and common ash, typical species found in the floodplain forest along the stream were sycamore (*Acer pseudoplatanus*), alder buckthorn (*Frangula alnus*), aspen (*Populus tremula),* pedunculate oak (*Quercus robur*) and European buckthorn (*Rhamnus catharctica*). Quaking sedge (*Carex brizoides*) gives a characteristic

appearance to the undergrowth. Marsh hawk's-beard (*Crepis paludosa*), hairy chervil (*Chaerophyllum hirsutum*), herb Paris (*Paris quadrifolia*) and many other species can be found there as well.

Figure 3.1: Ash-alder woods of slow rivers (left) and rare wood horsetail (*Equisetum sylvaticum*) (Photos: Branka Trčak)

Among the species that are interesting since they are not very common neither in Slovenia or in Carinthia, and are moreover not included on the Red List, we should mention fern *Matteucia struthiopteris*, which was recorded in the eastern part of the area, the Styrian lungwort (*Pulmonaria stiriaca*) and, in general, rather rare wood horsetail (*Equisetum sylvaticum*). Among the meadow species, in addition to the usual types of grasses, the wood clubrush (*Scyrpus sylvaticus*), the ragged-robin (*Lychnis flos-cuculi*), meadow buttercup and creeping buttercup (*Ranunculus acris* and *R. repens*), and in the wettest areas also the lesser spearwort, (*R. flammula*) are common. Meadowsweet (*Filipendula ulmaria*) and the yellow iris (*Iris pseudacorus*) are dominating, latter is a protected species for which measures must be taken to maintain the favorable condition of its habitat.

Yellow loosestrife (*Lysimachia vulgaris*) thrives in the area of now overgrown pond, and dominates especially in the central slightly higher part. Bogbean (*Menyanthes trifoliata*) and water horsetail (*Equisetum fluviatile*), can be found there as well: both are listed on the Red List as vulnerable (V) species. Marsh willowherb (*Epilobium palustre*), a species of bogs and oligotrophic wet meadows, common skullcap (*Scutellaria galericulata*), gypsywort (*Lycopus europaeus*). Broadleaf cattail marsh thistle (*Cirsium palustre*) occurs

in northern parts where there is more standing water. In the western part there is a stand of common reeds. In addition to the above-mentioned, among the nature conservation important for the area, we would like to emphasize the purple marshlocks, (*Potentilla palustris*), the rosemary-leaved willow (*Salix rosmarinifolia*), the marsh speedwell (*Veronica scutellata*) and the marsh violet (*Viola palustris*). All of the above, except the marsh violet, which is listed as an affected species (E) on the Red List, are listed as vulnerable (V). We also found black currant (Ribes nigrum), which is on the Red List as a rare (R) species, in the transitional bog area and in the adjacent floodplain forest. In the southern part, there are also more peat mosses and various types of willows. Schrubs that continue south into the forest have been cut down.

Figure 3.2: Bogbean (Photo by Nuša Šoštar Pirš, ZRSVN, 22.5.2023)

The invasive species Himalayan balsam (*Impatiens glandulifera*), which is on the European Invasive Species Regulation (Commission Implementing Regulation (EU) 2022/1203 of July 12, 2022), invades the edges of bogs and other areas - especially the forest and reeds. These species are subject to the strictest measures to prevent introduction and spread. Certain species that have been known in the area for a long time, especially orchids, have not been confirmed. It is possible that, if they thrive at the edge of meadows, we have overlooked them, but it is also very likely that they have disappeared due to the eutrophication of meadows. Certain meadows were mowed during our visit and this could also be the reason why we did not see them.

Table 3.2: List of priority flora and their conservation status according to RS and UZRV

Latin name	Common name	RS	UZRV
Alopecurus geniculatus L.	water foxtail	V	
Arabis pauciflora Garcke	/	R	
Carex rostrata	bottle sedge	V	
Carex vesicaria L.	bladder sedge	V	
Epipactis helleborine (L.) Crantz	broad-leaved helleborine		H
Equisetum fluviatile L.	water horsetail	V	
Gratiola officinalis L.	Gratiole	V	
Iris pseudacorus L.	yellow iris		H
Leucojum vernum L.	spring snowflake		O

Latin name	Common name	RS	UZRV
Menyanthes trifoliata L.	Bogbean	V	
Potentilla palustris (L.) Scop.	purple marshlocks	V	
Pseudostellaria europaea Schaeftl.	/	V	
Ribes nigrum L.	Blackcurrant	R	
Salix rosmarinifolia L.	rosemary-leaved willow	V	
Tetragonolobus maritimus (L.) Roth	dragon's teeth	V	
Thelypteris palustris Schott	marsh fern	V	
Veronica scutellata L.	marsh speedwell	V	
Viola palustris L.	marsh violet	E	

Figure 3.3: Presence of *Tetragonolobus maritimus* along the railway is most probably due to the activity of railway traffic (photo: Simona Strgulc Krajšek)

RESULTS: MOSSES

There is no published data on the presence of mosses in the Dolga Brda area, except for general information about peat moss (*Sphagnum* sp.) in the area of the former pond. 74 species of mosses were recorded in the entire area, of which 11 liverworts species and 63 species of *Bryopsida*.

The area was divided into 11 plots. 16 types of moss were recorded around the former pond. Two species of peat mosses *Sphagnum fallax* and *S. subsecundum* thrive in the southern part of the project area. In addition to these two species, two species which are classified as potentially endangered species (NT) on the Slovenian Red List (Martinčič 2016) were confirmed in the wetland area, *Calliergon giganteum* and *Drepanocladus aduncus*.

Figure 3.4: Two typical protected species of moss species from the forest in Dolga Brda - *Leucobryum* moss (*Leucobryum glaucum* - left) and Girgensohn's bogmoss (*Sphagnum girgensohnii* - right), (photo: Simona Strgulc Krajšek)

Forests are rich in mosses as various species of peat mosses thrive in them. Several types of peat mosses grow in the area: *Sphagnum capillifolium*, *S. girgensohnii*, *S. palustre*, *S. russowii*, *S. squarrosum* and *Leucobryum glaucum* which are classified as protected species. Acidophilic forest is characterized by species *Bazzania trilobata*, *Polytrichum formosum*, *Pleurozium schreberi*, *Pseudosceropodium purum* and several species from genus *Plagiomnium*. There is also a lot of brittle damp wood in the forest, which is the habitat of many liverworts, and potentially also of the *Buxbaumia viridis* species, which were otherwise not found.
By the road near the railroad crossing in proximity of the pond in a rather ruderalized area were found some interesting species of the one-year ephemeral types of mosses that thrive in open, disturbed habitats and are still poorly researched in Slovenia. Among them are: *Dicranella staphylina*, *Funaria hygrometrica* and *Physcomitrium pyriforme*.
The entire area of natural value Dolga Brda is of high nature conservation value, as there are preserved structures that enable the existence of vulnerable species. The area of the former pond is extremely rich in species, especially with endangered species that are very sensitive to changes in the water regime, so it is essential that this area is properly managed and that these species are preserved.

3.1.2 Habitat types

Habitat types were monitored in the entire area of natural value Dolga Brda. Field work was carried out on 29. 5. 2023.
Habitat types were mapped according to the current working version of the Slovenian typology (2011), which is a corrected and supplemented version of the typology from 2004 (Habitatni tipi Slovenije HTS 2004, Republika Slovenija, Ministrstvo za okolje, prostor in energijo - Agencija Republike Slovenije za okolje, 2004), and in accordance with the Guidelines for mapping non-forest habitat types (Kačičnik Jančar 2011). The obtained data were entered on orthophotos at a scale of 1:1,000 on the spot. In most

cases, individual plots were defined by boundaries in nature, which are most often conditioned by use.

Habitat types were evaluated in accordance with the Regulation on Habitat Types (Official Gazette of the Republic of Slovenia, no. 112/03, 36/09 and 33/13). Since monitoring was based on Slovenian typology, results are difficult to translate into English, as there is no official translation yet.

In the area of Dolga Brda, 42 different habitat types were recorded on 132 plots, there were 34 individual units according to typology, and nine combinations of habitat types. The list of all present habitat types is in Annex 4. The area of natural value is 17.02 ha.

Table 3.3: Size of Habitat type groups classified according to Regulation on Habitat types

Habitat types	Area (ha)	Area (%)
3 (Shrub and grassland)	3,91	23,0
-3 (Shrub and grassland in unfavourable conservation status)	0,57	3,3
4 (Forests)	5,63	33,1
-4 (Forests in unfavourable conservation status)	0,06	0,4
5 (Bogs and marshes)	0,11	0,7
Other	6,73	39,5
TOTAL	**17,01**	**100**

The area is dominated by forest, along the stream that later flows into the river Meža, there are *Ash-alder woods of slow rivers* (Physis 44.33), which cover a third of the area. As the ground rises on the slope, the forest changes to a habitat type *Acidophilous silver fir forests with Bazzania trilobata* (Physis 42.135), which covers 15.36% of the area. In this forest, fir is almost completely replaced by spruce, and the undergrowth is rich in mosses, and in the wettest parts, also peat mosses. Among non-forest areas, about 12% is covered by *Medio-european lowland hay meadows with meadow foxtail* (Physis 38.2222-S2), 7.66% is *field crops* (Physis 82.11) and 6.34% is *humid improved grasslands* (Physis 81.2). *Humid grasslands and tall herb communities* (Physis 37) make up a total of 10.38% of the area of natural value.

The area of the former pond, which is also the central part of the project area lies in the middle of *Ash-alder woods of slow rivers,* was classified as a combination between *Water horsetail beds* and *Transition mires* and covers 0.67% of the total area. In the western part, it passes into permanently or predominantly *Flooded Phragmites beds* (Physis 53.111), and in the eastern part into *Wood clubrush meadows* in combination with *Ruderal communities of Himalayan balsam* (Physis 37.219x87.2-S11). On the northern edge, where the soil is the wettest, they are narrow *Reedmace beds of broadleaf cattail* (Physis 53.131). Small reeds were observed in the entire area of the transitional bog. *Impatiens glandulifera* is probably more widespread than it was observed during monitoring in May, as it thrives in plant communities of one-year non-native invasive species and is the easiest to detect in July.

Figure 3.5: Combination of habitat types Atlantic and subatlantic humid meadows and Medio-european lowland hay meadows with meadow foxtail (Photo by: Branka Trčak)

In group 3 (shrubs and grasslands) habitat types *Medio-european lowland hay meadows with meadow foxtail* and *Meadowsweet stands and related communities* are prevailing. In cases where they appear in combination with stands of one-year non-native invasive species, for instance Himalayan balsam, or where the meadows are too intensively cultivated, we marked them as habitat types in a less favorable condition (-3). They can be found throughout the area of natural value, in the eastern and western parts mainly as grasslands, and in the central part as patches of tall stands grow in the forest.

Table 3.4: Table of shrub and grassland habitat types in the Dolga Brda area

Physis code	Habitat type	Area (%)
38.2222-S2	Medio-european lowland hay meadows with meadow foxtail	9,35
38.2222-S2	Medio-european lowland hay meadows with meadow foxtail	2,46
37.111	Meadowsweet stands and related communities	3,38
38.2221-S1	Medio-european lowland hay meadows with bulbous oat grass	3,14
37.21x38.2222-S2	Atlantic and subatlantic humid meadows x Medio-european lowland hay meadows with meadow foxtail	2,56
37.219	Wood clubrush meadows	2,17
37.21	Atlantic and subatlantic humid meadows	0,74
37.111x87.2-S11	Meadowsweet stands and related communities x Ruderal communities of Himalayan balsam	0,67
38.221	Medio-european lowland hay on relatively dry soil and slopes with bulbous oat grass	0,48
37.72	Shady woodland edge fringes	0,40
37.715	Mixed riverine screens	0,29
37.111x53.21	Meadowsweet stands and related communities x Large *Carex* beds	0,24
37.111x37.219	Meadowsweet stands and related communities x Wood clubrush meadows	0,16
35.12x87.2-S11	*Agrostis-Festuca* grasslands x Ruderal communities of invasive species	0,15
37.24	Flood swards and related communities	0,13
37.219x87.2-S11	Wood clubrush meadows x Ruderal communities of Himalayan balsam	0,04
37.313	Purple moorgrass meadow's and related communities of *Molinia*	0,01

Some observed habitat types that are in group 3 of Decree on habitat types (Official Gazette of the Republic of Slovenia št. 112/03, 36/09 in 33/13) are included on Annex 1 -

Natural habitat types of community interest whose conservation requires the designation of special areas of conservation, of the The Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora - "The Habitat Directive" as well.
These habitat types are:

- 6230* Species-rich *Nardus* grasslands, on silicious substrates in mountain areas (and submountain areas in Continental Europe)
- 6410 *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*),
- 6430 Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels,
- 6510 Lowland hay meadows (*Alopecurus pratensis*, *Sanguisorba officinalis*).

Habitat type lowland hay meadows (*Alopecurus pratensis, Sanguisorba officinalis*), dominates among listed.
From group 4 Forest habitat types, the area includes *Ash-alder woods of slow rivers*, which are present throughout the valley along the stream, in the western part also as a narrow strip along the stream. In the latter case, the habitat type is marked as being in a less favorable condition.

Table 3.5: Forest habitat types in Dolga Brda

Physis code	Habitat type	Area (%)
44.33	Ash-alder woods of slow rivers	33,08
84.2/44.33	Hedgerows / Ash-alder woods of slow rivers	0,36

Figure 3.6: The area of the former pond with swamp and bog communities (foto: Branka Trčak, CKFF)

Ash-alder woods of slow rivers are also protected by the Habitats Directive as priority habitat type (Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion,

Alnion incanae, Salicion albae) - 91E0*). They can be found in the central part of the area, on both sides of the meandering stream and by the stream in the far eastern part. In the undergrowth meadows of quaking sedge (*Carex brizoides*) give the forest a characteristic appearance, and in the undergrowth we can also find a rather rare species, horsetail (*Equisetum sylvaticum*).
There was only one plot considered for group 5 Bogs and marshes, which was in the area of the former pond, that is now in the stage of succession from swamp to bog. According to dominant species, the area was mapped as a combination of *Water horsetail beds* and *Transitional bogs* (Physis 53.147x54.5). Transitional bogs are also on Annex 1 of the Habitats Directive as 7140 *Transition mires and quaking bogs*.

We assess that the area as relatively well preserved. Strong influence on the vegetation has a well-preserved stream bed, which slowly meanders through the valley. Although wet grasslands are losing its diversity due to intense farming. Himalayan balsam is successfully spreading into the marshes, which could have a strong negative effect in the future.

3.1.3 Dragonflies

METHODS

Monitoring of dragonflies was carried out in the entire area of the natural value of Dolga Brda, with an emphasis on aquatic and marsh habitats. In the area of the former pond, we targeted the common hawker (*Aeshna juncea*), and in the areas of streams and ditches, we searched for the large golden-ringed dragonfly (*Cordulegaster heros*).
Dragonflies were observed with binoculars or with the naked eye, adults were caught with a butterfly net if necessary, and larvae with a water net. We used a standardized larval sampling method with a water net (Šalamun et al. 2010) to search for species Large golden-ringed dragonfly. Monitoring was executed in three days on 26. 6., 11. 7. in 12. 9. 2023.

RESULTS

In 2023, 15 species of dragonflies were recorded. Species and their conservation status are listed in the **Table 3.6**. **Table 3.6** also compares monitoring in year 2023 with previously known data.

Table 3.6: Observed dragonflies in Dolga brda before year 2023 and in year 2023

Latin name	Common name	RS	FFH	URZŽV	before 2023	2023
Lestes sponsa	Emerald damselfly				x	
Lestes virens vestalis	Small spreadwing	E		1,2	x	
Calopteryx virgo	Beautiful demoiselle				x	x
Platycnemis pennipes	White-legged damselfly					x
Coenagrion puella	Azure damselfly				x	x
Pyrrhosoma nymphula	Large red damselfly					x
Aeshna affinis	Southern migrant hawker	V				x
Aeshna cyanea	Southern hawker				x	x
Aeshna juncea	Common hawker	V			x	
Anax imperator	Emperor dragonfly					x
Gomphus vulgatissimus	Common clubtail	V				x

Latin name	Common name	RS	FFH	URZŽV	before 2023	2023
Onychogomphus forcipatus	Small pincertail					x
Cordulegaster bidentata	Sombre goldenring	V			x	x
Cordulegaster heros	Large golden-ringed dragonfly	V	II, IV	1,2	x	x
Somatochlora flavomaculata	Yellow-spotted emerald	V			x	x
Somatochlora meridionalis	Balkan emerald					x
Libellula depressa	Broad-bodied chaser					x
Sympetrum sanguineum	Ruddy darter				x	x
Sympetrum vulgatum	Vagrant darter				x	

RS: *Rules on the inclusion of endangered plant and animal species in the Red List* (Official Gazette of the Republic of Slovenia, no 82/2002, 42/2010). **E** – vulnerable species; **V** – vulnerable species;

FFH: Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (Official Journal L 206 of 22 July 1992), **II** – Annex II: animal and plant species of community interest whose conservation requires the designation of special areas of conservation; **IV** – Annex IV: animal and plant species of community interest in need of strict protection;

URZŽV: Decree on protected wild animal species (Official Gazette of the Republic of Slovenia, no. 46/2004, 109/2004, 84/2005, 115/2007, 96/2008, 36/2009, 102/2011, 15/2014). **1** – Appendix 1: Animals species for which a protective regime for the protection of animals and populations is defined; **2** – Appendix 2 (Chapter A): Animal species for which habitat protection measures and guidelines for maintaining the favourable condition of their habitats are defined

3.1.4 Amphibians

METHODS

Population size of true frog (*Ranidae*) and presence of selected amphibian species was determined in three periods in 2023: at the beginning of April, at the end of May and in the middle of September.

Spawns of the common frog (*Rana temporaria*) were counted in April in natural value Dolga Brda and in its immediate vicinity. All potential habitats of amphibians and all potential spawning grounds of common frog were examined. Based on the counted spawns, we can derive the minimum number of adult females in the area (Campbell et al. 2005, Crouch & Paton 2002), since as a rule, an adult female lays only one spawn in a season (Nöllert & Nöllert 1992) - thus the number of counted spawns represents the minimum number of adult females in the area. Based on the known ratio between the number of males and females in the population, the number of males for an individual was estimated.

Spawns were counted during the height of the mating season. In some locations, the spawn was fresh enough at the time of counting that they could be easily counted, while in others only the remains of spawn were visible, so the number is estimated. In the analysis, all counted spawns or assessment of the number of spawners at each location were used, as the area was only visited for the purpose of monitoring.

RESULTS

The population of common frog in the area is estimated to be stable. In the area of natural value, most of the spawning was recorded in the marsh in the northwest part of the area and outside the area of natural value in the north-west marsh below a small settlement Malinek (8014, 82939, **Figure 3.8**).

In the area of natural value, spawning was also recorded in swamp east below the small settlement Malinek (82935;), in the left tributary of Meža (33238, 82938), in a pond (82936) and in individual ditches and puddles throughout marshy valleys (e.g., 82933, 82937). A total of 1,111 common spawns was estimated, which means that in 2023 the minimum

number of females in the surveyed area was 1,111. After considering the sex ratio from the existing literature (Ashby 1969, Grossenbacher 1980, Ryser 1989, Schülpan and Günther 1996), there were 1,111 to 1,999 males, which means that the population of common frog counts at least 2,222 to 3,110 sexually mature specimens.

Figure 3.7: Common frog spawn (Photo by: Barbara Stupan, ZRSVN, 28.3.2023)

However, most of the spawn was deposited in marshes, which already have very little water in the spring and will eventually dry out completely and become overgrown without management. Consequently, the main spawning grounds of not only common frog, but other amphibians' species as well will be lost.

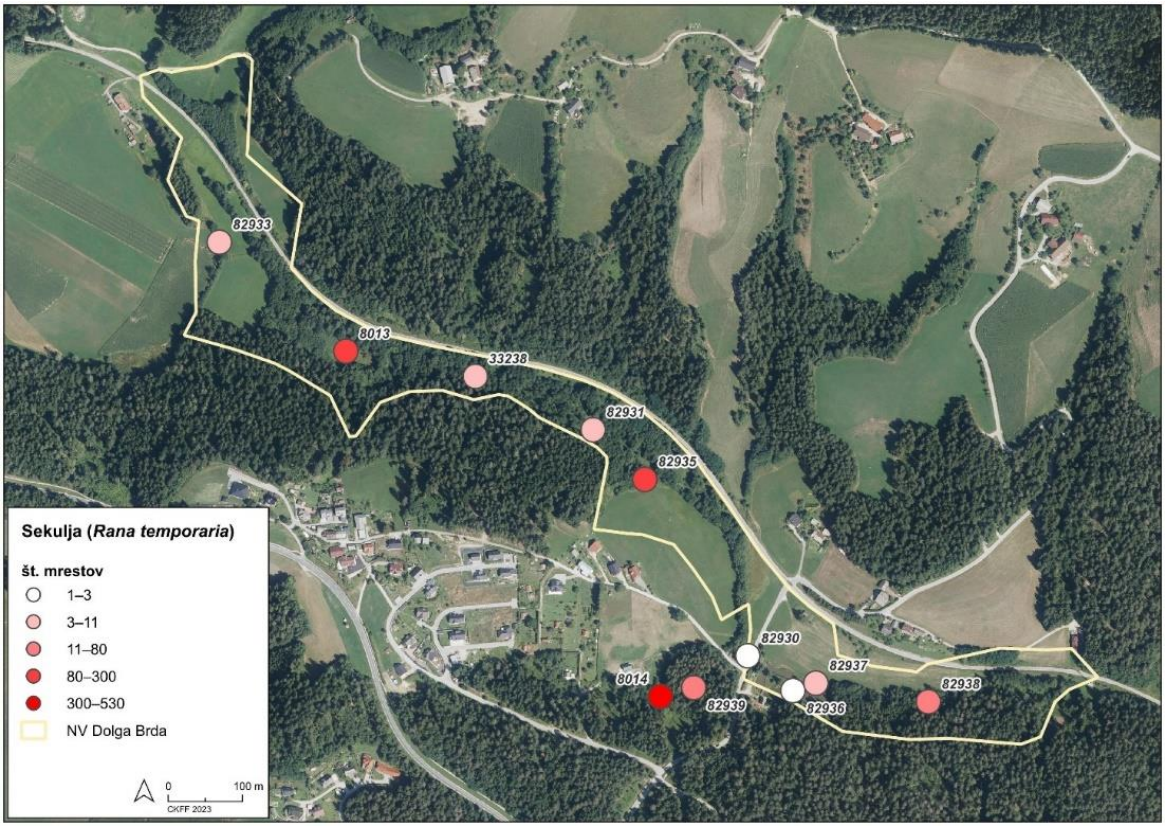

Figure 3.8: Number of common frog spawn by individual locations in the natural value area of Dolga Brda and in its immediate vicinity

Yellow-bellied toad (*Bombina variegata*) and European tree frog (*Hyla arborea*) were not confirmed during monitoring in the area, which does not mean that they are no longer

present. In particular, the yellow-bellied toad is most likely still present, but the population is most likely not large.
Other species that were observed are fire salamander (*Salamandra salamandra*), alpine newt (*Ichthyosaura alpestris*), smooth newt (*Lissotriton vulgaris*) and common toad (*Bufo bufo*).

3.1.5 Proposed measures

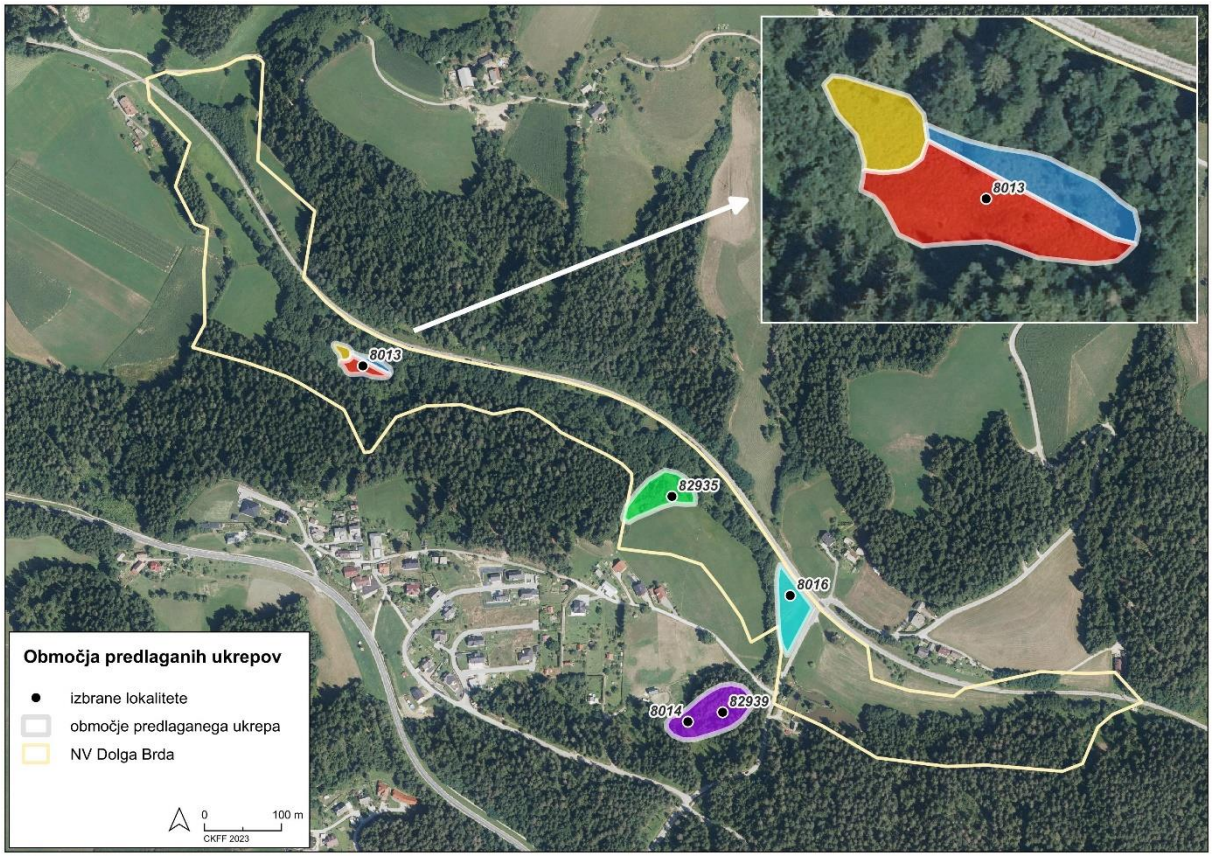

Figure 3.9: Colour coded areas of proposed measures

The central part of the bog and the part to the south (8013; red coloured area in **Figure 3.9**) should be preserved in their existing state since there are many typical wetland plants such as *Menyanthes trifoliata, Epilobium palustre, Equisetum fluviatile, Potentilla palustris, Veronica scutellata, Salix rosmarinifolia, Sphagnum spp*. The area next to the stream in the north and north-east part of area 8013 (blue colour) should be deepened (excavation of some ponds). At the same time, marsh must not be completely flooded.
Most of fallen trees and branches must be removed from the marsh, while some larger trunks in the marsh and on the edge of the marsh must be left for the possible development of liverworts and fungi.
It is necessary to check the state of the groundwater in natural value and find out why the area has dried in the last decade. It is necessary to provide more water in the marsh meadows and limit possible fertilization of meadows between the stream and the railway (8016; light blue coloured area) and south of the stream on the north edge of the meadow as well (82935; green coloured areas).

The area of natural value Dolga brda could be expanded to swamp in the forest (82939; floating mat of peat moss) and to the open marsh (8014; floating mat of peat moss, more than 500 spawns of common frog) south-west of the existing pond (purple coloured area in the picture), since the terrestrial habitat of the common frog, which spawns here, extends into the area of natural value. Thus, in the event of the destruction of this spawning ground, the condition of the common frog population would deteriorate even in natural value.
In the spring before flowering, the non-native Himalayan balsam (*Impatiens glandulifera*) must be removed for a couple of years in a row.

3.1.6 Additional surveys

Common spotted orchid (*Dactylorhiza maculata subsp. Fuchsii (Druce) Hyl*) was observed in the forest south of now dried up and overgrown pond, where the slope begins to ascend, by IRSCN on 21. 6. 2023. Large number of wild orchids was observed along the local road that borders on the natural value as well.

Figure 3.10: Common spotted orchid in the forest (left) and by the road (right). Photo by Barbara Stupan

3.2 Upper and lower part of the Helenski potok - povirje

Due to the same monitoring methods and researched species, the lower and upper part of the Helena stream are discussed together in this report.

3.2.1 Marsh fritillary (*Euphydryas aurinia*)

Figure 3.11: Marsh fritillary (Photo by: Martin Vernik, ZRSVN)

Figure 3.12: Devil's-Bit Scabious in bloom (Photo by: Barbara Stupan, ZRSVN)

The species is in decline and its regarded as endangered or vulnerable in most of its European range. On Helenski potok - povirje there is still one of last marsh populations in Slovenia. This area is included in national monitoring of butterflies, there were 2

previous monitoring in years 2017 in 2021. Population on this site is threatened by habitat loss because of abandonment of mowing and tree overgrowth. Due to this threat, there was already removal of overgrowth in year 2004 and an agreement was reached with the tenants to stop grazing in the area.

METHOD

In the area of the Helenski potok, the presence of marsh fritillary was determined in two periods, first in June 2023 when the area was checked for the presence of adults. Areas on which there were confirmed, were later examined in October for the possible presence of nests of caterpillars. With this protocol, we wanted to determine the breeding sites of the species and to find out which plants the caterpillars use for nesting.
In the October the nests are the largest and easiest to detect since the host plant Devil's-Bit Scabious (*Succisa pratensis*) is still in bloom, and therefore the perceptibility of them and nests is greater. When looking for nests of caterpillars, we examined the leaf rosette and the surrounding area near the ground in more detail, as the caterpillars sometimes make a nest in the immediate vicinity of the host plant. We opened the found nests a little to see the caterpillars and to make sure that they belonged to the marsh fritillary, while we did not disturb the caterpillars.

We recorded GPS coordinates of each found nest and the type of host plant. Majority of nests microlocations was marked with wooden stakes in nature for easier removal of three overgrowth and to prevent damage of the nests.

Figure 3.13: Search for nests in October (Photo by: Barbara Stupan, ZRSVN)

RESULTS

Entire area was monitored for adult specimens on 18.6.2023. They were confirmed on almost all areas of project area and on a pasture south of the natural value as well. During the monitoring of adults, reproduction of adults and laid eggs were observed on the Devil's-Bit Scabious as well.

A total of 136 nests of the caterpillars of the marsh fritillary were observed in October (2.10.2023). Nests were present in all locations where the adults were found in June. The primary host plant for caterpillars in this area is the Devil's-Bit Scabious, on which or in its immediate vicinity 132 nests of caterpillars were found. Four nests of caterpillars were also found on willow gentian (*Gentiana asclepiadea*).
We estimate that population of the marsh fritillary in area is stable at the moment with most of its population present in wet meadows. Without proper management wet meadows will be exposed to further succession and will become overgrown, as a result, the areas will no longer be suitable for the marsh fritillary.

Figure 3.14: A nest of caterpillars on the Devil's -Bit Scabious (topleft), marked nest with wooden stick (topright), a nest of caterpillars in the rosette of Devil's- Bit Scabious (bottomleft) and on a gentian (*Gentiana asclepiadea*) (bottomright) in the Helenski potok area in 2023 (Bhoto: Barbara Zakšek, CKFF)

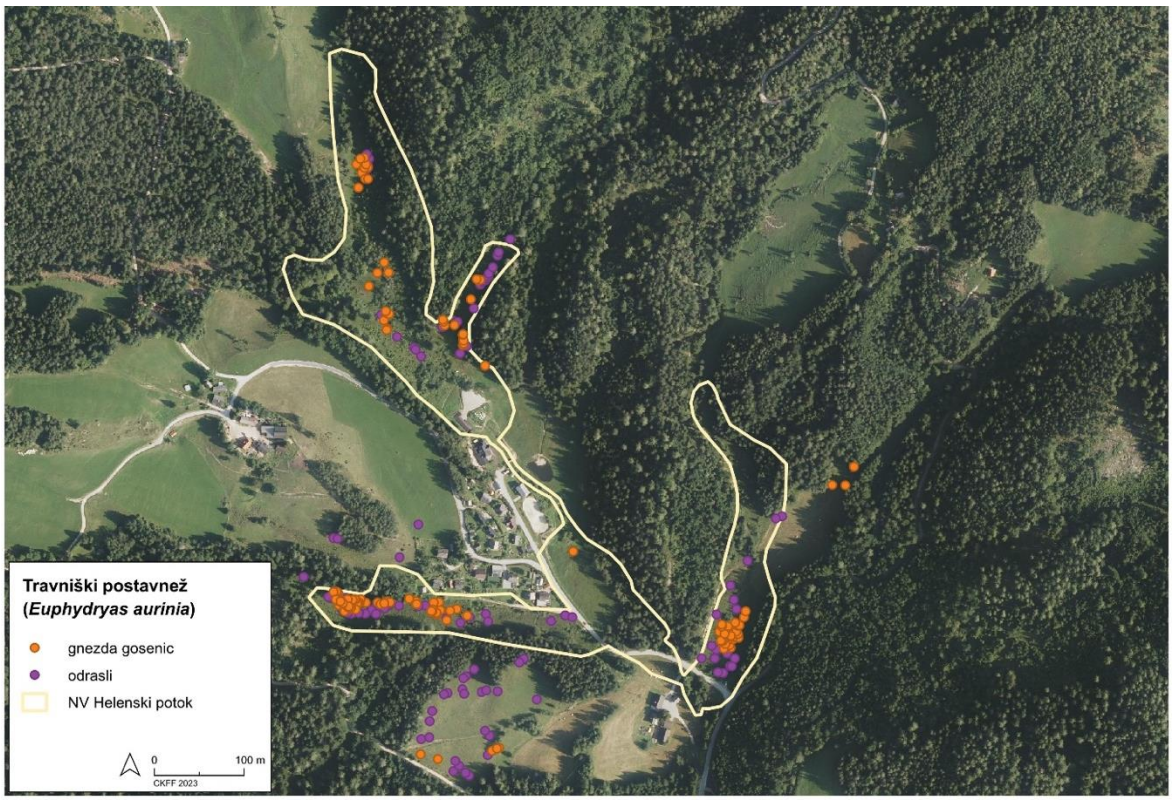

Figure 3.15: Locations of adult marsh fritillary (purple) and nests (orange) on Helenski potok – povirje

3.2.2 Proposed measures

Based on the presence of adults and larval stages four key areas were identified (**Figure 3.16**) in four different areas.

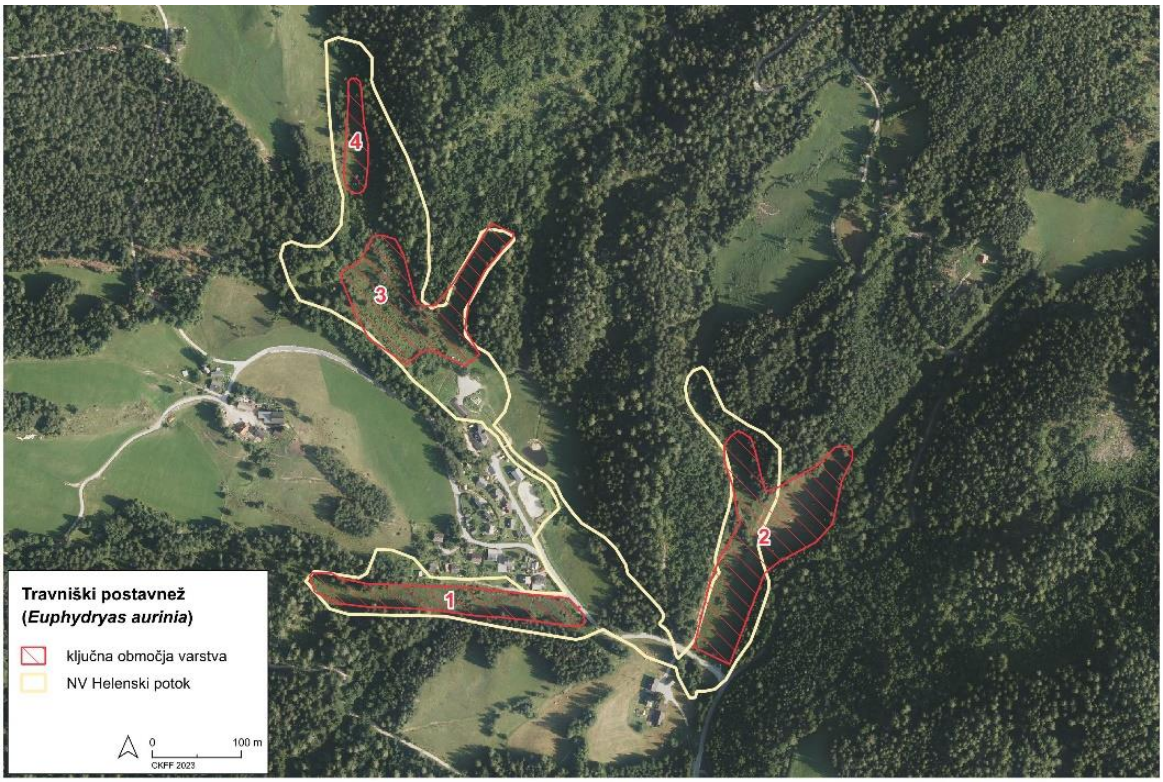

Figure 3.16: Numbered key areas for protection of the population of marsh fritillary in Helenski potok - povirje

1) The highest density of caterpillar nests was in the western part of the polygon. In the eastern part (near the road) there is also very little Devil's-Bit Scabious present. For this area, we suggest to remove tree species and mowing areas every few years (approximately every 3 years) to maintain suitable habitat. In this area, in 2023, we marked the nests of caterpillars in nature with stakes, so that in the event of possible interventions in the winter of 2023/2024, these areas can be avoided and there will be no damage to the nests of caterpillars.

2) Caterpillar nests were found on the unmowed area to the south. The central part was mowed during the autumn monitoring (2.10.2023). In this area removing the woody growth and mowing once every few years is suggested as well.

3) The area is quite overgrown, so it would be necessary to remove the woody growth.

4) In this area just mowing would be necessary for a few years, this would prevent spread of woody species.

It is crucial not to mow in all areas at the same time, mosaic maintenance is required. In the case of removal of the of woody vegetation, mowing should be postponed until next year. Mowing should be carried out in a mosaic pattern where possible, in addition areas with a high density of Devil's-Bit Scabious should be left unmowed. The most suitable time for mowing the meadows where the marsh fritillary appears is during the appearance of adult specimens. In Helenski potok that is usually in June. To protect the caterpillars, nests and rosettes of the Devil's-Bit Scabious, mowing should be done at a height of at least 10-15 cm above the ground. If a larger area is mowed in late summer or early autumn, the presence of caterpillar nests should be checked beforehand and at least some parts should be avoided.

3.2.3 Additional surveys

As part of citizen science, a group of biology students that attended Biological research camp (RTŠB) surveyed Helenski potok for two days, on 15. and 16. 7. 2023. Two species from the survey are protected with Slovenian legislation False heath fritillary (*Melitaea diamina*) and Alcon blue (*Phengaris alcon).* Woodland brown (*Lopinga achine*) is included on IV annex of Council directive (92/43/EEC) on the conservation of natural habitats and of wild fauna and flora.

Table 3.7: Survey of central part of Helenski potok (15.7.2023)

Latin name	RS	UZVRS
Aphantopus hyperantus		
Argynnis paphia		
Brenthis ino		
Coenonympha arcania		
Erebia euryale		
Erebia ligea		
Leptidea sinapis/juvernica		

Latin name	RS	UZVRS
Limenitis camilla		
Lycaena virgaureae		
Maniola jurtina		
Melitaea diamina	V	
Ochlodes sylvanus		
Pieris rapae		

Table 3.8: Survey of eastern part of Helenski potok on 16.7.2023

Latin name	RS	UZVRS	FFH
Aphantopus hyperantus			
Argynnis paphia			
Brenthis ino			
Celastrina argiolus			
Coenonympha arcania			
Cupido minimus			
Erebia euryale			
Erebia ligea			
Gonepteryx rhamni			
Lasiommata maera			
Leptidea sinapis/juvernica			
Lopinga achine			*IV*
Lycaena virgaureae			
Maniola jurtina			
Melanargia galathea			
Melitaea athalia			
Melitaea diamina	*V*		
Ochlodes sylvanus			
Papilio machaon			
Phengaris alcon/ Maculinea alcon	*E*	*V*	
Speyeria aglaja			
Thymelicus lineola			
Thymelicus sylvestris			
Vanessa atalanta			

Figure 3.17: Marsh helleborine and star gentian

IRSNC also observed a location where Alcon blue was observed in October. Majority of the meadow was mowed recently. We noticed some star gentian (*Gentiana cruciata*), that is host plant for mountain Alcon blue (*Phengaris rebeli*) but there was no sign of recent caterpillar activity in the flower.

Other major observation was a lot ripened seeds of marsh helleborine (*Epipactis palustris*) and peat mosses.

During monitoring of marsh fritillary on 18. 6. 2023, other species of *Lepidoptera* were observed by CKFF as well.

Table 3.9: Other observations of *Lepidoptera* at Helenski potok

Latin name
Carterocephalus palaemon
Coenonympha arcania
Coenonympha pamphilus
Erebia medusa
Hamearis lucina
Issoria lathonia
Leptidea sinapis/juvernica
Lysandra bellargus
Pieris bryoniae
Vanessa atalanta
Aglais urticae
Anthocharis cardamines
Pararge aegeria
Pieris rapae
Cyaniris semiargus
Melitaea athalia
Vanessa cardui
Pieris brassicae
Pieris napi
Erynnis tages
Pyrgus malvae
Chiasmia clathrata
Euclidia glyphica
Hemaris fuciformis
Pseudopanthera macularia
Siona lineata

3.3 Zadnji travnik – Olševa

3.3.1 Vegetation

METHODS

Flora on project area Zadnji travnik was monitored twice, on 11.6. and 17.7.2023. In the entire area of 175 higher plants were inventoried. All species are listed in Annex 1.

During monitoring area was divided into 4 parts (**Figure 3.18**): the central area of the raised bog, which includes a part overgrown with dwarf mountain pine (*Pinus mugo*) and the western part with hare's-tail cottongrass (*Eriophorum vaginatum*), the headwater area by the stream around the central area of the raised bog, the marsh west of the raised bog, where the influence of eutrophication due to grazing is noticeable, and pasture on the slope of the frontal moraine. The pasture is separated from the rest by an electric fence.

Figure 3.18: Project area Zadnji travnik with division for flora monitoring

RESULTS

Bog Zadnji travnik below Olševo is a typical raised bog in the last stages of the succession. Central part of the bog is overgrown with dwarf mountain pine and is rich in peat mosses (*Sphagnum divinum, S. capillifolium, S. fallax and S. fuscum*) (**Figure 3.20**) as well. In the central part, outside the area of dwarf mountain pine, species hare's-tail cottongrass (*Eriophorum vaginatum*) and round-leaved sundew (*Drosera rotundifolia*) (**Figure 3.21**) and rosemary-leaved willow (*Salix rosmarinifolia*) flourish. All these species are on the Red List as vulnerable species, the round-leafed dewdrop is also protected. Matgrass (*Nardus stricta*), cranberry (*Vaccinium vitis-idea*) and blueberry (*Vaccinium myrtillus*) were observed as well.

A shallow stream south of the bog flows freely, creating low-nutrient wetland conditions. Many plant species find their place there. Among them, there are three types of willowherbs associated with wetlands: marsh willowherb (*Epilobium palustre*), chickweed willowherb (*E. alsinifolium*) and *E. nutans*.

E. nutans is classified as a rare species on the Red List and it's only known location in Slovenia until now was from Pohorje (Strgulc Krajšek & Jogan 2008). Location Zadnji Travnik is the first known location outside of Pohorje region. The other two species of willowherb do not have nature conservation status, but nevertheless both are rare in Slovenia. Chickweed willowherb is a characteristic species of headwaters, especially at higher altitudes. Marsh willowherb is a wetlands species, that due to its attachment to

disappearing habitats, and its rarity, certainly belongs to one of the categories of the Red List.

Table 3.10: List of important species for nature conservation

Latin name	Common name	RS	UZRV	FFH
Arnica montana L.	wolf's bane	V	C, O	V
Carex acutiformis Ehrh.	lesser pond-sedge	V		
Dactylorhiza maculata subsp. *Fuchsii* (Druce) Hyl.	common spotted orchid	V	H	
Drosera rotundifolia L.	round-leaved sundew	V	×	
Epilobium nutans F. W. Schmidt		R		
Eriophorum latifolium Hoppe	broad-leaved bog-cotton	V		
Eriophorum vaginatum L.	hare's-tail cottongrass	V		
Helleborus niger L.	black hellebore		O°	
Listera ovata (L.) R. Br.	common twayblade		H	
Salix rosmarinifolia L.	rosemary-leaved willow	V		

In the Zadnji travnik project area, in addition to the listed raised bog species, there are also other endangered wetland species, such as broad-leaved bog-cotton (*Eriophorum latifolium*), common spotted orchid (*Dactylorhiza maculata* subsp. *fuchsii*), and lesser pond-sedge (*Carex acutiformis*).

Figure 3.19: Common spotted orchid in July (Photo by: Barbara Stupan, ZRSVN)

Several species of mosses have already been recorded in the Zadnji travnik area in the past, including 9 species of peat mosses, all of which are protected species, and the liverwort *Mylia anomala*, which is a potentially endangered species (Martinčič 2016).
A total of 59 species of mosses were recorded in the entire area, of which 21 are liverworts and 38 species of *Bryopsida*. Hornworts were not observed.

28 species of mosses were recorded in the central area of the bog. Among them are 4 types of peat mosses *Sphagnum divinum, S. capillifolium*, *S. fallax* and *S. fuscum*. 5 species of peat mosses that were previously confirmed in this area were not found. Those species are *Sphagnum centrale*, *S. flexuosum*, *S. pulchrum, S. rubellum* and *S. russowii*. It is possible that these species no longer grow in the area. Due to the difficulty of the group, it is also possible that the material was incorrectly determined in the past or, more likely, that we did not observe and sample the species in the field. The species of peat mosses are morphologically very similar to each other, and many can only be recognized in the laboratory, when we look at the micromorphological features under a microscope.

In the central area of the bog, the presence of the liverwort *Mylia anomala* was confirmed. In addition, *Cephaloziella spinigera*, which is rare on a European scale and is classified as a potentially endangered species (NT) on the European Red List was found as well. The data from Zadnji travnik is the second data of the occurrence of this species in Slovenia, the first data is from Pohorje from 2021 (Lobnik Cimerman et al., in press).

Figure 3.20: Peat moss in Zadnji travnik in May (Photo by: Jurij Tamše, ZRSVN)

The headwaters of the stream and the edge of the forest around the high bog are extremely rich with mosses, 35 species of mosses were recorded. Among them are two types of peat mosses: *Sphagnum capillifolium* and *S. squarrosum*. The latter has not yet been recorded in the Zadnje travnik area. Species *Buxbaumia viridis*, which is included in Annex II of the Habitats Directive, was found on wet, cracked stumps at the edge of the forest. The species needs very wet spruce or fir wood to thrive. Species was observed in several other places in the surrounding forest on the northern slope of Olševa.

The western edge of the bog, adjacent to the pasture, is lower in biodiversity. Among other species, pointed Spear-moss (*Caliergonella cuspidata*), which is typical of moist eutrophic habitats, thrives there.

3.3.2 Proposed measures

Moving away from the bog towards the frontal moraine, due to the influence of grazing, the amount of nutrients in the soil increases, which is also shown in the species composition. In addition to the typical species found on eutrophic mountain pastures, such as Good-King-Henry (*Chenopodium bonus-henricus*) and sorrel (R*umex spp*.), in lower-lying, more waterlogged parts, there is a larger growth site of creeping thistle (*Cirsium arvense*), which suggests, that the influence of eutrophication due to grazing also affects the wetland communities in the basin.

High bog species are ecologically highly specialized species, and one important factor is oligotrophic conditions. Eutrophication of the surroundings can threaten the existence of bog species, such as round-leaved sundew, hare's-tail cottongrass, and broad-leaved bog-cotton, cranberry, rosemary-leaved willow, and many others.
The central part of the bog with dwarf mountain pine and peat moss appears to be in good condition. A comparison between digital orthophoto images from 2006 and 2021 shows a significant change in the northern part, where there is less woody vegetation today. It is proposed that the existing situation without woody vegetation should be preserved.

Figure 3.21: Round-leaved sundew and hare's-tail cottongrass in Zadnji travnik (photo by: Branka Trčak, CKFF)

In the narrower area of the bog there are species of round-leaved sundew (*Drosera rotundifolia*) and hare's-tail cottongrass (*Eriophorum vaginatum*), there is also a lot of

spruce saplings (*Picea abies*), which should be monitored and, if necessary, removed so that they don't overgrow the bog.
The edge of the dwarf pine community is wet and rich with many rare and endangered bog species due to the small stream that slowly flows from the eastern part and creates meanders.

In the western part of the area, approximately at the border of wetlands, there is an electric fence, which restricts access to grazing livestock. West of the fence, the terrain is less humid and begins to rise. The sloping part on the western side (frontal moraine) is used as pasture and is quite eutrophic. Organic substances originating from cow excrement are washed into the area of the bog, which is already reflected in the species composition in the western part of the bog, where the present species are typical for habitats with an increased amount of nitrogen in the soil, such as, e.g., creeping thistle (*Cirsium arvense*). These species grow very successfully on richer soils and are a threat to poorly competitive species typical for bogs. Even eutrophication itself can threaten the growth of narrowly specialized bog species.

In the part of the raised bog, where the dwarf pine is absent, there are many spruce saplings. The area should be monitored and, if necessary, the spruce should be removed so that it does not overgrow wet meadows.

At the time of monitoring the small number of cattle was grazing, but the constant introduction of organic matter into the soil due has a strong impact on the vegetation of the wetlands, which is already beyond the reach of the electric herder. We suggest moving of electric fence up the slope so far that the cow excrement will no longer wash into the raised bog. Slope should be mowed once a year or, as a last resort, the grazing area should be grazed only twice a year and grazing should be limited to the shortest possible time. It is likely that the nitrophilic species will withdraw and at the same time species that are sensitive to excessive input of organic matter will be preserved.

3.4 Šumec

The site was surveyed by IRSNC on two occasions, firstly on 12. 5. 2023 in search of *Drosera anglica* and *Drosera rotundifolia*. None of the species were confirmed, but we observed more than 10 blooming alpine butterworts (*Pinguicula alpina*, see **Figure 3.22**) and five blooming *Dactylorhiza sp.* Alpine butterworts we were observed in the remains of the bog between stream, while *Dactylorhizas* were observed downstream under a small slope, that is inaccessible with agricultural machinery (see **Figure 3.22**).

On the second visit on 21. 6. 2023 broad-leaved bog-cotton grass (*Eriophorum latifolium, see* **Figure 3.22**), marsh grass of Parnassus (*Parnassia palustris*) and common spotted orchid (*Dactylorhiza maculata subsp. Fuchsii*) were in full bloom in the northern part of the site. Reed beds also appeared occasionally

Figure 3.22: *Dactylorhiza* sp. (left); Alpine butterwort (centre); broad-leaved cotton-grass (right). Photo by Barbara Stupan

Figure 3.23: Intensified meadows (photo by Barbara Stupan)

Most of the area was intensified and drained in last years (see **Figure 3.23**). The predominant habitat is intensive meadows while bog remained only in small area, close to the springs, which is hard to cultivate due to natural conditions of the area. Small fragment of remaining bog is slowly becoming overgrown and overshadowed by spruce and birch. Their removal will be necessary in the coming years if we want to maintain a suitable habitat for sundews.

Nearby meadows were also surveyes for butterflies on 16. 7. 2023 by students. False heath fritillary (*Melitaea diamina*) which is listed as vulnerable species on Slovenian Red List was observed (see **Table 3.11**).

Figure 3.24: Remaining fragment of bog where we observed Alpine butterworts. Sundews were observed in previous years (photo by Barbara Stupan)

Table 3.11: Butterflies observed south of the natural value of Šumec

Latin name	RS	UZVRS	FFH
Aphantopus hyperantus			
Araschnia levana			
Brenthis daphne			
Brintesia circe			
Coenonympha pamphilus			
Gonepteryx rhamni			
Leptidea sinapis/juvernica			
Lopinga achine			IV
Maniola jurtina			
Melanargia galathea			
Melitaea diamina	V		
Ochlodes sylvanus			
Pieris napi			
Thymelicus sylvestris			

3.5 Smrekovec

IRSNC surveyed site on 1. 6. 2023, we observed two bodies of water on Krnes I and Krnes II. In both adult Alpine newts were present. Due to low temperatures most of them was buried into muddy floor of water bodies. In both water bodies water vegetation vernal water-starwort (*Callitriche palustris*) was present but there was no layed eggs yet.

In the second body of water vernal water-starwort was present in smaller numbers, as grass dominated. The latter also had a low level of water and usually dries up in summer, and it has signs of trampling, since it is used as water supply for grazing livestock as well.

No other amphibian species that were previously observed such as *Bufo bufo, Bombina variegata* or *Rana temporaria* was confirmed on locations.

Figure 3.25: Bodies of water observed in Smrekovec

Appendix

Appendix 1: List of recorded species of Vascular plants in the Zadnji travnik natural value area

RS: - Rules on the inclusion of endangered plant and animal species in the Red List (Official Gazette of the RS, no. 82/02 and 42/10). V – Vulnerable species, **R** – rare species;

UZRV: -Decree on protected wild plant species (Official Gazette of the Republic of Slovenia, no. 46/04, 110/04, 115/07, 36/09 and 15/14). **C** –permitted to confiscate and exploit; **H** – measures to maintain the favorable condition of the habitat of the plant species; **O** – plant species for which taking from nature and collecting above-ground parts, except for seeds or fruits, is permitted for personal use; **O°** – plant species with no restrictions on collecting parts of plants above ground, except for seeds or fruits; **×** – plant species and their habitats that are subject to environmental liability;

FFH: - Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (Official Journal L 206 of 22 July 1992), last amended by Council Directive 2013/17/EU with of 13 May 2013 (Official Gazette L 158 of 10 June 2013) (Habitats Directive). **V** – *Annex V:* animal and plant species of community interest whose taking in the wild and exploitation may be subject to management measures.

Latin name	RS	UZRV	FFH
Acer pseudoplatanus L.			
Achillea millefolium L.			
Aconitum lycoctonum L.			
Adenostyles alliariae (Gouan) Kern.			
Agrostis stolonifera L.			
Ajuga reptans L.			
Alnus alnobetula (Ehrh.) Hartig			
Anemone nemorosa L.			
Anthoxanthum odoratum L.			
Aposeris foetida (L.) Less.			
Arnica montana L.	V	C, O	5
Astrantia carniolica Jacq.			
Athyrium filix-femina (L.) Roth			
Bellis perennis L.			
Betula pendula Roth			
Brachypodium sylvaticum (Huds.) P. Beauv.			
Briza media L.			
Calluna vulgaris (L.) Hull			
Caltha palustris L.			
Calycocorsus stipitatus (Jacq.) Rauschert			

Latin name	RS	UZRV	FFH
Campanula rapunculus L.			
Cardamine pratensis L. [s.l.]			
Cardamine trifolia L.			
Cardaminopsis halleri (L.) Hayek [s.l.]			
Carex acutiformis Ehrh.	V		
Carex echinata Murray			
Carex flava agg.			
Carex hirta L.			
Carex leporina L.			
Carex nigra (L.) Reichard [s.l.]			
Carex pallescens L.			
Carex panicea L.			
Carex pilulifera L.			
Carex sempervirens Vill.			
Carex spicata Huds.			
Carex sylvatica Huds.			
Carlina acaulis L. [s.l.]			
Carum carvi L.			
Centaurea jacea L.			
Chaerophyllum aureum L.			
Chaerophyllum hirsutum agg.			
Chamerion angustifolium (L.) Holub			
Chenopodium bonus-henricus L.			
Cirsium arvense (L.) Scop.			
Cirsium palustre (L.) Scop.			
Crepis aurea (L.) Cass.			
Crepis paludosa (L.) Moench			
Cruciata glabra (L.) Ehrend.			
Dactylis glomerata L. [s.l.]			
Dactylorhiza maculata subsp. fuchsii (Druce) Hyl.	V	H	
Daphne mezereum L.			
Deschampsia cespitosa (L.) P. Beauv. [s.l.]			
Doronicum austriacum Jacq.			
Drosera rotundifolia L.	V	×	
Dryopteris filix-mas (L.) Schott [s.str.]			
Epilobium alpestre (Jacq.) Krock.			
Epilobium alsinifolium Vill.			
Epilobium montanum L.			
Epilobium nutans F. W. Schmidt	R		
Epilobium palustre L.			
Eriophorum latifolium Hoppe	V		
Eriophorum vaginatum L.	V		
Fragaria vesca L.			
Galeopsis pubescens Besser			
Galium palustre L. [s.str.]			
Galium sylvaticum agg.			
Gentiana asclepiadea L.			
Geranium phaeum L.			
Geum rivale L.			
Gymnocarpium robertianum (Hoffm.) Newman			
Heliosperma pusillum (Waldts. & Kit.) Rchb.			
Helleborus niger L.		O°	
Hieracium pilosella agg.			
Homogyne alpina (L.) Cass.			
Homogyne sylvestris (Scop.) Cass.			
Hypericum maculatum Crantz [s.l.]			
Juncus effusus L.			
Juncus filiformis L.			
Juniperus communis L. [s.str.]			
Knautia drymeia Heuff. [s.l.]			
Lamium maculatum L.			
Larix decidua Mill.			
Lathyrus pratensis L.			
Leontodon autumnalis L.			
Leontodon hispidus L. [s.l.]			
Leucanthemum ircutianum (Turcz.) DC.			
Listera ovata (L.) R. Br.		H	

Latin name	RS	UZRV	FFH
Lonicera alpigena L.			
Lonicera nigra L.			
Lotus corniculatus L. [s.l.]			
Luzula luzuloides (Lam.) Dandy & Wilmott [s.l.]			
Luzula multiflora (Ehrh. ex Retz.) Lej.			
Luzula pilosa (L.) Willd.			
Luzula sylvatica (Huds.) Gaudin [s.l.]			
Lychnis flos-cuculi L.			
Maianthemum bifolium (L.) F. W. Schmidt			
Melampyrum sylvaticum L. [s.l.]			
Melica nutans L.			
Mercurialis perennis L.			
Milium effusum L.			
Mycelis muralis (L.) Dumort.			
Myosotis nemorosa Besser			
Myosotis scorpioides agg.			
Myosotis sylvatica Ehrh. ex Hoffm.			
Myosotis sylvatica agg.			
Nardus stricta L.			
Omalotheca sylvatica (L.) C. H. & F. W. Schultz			
Omphalodes verna Moench			
Oxalis acetosella L.			
Paris quadrifolia L.			
Petasites hybridus (L.) Gaertn., Mey. & Scherb.			
Phegopteris connectilis (Michx.) Watt			
Phleum rhaeticum (Humphries) Rauschert			
Phyteuma orbiculare L. [s.str.]			
Phyteuma ovatum Honck.			
Picea abies (L.) H.Karst.			
Pinus mugo Turra			
Plantago major L. [s.l.]			
Plantago media L.			
Poa alpina f. vivipara Linnaeus			
Poa pratensis L. [s.str.]			
Polygala amara L. [s.l.]			
Polygala comosa Schkuhr			
Polygonatum verticillatum (L.) All.			
Polygonum viviparum L.			
Potentilla erecta (L.) Raeusch.			
Prunella vulgaris L.			
Pulmonaria stiriaca Kerner			
Ranunculus acris L.			
Ranunculus lanuginosus L.			
Ranunculus platanifolius L.			
Ranunculus repens L.			
Rubus idaeus L.			
Rumex acetosa L.			
Rumex alpestris auct. non (Jacq.) Á. Löve			
Rumex alpinus L.			
Rumex obtusifolius L. [s. l.]			
Salix rosmarinifolia L.	V		
Sambucus racemosa L.			
Saxifraga cuneifolia L.			
Saxifraga rotundifolia L.			
Scrophularia scopolii Hoppe			
Senecio cacaliaster Lam.			
Senecio ovatus (Gaertn., Mey. & Scherb.) Willd.			
Silene dioica (L.) Clairv.			
Silene vulgaris (Moench) Garcke [s.l.]			
Solidago virgaurea L. [s. l.]			
Sorbus aucuparia L. [s.l.]			
Stachys sylvatica L.			
Stellaria graminea L.			
Stellaria holostea L.			
Stellaria nemorum L.			
Symphytum tuberosum L. [s.l.]			
Taraxacum officinale agg.			

Latin name	RS	UZRV	FFH
Thalictrum aquilegiifolium L.			
Thesium alpinum L.			
Thymus pulegioides L.			
Trifolium pratense L. [s.l.]			
Trifolium repens L.			
Trollius europaeus L.			
Tussilago farfara L.			
Urtica dioica L.			
Vaccinium myrtillus L.			
Vaccinium vitis-idaea L.			
Valeriana dioica L.			
Valeriana tripteris L.			
Veratrum album L. [s.l.]			
Veronica chamaedrys L.			
Veronica serpyllifolia L. [s.l.]			
Veronica urticifolia Jacq.			
Vicia cracca agg.			
Vicia sepium L.			
Vincetoxicum hirundinaria Medik. [s.l.]			
Viola biflora L.			

Appendix 2: List of recorded species of vascular plants in the natural value area of Dolga Brda

RS: - Rules on the inclusion of endangered plant and animal species in the Red List (Official Gazette of the RS, no. 82/02 and 42/10). V – Vulnerable species, **R** – rare species.
UZRV: -Decree on protected wild plant species (Official Gazette of the Republic of Slovenia, no. 46/04, 110/04, 115/07, 36/09 and 15/14). **C** – permitted to confiscate and exploit; **H** – measures to maintain the favorable condition of the habitat of the plant species; **O** – plant species for which taking from nature and collecting above-ground parts, except for seeds or fruits, is permitted for personal use; **O°** – plant species with no restrictions on collecting parts of plants above ground, except for seeds or fruits; **×** – plant species and their habitats that are subject to environmental liabilityi;
TUJ: T – invasive species.

Latin name	RS	UZRV	TUJ
Abies alba Mill.			
Acer pseudoplatanus L.			
Achillea millefolium L.			
Aegopodium podagraria L.			
Agrostis stolonifera L.			
Ajuga reptans L.			
Alchemilla vulgaris agg.			
Allium carinatum L. [s.l.]			
Alnus glutinosa (L.) Gaertn.			
Alopecurus geniculatus L.	V		
Alopecurus pratensis L.			
Anemone nemorosa L.			
Angelica sylvestris L.			
Anthoxanthum odoratum L.			
Anthriscus sylvestris (L.) Hoffm.			
Arabis pauciflora Garcke	R		
Arenaria serpyllifolia L. [s.str.]			
Armoracia rusticana Gaertn., Mey. & Scherb.			
Arrhenatherum elatius (L.) J. & C. Presl			
Artemisia vulgaris L.			
Athyrium filix-femina (L.) Roth			
Barbarea vulgaris R. Br.			
Bellis perennis L.			
Betonica officinalis L.			
Betula pendula Roth			
Blechnum spicant (L.) Roth			
Brachypodium sylvaticum (Huds.) P. Beauv.			
Bromus hordeaceus L. [s.l.]			
Calluna vulgaris (L.) Hull			

Latin name	RS	UZRV	TUJ
Caltha palustris L.			
Calystegia sepium (L.) R. Br.			
Campanula patula L.			
Capsella bursa-pastoris (L.) Medik. [s.l.]			
Cardamine amara L. [s.l.]			
Cardamine flexuosa With.			
Cardamine hirsuta L.			
Cardamine impatiens L.			
Cardamine pratensis L. [s.l.]			
Cardaminopsis halleri (L.) Hayek [s.l.]			
Carex brizoides L.			
Carex divulsa subsp. leersii (F. W. Schultz) W. Koch			
Carex flava agg.			
Carex hirta L.			
Carex leporina L.			
Carex pallescens L.			
Carex pilulifera L.			
Carex rostrata Stokes	V		
Carex spicata Huds.			
Carex sylvatica Huds.			
Carex vesicaria L.	V		
Carum carvi L.			
Centaurea jacea L.			
Centaurea jacea agg.			
Cerastium glomeratum Thuill.			
Cerastium glutinosum Fr.			
Cerastium holosteoides Fr. em. Hyl.			
Chaerophyllum hirsutum L. [s.str.]			
Chaerophyllum hirsutum agg.			
Chrysosplenium alternifolium L.			
Cirsium arvense (L.) Scop.			
Cirsium oleraceum (L.) Scop.			
Cirsium palustre (L.) Scop.			
Cornus sanguinea L. [s.l.]			
Corylus avellana L.			
Crataegus monogyna Jacq.			
Crepis biennis L.			
Crepis paludosa (L.) Moench			
Cruciata glabra (L.) Ehrend.			
Cynosurus cristatus L.			
Dactylis glomerata L. [s.l.]			
Daphne mezereum L.			
Daucus carota L.			
Deschampsia cespitosa (L.) P. Beauv. [s.l.]			
Doronicum austriacum Jacq.			
Dryopteris carthusiana (Vill.) H. P. Fuchs			
Dryopteris dilatata (Hoffm.) A. Gray			
Dryopteris filix-mas (L.) Schott [s.str.]			
Epilobium hirsutum L.			
Epilobium lamyi F. W. Schultz			
Epilobium palustre L.			
Epilobium parviflorum Schreb.			
Epilobium roseum Schreb.			
Epipactis helleborine (L.) Crantz		H	
Equisetum arvense L.			
Equisetum fluviatile L.	V		
Equisetum palustre L.			
Equisetum sylvaticum L.			
Equisetum telmateia Ehrh.			
Erigeron alpinus L.			
Erigeron annuus (L.) Pers. [s.l.]			T
Erophila verna (L.) Chevall.			
Euonymus europaea L.			
Eupatorium cannabinum L.			
Euphorbia cyparissias L.			
Fagus sylvatica L.			
Fallopia japonica (Houtt.) Ronse Decr.			T

Latin name	RS	UZRV	TUJ
Festuca pratensis Huds.			
Festuca pratensis agg.			
Filipendula ulmaria (L.) Maxim.			
Fragaria vesca L.			
Frangula alnus Mill.			
Fraxinus excelsior L.			
Galium aparine L.			
Galium mollugo L. [s.str.]			
Galium palustre L. [s.str.]			
Galium uliginosum L.			
Genista germanica L.			
Genista tinctoria L.			
Gentiana asclepiadea L.			
Geranium palustre L.			
Glechoma hederacea agg.			
Glyceria notata Chevall.			
Gratiola officinalis L.	V		
Helictotrichon pubescens (Huds.) Pilg. [s.l.]			
Hieracium murorum L.			
Holcus lanatus L.			
Humulus lupulus L.			
Hypericum perforatum L. [s.l.]			
Hypericum tetrapterum Fr.			
Hypochoeris glabra L.			
Impatiens glandulifera Royle			T
Impatiens noli-tangere L.			
Impatiens parviflora DC.			T
Iris pseudacorus L.		H	
Juglans regia L.			
Juncus articulatus L.			
Juncus compressus Jacq.			
Juncus conglomeratus L.			
Juncus effusus L.			
Juncus inflexus L.			
Knautia arvensis (L.) Coult.			
Lamium album L.			
Lamium maculatum L.			
Lathyrus pratensis L.			
Leontodon autumnalis L.			
Leontodon hispidus L. [s.l.]			
Leucanthemum ircutianum (Turcz.) DC.			
Leucojum vernum L.		O	
Lolium multiflorum Lam.			
Lolium perenne L.			
Lotus corniculatus L. [s.l.]			
Luzula luzuloides (Lam.) Dandy & Wilmott [s.l.]			
Luzula multiflora (Ehrh. ex Retz.) Lej.			
Luzula pilosa (L.) Willd.			
Lychnis flos-cuculi L.			
Lycopus europaeus L. [s.l.]			
Lysimachia vulgaris L.			
Lythrum salicaria L.			
Maianthemum bifolium (L.) F. W. Schmidt			
Matteuccia struthiopteris (L.) Tod.			
Medicago lupulina L.			
Melampyrum pratense L. [s.l.]			
Melilotus officinalis (L.) Lam.			
Mentha aquatica L.			
Mentha longifolia (L.) Huds. [s.l.]			
Menyanthes trifoliata L.	V		
Moehringia trinervia (L.) Clairv.			
Molinia caerulea (L.) Moench [s.l.]			
Molinia caerulea subsp. arundinacea (Schrank) K. Richt.			
Mycelis muralis (L.) Dumort.			
Myosotis arvensis (L.) Hill			
Myosotis nemorosa Besser			
Myosotis scorpioides agg.			

Latin name	RS	UZRV	TUJ
Myosoton aquaticum (L.) Moench			
Nasturtium officinale R. Br.			
Oxalis acetosella L.			
Oxalis fontana Bunge			T
Paris quadrifolia L.			
Pastinaca sativa L.			
Peucedanum palustre (L.) Moench			
Phalaris arundinacea L.			
Phegopteris connectilis (Michx.) Watt			
Phleum pratense L. [s.str.]			
Phragmites australis (Cav.) Trin. ex Steud.			
Picea abies (L.) H.Karst.			
Pimpinella major (L.) Huds. [s.l.]			
Pinus sylvestris L.			
Plantago lanceolata L.			
Plantago major L. [s.l.]			
Poa annua L.			
Poa compressa L.			
Poa nemoralis L.			
Poa palustris L.			
Poa pratensis L. [s.str.]			
Poa trivialis L. [s.l.]			
Polygonum hydropiper L.			
Polypodium vulgare L.			
Populus tremula L.			
Potentilla erecta (L.) Raeusch.			
Potentilla palustris (L.) Scop.	V		
Potentilla reptans L.			
Prenanthes purpurea L.			
Prunella vulgaris L.			
Prunus avium L.			
Prunus padus L.			
Prunus spinosa L. [s.str.]			
Pseudostellaria europaea Schaeftl.	V		
Pteridium aquilinum (L.) Kuhn			
Pulmonaria stiriaca Kerner			
Quercus robur L.			
Ranunculus acris L.			
Ranunculus auricomus agg.			
Ranunculus ficaria subsp. bulbilifer (Marsden-Jones) Lawalrée			
Ranunculus flammula L.			
Ranunculus repens L.			
Rhamnus catharticus L.			
Rhinanthus alectorolophus Pollich [s.l.]			
Ribes nigrum L.	R		
Ribes rubrum L.			T
Robinia pseudoacacia L.			
Rorippa palustris (L.) Besser em. Jons.			
Rorippa sylvestris (L.) Besser			
Rubus idaeus L.			
Rumex acetosa L.			
Rumex crispus L.			
Rumex obtusifolius L. [s. l.]			
Salix cinerea L.			
Salix fragilis L.			
Salix purpurea L.			
Salix rosmarinifolia L.	V		
Sambucus nigra L.			
Sanguisorba officinalis L.			
Sanicula europaea L.			
Saxifraga tridactylites L.			
Scirpus sylvaticus L.			
Scrophularia nodosa L.			
Scutellaria galericulata L.			
Sedum sexangulare L.			
Selinum carvifolia (L.) L.			
Senecio ovatus (Gaertn., Mey. & Scherb.) Willd.			

Latin name	RS	UZRV	TUJ
Silene dioica (L.) Clairv.			
Solanum dulcamara L.			
Solidago canadensis L.			T
Solidago virgaurea L. [s. l.]			
Sonchus asper (L.) Hill [s.l.]			
Sorbus aucuparia L. [s.l.]			
Sparganium erectum agg.			
Stellaria graminea L.			
Succisa pratensis Moench			
Tanacetum vulgare L.			
Taraxacum officinale agg.			
Tetragonolobus maritimus (L.) Roth	V		
Thalictrum lucidum L.			
Thelypteris palustris Schott	V		
Trifolium pratense L. [s.l.]			
Trifolium repens L.			
Trisetum flavescens (L.) P. Beauv.			
Tussilago farfara L.			
Typha angustifolia L.			
Typha latifolia L.			
Urtica dioica L.			
Vaccinium myrtillus L.			
Vaccinium vitis-idaea L.			
Valeriana dioica L.			
Veronica arvensis L.			
Veronica beccabunga L.			
Veronica chamaedrys L.			
Veronica officinalis L.			
Veronica scutellata L.	V		
Veronica serpyllifolia L. [s.l.]			
Viburnum opulus L.			
Vicia cracca L.			
Vicia cracca agg.			
Vicia hirsuta (L.) Gray			
Vicia sepium L.			
Viola arvensis Murray			
Viola palustris L.	E		

Appendix 3: List of recorded species of vascular plants in the former pond of natural value area of Dolga Brda

RS: - Rules on the inclusion of endangered plant and animal species in the Red List (Official Gazette of the RS, no. 82/02 and 42/10). V – Vulnerable species, **R** – rare species;

UZRV: -Decree on protected wild plant species (Official Gazette of the Republic of Slovenia, no. 46/04, 110/04, 115/07, 36/09 and 15/14)

C –permitted to confiscate and exploit; **H** – measures to maintain the favourable condition of the habitat of the plant species; **O** – plant species for which taking from nature and collecting above-ground parts, except for seeds or fruits, is permitted for personal use; **O°** – plant species with no restrictions on collecting parts of plants above ground, except for seeds or fruits; **×** – plant species and their habitats that are subject to environmental liability

TUJ: T – invasive species

Latin name	RS	UZRV	TUJ
Aegopodium podagraria L.			
Ajuga reptans L.			
Alnus glutinosa (L.) Gaertn.			
Angelica sylvestris L.			
Caltha palustris L.			
Cardamine amara L. [s.l.]			
Carex vesicaria L.	V		
Cirsium oleraceum (L.) Scop.			
Cirsium palustre (L.) Scop.			
Deschampsia cespitosa (L.) P. Beauv. [s.l.]			
Dryopteris filix-mas (L.) Schott [s.str.]			
Epilobium palustre L.			
Equisetum fluviatile L.	V		

Latin name	RS	UZRV	TUJ
Eupatorium cannabinum L.			
Filipendula ulmaria (L.) Maxim.			
Galium aparine L.			
Galium palustre L. [s.str.]			
Impatiens glandulifera Royle			T
Impatiens noli-tangere L.			
Lamium maculatum L.			
Lychnis flos-cuculi L.			
Lycopus europaeus L. [s.l.]			
Lysimachia vulgaris L.			
Lythrum salicaria L.			
Menyanthes trifoliata L.	V		
Myosotis nemorosa Besser			
Myosotis scorpioides agg.			
Phalaris arundinacea L.			
Phragmites australis (Cav.) Trin. ex Steud.			
Polygonum hydropiper L.			
Populus tremula L.			
Potentilla palustris (L.) Scop.	V		
Ranunculus auricomus agg.			
Ribes nigrum L.	R		
Salix cinerea L.			
Salix fragilis L.			
Salix purpurea L.			
Salix rosmarinifolia L.	V		
Scirpus sylvaticus L.			
Scutellaria galericulata L.			
Solanum dulcamara L.			
Sparganium erectum agg.			
Thelypteris palustris Schott	V		
Typha angustifolia L.			
Typha latifolia L.			
Urtica dioica L.			
Valeriana dioica L.			
Veronica chamaedrys L.			
Veronica scutellata L.	V		
Viola palustris L.	E		

Appendix 4: List of habitat types in Dolga Brda

Physis code	Plot number	Habitat type	FFH	Bern	Area (ha)	Area (%)
44.33	22	Ash-alder woods of slow rivers	91E0*	B	5,63	33,08
42.135	9	Acidophilic fir forests with greater whipwort			2,61	15,36
38.2222-S2	3	Medio-european lowland hay meadows with meadow foxtail	6510		1,59	9,35
82.11	2	Field crops			1,30	7,66
81.2	8	Humid improved grasslands			1,08	6,34
37.111	7	Meadowsweet stands and related communities	6430		0,58	3,38
38.2221-S1	2	Medio-european lowland hay meadows with bulbous oat grass	6510		0,53	3,14
37.21x38.2222-S2	1	Atlantic and subatlantic humid meadows x Medio-european lowland hay meadows with meadow foxtail	6510	B	0,44	2,56
38.2222-S2	3	Medio-european lowland hay meadows with meadow foxtail	-6510		0,42	2,46
37.219	5	Wood clubrush meadows		B	0,37	2,17
24.1S-21	9	River course			0,28	1,67
86.43	2	Railroad switch yards and other open spaces			0,25	1,50
22.13	1	Eutrophic waters			0,22	1,31
84.2	9	Hedgerows			0,15	0,90
81.1	1	Dry improved grasslands			0,13	0,77
84.2/83.324	2	Hedgerows / Locust tree plantations			0,13	0,76
37.21	1	Atlantic and subatlantic humid meadows		B	0,13	0,74
86.S712	3	Towns, villages, industrial sites (Other asphalt roads)			0,12	0,68
37.111x87.2-S11	1	Meadowsweet stands and related communities x Ruderal communities of Himalayan balsam	6430		0,11	0,67
53.147x54.5	1	Water horsetail beds x Transitional bogs	7140	B	0,11	0,67

Physis code	Plot number	Habitat type	FFH	Bern	Area (ha)	Area (%)
86.2	3	Villages			0,09	0,54
38.221	2	Medio-european lowland hay on relatively dry soil and slopes with bulbous oat grass	6510		0,08	0,48
87.2	3	Ruderal communities			0,08	0,47
37.72	1	Shady woodland edge fringes	6430		0,07	0,40
84.2/44.33	2	Hedgerows / Ash-alder woods of slow rivers	- 91E0*		0,06	0,36
37.715	1	Mixed riverine screens	6430		0,05	0,29
31.86	1	Bracken fields			0,05	0,27
24.1S-23	7	River course (regulated)			0,04	0,26
86.S722	4	Cart track (forest track)			0,04	0,26
85.12	1	Park lawns			0,04	0,25
37.111x53.21	1	Meadowsweet stands and related communities x Large *carex* beds	6430		0,04	0,24
53.111	1	*Flooded Phragmites beds*			0,04	0,21
85.3	2	Gardens			0,03	0,18
37.111x37.219	1	Meadowsweet stands and related communities x Wood clubrush meadows	6430		0,03	0,16
35.12x87.2-S11	1	Agrostis-festuca grasslands x Ruderal communities of invasive species	- 6230*		0,03	0,15
37.24	1	Flood swards and related communities		B	0,02	0,13
53.131	3	Reedmace beds of broadleaf cattail			0,01	0,06
37.219x87.2-S11	1	Wood clubrush meadows in combination with Ruderal communities of Himalayan balsam		-B	0,01	0,04
86.S721	1	Gravel road			0,01	0,03
44.92	1	Mire willow scrub			0,00	0,03
87.2-S11	1	Ruderal communites of one year old invasive species			0,00	0,03
37.313	1	Purple moorgrass meadow's and related communities of molinia	6410	B	0,00	0,01
	132				17,02	100,00

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