Rufford Small Grant

(for Nature Conservation)

FINAL REPORT

PROJECT TITLE

RESTORATION OF SMALL HEADWATER WETLANDS IN BULGARIA

NAME OF APPLICANT AND/OR ORGANISATION

TRAYKOV, IVAN TRAYKOV

1. ABSTRACT

The loss of lowland wetlands, dike construction and deforestation has strongly increased the significance of the headwater wetlands. Such wetlands are found mostly on the mountains, hills and landslide areas in Bulgaria – regions not suitable for agriculture or with restricted exploitation. Although not deliberately, such wetlands have been altered by shepherds, fishermen and tourists, resulting in lowering of the water level and further reduction of their size and depth due to overgrowth by the macrophyte communities. The restoration of the Dragichevo, Boyana and Lozen lakes is part of the project on the restoration of the natural wetlands around Sofia through macrophyte removal and/ or increase of the water level. The work is done by volunteer students and people from the local communities.

2. INTRODUCTION

The aim of the project is the restoration of three small headwater wetlands in Bulgaria and increasing their water tables to levels close to the recorded in the past. The tasks for achieving the aim are listed in Table 1. The wetlands are situated on the mountains surrounding Sofia: Lijulin Mt., Vitosha Mt. and Lozenska Mt. The mountains are part of the Plana – Zavalska mountain chain, which in Bulgaria includes also the Plana Mt., Viskjar Mt. and Zavalska Mt., and on the Serbian side of the border – Greben Mt. and Vlashka Mt.

Table 1: The major tasks and the subtasks of the project are listed in the table below:

TASK/SUBTASK	**DURATION - 18 MONTHS**								
I. DATA COLLATION	ONE BOX = TWO MONTHS								
ASSESS EXISTING ENVIRONMENTAL DATA									
IDENTIFY/FILL GAPS IN EXISTING DATA SETS									
CONDUCT PRELIMINARY MONITORING OF THE LAKES									
II. APPLY RESTORATION MEASURES									
SPECIFY POTENTIAL RESTORATION TECHNIQUES									
CONDUCT SELECTED RESTORATION MEASURES									
III. EVALUATE AND MONITOR RESTORATION									
CONDUCT MONITORING OF THE RESTORATION EFFECT									
PUBLISH INFORMATION BROCHURES			**X**						**X**
PREPARE INTERMEDIATE AND FINAL REPORTS						**X**			**X**

The first data on the Dragichevo Lake could be found in Petkov (1922), but the first detailed description on the morphometry and water level changes are given by Vodenicharov

(1958). In 1946 after an unsuccessful melioration activity a permanent decrease of the water level by 1.5m and of the surface area to 8000m^2 took place. A second dramatic decrease happened in 1962 when after a clear cutting of the hill and plough up of the land the old landslide got activated again. As a result the surface area of the lake was decreased approximately two times. As a consequence of this a rapid invasion of macrophytes, both submerged and emerged, took place. The accelerated aging of the lake led to further reduction of the surface area and depth - 50cm since the 60s. Through out this chain of events one of the biggest landslide lakes in Bulgaria was strongly diminished in size and depth – from approximately 10m to 3m for less than a century.

The Boyana Lake is a semi artificial water body situated on the Vitosha Mountain near Sofia. In order to increase the water level of the natural wetland a dam has been constructed in the beginning of the last century. The lake is a small (V = 5160 m ^{3}; A = 5180 m^2), shallow (Zmax = 2.1, Zm = 0.98) forest lake. The theoretical retention time is approximately 80 days and the lake has been used to supply additional waters for the first hydro power plant in Bulgaria, lightening the king's palace in the beginning of the last century. The lake is fed by groundwater, and the outflow is regulated by a small artificial canal. The lake is situated on the northern slopes of the mountain on 1000m.a.s.l. Ice forms in mid November, persists until the end of Mach, and reaches a depth of up to 50cm.

The Lozen Lake has also been a subject to reduction of its depth and area. The lake has not had any special use in the past or in the present. The lake was used only as a source of water for the domestic animals, when they were brought up the mountain for grazing, and as a spot for hunting waterfowl, wild boars, dears, etc.

3. RESULTS

3.1. Dragichevo landslide lakes:

A detailed description of the region and the vegetation of the landslide lakes were done.

A map of the landslide area has been supplied and a mapping of the wetlands on the landslide area has been done (Annex I). Total of 33 wetlands has been found, situated from 896m.a.s.l. to 983 m.a.s.l. The coordinates of the ponds and some descriptive information are listed in Table 1.

Bathometric maps have been constructed to 3 of the biggest lakes, subject to restoration (Annex I). The artificial dykes have been filled up and reinforced with sods and stones. After the winter period they are holding back the water, but the real effect (long lasting) will be monitored throughout the 2007 and the fill-up of the dykes will be repaired if necessary.

The construction of the dam on the Dragichevo Lake was canceled, as the landslide area was included into the NATURA 2000 network.

The region of the landslide lakes on the Ljulin Mountain is characterized with semi-continental climate, with dry summer and irregularly distributed precipitations. The major soil types are of Eutric Cambisols (CMe), Chromic Cambisols (chromic, CMx) and Eutric Gleysols (eutric, Gle) on the slopes where the groundwater table is close to the surface.

The region, with its 94 species is characterized with relatively high diversity of the higher vegetation. Most abundant are the ecological groups of the hydrophytes, hygrophytes, mesohygrophytes and hygromesophytes.

Typical hydro- and hygrophytes can be found only in the lakes retaining water through out the year. The dominant species are *Thypa latifolia, Potamogeton natans, Callitriche cophocarpa* and *Shoenoplectus lacustris*. The dominance of the macrophytes and the invasion of the *S. lacustris* in the lakes are a sign of late succession and eutrophication of the lakes.

Hygrophytes and mesohygrophytes are typical for the temporary autumnal ponds down the hill. Depending on the length of the dry period hygrophyte species (*Glyceria plicata, Alopecurus Aequalis, Alisma plantago-aquatica*) or more mesophytic species (*Juncus conglomerates, J. inflexus, Agrostis capilaris, Rorhippa polifera*) predominate in the lakes.

In the very small and ephemeral ponds a secondary halophytisation with the dominance of halophytic species as *Mentha pulegium, Ranunculus repens, Alopecurus aequalis, Rumex pulcher* was observed.

Due to the xerophytisation of the region with the decrease of the elevation a stratification of the lakes could also by observed – the uppermost lakes are the deepest and more or less permanent, and lower on the slope are the temporary autumnal and ephemeral ponds. In this gradient of lake types a clear change in the vegetation can be seen from hydrophytes through hygrophytes to mesohygrophytes and hygromesophytes.

The landslide lakes play an important role for all forms of life in the relatively dry Ljulin Mountain. The lakes are used as breeding ground for different frogs and toads such as: *Bufo bufo, B viridis, Bombina variegata, B. bombina* and *Hyla arborea*, as well as the Fire salamander (*Salamandra salamandra)* and the common newt (*Triturus vulgaris).*

The biggest lake in the system, known as the Dtagichevo Lake is one of the few natural lakes in Bulgaria to be classified as "Natural eutrophic lake with Magnopotamion and Hydrocharition type of vegetation" – code 3150, according to Directive 92/43/EEC - "Conservation of natural habitats and of wild fauna and flora". This was the reason the landslide region to be included into the NATURA 2000 network in Bulgaria.

3.2. Boyana Lake: (N42.63574; E23.26965)

We have collected the available historical data for the lake, including: ancient usage as water supply, construction of the main dike, usage for hydropower production (for the first HPP in BG), introduction of exotic fishes, etc. Mapping of the surface area and the bathometry of the lake has been done. Vegetation mapping of the lake has not been done as more than 98% of the lake surface has been covered by pondweed, which was subsequently removed. Since November 2004 we have conducted regular (monthly/ to twice per month) monitoring of the lake, which includes basic chemistry, phytoplankton and zooplankton. Parts of the data were used to supply three MSc theses. Another MSc thesis, comparing the results of the Dragichevo and the Boyana lakes will be defended in September.

As we could not start the reinforcement of the main outlet of the lake (because of the rains), most of our efforts in 2005 have been concentrated on the manual removal of the pondweed. We have succeeded to remove more than 80 % of the pondweed from the deep portion of the lake. In addition to the pondweed we have removed a huge amount of tree trunks and smaller debris, including parts of furniture from the nearby hut (abandoned and partly destroyed).

In May 2006 we reintroduced the grass carp in the lake. A total of 150 grass carp and 50 tench specimens have been released into the lake. The grass carp has proven to be very efficient in controlling the amount of the pondweed in the lake, so we hope to achieve good sustainable results in the future. In June 2006 the pondweed in the lake have started to reappear again in some parts of the lake. After examining the causes of the rapid re-growth we found that the reason was in the high amount of the sunken macrophytes shoots to the bottom of the lake while they have been pulled out in the previous summer. By the end of June we cleaned up the bottom with garden rakes to collect the remaining of the shoots and continued the work by removing additional 15 % of the vegetation. The vegetation control was accomplished by volunteers, most of which were students from the Sofia University, NGO's volunteers, some people from the local communities and occasionally with the help of tourists passing by the lake.

The preliminary results of the projects were presented on the 10th International Conference of Greece and Adjacent Regions, Patras, Greece in June 2006. Now we have prepared and submitted a paper to the Journal of Balkan Ecology, presenting the results and the effect of the macrophytes removal on the abiotic parameters in the lake.

3.3. Lozen Lake: N42.58715 E23.44627

We have collected historical data about the lake. We provided map of the region and collected preliminary monitoring data. In 2006 we bathymetrically mapped the Lozne Lake.

We have stabilized the road crossing though the canal draining the lake. This part of the canal was filled up with soil, left to settle and reinforced with tree trunks and stones, so it can bear off the load of the trucks.

3.4. Others:

In 2006 we had another 12 volunteers participating in the restoration project, as well as most of the people from the previous year. Irrespective of the big number of the volunteers, the average number at any occasion was between 5 and 8 people, as most of them were occupied with their study or work arrangements.

Information brochure was published and distributed to the information centers on Vitosha Mountain. The Dragichevo landslide area was used as a training are for the stuff of the Regional Inspectorates, which are responsible for the collection and assessment of the environmental data.

The Executive Environmental Agency decided to carry on the practical course on macrothyte determination and environmental assessment (required by the Water Framework Directive) on the landslide lakes. The participants were introduced to the objectives and the results of the current project.

We have made wooden frames for signs at the Boyana Lake, close to the fire place, but unfortunately a couple of days later they were destroyed and the wood burned in the fire. So we decided to use a laminated posters hanged directly on the trees. It worked, so we adopted this kind of marking of the spots and updating the progress on the project.

ANNEXE I

DRAGICHEVO LANDSLIDE LAKES

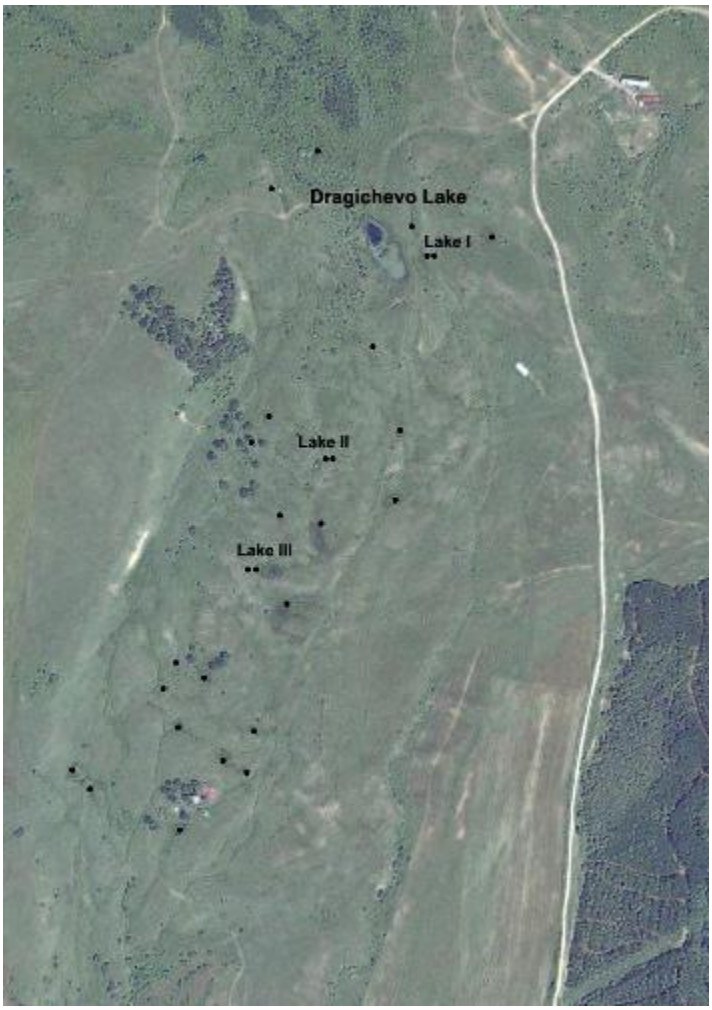
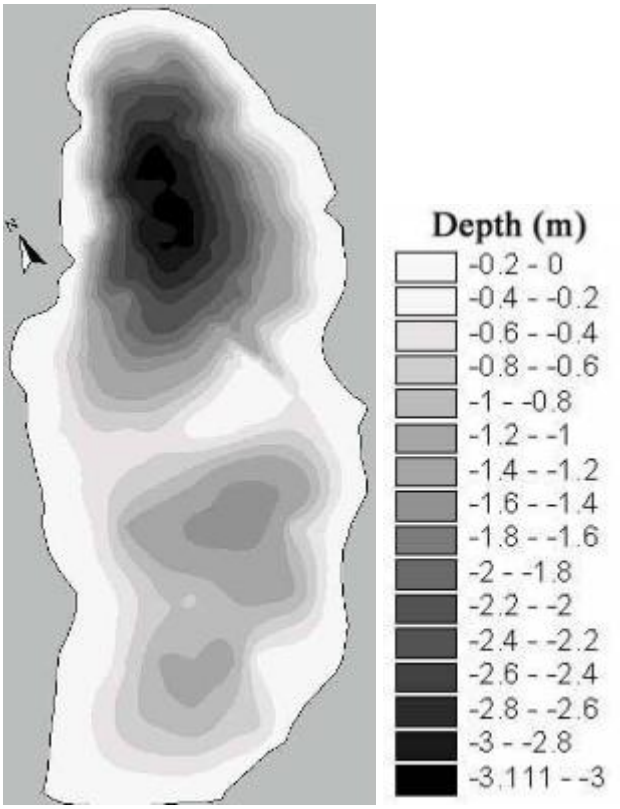


FIG.1: DRAGICHEVO LANDSLIDE LAKE AREA. The position of the lakes are marked with "•", and the position of the restoration lakes are marked with "••".



Morphometrical parameters of the Dragichevo Lake:

Parameter	Value
Maximum length	95m
Maximum width	38m
Maximum depth	3,1m
Mean depth	1.11m
Surface area	3 035m^2
Volume	3 045m^3

FIG.2: BATHOMETRIC MAP OF THE DRAGICHEVO LAKE. Morphometric parameters of the lake.

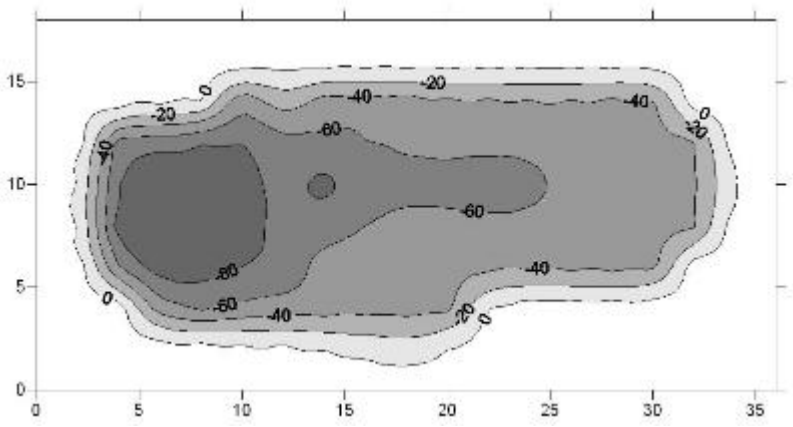


FIG.3: BATHOMETRIC MAP OF **LAKE I**. The depths mentioned are the "potentially achievable"; the real depths are approximately 30cm lower.

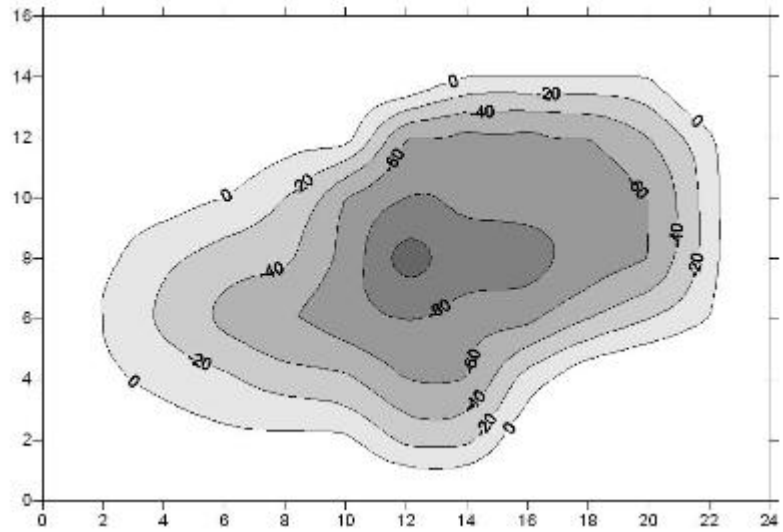


FIG.4: BATHOMETRIC MAP OF **LAKE II**. The depths mentioned are the "potentially achievable"; the real depths are approximately 30cm lower.

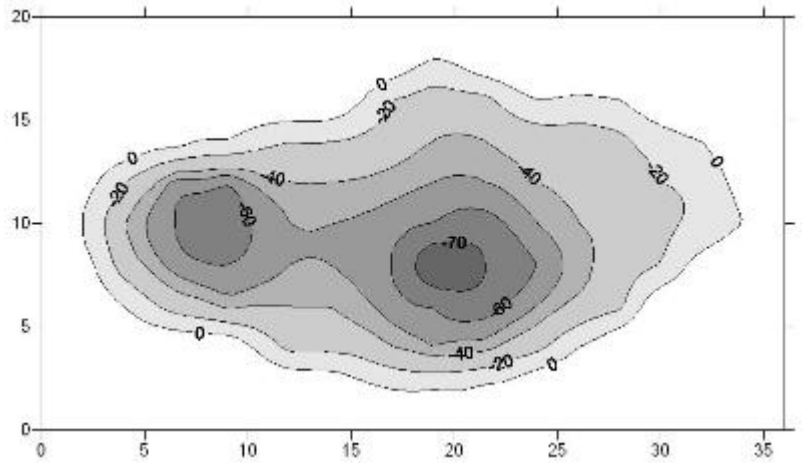


FIG.4: BATHOMETRIC MAP OF **LAKE III**. The depths mentioned are the real depths; "Potentially achievable" depths – +30cm.

TABLE 1: Coordinates of the ponds and some remarks.

#	m.a.s.l.	North	East	Length/ Wight	Remarks
1	983	42° 37' 59.0''	23° 09' 20.3''	20m/5m	Channels with tuffs of Juncus.
2	982	42° 37' 58.3''	23° 09' 22''	4m/2m	Temporary autumnal pond
3	973	42° 37' 55.2''	23° 09' 20.2''	40m/5m	Overgrown by Juncus,Typha and Potamogeton
4	967	42° 37' 55.7''	23° 09' 21''	15m/4m	Open water
5	965	42° 37' 55.3'	23° 09' 22.2''	30m/10m	Dried up, haline
6	965	42° 37' 52.4''	23° 09' 27.4''		Open water, Typha and Juncus. **Lake I**
7	965	42° 37' 52.9''	23° 09' 27.0''		Open water, Typha, Potamogeton.**The Dragichevo Lake.**
8	962	42° 37' 51.4''	23° 09' 23''	7m/3m	Through flow
9	961	42° 37' 49.9''	23° 09' 23''	10m/3m	Open water with tuffs of Juncus and Typha
10	946	42° 37' 48.1''	23° 09' 22''	5m-диам.	Channels with tuffs of Juncus and Poaceae
11	943	42° 37' 42.5''	23° 09' 26.2''	40m/30m	Temporary open water, overgrown by Poaceae and Juncus
12	935	42° 37' 46.4''	23° 09' 18.3''		Open water with tuffs of Juncus and Poaceae
13	928	42° 37' 42.3''	23° 09' 20.2''		Dried canals with tuffs of Poaceae
14	927	42° 37' 43.7''	23° 09' 22.6''	20m/10m	Half-overgrown by Typha, Potamogeton and Ranunculus. **Lake II**
15	927	42° 37' 40.4''	23° 09' 23.3''	50m/20m	Shallow water Overgrown by Juncus and Poaceae
16	927	42° 37' 42.8''	23° 09' 20.2''		Overgrown by Juncus and Poaceae
17	925	42° 37' 43.4''	23° 09' 18.7''	30m/15m	Dried up. Poaceae and Juncus
18	925	42° 37' 44.5''	23° 09' 19.1''		Dried up, haline
19	925	42° 37' 39.0''	23° 09' 21.3''	30m/15m	Open water, Typha, Potamogeton and tuffs of Juncus. **Lake III**
20	923	42° 37' 44.1''	23° 09' 17.7''	5m/5m	Temporary
21	919	42° 37' 37.2''	23° 09' 20''	60m/40m	Overgrown by Typha, Juncus and some Poaceae
22	905	42° 37' 33.8''	23° 09' 13.5''		Open, clear water. Ranunculus, Juncus.
23	903	42° 37' 34.4''	23° 09' 17.3''	40m/15m	Some water
24	903	42° 37' 33.3''	23° 09' 13''	3m/1.5m	Dried up. Juncus and Poaceae.
25	902	42° 37' 34.7''	23° 09' 14.7''	15m/3m	Dried up. Juncus and Poaceae.
26	902	42° 37' 32.4''	23° 09' 17.3''	7m/14m	Dried up.
27	901	42° 37' 30.9''	23° 09' 18.3''	30m/6m	Kidney shaped; open water, Juncus and Poaceae
28	900	42° 37' 30.3''	23° 09' 18.2''	10m/6m	Some water, Juncus
29	900	42° 37' 30.9''	23° 09' 19.6''	3m/1.5m	Dried up, haline
30	899	42° 37' 31.7''	23° 09' 15.8''	40m/4m	Some water, Juncus and Poaceae.
31	899	42° 37' 33''	23° 09' 14''	30m/3m	Some water
32	899	42° 37' 29.4''	23° 09' 09.2''	20m/5m	Water with Typha, Juncus and Potamogeton.
33	896	42° 37' 29.7''	23° 09' 09.9''	25m/25m	Water with Ranunculus и Juncus

Pic 1. Dragichevo Lake

ANNEXE II

Pic. 2): Members of the Executive Environmental Agency, Regional Inspectorates and Sofia University visiting the Dragichevo landslide lakes.

Pic. 3a): Members of the volunteer team working on Lakes I and II at the Dragichevo landslide lakes.

Pic. 3b): Members of the volunteer team working on Lakes I and II at the Dragichevo landslide lakes.

ANNEXE III

DRAGICHEVO LANDSLIDE LAKES

Pic. 4a): Damming of the ditch of Lake I.

Pic. 4b): Damming of the ditch of Lake II.

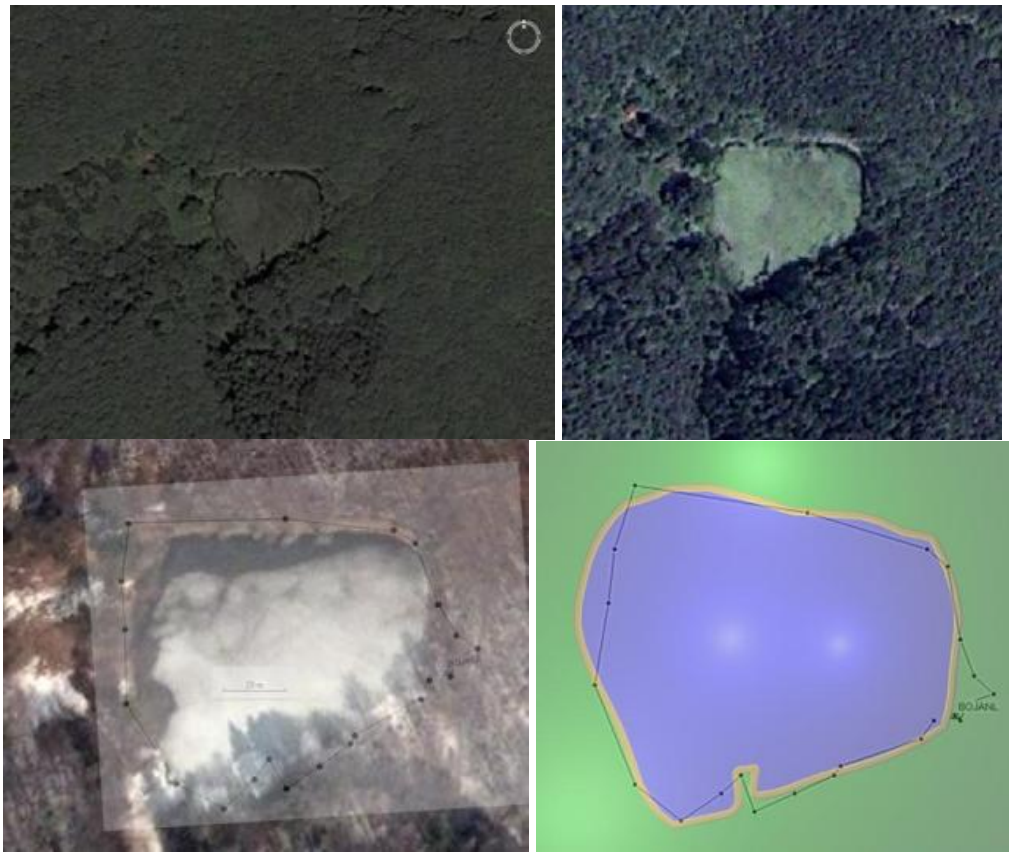
Pic.5: New landslide – Spring 2006

Pic.6a: Sediment sampling – 2006

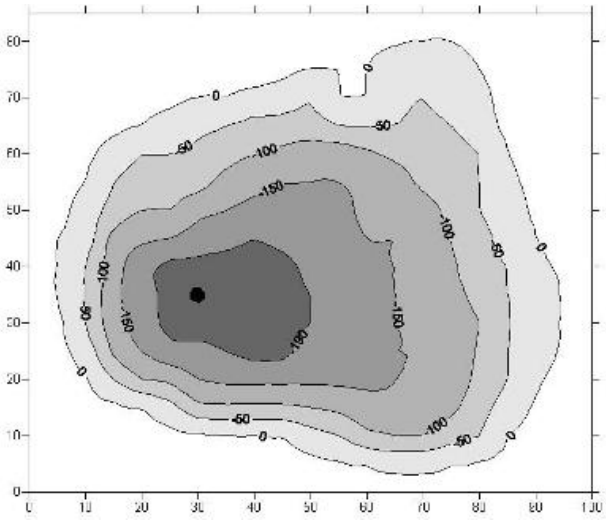
Pic.6b: Sediment sampling – 2006

ANNEXE IV

THE BOYANA LAKE



PIC. 7: THE BOYANA LAKE: satellite image (top and bottom-left images) and the surface map constructed in 2005 (right). Dotted line – GPS tracking of the shore line.



PIC. 8: BATHOMETRIC MAP OF THE BOYANA LAKE: The depths mentioned are the real depths.

Pic. 9: A deer grazing on the pondweed in the Boyana Lake – June 2005

Pic. 10: Boyana Lake – before the removal of the pondweed – June 2005.

Pic. 11: Removal of debris and pondweed from the Boyana Lake – July/ September 2005.

Pic. 12: Removal of debris and pondweed from the Boyana Lake July/ September 2005.

ANNEXE V

Pic. 13: General view at the end of the summer – September 2005.

Pic. 14: Boyana Lake – December 2005 (up) and March 2006 (down)

Pic. 15: Boyana Lake – After the removal of the pondweed and reintroduction of the grass carp – June 2007

Pic. 16a: Boyana Lake – Reintroduction of the grass carp and tench – May 2006

Pic. 16b: Boyana Lake – Reintroduction of the grass carp and tench – May 2006

ANNEXE VI

THE LOZEN LAKE

FIG.17: THE LOZEN LAKE: satellite image.

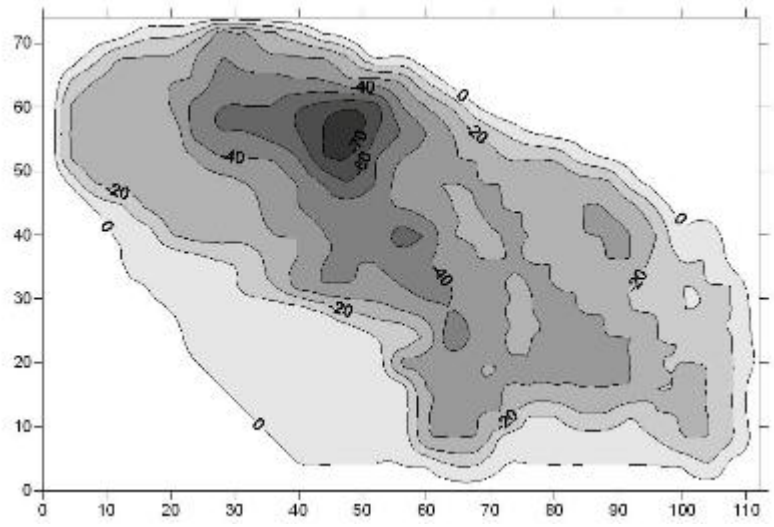


FIG.18: BATHOMETRIC MAP OF THE LOZEN LAKE: The depth figures are the real depths.

Pic. 19: The Lozen Lake – general view (up) and the ditch draining the lake (bottom) – July 2006.

ANNEXE VII

THE LOZEN LAKE

Pic. 20: The project team