COUNCIL OF EUROPE CONSEIL DE L'EUROPE

Strasbourg, 16 January 2002

PE-S-DE (2002) 18
English only

[diplôme/docs/2002/de18e_02]

COMMITTEE FOR THE ACTIVITIES OF THE COUNCIL OF EUROPE IN THE FIELD OF BIOLOGICAL AND LANDSCAPE DIVERSITY

(CO-DBP)

Group of specialists – European Diploma for protected areas

28-29 January 2002
Room 15, Palais de l'Europe, Strasbourg

Tihany Peninsula, Hungary

FRESH APPLICATION
as requested by the Committee of Ministers

Document prepared
by the Directorate of Culture and Cultural and Natural Heritage

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1.1. SITE NAME
Tihany

1.2. COUNTRY
Hungary

1.3. DATE CANDIDATURE

August 2001

1.4. SITE INFORMATION COMPILATION DATE
July 2001

1.5. ADDRESSES: Administrative Authorities

National Authority	Regional Authority	Local Authority
Name: Authority for Nature Conservation, Ministry of Environment Address: Budapest, Költő u. 21. H-1121 Hungary Tel.: +36-1-395-7093 Fax: +36-1-200-8880 E-mail: tardy@mail2.ktm.hu	Name: Balaton-felvidéki Nemzeti Park Igazgatóság (Balaton Uplands National Park Directorate) Address: Veszprém, Vár u. 31. H-8200 Tel.: +36-88-427-855 +36-88-427-056 Fax: +36-88-427-023/119 E-mail: bfnp@ktm.x400gw.itb.hu	Name: Tihany Község Polgármesteri Hivatala (Tihany Municipality) Address: Tihany, Kossuth L. u. H-8237 Tel.: +36-87/448-545 Fax: +36-87/448-700 E-mail:

1.6. ADDRESSES: Site Authorities

Site Manager	Site Information Centre	Council of Europe Contact
Name: Balaton-felvidéki Nemzeti Park Igazgatóság (Balaton Uplands National Park Directorate) Address: Veszprém, Vár u.31. H-8200 Tel.: 36-88-427-855 36-88-427-056 Fax.:36-88-427-023/119 E-mail.: bfnp@ktm.x400gw.itb.hu	Name: Address: Tel. Fax. E-mail	Name: Address: Tel. Fax. E-mail

1.7. SUMMARY DESCRIPTION

The Tihany Peninsula stretches into the central depression of Lake Balaton, which lies in the Balaton basin, Western Transdanubia, Hungary.

1.8. EUROPEAN INTEREST JUSTIFYING THE CANDIDATURE

The natural endowments and beauty of the Tihany Peninsula are unique not only by Hungarian, but even by European standards. Lake Balaton itself is also unique, being a vast but at the same time extraordinarily shallow, and thus vulnerable lake. The Tihany Peninsula is the only one in the lake, its situation and size exercising a great influence on it. The geological past can be traced back on remarkable landscape features such as sediment banks, basalt tuff rocks, crater lakes and geyser cones. Because of its particular geology and climate, the peninsula has become a plethora of natural and cultural assets. The great diversity of geographical and climatic conditions have given rise to a rich wildlife: habitats range from extremely dry rock grasslands through dense woodlands to permanently wet areas, such as lakes, and the list of rare and protected species is remarkably long.

The opportunities offered by the diverse conditions were recognised by our ancestors in early times: the historical monuments of the peninsula recall a long and eventful history. Centred around the Benedictine Abbey, the ancient village forms an integral part of the picturesque landscape, and sustains the traditional architecture and management practices of past centuries. The old land use forms, such as grazing, vine and almond growing have also contributed to the formation of the characteristic Tihany landscape.

Recognising the outstanding assets of the peninsula, the first Landscape Protection Area in Hungary was established here in 1952. The designation was justified by the beautiful scenery, the particular geological and geomorphological features, the diverse flora and fauna as well as the historical and cultural monuments. Today, it forms part of the Balaton Uplands National Park, established in 1997, integrating and completing the formerly separate landscape protection areas and nature conservation areas of the region.

1.9. SELECTION METHODOLOGY

The Tihany Peninsula was declared protected in 1952, as the first Landscape Protected Area in Hungary. Its unique natural endowments, geological formations, native flora and fauna as well as its historical monuments make it an invaluable gem, an open air museum of not only the Balaton region, but the whole of Hungary.

1.10 MAIN AIM OR MOTIVATION

The long term conservation, maintenance and presentation of the unique natural endowments would be better guaranteed by acquiring this designation.

1.11. DATES (to be filled in by the Council of Europe)

DATE OF FIRST EXAMINATION DATE OF EXPERT VISIT

DATE OF SECOND EXAMINATION DATE OF AWARD

2. SITE LOCATION

2.1. SITE CENTRE LOCATION

LONGITUDE LATITUDE

17	**°**	**52**	**'**	**30**	**"**	**N**	**46**	**°**	**55**	**'**	**00**	**"**

2.2. AREA (ha) 2.3. SITE LENGTH (km)

Total Area		**1536,33**	**5,60**	
Core		**563,31**		
Buffer		**333,75**		
Transition		**639,27**		

2.4. ALTITUDE (m)

MINIMUM	MAXIMUM	MEAN
water level of Lake Balaton:105.4 m	Csúcs Hill: 232.4 m	170

2.5. ADMINISTRATIVE REGION

REGION NAME % COVER
Tihany, County Veszprém, Hungary

Tihany village 100 %

Marine area not covered by the terrestrial part —

3. NATURAL HERITAGE

3.1. GENERAL ABIOTIC DESCRIPTION (Geomorphology, geology and hydrogeology)

Geology

GEOLOGICAL STRUCTURE AND EVOLUTION

Although the geological formations building up the peninsula have numerous specific features, their geological position renders them part of the South-eastern foreground of the Balaton Uplands area.
The basalt volcanic activity of the Balaton region, and the postvolcanic activity continuing into the Pleistocene have created a particular Quarternary relief and sediment formation. The tectonic events of the Pleistocene, which have significantly contributed to the formation of Lake Balaton, as well as a secondary depression of certain parts of the basin in the Early Holocene have also enriched the geomorphology of the relief and increased the diversity of the sediments.

Neither the rocks of the crystalline basal mountain, nor those of the Permo-Triassic sedimentary cycle can be found on the surface, but their presence in the depths can be detected, since a lot of Permian red sandstone, Triassic limestone and dolomite occur among the debris of basalt tuff and agglomerates on the surface. Phyllites have also been identified in the inclusions around the Monk Dwellings. The limestone and dolomite inclusions in the basalt tuff of Csúcs Hill are of the same origin as of the neritic carbonates of the Megye Hill strata and the Middle Triassic limestones of the Balaton Uplands.

No Mesozoic or Palaeogene formations are known from the area; even the oldest Cainozoic sediments have been brought to surface by deep drilling. About 100 m under the Pannonic sediments, the bedrock of the basin under Tihany Peninsula is variegated with neritic limestone and calcarious clay from the Sarmatian stage.

The Pannonic formations, which have played a significant role in the geological evolution of the Peninsula, have been found both under the tephra (this term refers comprehensively to all kinds of eruptive rock debris) at the edges of the peninsula as well as in the interior. The most well-known of them are the 30 m high geological key section, the cut roads to Cyprian spring as well as some ravines and borrow pits (clay and sand quarries).

The abrasion debris of Diás Formation, the offshore fine particle sediments of the Tihany Formation and the blocks containing vulcanites of the Tapolca Basalt Formation can be lithostratigraphically classified as

distinct units. The last two formations have classic exposures on the surface and contribute significantly to the geological highlights of the area.

The Pannonic volcanic activity has already been mentioned on explaining the occurrence of older rocks, such as Permian red sandstones, Mesozoic dolomites and limestones in the volcanic formations of the peninsula. All of these rock inclusions have been brought to surface by the volcanic explosions in the peninsula. The sequence of strata explored by drillings shows that the Sarmatian limestone was covered by sandstone from the Paratethys sea, first formed from relatively deeper but later shallower sea. The fossil remains indicate changes in the salt content of the Paratethys: it can be followed how the water turned brackish and later fresh. The characteristic fossil bivalve shell of Tihany, the Congeria ungula caprae (popularly known as 'goat's hoof') indicates a certain stratum for paleontologists. Unfortunately, its stock has almost completely been depleted by collectors and tradesmen. Some specimens are still found occasionally in the Fehér bank and the trail towards the Monk Dwellings. When the area became a brackish shelf sea and later a freshwater lake and marshland, the basalt volcanism of the Tihany Peninsula started. Lajos Lóczy sr. drew several conclusions from his research on the local volcanic activity that have withstood the changes of time and scientific knowledge. He distinguished eruption centres and various types of eruption, and he recognised that *the vigorous explosive eruptions occurred in shallow seas*.

After a long break, the analysis of sediments deposited by volcanic explosions came again into focus in the 70s, and the last ten years a new theory on the volcanism of the peninsula was born. The results of geological mapping have been put into a new context by the analysis of aerial photographs, satellite images and digitised landscape models. Obviously, there is a strong interrelation between the tectonic structure of the peninsula and the volcanic activity. The vulcanites are arranged in annular patterns which may correspond to a single ancient volcanic structure.

According to the sedimentological data, the rocks rich in magmatic grains and their stratification are similar to those found in SURTSEY type hydroeruptions and in STROMBOLI type eruptions. The cross-stratifications indicative of currents, the buckling sediment strata and other stratigraphic features as well as the position of volcanic bombs can be analysed to locate the eruption centres. In certain cases, the occurrence of Hawaii type lava fountains can also be suspected. The Tihany Volcano is relatively old in comparison with other volcanoes in the Balaton Uplands region. It was born about 7 million years ago according to K/Ar radiometric data. The eruptions succeeded in several stages.

The first eruptions occurred in the centre of the peninsula, when the rising basalt flow reached the highly aqueous subsurface strata, and the sudden evaporation of the water led to a hydroeruption similar to a Surtsey (Iceland) type eruption. The strata above the eruption centre were blasted and it was in this stage when the vulcanites variegated with the debris of older rocks were formed.

In the second stage, the centre was probably above the Füredi Basin, and the eruption was similarly explosive. The two stages may have coincided for some time.

The third stage began with a new volcanic conduit on Csúcs Hill. The activity of the volcano started in a somewhat drier environment and less deep as the first two stages.

In the fourth stage, the eruption centre returned to the interior of the peninsula. A characteristic rock succession called *maar* also formed during the explosions. This succession is dominated by the blasted rocks of the basal mountain as opposed to those formed by the primary magmatic flow.

In the last stage, gases played the main role in the volcano's activity, and similarly to the still puffing, bubbling, hissing and cracking craters of today's Stromboli, a number of cinder cones were built in the northern part of the peninsula and probably also in the area of the present Lake Külső (Exterior). The smoking and fire-spattering craters of Tihany were surely a beautiful sight! The intensive thermal spring activity, always increasing as volcanic activity declines, probably began in this period.

The Pleistocene postvolcanic formations are just as well-known: the traces of this activity, which begins in the last stage of or after the volcanic activity, can be found throughout the peninsula and contribute significantly to the creation of its present character.

The geyserite cones are made up of an extraordinarily variable mixture of travertine and hydroquartzite. Laminar structures are frequent in the lower strata (as shown perfectly at the Csúcs Hill station of the Lóczy study trail), indicating a rhythmical succession of precipitation. The original shape of the geyserite cones can still be recognised, diversified by conduits of thermal water and hollows. The precipitation of geyserite occurred in several stages, the opal and chalcedonyte fillings and the hollows cast with hydroquartzite correspond to dissolution phases, and other chemical and physical processes. The geyserite cones are arranged more or less in N-S, NE-SW and NW-SE directed rows.

The Upper Pleistocene formations are periglacial colluvia of various origins, the taluses of various materials such as talus loess surround the higher elevations as a mantle or cover them in a shallow sheet.

It would take a separate chapter to describe the Holocene sediments of the Balaton basin and the stratigraphical conditions of the Holocene lacustrine strata. In addition to the mud, sandbank and peat-lined lacustrine clay of Bozsai, Aszófői and Tihanyi bays, the layers of palustrine clay in Lakes Külső and Belső refer to the climate-dependent changes in water level.

GEOMORPHOLOGY

During the geomorphological mapping of the peninsula, the formations and groups of formations were classified according to their origins. In identifying both large and small formations, the relations between the rock type, the processes and the resulting form were all considered.
The main distinguishing features in identifying formations are the motional, karstic, abrasion, hydrographic and anthropogenic phenomena.
Tihany contains a plethora of volcanic, postvolcanic, derasion, limnic abrasion and erosion formations.
The volcanism, the intensive tectonic movements and the various external forces (linear erosion, weathering, gravity, frost, soil creeping, limnic abrasion and deflation) created all together the morphology of the peninsula. Naturally, the volcanic formations have by now mostly reshaped, the degree of which depends on the durability and hardness of the rock. The least affected areas are where the volcanic beds have been covered by the postvolcanic geyserite cones. These are the highest peaks in the peninsula: the 232 m high Csúcs Hill, the 224 m high Nyereg Hill and the 218 m high Óvár. In lack of this 'protection', the ground surface lies lower, and is more dissected by valleys, escarpments and slopes.
The depressions in the place of the assumed eruption centres have been filled with impermeable talus by Pleistocene periglacial processes, and thus withheld water, creating spectacular lakes, i.e. Lakes Belső, Külső and Rátai marsh. The permanent or temporary character of these lakes depended on the changes in climate, as shown by the limnic raised beaches. Lake Belső has been in existence for a long time. Lake Külső was mostly drained in the last century, but has by now been restored. The third lake (Rátai) is a temporarily filled small depression.

The most characteristic and most valued geomorphological formations are the numerous geyser cones, created by the postvolcanic activity of the Tihany, producing hard rocks, mainly hydroquartzite and siliceous travertine. The geyserite cones occur in groups in several sites, most commonly in the southern and south-western parts of the peninsula. The most important ones are described in the following chapter.
Numerous derasion valleys, i.e. dry valleys without a watercourse can be found in the area. These include the valleys formed on basalt tuff and basalt agglomerates as well as on loose sediments among the geyserite cones. Perhaps the most interesting of them are the ones with a high gradient and steep banks, such as the southern slope of Cser Hill, and the slopes of Geyser Field and Hármas Hill.
Deflation formations include the wind-shaped basalt tuff surfaces, the ledges and depressions e.g. at Kiserdő Summit and at the Monk Dwellings. The wind-shaped basalt tuff rocks are a special sight of the peninsula.

THE GEOLOGICAL HERITAGE

The scientific, popular scientific and literary work on the geological and paleontological heritage in Hungary has a long history.
The Tihany geyserite has always been mentioned among the geologically most important three objects (alongside with Ipolytarnóc and Badacsony).
'On designating Tihany Peninsula as a Landscape Protection Area, special protection measures were provided to the geyser cones (the decree on protection lists 110 of them), Lake Belső and the wind-shaped basalt tuff rocks. The designation was proposed by the Hungarian State Institute for Geology and passed by the National Conservation Council as Decree No. 392/1952. The decree declares that quarrying is prohibited in the peninsula. Since the designation of protected status, the construction of new hotels destroyed the most beautiful Pannonic exposures and bird nesting sites'. The above quotation is cited from the 1967 status report by András Tasnádi Kubacska and József Fülöp to the Geological Committee of the Hungarian Acadamy of Sciences.
In the last decades, the main objective of protection was complemented by the aim of professional management and interpretation to the public. The most beautiful geyserite cones have been cleaned and can be approached on signalled tourist trails. Cleaning took place with utmost care and without damaging the rocks. Visitors can learn about the geological assets on professional nature trails with information boards and brochures in Hungarian and foreign languages.
The Tihany Peninsula is like an open-air museum whose collection is not yet completely registered, but the most valuable ones have already been classified and labelled. The 'collection' is rich in unique, irreplaceable and aesthetically spectacular assets that can be studied and compared 'in situ' by scientists as well as admiring tourists.
The geological heritage of the Tihany Peninsula represents nearly the full range of Earth sciences, providing illustrations of mineralogy, lithology, paleontology, stratigraphy, volcanology, geomorphology, tectonophysics, history of science, speleology, geological conservation, paleoclimatology, geography, geophysics etc. It is hardly possible to give a complete list of these assets: a geological key section; the remnants of Pliocene basalt volcanism; the traces of explosive volcanic activity, eruption centres and tuff rings; the objects left by postvolcanic activity; the geyserites; the fossils of Fehérpart (White Bank), the type locality of Pannonic Tihany

Formations; the geomorphological features: the cones, the wind-shaped rocks and the spring caves; the research sites of the Balaton monography made in the early 20th century; and the geological interpretation sites strung together by Lóczy study trail.

Here is a selection of the most important geological monuments of the Tihany Area:
Fehérpart (White Bank)
A few million years ago, this region was covered with lakes and marshes. Tihany is one of the longest known geological research sites in the region, holding many fossils, predominantly molluscs. Researchers of the Pannonic stratigraphy know this area as the type locality (locus tipicus) of the Tihany Formation rocks. Fossil bivalves called goat hoofs could be bought from local vendors until the middle of the 20th century (the author of these lines also bought one as a child), and the legend of the Tihany lambs with golden fleece could even be read on postcards. In one stage of the Pannonic age, Fehérpart was a flood plain with mixed woodlands of sweetgum (*Liquidambar europaea)*, plaintain (*Platanus leucophylla)* and walnut (*Juglans acuminata*) trees. Beautiful leaf imprints of *Smilax* indicate the presence of lians. The remains of leaves in Tihany are relatively large and have intact edges, attesting a humid climate.

The remnants of the activity of the Tihany Volcano

- Butte hills whose subsistence was supported by postvolcanic activity and thus resisted to detrimental effects: Csúcs Hill, Nyereg Hill, Óvár
- Eruption centres: Lakes Belső, Külső, and Rátai marsh
- Phenomena connected to volcanic sediments – Monk Dwellings. There are three dwellings of a total length of about 200 m and at a height of about 20 m in the northern side of Óvár. They demonstrate various phenomena related to volcanic eruptions and the sedimentation of debris in aqueous media (flow canals, erosion grooves, volcanic dust of various rocks, lapilli, embedded bombs, layering and cross-stratification). The distortions caused by the volcanic bombs can be observed in the formerly plastic, soft rocks.
- Parasite cones: 5-10 m high cones, around the eruption centres of the former Tihany Volcano, on the southern edge of Lake Külső and in the zone south-west of Rátai marsh.
- Postvolcanic formations:

Considered to be the most characteristic, unique geological features of the peninsula. These geyserite cones are noted for their particularly interesting and impressive appearance.

1. Aranyház (Golden House), the most well-known of these formations, renowned for its multiple complexity, is found to the south of Lake Belső. Its vent, open to the south, has 3 m high vertical walls and gradually tapers upwards from the 3 m long and 1 m wide base. It contains several smaller, open hollows, which are probably also the remnants of former vents. Its name derives from its yellow lichen growth.

2. The geyser cone near Cser Hill, about 170 m to the northwest of the triangulation point, has a vent open to the east. In its side walls, it has spherical hollows about half a meter wide, which were dissolved by the, turbulent hot waters surging up.

3. The vent of the geyserite cone of Hármas Hill opens on the top and can be traced down to about 7 m, where it is stuffed by debris. The vent, which is about 10 m wide on the top, narrows in downwards. Its side walls hold several 1-2 m long and half a meter wide passages, which were probably parasite vents.

4. Nyereg Hill is a narrow, rocky ridge connecting Csúcs Hill with Apáti Hill, and offering a wonderful view. This ridge is one of the most important geological monuments of the peninsula. The ancient vegetation was here conserved by the hot mud, so that the hydroquartzite formed later now contains numerous fossil plant remains. The geyser cones of Nyereg Hill are characterised by larger dissolution hollows. The geyserite is typically laminar in character and the 1-1,5 x 2-3 m large hollows are always found along the layers of the laminar geyserite.

5. The 25-30 m cone of Csúcs Hill is a very impressive sight. The thermal water surging up spurt out through several smaller vents, which can still be seen very well. According to the popular belief, the hollow in the western side of the hill was inhabited by Jóska Sobri, a legendary outlaw of the Bakony Hills.

6. The Forrás (Spring) Cave is a hollow formed in the geyserite cone of Kálvária Hill near the Tihany Abbey. This, the largest known cave of the peninsula, is open to visitors. It is about 8 m long, 5 m wide and 3 m high and holds several smaller, spherical hollows in the side walls.

Climate:

The peninsula has a Submediterranean climate, the annual mean temperature is higher than in other parts of the Balaton region, reaching 10.7 ^{o}C. The average number of sunny hours is 2010-2030 per year, the mean annual rainfall is 613 mm. The last frosts occur between 25-30 March and the frost-free season lasts 220-225 days till mid-November. The mean of absolute maximum temperatures in summer is 33.0-33.2 ^{o}C, while that of absolute minimum temperatures in winter is -13 ^{o}C. The average number of days with snow-cover is only 27, while the average thickness of the snow-cover is 25 cm. The microclimatic conditions are very variable.

3.2. HABITATS

1.Wetlands:

1.1. Lake Balaton:

This includes the water surface around the peninsula, and the protected Bózsai bay therein. The characteristic vegetation of open water surfaces consists of various ground-rooting pondweed and water-milfoil associations (*Potametum perfoliati*, *Myriophylletum verticillati*). The shoreline is fringed by reedbeds (*Phragmitetum communis)* of various widths, alternating locally with Lesser Bulrush beds (*Typhetum angustifoliae*). The reedbeds are replaced by sedges and other emergent vegetation towards the shore (e.g. *Caricetum ripariae*). The western side of the peninsula holds the last natural shoreline of Lake Balaton.

1.2. Lake Külsõ (Exterior):

Lake Külsõ has formed in the main crater of the former volcano of the peninsula. It is very shallow because of the advanced sedimentation. Its water intake comes entirley from precipitation. Draining canals were created by digging and explosions in the early XIXth century in order to drive the water from the lake through Aszófõi stream to Lake Balaton. The drained area was used as a hayfield. In 1973, the management of the area was taken over by the nature conservation authority. It was then that the restoration of the original conditions of the lake began by closing down the canal. The average depth of the lake is 1 m, appr. 70 % of the surface is covered by vegetation. The vegetation is characterised by floating Bladderwort associations in the open water surface (*Utricularion vulgaris*),while the other parts are occupied by reedbeds (*Phragmitetum communis*) and Lesser Bulrush beds (*Typhetum angustifoliae*). Sedges that do not form tussocks (*Caricetum ripariae, Caricetum acutiformis*) can be found at several places along the shore.

1.3. Lake Belsõ (Interior):

Lake Belsõ was also formed in a former volcanic crater, but it is significantyl deeper than that of Lake Külsõ. The proportion of open water surfaces is presently 70 %, but shoreline reedbeds (*Phragmitetum communis*) are vigorously extending. The lake is primarily used for angling and it is stocked with large amounts of fish and fry every year.

1.4. Rátai-csáva (marsh):

Formed in the place of the third largest volcanic eruption centre, this area has already been completely drained and filled with sediments. It temporarily holds a 30-50 cm deep, 0,2 ha large water surface. Its vegetation is an undistinctive stalky association.

2. Grasslands

2.1. Dry grasslands

The most typical association of dry grasslands in the peninsula is the slope steppe (*Cleistogeni-Festucetum rupicolae*), whose major occurrences are in Apáti-ridge, Nyereg Hill and the northern side of Óvár. They are characterised by several Submediterranean species, such as *Sternbergia colchiciflora,* Autumn Squill *(Scilla autumnalis),* a bindweed *(Convolvulus cantabricus)*, etc. The more disturbed, secondary grasslands are most reminiscent of the mountain dry pasture association (*Cynodonto-Festucetum pseudovinae*). Examples include the 'old lavender field' and several sites in Apáti Hill. This vegetation type holds the only strictly protected plant of the peninsula, a foxglove (*Digitalis lanata),* whose occurrence here probably originates from garden specimens. Several abandoned arable lands, vineyards and orchards can be found in the peninsula. Their vegetation depends on how long ago the cultivation ceased. They are usually heavily invaded by shrubs, the vegetation being of a transient character (*Pruno spinosae-Crataegetum*).

3. Forests

3.1. Closed forests

The western and northern slopes running down steeply to the lake hold Sessile Oak - Turkey Oak woods (*Quercetum petraeae-cerris*), typically mixed with numerous other species, such as Sycamore (*Acer platanoides)*, Field Maple (*Acer campestre)* and Small-leaved Elm (*Ulmus minor*). Some of these woodlands were formerly wooded pastures, and the bulk of the stands still consist of 140-170 year old Sessile Oaks (*Quercus petraea*) and Downy Oaks (*Quercus pubescens*). Other oak species can also be found, such as *Quercus polycarpa*, Turkey Oak (*Quercus cerris*), *Quercus virgiliana* and the natural hybrids of the latter with Downy Oak (e.g. *Quercus Budensis*).

The ridges surrounding the peninsula have locally been afforested with Black Pine (*Pinus nigra*). These stands are around 50 year old. The lower canopy and scrub levels have been reoccupied by the native deciduous scrub and tree species, primarily the Manna Ash (*Fraxinus ornus*), the Saint Lucie Cherry (*Cerasus mahaleb*), and here and there even some oak species. As the Black Pines gradually die out, the natural vegetation takes over again.

3.2. Open deciduous forests and scrub forests

Along the edges of the former volcanic calderas, the shallow soil formed on the balast tuff or geysirite rocks maintain patches of Wig Tree – Downy Oak woods (*Cotino-Quercetum pubescentis*) variegated with slope steppe grasslands (*Cleistogeni-Festucetum rupicolae*) and transient scrubs. The canopy storey is formed by Downy Oak (*Quercus pubescens*) and Manna Ash (*Fraxinus ornus*), with *Quercus virgiliana* also occurring on the Kiserdõ summit. The scrub storey is dominated by Wig Trees (*Cotinus coggygria*) and Saint Lucie Cherry (*Cerasus mahaleb*) trees. The understorey holds several botanical highlights.

3.3. FLORA

The flora of the Tihany Area is of a secondary character. The original vegetation probably consisted primarily of xerotherm woodlands, which only remained in patches on the outer hills by the end of the last century. Parallel with the retreat of cultivation and grazing, some of the interior area was reforested by natural regeneration. The grasslands are predominantly secondary, but a few smaller patches of rock grasslands have remained intact.

A typical grassland association of the site is a slope steppe grassland variety widespread in the Transdanubian Hill Range (*Diplachno-Festucetum rupicolae*), with many Submediterranean plant species: a cornsalad, *Valerianella pumila*, *Convolvulus cantabricus* and *Sternbergia colchiciflora*. The same grasslands are at places adorned with multitudes of Autumn Squill (*Scilla autumnalis*), as well as other protected plants: Scorpion Senna (*Coronilla emerus)*, Wild Cotoneaster (*Cotoneaster integerrimus)*, Early Star-of-Bethlehem (*Gagea bohemica)*, *Paronychia cephalotes*, and *Medicago rigidula*. The pannonic grasslands above the monk dwellings hold several rare plant species, such as Yellow Pheasant's Eye (*Adonis vernalis)*, *Cotoneaster tomentosus*, Jurinea (*Jurinea mollis)*, Large-flowered Pasque Flower (*Pulsatilla grandis)*, *Centaurea sadleriana*, etc.

The southwestern ridge supports a nice Sessile Oak - Turkey Oak wood (*Quercetum petraeae - cerris*) with many Downy Oaks *(Quercus pubescens*) and other xerotherm oak species as well as their natural hybrids (*Quercus virgiliana, Quercus polycarpa, Quercus Budensis*). Typical mixing species include Manna Ash (*Fraxinus ornus*), Field Maple (*Acer campestre*) and Small-leaved Elm (*Ulmus minor).* The ridges are covered at several places with Downy Oak – oak scrub forests (*Cotino-Quercetum pubescenti*) with many Wig Trees (*Cotynus coggygria*) and Saint Lucie Cherry (*Cerasus mahaleb*) trees.

Formerly, several medicinal herbs were grown in the peninsula, the most well-known being the lavender. The lavender field planted in the 1920's has by now transformed into a special habitat with a characteristic Mediterranean flora and fauna. Similarly, *Digitalis lanata*, a strictly protected species found in several sites of the area, is probably a remnant from cultivation.

Strictly protected species:

1. *Digitalis lanata*: Lavender field, 1 000 individuals

Protected species:

1. Small Pasque Flower (*Pulsatilla pratensis subsp. nigricans*): Apáti Hill, Nyereg Hill, Kiserdõ Summit, 100-1 000 individuals
2. Large-flowered Pasque Flower (*Pulsatilla grandis)*: Óvár, 10-100 individuals
3. Yellow Pheasant's Eye (*Adonis vernalis*): Nyereg Hill, Apáti Hill, Kiserdõ Summit, Óvár, 1 000 individuals
4. *Ranunculus illyricus*: Nyereg Hill, Apáti Hill, Kiserdõ Summit, 1 000 –10 000 individuals
5. Simple-leaved Clematis *(Clematis integrifolia)*: Felsõ-láp (Upper bog), 1 000 individuals
6. *Cotoneaster matrensis*: Apáti Hill, Csúcs Hill, Óvár, 100-1 000 individuals
7. *Medicago rigidula*: Apáti Hill, Kiserdõ Summit, Ráta, Vadparlag, 1 000- 10 000 individuals
8. *Pisum elatior*: Gurbicza, 10- 100 individuals
9. Scorpion Senna (*Coronilla emerus*): Apáti Hill, Nyereg Hill, Óvár, 1 000 individuals
10. Burning Bush (*Dyctamnus albus*): Gurbicza, Szarkádi Forest, Gejzírmezõ (Geyser Field), Csúcs Hill, 1 000 individuals
11. *Linum tenuifolium*: Óvár, Aranyház, 1 000 individuals
12. *Vinca herbacea*: Csúcs Hill, Nyereg Hill, 1 000 individuals
13. *Onosma arenarium*: Kiserdõ Summit, 10 individuals
14. Honesty (*Lunaria annua*): adventive species, Apáti Hill, 100 individuals
15. *Erysimum odoratum*: Óvár. Nyereg Hill, Csúcs Hill, Gejzírmezõ, 10 000 individuals
16. *Inula oculus-christi*: Csúcs Hill, Nyereg Hill, Apáti Hill, Kiserdõ Summit, 1 000- 10 000 individuals
17. *Paronychia cephalotes*: Nyereg Hill, Kiserdõ Summit, 1 000 individuals

18. Early Star-of-Bethlehem (*Gagea bohemica*): Apáti Hill, Kiserdõ Summit 100 000 individuals
19. Round-headed Leek (*Allium sphaerocephalon)*: Csúcs Hill, Nyereg Hill, Apáti Hill, Kiserdõ Summit, 1 000- 10 000 individuals
20. Autumn Squill (*Scilla autumnalis*): Nyereg Hill, Apáti Hill, Kiserdõ Summit, 10 000-100.000 individuals
21. *Ornithogalum pyramidale*: Gurbicza, Bozsai bay, 1 000- 10 000 individuals
22. *Ornithogalum refractum*: Ürge Hill, 1-10 individuals
23. *Sternbergia colchiciflora*: Gurbicza, Csúcs Hill, Nyereg Hill, Apáti Hill, Óvár, Kiserdõ Summit, 100 000-1 000 000 individuals
24. *Iris pumila*: Gurbicza, Csúcs Hill, Nyereg Hill, Apáti Hill, 10 000-100 000 individuals
25. Variegated Iris (*Iris variegata*): Gurbicza Summit, 10-100 individuals
26. Lady Orchid (*Orchis purpurea*): Csúcs Hill, Nyereg Hill, Gejzírmezõ (Geyser Field), 100-1000 individuals
27. Early Marsh-orchid (*Dactylorhiza incarnata*): Bozsai bay, Felsõ-láp (Upper bog), 1 000 individuals
28. White Helleborine (*Cephalanthera damasonium*): Sajkodi shore, 10 individuals
29. *Stipa joannis*
30. *Stipa ericaulis*

Locally important species:

1. *Lathyrus sphaericus*: Apáti Hill, 100 individuals
2. Milk-parsley (*Peucedanum palustre*): Alsó-Szarkád, 100 individuals
3. Narrow-fruited Cornsalad (*Valerianella dentata*): Alsó-Szarkád, loess banks, 100 individuals
4. *Valerianella pumila*: Gurbicza, Csúcs Hill, 1 000 individuals
5. Bladderwort (*Utricularia vulgaris*): Külsõ-tó, Felsõ-láp (Upper bog), 10 000 individuals
6. Corn Mignonette (*Reseda phyteuma*): Gurbicza, Csúcs Hill, 1 000 individuals
7. *Inula germanica*: Kiserdõ Summit, 100- 1 000 individuals
8. *Quercus polycarpa*: Szarkádi Forest, 1-10 individuals
9. *Quercus virgiliana*: Kiserdõ, Szarkád, 1-10 individuals
10. Coralrroot (*Dentaria bulbifera*): Csúcs Hill, 100 individuals
11. *Allium atropurpureum*: Óvár, Sajkod, 100 individuals

3.4. FAUNA

The fauna of the peninsula is also characterised by a high proportion of southern species. A rare representative of this group is the Round-mouthed Snail (*Pomatias elegans)*, whose only other site in Hungary is at Õrtilos. Another warmth-loving species is the House Centipede (*Scutigera coleoptrata)*, which still subsists in open air conditions in Tihany, but is only found in cellars and buildings further north. The buzzing noise produced by the Vineyard Cicadas (*Tibicen haematodes)* and Manniferous Cicadas *(Cicada orni)* in summer evenings creates a typical Mediterranean atmosphere. Researchers have found nearly a thousand species of beetles in the peninsula. This large number is explained by the variegated microclimatic conditions. The number of butterflies and moths revealed exceeds 800. The vertical banks provide habitat to numerous insects, the most typical of which are *Odynerus spiricornis*, the common *Sceliphron destillatorium* (two wasp species) and the bee *Anthophora parietina var. fulvocinerea*. A rare representative of ants is *Cataglyphis bicolor*, which lives on warm, southern hillsides. Typical insect species of Szarkádi Forest include the protected Great Capricorn Beetle (*Cerambyx cerdo)*, Stag Beetle (*Lucanus cervus*) and Lesser Stag Beetle (*Dorcus paralelepipedus).*

14 of the 22 amphibian and reptile species occurring in the Bakony Hills can be found in the peninsula. The Smooth Newt (*Triturus vulgaris*) lives both in Lake Balaton and Lake Külsõ. Spadefoot Toad (*Pelobates fuscus*) and Agile Frog *(Rana dalmatina*) are widespread in the peninsula, while green frogs (*Rana ridibunda, Rana esculenta, Rana lessonae*) and Fire-bellied Toad *(Bombina bombina*) are more restricted to wetlands. A nice population of the European Pond Tortoise (*Emys orbicularis*) lives in Lake Balaton as well as in Lake Külsõ. In addition to the common Grass Snake *(Natrix natrix*), Dice Snake (*Natrix tessellata*), Aesculapian Snake (*Elaphe longissima*) and Smooth Snake (*Coronilla austriaca*) a rare race of the Grass Snake (*Natrix natrix persa*) with two dorsal lines has also been found.

The avifauna of the Landscape Protection Area is also rich. The role of Lake Belsõ has been taken over by Lake Külsõ, offering an undisturbed habitat to many species of waterbirds. The most valuable breeding species are Greylag Goose (*Anser anser*) and Great White Egret (*Egretta alba*), but the Purple Heron (*Ardea purpurea*) also regularly nests here since 1996. Marsh Harriers (*Circus aeruginosus*), Little Bitterns (*Ixobrychus minutus*), Lapwings (*Vanellus vanellus*), Bitterns (*Botaurus stellaris*), Little Grebes (*Tachybaptus ruficollis*) breed in Lake Külsõ, as well as numerous other reed-dwelling songbirds, such as the scarce Moustached Warbler *(Acrocephalus melanopogon*). The breeding of Great White Egrets was first observed on the lake in 1999, when there were two colonies with a total of 32 pairs. Hobbies (*Falco subbuteo*) turn up in various parts of the

peninsula every year, and breeding has also been confirmed in some years. Among nocturnal birds of prey, Scops Owls (*Otus scops*) are specially noteworthy, being a typical Mediterranean element in the fauna, but Tawny Owls (*Strix aluco*) and Long-eared Owls (*Asio otus*) also nest in the peninsula. There is a significant population of Black Woodpeckers (*Dryocopus martius*) and Green Woodpeckers (*Picus viridis*), but Grey-headed Woodpeckers (*Picus canus*) also occur. Other important species include Kingfisher (*Alcedo atthis*) and Hoopoe (*Upupa epops*). A few pairs of Bee-eater *(Merops apiaster*) nest in the eastern sediment banks of the peninsula. Corncrake *(Crex crex*) has also been registered in Felsõ bog.

Among protected mammals, the Otter (*Lutra lutra*) has a steady foothold in the peninsula, just like Common Dormouse (*Muscardinus avellanarius*), Squirrel (*Sciurus vulgaris*), Badger (*Meles meles*) and Souslik (*Citellus citellus*). There are records of Wild Cat *(Felis sylvestris*), too. Several bat species have also occurred in the area, typical ones include Brown Long-eared Bat (*Plecotus auritus*), Grey Long-eared Bat (*Plecotus austriacus)* and Nathusius' Pipistrelle (*Pipistrellus nathusii*).

Checklist

(extracted from research reports)

(P = protected, SP = strictly protected, RB = included in the Red Data book, NP = not protected)

Molluscs *(Mollusca)*

- Bivalves (*Lammellibranchiata*)

1. *Unio crassus* NP
2. Painter's Mussel (*Unio pictorum*) NP
3. Swollen River Mussel (*Unio tumidus*) NP
4. Swan Mussel (*Anodonta cygnea*) NP
5. Zebra Mussel (*Dreissena polymorpha*) NP
6. Compressed River Mussel (*Pseudanodonta complanata*) NP
7. River Pea Mussel (*Pisidium amnicum*) NP

- Snails (*Gastropoda*)

aquatic species:

1. *Bythinia tentaculata* NP (Lake Külsõ)
2. *Bythinia leachi* NP (Lake Külsõ)
3. Common River Snail (*Viviparus contectus*) NP
4. Common Valve Snail (*Valvata piscinalis*) NP (Lake Külsõ)
5. Flat Valve Snail (*Valvata cristata*) NP
6. *Lythoglyphus naticoides* NP
7. Ram's Horn (*Planorbis planorbis*) NP (Lakes Belsõ and Külsõ)
8. Great Ram's Horn Snail (*Planorbarius corneus*) NP (Lake Külsõ)
9. *Anisus spirorbis* NP (Lake Külsõ)
10. White Ram's Horn Snail (*Gyraulus albus*) NP (Lake Külsõ)
11. Shining Ram's Horn Snail (*Segmentina nitida*) NP
12. Lake Limpet (*Acroloxus lacustris*) NP
13. Great Pond Snail (*Lymnaea stagnalis*) NP (Lakes Belsõ and Külsõ)
14. Ear Pond Snail (*Lymnaea auricularia*) NP (Lake Külsõ)
15. Liver Fluke Snail (*Galba truncatula*) NP
16. Fountain Bladder Snail (*Physa fontinalis*) NP

terrestrial species:

1. Large Amber Snail (*Succinea putris*) NP (Lake Külsõ)
2. Slender Amber Snail (*Succinea elegans*) NP
3. Small Amber Snail (*Succinea oblonga*) NP (Lake Külsõ)
4. *Orcula dolium* NP
5. Moss Snail *(Pupilla muscorum*) NP
6. Narrow-mouthed Whorl Snail (*Vertigo angustior*) NP

7. *Abida frumentum* NP
8. Ribbed Grass Snail (*Vallonia costata*) NP
9. Round-mouthed Snail (*Pomatias elegans*) P, RB
10. Three-toothed Snail (*Chondrula tridens*) NP
11. *Zebrina detrita* NP
12. *Balea biplicata* NP
13. Glossy Glass Snail (*Oxychilus glaber*) NP
14. Pellucid Glass Snail (*Vitrina pellucida*) NP
15. *Daudebardia rufa* NP
16. Great Grey Slug (*Limax maximus*) NP
17. *Helicopsis striata* NP
18. Carthusian Snail (*Monacha carthusiana*) NP
19. Hairy Snail (*Trichia hispida*) NP
20. *Euomphalia strigella* NP
21. *Cepaea vindobonensis* NP
22. Roman Snail (*Helix pomatia*) P

Dragonflies (Odonata)

1. (*Platycnemis pennipes*) NP
2. (*Coenagrion ornatum*) P
3. (*Coenagrion puella*) NP
4. (*Coenagrion pulchellum*) NP
5. (*Coenagrion scitulum*) P
6. (*Erythromma najas*) NP
7. (*Erythromma viridulum*) NP
8. (*Ischnura elegans*)NP
9. (*Ischnura pumilio*) NP
10. (*Enallagma cyathigerum*) NP
11. (*Sympecma fusca*) NP
12. (*Lestes barbarus*) NP
13. (*Lestes dryas*) P
14. (*Lestes sponsa*) NP
15. (*Lestes virens*) NP
16. (*Chalcolestes viridis*) NP
17. (*Agrion splendens*) NP
18. (*Agrion virgo*) P
19. (*Brachytron pratense*) NP
20. (*Aeshna affinis*) NP
21. (*Aeshna cyanea*) NP
22. (*Aeshna grandis*) NP
23. (*Aeshna mixta*) P
24. (*Aeshna viridis*) P, RB
25. (*Anaciaeshna isosceles*) P
26. *(Anax imperator*) NP
27. (*Anax parthenope*) NP, RB
28. (*Gomphus vulgatissimus*) NP
29. (*Cordulia aeneaturfosa*) NP
30. (*Somatochlora aenea*) P
31. (*Epitheca bimaculata*) NP
32. (*Libellula depressa*) NP
33. *(Libellula fulva*) P
34. (*Libellula quadrimaculata*) NP
35. (*Orthetrum albistylum*) NP
36. (*Orthetrum brunneum*) NP
37. (*Orthetrum cancellatum*) NP
38. (*Orthetrum coerulescens*) NP

39. (*Crocothemis servilia*) NP
40. (*Sympetrum depressiusculum*) P
41. (*Sympetrum flaveolum*) P
42. (*Sympetrum fonscolombii*) NP
43. (*Sympetrum meridionale*) NP
44. (*Sympetrum pedemontanum*) NP
45. (*Sympetrum sanguineum*) NP
46. (*Sympetrum striolatum*) NP
47. (*Sympetrum vulgatum*) NP
48. (*Leucorrhinia pectoralis*) NP

Orthopterans (*Orthoptera*)

1. (*Phaneroptera falcata*) NP
2. (*Phaneroptera nana*) NP
3. (*Leptophyes albovittata*) NP
4. (*Leptophyes boscii*) NP
5. (*Conocephalus fuscus*) NP
6. (*Conocephalus dorsalis*) NP
7. (*Homocoryphus nitidulus*) NP
8. (*Pholidoptera aptera*) NP,
9. (*Pholidoptera fallax*) NP
10. (*Platycleis grisea*) NP
11. (*Platycleis affinis*) NP
12. (*Tessellana vittata*) NP
13. (*Roeseliana roesel*i) NP
14. (*Phacocleis germanica*) NP
15. (*Decticus verrucivorus*) NP
16. (*Ephippigera ephippiger*) NP
17. (*Oecanthus pellucens*) NP,
18. (*Gryllotalpa gryllotalpa*) NP,
19. (*Tetrix subulata*) NP
20. (*Tetrix bipunctata*) NP
21. (*Pezotettix giornae*) NP
22. (*Calliptamus italicus*) NP
23. (*Oedaleus decorus*) NP
24. (*Oedipoda coerulescens*) NP
25. (*Ailopus thalassinus*) NP
26. (*Parapleurus alliaceus*) NP
27. (*Acrida hungarica*) P, RB
28. (*Chrysochraon dispar*) NP
29. (*Stenobothrus lineatus*) NP
30. (*Stenobothrus crassipes*) NP
31. (*Stenobothrus nigromaculatus*) NP
32. (*Stenobothrus stigmaticus*) NP
33. (*Omocestus ventralis*) NP
34. (*Omocestus haemorrhoidalis*) NP
35. (*Omocestus petraeus*) NP
36. (*Glyptobothrus biguttulus*) NP
37. (*Glyptobothrus mollis*) NP
38. (*Glyptobothrus brunneus*) NP
39. (*Chortippus albomarginatus*) NP
40. (*Chortippus dorsatus*) NP
41. (*Chortippus longicornis*) NP
42. (*Chortippus montanus*) NP
43. (*Euchortippus declivus*) NP
44. (*Myrmeleotettix maculatus*) NP

45. (*Gomphocerippus rufus*) NP
46. (*Dociostaurus brevicollis*) NP

Cydnid bugs (*Cydnidae*)

1. (*Sehirus ovatus*)
2. (*Thyreocoris scarabaeoides*)

Cicadas (*Cicadidae*)

1. Vineyard Cicada (*Tibicina haematodes*) P
2. Manniferous cicada (*Cicada orni*) P

Beetles (*Coleoptera*)

1. (*Cicindela campestris*) NP
2. (*Cicindela arenaria*) NP
3. (*Cicindela lunulata*) NP
4. (*Carabus coriaceus*) P
5. (*Carabus violaceus*) P
6. (*Carabus granulatus*) P
7. (*Carabus conpexus*) P
8. (*Calosoma sycophanta*) P
9. (*Calosoma inquisitor*) NP
10. (*Scarites terricola*) NP
11. (*Broscus cephalote*s) NP
12. (*Clivina ypsilon*) NP
13. (*Licinus cassideus*) NP
14. (*Harpalus cupreus*) NP
15. (*Stenolophus steveni*) NP, RB
16. (*Osimus ammophilus*) NP, RB
17. (*Cymindis axillaris*) NP
18. (*Cymindis scapularis*) NP
19. (*Cymindis variolosa*) NP
20. (*Polystichus connexu*s) NP
21. (*Dytiscus latissimus*) P, RB
22. (*Hydrophilus piceus*) NP
23. (*Anthaxia hungarica*) P, RB
24. (*Capnodis tenebrionis*) P
25. (*Pedinus hungaricus*) P, RB
26. (*Gnaptor spinimanus*) NP
27. (*Lioderina linearis*) P, RB
28. (*Cerambyx cerdo*) P, RB
29. (*Megopis scabricornis*) P
30. (*Calamobius filu*m) P
31. (*Dorcadion aethiops*) NP
32. (*Dorcadion pedestre*) NP
33. (*Acanthocinus aedilis*) P
34. (*Lucanus cervus*) P, RB
35. (*Dorcus parallelopipedus*) P
36. (*Copris lunaris*) P
37. (*Oryctes nasicornis*) P
38. (*Pentodon idiota*) NP
39. (*Potosia hungarica*) P
40. (*Potosia aeruginosa*) P, RB
41. (*Haemonia mutica* ssp. *balatonica*) NP, RB

42. (*Crepidodera crassicornis*) NP

Butterflies (*Diurna*)

1. (*Iphiclides podalirius*) P
2. (*Papilio machaon*) P
3. (*Colias chrysotheme*) P, RB
4. (*Agrodiaetus admetus*) P, RB
5. (*Polyommatus daphnis*)
6. (*Nordmannia w-album*) NP
7. (*Vanessa atalanta*) P
8. (*Inachis io*) P
9. (*Aglais urticae*) NP
10. (*Argynnis niobe*) NP
11. (*Argynnis paphia*) NP
12. (*Argynnis aglaja*) NP
13. (*Brenthis hecate*) NP
14. (*Mellitaea aurelia*) NP
15. (*Mellitaea trivia*) NP
16. (*Limenitis camilla*) P
17. (*Limenitis sappho*) NP, RB
18. (*Chazara briseis*) P
19. (*Kanetisa circe*) NP

Fish (*Pisces*)

1. European Mud-minnow (*Umbra crameri*) P, RB
2. Pike (*Esox lucius*) NP
3. Roach (*Rutilus rutilus*) NP
4. Rudd (*Scardinius erythrophthalmus*) NP
5. Asp (*Aspius aspius*) NP
6. Bleak (*Alburnus alburnus*) NP
7. White Bream (*Blicca bjoerkna*) NP
8. Bream (*Abramis brama*) NP
9. Knife (*Pelecus cultratus*) NP
10. Tench (*Tinca tinca*) NP
11. Bitterling (*Rhodeus sericeus*) NP
12. Crucian Carp (*Carassius carassius*) NP
13. Carp (*Cyprinus carpio*) NP
14. Loach (*Misgurnus fossilis*) P
15. Wels (*Silurus glanis*) NP
16. Cat-fish (*Ictalurus nebulosus*) NP
17. Eel (*Anguilla anguilla*) NP
18. Common Sunfish (*Lepomis gibbosus*) NP
19. Perch (*Perca fluviatilis*) NP
20. Pike-perch (*Stizostedion lucioperca*) NP
21. *Stizostedion volgense* NP
22. Tubenose Goby (*Proterorhinus marmoratus*) NP
23. *Neogobius fluviatilis* P

Amphibians (*Amphibia*) P

1. Smooth Newt (*Triturus vulgaris*)
2. Brown Toad (*Bufo bufo*)

3. Green Toad (*Bufo viridis*)
4. Spring Frog (*Rana dalmatina*)
5. Pond Frog (*Rana ridibunda*)
6. Edible Frog (*Rana esculenta*)
7. Spadefoot Toad (*Pelobates fuscus*)
8. Tree Frog (*Hyla arborea*)
9. Fire-bellied Toad (*Bombina bombina*)

Reptiles (*Reptilia*) P

1. Wall Lizard (*Podarcis muralis*)
2. Sand Lizard (*Lacerta agilis)*
3. Green Lizard (*Lacerta viridis*)
4. Aesculapian Snake (*Elaphe longissima*)
5. Dice Snake (*Natrix tessellata*), black morph also occurs
6. Grass Snake (*Natrix natrix*)
7. Smooth Snake (*Coronella austriaca*)
8. European Pond Tortoise (*Emys orbicularis*)

Birds (*Aves*)

1. Little Grebe (*Podiceps ruficollis*) P
2. Great Crested Grebe (*Podiceps cristatus*) P
3. Bittern (*Botaurus stellaris*) P
4. Purple Heron (*Ardea purpurea*) P
5. Grey Heron (*Ardea cinerea*) NP
6. Little Bittern (*Ixobrychus minutus*) P
7. Great White Egret (*Egretta alba*) SP, RB
8. Mute Swan (*Cygnus olor*) P
9. Greylag Goose (*Anser anser*) P
10. Garganey (*Anas querquedula*) NP
11. Pochard (*Aythya ferina*) NP
12. Mallard (*Anas platyrinchos*) NP
13. Common Buzzard (*Buteo buteo*) P
14. Sparrowhawk (*Accipiter nisus*) P
15. Marsh Harrier (*Circus aeruginosus*) V
16. Partridge (*Perdix perdix*) NP, RB
17. Quail (*Coturnix coturnix*) P. RB
18. Pheasant *(Phasianus colchicus)* NP
19. Moorhen (*Gallinula chloropus*) P
20. Little Crake *(Porzana parva)* P
21. Spotted Crake *(Porzana porzana)* P
22. Water Rail *(Rallus aquaticus)* P
23. Coot (*Fulica atra*) NP
24. Lapwing (*Vanellus vanellus*) P
25. Wood Pigeon (*Columba palumbus*) NP
26. Turtle Dove *(Streptopelia turtur)* P
27. Collared Dove *(Streptopelia decaocto)* NP
28. Cuckoo (*Cuculus canorus*) P
29. Long-eared Owl (*Asio otus*) P
30. Scops Owl (*Otus scops*) P, RB
31. Little Owl (*Athene noctua*) SP, RB
32. Tawny Owl (*Strix aluco*) P
33. Swift (*Apus apus*) P
34. Kingfisher (*Alcedo atthis*) P
35. Bee-eater (*Merops apiaster*) SP
36. Hoopoe (*Upupa epops*) P

37. Wryneck (*Jynx torquilla*) P
38. Black Woodpecker (*Dryocopus martius*) P, RB
39. Syrian Woodpecker (*Dendrocopos syriacus*) P
40. Great Spotted Woodpecker (*Dendrocopos maior*) P
41. Middle Spotted Woodpecker (*Dendrocopos medius*) P, RB
42. Lesser Spotted Woodpecker (*Dendrocopos minor*) P
43. Green Woodpecker (*Picus viridis*) P
44. Grey-headed Woodpecker (*Picus canis*) P
45. Crested Lark (*Galerida cristata*) P
46. Skylark (*Alauda arvensis*) P
47. Barn Swallow (*Hirundo rustica*) P
48. Housemartin (*Delichon urbica*) P
49. White Wagtail (*Motacilla alba*) P
50. Red-backed Shrike (*Lanius collurio*) P
51. Wren (*Troglodytes troglodytes*) P
52. Grasshopper Warbler (*Locustella naevia*) P
53. Savi's Warbler (*Locustella luscinioides*) P
54. River Warbler (*Locustella fluviatilis*) P
55. Moustached Warbler (*Acrocephalus melanopogon*) P
56. Sedge Warbler (*Acrocephalus schoenobaenus*) P
57. Reed Warbler (*Acrocephalus scirpaceus*) P
58. Marsh Warbler (*Acrocephalus palustris*) P
59. Great Reed Warbler (*Acrocephalus arundinaceus*) P
60. Garden Warbler (*Sylvia borin*) P
61. Blackcap (*Sylvia atricapilla*) P
62. Common Whitethroat (*Sylvia communis*) P
63. Chiffchaff (*Phylloscopus collybita*) P
64. Stonechat (*Saxicola torquata*) P
65. Northern Wheatear (*Oenanthe oenanthe*) P
66. Collared Flycatcher (*Ficedula albicollis*) P
67. Black Redstart (*Phoenicurus phoenicurus*) P
68. Robin (*Erithacus rubeola*) P
69. Nightingale (*Luscinia megarhynchos*) P
70. Blackbird (*Turdus merula*) P
71. Mistle Thrush (*Turdus viscivorus*) P
72. Song Thrush (*Turdus philomelos*) P
73. Long-tailed Tit (*Aegithalos caudatus*) P
74. Marsh Tit (*Parus palustris*) P
75. Blue Tit (*Parus caeruleus*) P
76. Great Tit (*Parus major*) P
77. Penduline Tit (*Remiz pendulinus*) P
78. Bearded Tit (*Panurus biarmicus*) P
79. Nuthatch (*Sitta europaea*) P
80. Short-toed Treecreeper (*Certhia brachydactyla*) P
81. Wryneck (*Jynx torquilla*) P
82. Hooded Crow *(Corvus cornix)* NP
83. Jackdaw *(Coloeus monedula)* P
84. Magpie *(Pica pica)* NP
85. Jay *(Garrulus glandarius)* NP
86. Chaffinch (*Fringilla coelebs*) P
87. Goldfinch (*Carduelis carduelis*) P
88. Linnet (*Acanthis cannabina*) P
89. Hawfinch (*Coccothraustes coccothraustes*) P
90. Golden Oriole (*Oriolus oriolus*) P
91. Reed Bunting (*Emberiza schoeniclus*) P
92. Yellowhammer (*Emberiza citrinella*) P
93. Corn Bunting (*Emberiza calandra*) P
94. Starling (*Sturnus vulgaris*) NP
95. House Sparrow (*Passer domesticus*) NP
96. Tree Sparrow (*Passer montanus*) NP

Non-breeding regular visitors to the area:

1. Smew (*Mergus albellus*) P
2. Night Heron (*Nycticorax nycticorax*) P
3. White Stork (*Ciconia ciconia*) SP, RB
4. Black Stork (*Ciconia nigra*), SP
5. Corncrake (*Crex crex*) SP
6. Teal (*Anas crecca*) P
7. Tufted Duck (*Aythya fuligula*) P
8. Goldeneye (*Bucephala clangula*) P
9. Gadwall (*Anas strepera*) P, RB
10. White-tailed Eagle (*Heliaëtus albicilla*) SP, RB
11. Honey Buzzard (*Pernis apivorus*) P. RB
12. Black Kite (*Milvus migrans*) P
13. Goshawk (*Accipiter gentilis*) P
14. Hen Harrier (*Circus cyaneus*) P
15. Saker Falcon (*Falco cherrug*) SP, RB
16. Hobby (*Falco subbuteo*) P
17. Kestrel (*Falco tinnunculus*) P
18. Common Tern (*Sterna hirundo*) P
19. Fieldfare (*Turdus pilaris*) P
20. Siskin (*Carduelis spinus*) P
21. Brambling (*Fringilla montifringilla*) P
22. Bullfinch (*Pyrrhula pyrrhula*) P
23. Raven (*Corvus corax)* P

Mammals: (*Mammalia*)

1. Eastern Hedgehog (*Erinaceus concolor*) P
2. Common Mole (*Talpa europaea*) P
3. Common Shrew (*Sorex araneus*) P
4. Pygmy Shrew (*Sorex minutus*) P
5. Mediterranean Water Shrew (*Neomys anomalus*) P
6. Bicoloured White-toothed Shrew (*Crocidura leucodon*) P
7. Long-eared Bat (*Plecotus auritus*) P
8. Grey Long-eared Bat (*Plecotus austriacus*) P
9. Nathusius' Pipistrelle (*Pipistrellus nathusii*) P
10. Blyth's Bat (*Myotis blythi*) P
11. Daubenton's Bat (*Myotis daubentoni*) P
12. Serotine Bat (*Eptesicus serotinus*) P
13. Common Noctule (*Nyctalus noctula*) P
14. Leisler's Bat (*Nyctalus leisleri*) P
15. Common Pipistrelle (*Pipistrellus pipistrellus*) P
16. European Hare (*Lepus europaeus*) NP
17. European Souslik (*Spermophilus citellus*) P
18. *Chlethrionomys glareolus* NP
19. Water Vole (*Arvicola terrestris*) NP
20. Muskrat (*Ondatra zibethica*) NP
21. Common Vole (*Microtus arvalis*) NP
22. Common Field Mouse (*Apodemus sylvaticus*) NP
23. Yellow-necked Field Mouse (*Apodemus flavicollis*) NP
24. House Mouse (*Mus musculus*) NP
25. Otter (*Lutra lutra*) SP, RB
26. Red Fox (*Vulpes vulpes*) NP
27. Stoat (*Mustela erminea*) P
28. Weasel (*Mustela nivalis*) P
29. Beech Marten (*Martes foina*) NP
30. European Polecat (*Mustela putorius*) NP

31. Roe Deer (*Capreolus capreolus*) NP

3.5. LANDSCAPE

General description

The landscape assets of Tihany Area are unique even by European standards. The reflection of Lake Balaton surrounding the peninsula with forested hills, the water surfaces of the two interior lakes, the balanced proportion of vineyards, woodlands, meadows and open grasslands and the nicely fitting buildings show a perfect harmony between natural and cultural landscapes. The intact natural grasslands next to the settlements and resort areas, the peculiarly shaped rocks, the view of Lake Külső and its birds, Bozsai bay and the reedbeds fringing the shoreline are a relief to contemplate. Particularly good views are offered from the summits and the open areas of the peninsula.

The ancient village with its thatched stone houses blends harmoniously with the hillside of the eastern ridge. It is a protected cultural monument, with several strictly protected buildings.

With the changes of seasons, the diversity of nature unfolds before our eyes. The most beautiful periods are the almond blossoming in early Spring and the autumn colouring of karst scrub forests in October, when Wig Trees are already red, Manniferous Ash turns yellow and oak trees are still green and this is all complemented by white geyserite cones against the blue sky.

Depending on land use, the natural vegetation slightly changes with time. The natural regeneration of woodlands has begun in former grasslands, vineyards and arable lands. The reasons for this process are:

- the abandonment of vineyards
- the retreat of grazing
- the abandonment of arable lands and lavender groves

As a result of human interference, several non-native plant species (Black Pine, Black Locust and Ailanthus) have established themselves. Because of their aggressive, invasive nature, the native vegetation can only be restored by carefully planned professional methods.

The changes in land use are primarily related to historical eviolution and are determined by the vegetation and relief. Initially, landscape evolution followed social and historical changes. In some cases, this evolution brought positive changes in forming the character of the landscape, such as the appearance of traditional methods of cultivation, e.g. wine, fruit and lavender growing. These methods were determinative until the mid 20th century, when the centralisation of production upset the balance between natural economic growth and the enviroment. The economic interests, the spreading of monocultures and intensive wine growing caused a marked change in the original landscape character. The increase of rural tourism in recent decades brought new elements into the traditional village structure, including intensive building developments in some parts of the settlements, causing a significant pressure on the environment and the landscape. The protected status of an area makes it possible to restrict such processes and to prevent any excessive pressure on the natural environment and the landscape. The management guidelines prescribed by the National Park Directorate and implemented for several years make it possible to restore the balance between the natural vegetation and the typical local management forms. A conscientious landscape policy may restore the characteristic Tihany landscape that has evolved throughout centuries and may create a balance between the diverse vegetation and geological conditions and the traditional ways of management.

Measures to achieve this aim include:
- graving of partly afforested grasslands to stop natural succession
- destruction or replacement of adventive plant species
- reviving and managing lavender fields and almond groves
- protection of inner water surfaces and the maintanance of natural hydrological conditions
- protection and management of shoreline reedbeds, with special regard to strictly protected reedbeds
- restriction of the expansion of building areas

A conservationist perspective

After eliminating the present anomalies (facilities inharmonious with the landscape, excessive expansion of building areas, etc.), a many-faceted, mostly self-sustaining

system with natural processes will develop. Conservation management will restore the original vegetation, which is favourable from the point of view of biological diversity and the survival of the characteristic, native species.
The restored historical landscape will fit organically into the natural landscape which will tolerate the anthropogenic effects.

The main conservation management principles are:

- to restore natural habitats and plant communities both in a direct and an indirect way, i.e. by management and by restrictions (for example, the restriction of visiting may help the regeneration of natural areas)
- to encourage and maintain traditional management of areas owned by the national park directorate
- to restore the original land use units
- balanced information dissemination (controlled nature education and ecoturism)
- to support developments in the interior area of settlements so as to preserve their traditional character
- to maintain the character of the exterior areas of settlements by restrictive regulations on constructions and developments

The history of settlements

Wine cultivation has been practised in Tihany for ages, turning the hills into winegrowing areas. Evidence of high-standard vine cultures exists since the Roman age.
The foundation charter of Tihany Abbey tells us that king András I donated among others vineyards to the Abbey together with 20 families to cultivate the wine.

In the 11th century, Óvár was the most suitable place for winegrowing, but later it was introduced to other parts of the peninsula, such as the slopes of Kopasz, Cser and Kiserdő Hills. Winegrowing and selling was a major source of income for the defenders of the castle and the villagers. The wine cellar and press of the domain were built near Lake Belső.

At the end of the 19th century, the vine cultures were almost completely destroyed by Phylloxera (vine-pest). In the 1910s, there was a large-scale introduction of several resistent, selected vine races. In the 1960s, some red types were also introduced (Oporto, Kékfrankos and Medoc) in the areas west of Lake Belső.

The old, arched cellars bore deep in the hillside and usually have a wine press house or sometimes a shack in front of them. The Abbey's press house, built in 1822, is protected. It is a large, two-piece, barrel vaulted cellar and press house built in the hillside. Its entrance has a projecting roof and a tympanum standing on two pillars.
The recreational use of wine hills leads to the disappearance of industrial buildings. The declining proportion of wine-growing areas and buildings is one of the biggest conflicts of landscape management.

Location facts and land use

The favourable location, climatic conditions and shallowness (an average of 2-3 m) of the largest lake in Central Europe, Lake Balaton, have made it the centre of a distinguished resort area. The lake and its surroundings are a favourite target of both foreign and domestic holiday-makers.

On the northern and western side of Lake Balaton, a range of protected areas have been designated in order to safeguard the geological and landscape diversity, the wildlife, the habitats and the cultural resources. The first one was the Tihany Landscape Protection Area in 1952. Later, Landscape Protection Areas were established on the Badacsony Hill, in the Káli Basin, the Pécselyi Basin, the Keszthelyi Hills and the Kis-Balaton.

In 1997, in order to better co-ordinate management and ensure a more comprehensive and efficient conservation work, the former landscape protection areas and the adjoining most important natural areas were designated in the highest protection category in Hungary under the name Balaton Uplands National Park.

The Balaton Uplands National Park has two interesting features as regards land use and settlement structure. First, beside the near-natural and managed natural areas, there is a high proportion of cultivated areas within the national park. This refers primarily to the wine hills which bear a traditional, cultural importance in the region. Second, the basins and waterside areas of the national park comprise large residential areas, in order to protect their landscape and cultural heritage.

The pressure of tourism and building industry often affects protected settlements and wine hills. Therefore, the regional development plan and the local development plans of the settlements are drafted in collaboration with the local governments concerned, planners and the National Park experts.

The attraction of Tihany, however, which satisfies the most exquisite requirements, will only remain as long as the present natural environment is maintained and developments do not impose an excessive pressure on the environment.

Therefore, quantitative development is no longer practicable in the Tihany Area, and the buildings of tourism industry and services need to be developed qualitatively, in the built-in residential areas.

The conciliatory meetings and planning proposals during the preparation of development plans have led to solutions favouring primarily conservation aspects. The regular participation of the National Park Directorate as a co-operating authority in settlement development and construction affairs ensures the integration of conservation aspects even in everyday development issues.

4. CULTURAL HERITAGE AND SOCIO-ECONOMIC CONTEXT

4.1. CULTURAL HERITAGE

The monuments of cultural heritage

Archaeological assets and the highlights of the settlements:

The history of the peninsula, the presence of man forming and appreciating the Tihany landscape can be traced back from the Iron Age until the present day with the help of archaeological and cultural monuments.
The first findings commemorating human creation in the Tihany Peninsula originate from the Iron Age. The curving earthwork of Óvár, the pieces of earthenware from the common graves to the west of it and the findings of the Gödrös and Diós hillsides are from the Paleolithic.

Later, the area was inhabited by Celts, and even later it belonged to the Roman Province 'Pannonia'. In Sajkod, Roman findings and the traces of a Roman manor were unearthed.

The Sajkodi and Füredi bays were connected by a several hundred meter long canal and embankment, probably as a measure of defence. The 'Sajka út' (Boat Way) is commemorated in a district name, Sajkod.
The first document to mention the wall and the trench was written in 1416. Other descriptions speak about towers and dykes, between which boats communicated. The barbicans can be seen in a 1781 map as well as a survey drawing made during the reign of Joseph II.

The ruins of a 12th century church can be found at the foot of Apáti Hill, and there was also a small church near the ferry in the 12th century. The latter can be identified as the St. Margareth Chruch documented from Újlak village. Otherwise, Tihany village was situated between the Abbey and Lake Belső (formerly even called Kis-Balaton, i.e. Little Balaton). The neighbourhood of the ferry, Kopasz Hill, Gödrös and Sajkod were developed into resort areas at the beginning of the 20th century.

Traditional trades and economy:

The population of Tihany comprised the soldiers of the castle and the servant families. As the Turkish war was over, the main occupation became farming, wine growing and fishing for centuries. No industrial buildings were planted in the peninsula, and the characteristic Tihany stone cannot be mined since the declaration of protected status.

The peninsula has always held large woodlands and meadows. The size of hayfields was to be increased by draining Lake Külső, according to the plan referred to above. This work was begun, but the narrow ditches collapsed and the project broke off.

The area of arable lands was relatively small, but orchard groves (walnut, plum, almond, sour cherry, cherry and apple) and vineyards were important. The local climate is in favour of submediterranean plants, such as fig trees.

Wine growing has always been important since the Roman age. in the early 1870s, 146 acres of vineyards were cultivated in Tihany, but a disease from America called Phylloxera swept out almost the whole vine culture by the 1890s. Replantation is the merit of Ignác Darányi agricultural minister, who urged the plantation of selected resistent races. This way the total area of vineyards increased to 87 acres in Tihany by 1935, and after the 1960s new red types were introduced to the peninsula.

The cultivation of medicinal herbs adds an interesting colour to the agriculture of the peninsula, and provides important raw materials to pharmaceutical industry. In addition to the lavender fields, foxglove, garden angelica, thyme and other herbs are also grown.

The population increased very slowly until the beginning of the 20th century. The reason for this is the persistence of feudal conditions, the lack of arable lands and pastures, and the remoteness of the settlement from major roads. Significant improvement only began in the 1920s and 30s. This was due to the construction of the port and Hotel Sport, the building of the shoreline road and the public services, and the parcelling of the resort area. The population has shifted to make a living from tourism and catering. Fishing and agriculture gradually lost their importance.

Fishing:

A separate chapter is needed to deal with fishing, which always played a determinative role in the history of the peninsula, thanks to its geographical situation. Certain forms of fishing, i.e. Knife fishing and ice fishing are

characteristic of the settlement and bear an ethnographical significance. This profession is already mentioned in 1055, the Tihany foundation charter: the king donated the abbey ten fishermen – it took ten people to draw the fishing net.

Fishermen associated in groups called 'bokor' (=bush), since the most important tools, the net and the drag-net could only be handled by a group of people. A hundred years ago, 7 fishing associations worked in Tihany, each numbering 10 people (their names were Disznósiak, Ujjak, Sejmek, Honvédek, Kisek, Jegesek etc.) The Disznósiak (Pig fishers) bought their fishing equipment for pigs, hence their name. Their former guildhall is today a part of the ethnographical museum. They stored their chestbox, money, stamp, fishing equipment and symbolic jar here. They also started from here, picking up their equipment when they went fishing.

The tiring work of fishermen included two peculiar local methods, Knife fishing and ice fishing.

Knife fishing, catching the 'observed fish', relies on the special geological conditions of Tihany, since this is the only place at Lake Balaton where there are hills right next to the shore, providing vantage points to watch the movements of the schools of fish.
The movements of Knife schools were watched by a sharp-eyed member of the fishermen group, the 'hillwalker', who indicated the dark schools to his companions by waving conventional signs with his coat until they reached the school. At the appropriate signal, the fishermen lowered the anchor, pulled the net around the school of Knife and dragged them to the shore. A successful ctach may have weighed up to 10 tons.

Ice fishing in winter was even more important than the summer catches. The thick ice was able to support the sledg carrying the equipment and the cold weather was favourable to store and transport the fish. The fishermen fixed special horseshoes on their boots against slipping.
Ice fishing began by cutting a number of ice-holes. The net was sank under the ice through the 'entrance hole', where its 'guiding rod' was directed towards the 'drawing holes'. The net was drawn by a rope through the holes, going from hole to hole. It took several hours of hard work to reach the 'outdraw hole', where the guiding rod, the rope, the net and finally the sack full of fish were taken out on the surface.
Ice fishing was a rather dangerous activity, and sometimes resulted in accidents requiring casualties.

At the end of the 19th century, fisherman asociations were replaced by large-scale fishing from large ships and new methods. This caused a decline in the fish stock, and created new problems.

Hunting:

The special conservation importance of the Tihany Peninsula is highlighted by numerous geological, geographical, botanical and zoological studies. It is no surprise that Jenő Nagy already proposed nearly 70 years ago to conserve this area as a national park (Nagy, 1931.). However, the conditions of the country's first landscape protection area are more and more controversial. On one hand, efforts are made to preserve an outstandingly diverse habitat, which can even be called an ecological island with unique geological, landscape, botanical and zoological assets, while on the other hand, overcoming or at least moderating the ever-increasing anthropogenic pressure, which has reached a critical level, poses great difficulties. It is no longer possible to maintain so large populations of plants and animals in Tihany as the carrying capacity of the habitats. Restricted by the diverse social demands, the biological diversity and original species composition can only be mainained with a carefully planned management. Naturally, this statement also refers to game stocks. The small populations of game animals add a pleasing colour to the area, but it must be emphasised that in addition to their passive protection, their genetic properties also need to be maintained at a high standard. Unfortunately, the Roe Deer stock of Tihany is already rather degenerated.

Because of its isolation and proportions, Tihany has never been a significant hunting ground. This explains why it is difficult to outline past conditions from earlier sources: writings on hunting are mostly just artistic.

The conservation-designated hunting ground established in the Tihany Peninsula and the adjacent areas is also part of the Balaton Uplands National Park. Its natural conditions are in many ways unique and it has an outstanding touristic importance. These facts determine the management of game stocks, too. Only maintenance and if necessary, population control measures are allowed. The 10-year game management plan must take into account the past and present of natural conditions and hunting, as well as the potential changes that may influence the protected status (e.g. changes in ownership conditions, land use, inceasing tourism or development, etc.). The prescriptions of the international conventions and designations that apply in the area must fully be met already in the planning process. The objective of long-term planning is a game stock representing the former, natural conditions of this geographical region in terms of species composition, population size and genetic background. Population sizes must be set at a level that ensures the survival of the given species but does not cause any overdue damage to the habitat. The multifarious interests in the Tihany

Area forecast a high likelihood of unpredictable ecological changes. Because of this possibility, the game management plan should have a high degree of flexibility to be able to react to changes adequately.

For the above reasons, and because more than half of the area is state-owned, the new law on hunting and game management makes it possible that game management be carried out by the National Park Directorate as part of conservation management, and thus be able to fulfil the above requirements. The NP Directorate is not only entitled but even obliged to do so.

Linguistic records and locality names:

The following linguistic records and locality names refer to the history, famous personalities and major events of the peninsula.
The word Tihany is derived from the Slavonian word 'tichony' meaning quiet. The surrounding *Lake Balaton* was also named by Slavs: 'blato' means mud or a shallow wetland.
The district name *Sajkod* refers to the 'Sajka út' (=Boat way), a canal built by the Romans to connect Aszófői and Füredi bays for defence.

The Tihany Goat Hoofs are the fossil remains of a now extinct bivalve, Congeria ungula caprae, which once lived in the Pannonic sea. They are found in one particular zone of the peninsula. Its fable has been written up in a poem by *János Garay*. Formerly, children sold Goat Hooves for a few pennies to visitors, while reeling off the legend in a choir. Today, this famous fossil can only rarely be found.

The presence of nature conservation

The idea to create a *Tihany National Park* was already raised in 1943 by Károly Lukács. In 1944, Jenõ Cholnoky, a geographer studying the geology of the peninsula, wrote a study on its establishment.

Eventually, in 1952, the Tihany Landscape Protection Area was created, being the first of its kind in Hungary. It contains a range of unique assets of all fields of nature conservation. This legal protection contributed significantly to the success of their preservation against all kinds of development policies that would have exerted an excessive pressure on the natural environment with no regard to its assets. Conserving the natural heritage while maintaining the high number of visitors and the high standard of tourism requires a carefully planned and conceptuous management.

On establishing the Balaton Uplands National Park in 1997, this area was also given the highest grade of protection.

A LIST OF THE BUILDINGS AND SITES UNDER CULTURAL PROTECTION:

MJ **APÁTI** Land registration number: 048/3.
Church ruins, Roman style, 13th century

MK the cultural monuments in the neighbourhood of the Apáti church ruin

MJ **SZERKŐHEGY** Land registration number.: 075/17.
Cellar and wine press of the abbey, classical style, built in 1822.

MJ **ÚJLAK** Land registration number: 0104/3.
Church ruin, Roman style, 13th century.

MK the cultural monuments in the neighbourhood of the Újlak church ruin

4.2. SOCIO-ECONOMIC CONTEXT

5. EDUCATIONAL AND SCIENTIFIC INTEREST

The National Park Directorate stresses more and more the importance of education and information disemination in the Tihany area, too.The centre of this work is the National Park's research station, located about 3 km from the nearest settlements, in Szarkádi Forest. The centre has the facilities to receive small groups to hold them lecture, slide shows or trainings.

The park of the research station is the venue of the annual Tihany Nature Conservation Camp. It is attended by secondary school students in one week periods. As an important element, the programme always inlcudes some practical conservation work, such as the elimination of bushes on geyser cones, cutting Ailanthus trees, etc. Participants also learn about the natural assets of the peninsula, with the help of a geologist, a botanist and a zoologist. They also take part personally in the various research methods, ranging from botanical surveys through the trapping of small mammals to bird ringing.

The National Park will start the extension of the research station still in 1999, furnishing a larger lecture hall and its auxiliary premises in the attic. This will make it possible to deliver high-standard, professional programmes to groups of 30-40 students.

Another important instrument of nature education is the Lajos Lóczy study trail, leading visitors to the most beautiful spots and showing the biggest natural highlights of the peninsula. Bilingual information boards advertise the sights, while orientation is supported with large maps and small plates with directions. The total length of the trail is 7.5 km.

Next to the trail, a traditional cellar and wine press called Bocsár cellar had been renovated by 1998. The National Park staff collect tools and other objects preserving the memory of traditional agricultural practices, such as wine, fruit and herb growing.

According to needs, the National Park provides expert guiding to the various stretches of the trail. Guided tours last 2.5-3 hours and cover about 3 km. These tours are most popular among students coming to hike and perhaps even camp in or near the peninsula. Longer, even full-day guiding can also be arranged, as well as special programmes (for example, ornithological or botanical tours).

The National Park offers 'open days' with free guiding to certain parts of the trail, expecting primarily local families.

In the draft educational plan of the National Park, an important role is devoted to the peninsula, as one of the most suitable sites for the interpretation of natural assets.
(J. Vers)

6. SITE DESCRIPTION

6.1. VULNERABILITY

The aspects of wildlife conservation:

- excessive pressure by human presence:

In certain seasons, the peninsula is exposed to a very serious pressure caused by the large number of tourists. The most critical months are July and August. At this time, the noise and air pollution of cars and the multitudes of tourists, sometimes numbering tens of thousands and concentrating in the settlements, cause a significant pressure. It is very fortunate for wildlife conservation that only a fraction of visitors leave the settlements, since most of them remain confined to the shore of Lake Balaton and the cultural monuments. By this time, the breeding period of birds is mostly over, and the botanically more important sites are also less vulnerable. Nevertheless, the pressure on natural areas is significant in this period, so it should be diminished rather than increased. An interesting issue is raised by the attempts to eliminate mosquitoes and ticks for the sake of holiday-makers. Mosquitoes are destroyed within settlements every year, with biological and sometimes chemical methods. The National Park does not allow any measures for extermination outside the residential areas. Permission to take measures against ticks in beaches and residential areas has been requested a few times. Superselective, species specific chemicals do net exist yet. Such interventions would certainly cause harmful effects in the food-chain of ecosystems.

- agricultural use:

Most of the peninsula is agriculturally managed. This alone is not harmful, moreover, it is agricultural management that creates certain natural assets, a significant part of which can only be maintained by management. Conflicts are raised only by certain management practices, for example:

- large, contiguous vine monocultures,
- the use of pesticides, herbicides and chemical fertilisers,
- abandonment of pastures and hayfields due to the decline of animal husbandry, etc.

- tourism

One of the most attractive target areas of tourism in Hungary is Lake Balaton and the surrounding region.
The national importance and rank of this region's tourism is indicated by the fact that the largest contiguous resort area of the country is located here.

Every year, Lake Balaton is visited by tourists from about 20-25 European countries and all the continents. Germans usually represent about 35-40 % of them. The number of Dutch, Austrian, Danish and Polish citizens is also increasing.

In accordance with the local conditions and climate, the seasonality of tourism is a determining factor in the Balaton Recreational Region.

Tourists and holiday-makers are not only attracted by the bathing possibilities, but also by the diverse landscapes of the Balaton Uplands.
The Balaton Uplands National Park has been established in this region, which is an outstandingly valuable part of Hungary, characterised by a rich and diverse natural heritage. It holds unique geological, landscape, botanical, zoological as well as cultural and historical assets.
These natural assets, however, have been over-exploited by human activities for several decades.
Mass tourism can be very harmful to environment if it only exploits resources and does not contribute to their protection. It can have a very positive effect, however, if a significant part of its profit is spent on nature conservation.

Conscious tourists can be active conservationists, but to achieve this, conservation bodies have to work hard to raise awareness and strengthen environmental thinking.

In the past few years, a major change has begun to take place in social opinion regarding the relations of nature, nature conservation and tourism, both in Hungary and on an international scale.

It is also an important objective of the National Park to improve the relationship between tourism and nature conservation. The interpretation of natural assets to visitors of Lake Balaton without doing the least damage to them is a great challenge.
The National Park wishes to realise green tourism in line with the following principles:

- The local population has to be involved in the interpretation of the National Park's natural assets
- Needs and opportunities must be harmonised for the sake of those seeking recreation and rest in the area
- Management practices and in some cases management plans ensuring and promoting the maintenance and enrichment of natural assets must be prepared and approved by all stakeholders
- Raising awareness in local communities for nature conservation issues
- Contribution to the tools of education in introducing children to their natural environment.

The unsurpassed landscape assets and historical monuments of the Balaton Uplands National Park make it an open-air museum, a true gem of the country. The developments of management and interpretation are not considered by the National Park as an objective, but as an indispensable requirement, as necessary as the recreational areas are for the local communities and visitors.

The National Park staff aims to develop a network of interpretation facilities, to which a programme has been elaborated to better involve the countryside away from the shoreline in ecotourism. These programmes will make it possible to handle the conflicts between nature conservation and tourism.

Natural assets can be studied in nature trails with information boards, such as the Lajos Lóczy study trail in Tihany.
There are 6 hotels in the area, and the number of commercial accommodations per one thousand local inhabitants is 46559.
(A. Kopek)

6.2. PROTECTION STATUS
National Park

6.3. OWNERSHIP
Ownership conditions are shown in the attached tables and diagrams.

6.4. DOCUMENTATION

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Plan:
A Tihanyi (Külső) tó lecsapolásának terve (1820) - készítette:Bajomy István, Zala Vármegye mérnöke - Veszprém megyei Levéltár (Plan to drain Lake Külső at Tihany)

APPENDICES
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7. SITE MANAGEMENT

7.1. MANAGEMENT PLANS

Proposed conservation management and agricultural practices in the Tihany Peninsula

Forests:
The forests of the Tihany Peninsula do not need any particular management, they are to be preserved in their present state. Only two kinds of activities need to be carried out regularly:

- clearing shrubs off the geyser cones (the present, good state has to be maintained from year to year),
- alien invasive tree species, primarily Ailanthus trees (*Ailanthus altissima*) have to be eradicated in near-natural grasslands and karst scrub forests, mainly at the edge of the geyser cone field and on Akasztó Hill.

Reedbeds:
Larger reedbeds must be harvested. This task is mostly accomplished every year, without need for support. The reedbed of Lake Külső does not need management.

Grasslands:
Wet grasslands must be cut regularly. They are situated mainly along Bozsai bay, to the south of Lake Belső and to the north of Lake Külső. The cutting of Diósi meadows is a special problem. Some parts on the west are regularly cut, but the more central, lower lying areas have been invaded with Solidago gigantea and are no longer managed. This habitat must be restored, but first the ownership conditions need to be settled.
Dry grasslands must be grazed. Two main types can be distinguished. The poorer, partly secondary grasslands, such as Rátai marsh or the grasslands to the west of Apáti church ruins, are grazed by sheep. The shepherds rent

the National Park's barn. The grazing of genuine primary grasslands or secondary grasslands rich in protected species poses a more difficult question. These include Diós Summit, Kiserdő Summit, the eastern slope of Apáti Hill and some sites near the geyser cone field and Akasztó Hill. The best management for these grasslands would be grazing by the National Park's own Racka sheep flock.

Cultivated areas:
Orchards are relatively few. Mostly almond groves and in slightly more wet areas, plum plantations should be supported. The maintenance of ancient local varieties, especially almond, plum, apple and pear varieties is of primary importance. To achieve this objective, a small stock plantation is proposed.
In **vineyards**, it would be favourable to lay down with grass at least every second line as a first step, for soil protection and landscape aesthetical reasons. Soil fertilisation is a problematic issue, because either no fertilisers are used or chemicals are used to supply nutrients. Farmers must be urged to use organic fertilisers.
Arable lands and gardens: there are few arable lands in the area. Farmers must be urged to carry out stubble-stripping as soon as possible so that Ragweed (*Ambrosia elatior*) cannot grow up. The small plots make it possible to increase the diversity of habitats, and thereby help locally extinct species to resettle (e.g.: Partridge-*Perdix perdix*)
Any intention to establish **lavender** plantations in more fields in the interior of the peninsula is to be supported. The maintenance of the old lavender field in the present condition will be an important task in the future, too.
It would be important to grow medicinal herbs and spices in as large an area as possible. Primarily hyssop, thyme, lovage, clary, safflower and borage can be considered, but native medicinal plants can also be supported, for example Meadow Clary and Spring Adonis. In more wet sites, mint could also be planted in small patches, but this plant is usually grown as an annual culture.

It would be important to start bee-keeping and to this end to grow fields of bee plants in the area. One of the best bee plants is Tansy Phacelia. In addition to annual bee fields, the possibility of establishing self-sustaining, perennial plantations with a mixture of White Mustard, Tansy Phacelia and Buckwheat is investigated.

In some places, sheep fodder can also be grown. The best example is Sainfoin. This plant lives 8-10 years, and the blossoming period falls on June, when Sainfoil fields provide a beautiful sight right in the touristic season.

Hayfields and pastures for horses can be created in both wet and dry sites. Primarily stolonic grass species with a strong stele are suitable for this purpose, such as Meadow Fescue (*Festuca pratensis*), Hungarian Brome (*Bromus inermis*) and Perennial Rye-grass (*Lolium perenne*), wih about 10 % legumes added.

These management practices are not easy to realise. Those co-operatives must be supported where land-owner or fodder-producing farmers join those who own livestock. In the areas owned and managed by the National Park, nature-friendly mamanagement must be practised and shown as a model to farmers.

Natural geological and geomorphological formations of European value in the Tihany peninsula

Introduction

During the course of the year 2000 a proposal was prepared for the Tihany peninsula to win the European Diploma, describing in a complex form its landscape, geological, botanical, zoological and cultural historical assets. The evaluation summary on the proposal requires that more emphasis be laid on the geological and geomorphological natural formations and their preservation. The following includes a more detailed demonstration of these natural assets worthy of European recognition, and a proposal for reducing the burden from the significant pressure of tourism, as well as for a better demonstration of the natural assets, thereby ensuring more efficient protection.

A geohistorical outline of the region and the peninsula

The largest shallow lake in Central Europe is framed to the north by the medium high Bakony Hills, a region divided by basins. Opposite to this area, mainly built up of various mesozoic limestone and dolomite rocks, the southern and eastern shoreline of Lake Balaton is accompanied by a range of more recent hills and plains made up of loose sedimentation,

whilst to the west lies the marshland of the Kis-Balaton. The Tihany peninsula, embraced by the water of the Lake Balaton, can be found in the middle of this geographically extremely varied region.

The oldest rock in the area, the fillite, was formed during the first half of the Palaeozoic from deposited fine, crumbly sea sediments which later became metamorphic rock. During the Permian era, a series of red sand stone and alluvial rock flour was deposited onto this, measuring several hundred metres in thickness. At the beginning of the Triassic period the area was under sea, and during this time several types of limestone, marl and dolomite formed a layer several kilometres thick. This process probably lasted till the end of the Cretaceous period, but as a result of the rising of the area and the mainland, the consecutive erosion made the majority of these rocks disappear without a trace. The sea only returned during the Miocene period but even then the Bakony remained a mainland rising as an island above its environment. The pre-historic geographical scene was similar during the Pliocene epoch; the Pannonian inland sea filled the Carpathian basin, today's mountains formed islands and the shoreline stretched along the Riviéra of the Balaton. Formations following a series of volcanic activity that began some 7 million years ago and spread over 3-4 million years can be found in the form of tuff rings on the southern side of the Kisalföld, spectacular basalt capped butte hills of the Tapolca basin as well as several volcanos of the Balaton Uplands, the easternmost of which is Tihany. The volcanic eruptions that occurred in several phases were followed here by thermal water post volcanic phenomena – details on this are found in a separate chapter later on. Lake Pannon was gradually filled up by deposits and lost its salinity, drying out totally over a period of time and its bed sloped as a flat terrain from the foot of the Bakony Hills to the south. As a result of tectonic movement which increased during the Pleistocene epoch the hilly region visible today rose higher and higher to a point where the band which formed the south-eastern frontage, stretching 10 km wide over an area 100 km long, collapsed in several steps. Smaller basins developed where water had appeared some tens of thousands of years ago, and with the shores of the separating ridges having been washed away, the contiguous lake today called Balaton was formed some thousands of years ago. Climatic changes caused the water level of the lake to vary significantly and the beating of the waves constantly destroys the high shores of the peninsula.

One of the oldest (7 million year old) volcano of the region, having the most complicated structure, thereby making it the most interesting, rose on what is today the Tihany peninsula and its immediate surroundings. It has been studied for over 100 years, and the processing and re-evaluation of data in a modern approach started a few years ago, although there are still a number of unanswered questions which remain open.

The land structure contours created by the volcanic activity are well distinguished in the areas next to the Balaton and on the peninsula itself: such a contour is for example the south-western straight shoreline. The alkaline basalt magma was pushed upwards from a depth of at least 50 km, along the line of deep fractures. However, it is interesting that in contrast to the Balaton Uplands there are no traces of lava flow here. The formation of pyroclasts are visible and characteristic everywhere and can be explained by the fact that the rising magma encountered water saturated sedimentation a few hundred metres from the surface. The initial steam explosions happened beneath the centre point of the peninsula, the rocks dating from the fillite, red sandstone era. This is verified by the foreign detritus lumps embedded in the basalt tuff (which are sometimes half a metre long). At first the exploded material fell into shallow water, then gradually it became a thicker layer and formed dry land. Later on the centres of the explosions moved both horizontally and vertically, which is reflected on one hand by the ringed formations overlapping one another in both space and time, and on the other hand by the granulous composition of the pyroclasts.

The sediments deposited by the so-called basic ramming flux can be readily studied in the numerous rocky outcrops on the peninsula. During the formation of these extraordinary

layered structures, the rock particles originating from the lacerated magma were spread out horizontally, through turbulent flow, in the eruption cloud accompanying the high energy explosion. This phenomenon is very similar to the process occurring in the neck part of a nuclear explosion cloud. In the 3rd eruption phase of the volcano the explosions happened closer to the surface, and the crater was probably somewhere in the region of the Csúcs Hill. The several tens of metre thick layer of ejected material has been exposed by the former stone quarry on the side of Apáti Hill overlooking Lake Külső. In the 4th phase of eruptions the chimney was beneath what is today Lake Külső – the red sandstone inclusions can be studied at the base of the rock wall of the Kis-erdő Summit. In the final phase of activity, the water steam providing the explosive energy was replaced by gases from the magma – during this period at least half a dozen blowing cones were formed on the northern side of Tihany.

The Geyser Cones of Tihany

Parallel to the cessation of volcanic activity, hot spring activity began, which is well demonstrated by the rocks on the ridge of the Nyereg Hill: the surface of the inclined basalt tuff was covered by laminated geyserite having the same incline. The magma, which was trapped at a deep level and was cooling off extremely slowly, provided thermal energy for the hydrothermal phenomena for a long time afterwards. The waters which had seeped in from the surface along the tectonic cracks heated up and broke to the surface once again. They became aggressive in the deep level – probably mixing with volcanic gases (e.g. CO_2) and dissolved the carbonate and silica materials in the rocks. The rock named geyserite precipitated from hot waters breaking to the surface, as a result of the rapid decrease in pressure and temperature. At the moment, researchers are divided in asserting whether these were real, erupting geysers, or merely "simple" hot springs. In order to decide this along with many other genetic questions, it will be necessary to conduct several more investigations in the near future.

It is however certain, that these special geological and geomorphological formations represent a unique natural asset. In the barely 4 km diameter of the peninsula originally there must have been around 130-150 fontal cones, however, unfortunately the stone quarrying over the past centuries (or thousands of years?) has totally destroyed some of them. Since declaring them protected, luckily this is no longer a threat, at the moment there are 80 located on various sites around the peninsula. They usually occur in groups; and usually form a line along a fracture furrow, creating over several hundreds of meters a ridge, as for example on the Hosszú Hill and the Cser Hill or between the Csúcs Hill and the Nyereg Hill. They occur irregularly but in large numbers in the area between the Inner Lake and the Szarkádi Summit, this is where the most famous of them, having perhaps the best appearance rises, the Aranyház (Golden house) as it is called, and this is where the cones of the Geyser field also stand tall. Surprisingly pyroclasts can rarely be found on this part of the peninsula and the several dozen fontal cones are built upon Pannonian sedimentation. It is presumed that the hot springs here were fed by the heat energy of a sub-volcanic body stagnating in the deep. In the immediate vicinity of the Abbey is another well-known fontal cone, which had encased the Forrás-barlang (Spring cave), which has been lit up and can be visited.

It is difficult to assess their former height, since the degree of erosion is unknown, although the resistance of the rock would suggest that not much is missing. At present their shape is more or less a regular cone mantle, which naturally does not always reflect the original form, since this is in part due to later erosion. They frequently stretch in a particular direction or in some cases have grown together with the neighbouring cones during their formation. Their relative height must have been in the order of tens of meters, and their average diameter at the base does not exceed one hundred metres. It is probable that this later measurement can be a lot less, however the pieces of rock which roll down from the top have created a rubble mantle, hiding and seemingly increasing the side measurements. As a result of this coverage the angle of the original side walls is also unknown, it is just supposition that they must have been fairly steep. Whilst morphological evaluation is made difficult by the fact that the solitary rock has been depleted from many cones in rings or slices, this fact enables the understanding of the rock structure conditions.

The rock matter called geyserite is undefined at present: this is the collective name for the sedimentation made up of limestone, dolomite and silica precipitated from the water of hot springs, and this is also the name given to the finely layered material of hot water springs, which has later become silicated. Generally this is an extremely varied ratio of mix between freshwater limestone and hydroquartzite, which are connected to each other along irregular surfaces according to the precipitation conditions prevailing at the time. Sometimes this silica material has a quite clear, chalcedony, opal character, and such rocks are to be seen along the

tourist route on the north-eastern side of the Szarkádi Summit. Sometimes the part of the rock having more concentrated SiO_2 is situated filling a crevice or as a layer, although it is also known in the form of mineral precipitation.

The structure of the rock material generally shows a layered character at the bottom of the formations, although this is generally no larger than one metre. The several metres thick mass layer above it is occasionally broken up by finally layered parts. In purely bulky formations occasionally a thick bench-like character can be observed. The above mentioned lamination generally means mm thick micro-layers and reflects on the rhythmic nature of the precipitation of the material.. Relevant literature interprets this as lake sediment formation, but site observations have shown occurrences where there has also been laminate precipitation from waters running down the irregular, or crooked and sometimes vertical surface of the fontal cone.

It has been mentioned previously that the internal structure of the fontal cones is exposed very well in some places and by analysis of these it is possible to discover and understand the process of the creation of the large form. The geyserite found on the ridge of the Nyereg Hill contains material precipitated from numerous small springs like a column separated from its environment, or visible in a section. Boiling water broke surface in the centre of these columns, usually having a diameter of some dms and a height which can be expressed in metres, then bubbling out the top ran down around the surface, whilst the soluble material precipitated from it. By way of a weak comparison, the structure resembles a column of cups with a hole at the bottom, stacked into one another and turned upside down. After a while the channel for the water gushing up inside these became blocked, the formation of columns ceased and the water found a new site for the continuation of the building process. These forms often grew in a line simultaneously, next to one another and in time grew together sideways, then the process was repeated at the top. This also explains the vertical nature of the big cones, since the small columns which form part of them also grew mainly upwards and it was only the dissolved material in the water running down them which filled the smaller remaining empty gaps between the columns. It was also observed that the inner spring channel, about as thick as an arm, was filled in afterwards by the rock material , then this was again broken through by a newer, thinner pipe channel. These pipes sometimes branched out upwards, like a fan. This also shows that precipitation and solution were both prevalent but to a differing degree during the formation of the fontal cones. Naturally the former was the dominant effective factor, but sometimes quite large chimneys, in fact even caves were formed. The walls of these sometimes show the traces of solution by the boiling water, as well as the smaller smooth walled crevices and the larger sphere pans. In some places there are parts of rock with holes like in cheese and also dead-end channels twisting with irregularity. In several places inside the cones we observed large flat dome-like structures a few metres in diameter and also the remains of dissolved crevices. In these cases post formation activities can also be presumed.

The larger spring chimneys, and cave remains are generally filled in by their own rock debris, but in some places we also found yellow rock flour of rearranged loess origin. Examination of the filler sediments can reveal a lot about the age of the formation of the cones and also about the changes in terms of sedimentation geology, morphology and climate.

Nature conservation

The geyser cone formation group in Tihany briefly outlined in the foregoing and which without a doubt requires further research, represents a special part of our geological past. The number of cones, their shape, inner structure and rock material in itself is a unique natural treasure. If we then add to this the special formations of the explosive volcanism which

happened here, the visual exhibition and the two lakes of the peninsula, as well as the beauty of the surrounding Balaton landscape – not to mention the botanical and zoological assets – then deservedly the Tihany peninsula can be listed among the valuable areas of Europe.
These aspects as well as the cultural historical memorials play a big role in the fact that from spring to autumn many tourists visit the region, although the large majority of them only view the landscape from the village. There is a double role required from the nature conservation authority:

- to preserve efficiently and in an unchanged form
- whilst at the same time acquainting as many people as possible with these unexampled natural assets.

In our opinion this seeming contradiction can be resolved. The majority of tourists wish to see sights in the village (exhibitions, publications) and not on site. Those wishing to go on excursions have to be dispersed on the various parts of the peninsula. Luckily the most valuable parts are relatively afar from the village and can only be approached on foot. It is possible to comply with the double requirement referred to above with a suitably worked out plan and information system. In the following we offer some suggestions for this.

Everywhere in the touristic offer about the Balaton Region, the National Park and within this the Tihany peninsula, an emphasis must be made on the unique nature of the geological natural assets. Signs placed alongside the main roads leading here should also indicate this: at the turnoff places from route 71 and in the boat harbour where most people occur.

Visitors to the peninsula should be directed according to their levels of interest – for this the necessary publications and demonstration sites should be established. **Museum and Visitors Information Centre.** "Those not wishing to go out onto the rough ground" should be informed by way of a museum exhibition within the village – where through prepared objects visitors can get to know the natural picture of the living and non-living world.

- Site table of the peninsula, indicating on it the various natural assets
- Illustrating with figures the history of the development of the peninsula (text, photo, geological map)
- Demonstration of geological notability ("artificial geyser cone", various types of rock exhibited, photos.) On the rocks the sections of soil profiles formed on them using original materials
- Detail of individual habitats using dioramas :
    - basalt tuff – surfaces, grasslands
    - the geyser cone environment
    - forested areas
    - lakes

  (these can be further broken down and refined)
- Historical part – the appearance of man here, archeological, historic monuments, folklore, farming, tourism, nature conservation

The stock in the museum shop – publications of a high quality, books, postcards, memorabilia – secures what has been seen in one's memory. Such a museum would attract an enormous number of visitors, here everyone could "learn" about the peninsula – this would suffice the majority of people and so not everyone would go out into nature.

Those really interested in nature would receive some directed informative material here at the information centre, they could choose the site they wish to visit – according to their time and interest – this would provide the opportunity to regulate tourist traffic.
The less mobile could be recommended the geyser cone and Spring cave adjacent to the Abbey – it is near and central. The visitor can get quite a good impression of this formation in real life, a board could describe the essence of the phenomena and the form

as well as its values.

It is practical to divide those really wishing to go into the country spreading them over the various points of the peninsula – this could be done by those working in the information centre by direct recommendation, or by well positioned boards throughout the village.

Smaller tour circles could be recommended

- Monks residence – Óvár
- Walk around Lake Belső via the Aranyház
- Kis-erdő Summit – here some of the visitors already stop at the tourist resting place if their attention is drawn to some phenomena through information boards (wind eroded cliffs, red sandstone inclusions, view of Lakes Külső and Belső)
- The more adventurous can go for a 1 km hike on the marked circular nature trail where explanation boards could also be placed.
- Things to see:
  - 10 m high basalt tuff wall with rubble inclusions at the base
  - frost cracking from the Ice Age, blocks moved by movement of the slope
  - tafoni-like crevices, selective rock decay
  - traces of laminated geyserite at the return – possibly exposing it a little from beneath the soil. (A larger tour (3-5 km long) can go on from here towards the Aranyház or among the vines towards the Lavender plantation.)
  - back along the ridge of the summit smoke tree vegetation and the leaning tuff rocks at the look-out point
  - view of Lake Külső, panorama of the Balaton Uplands

Minibus tour variation – Tourists are taken from the centre to the Apáti church ruin, they walk along part of the ridge (Nyereg Hill, Csúcs Hill) and descend to the beach. Along the tourist route the places for diversion must be marked exactly – thereby presumably less people will follow the trail through, lessening the impact.

Geyser tour starting from the parking lot next to Lake Belső – here also the impact can be halved by having a round tour. Aranyház – exposed cones – Szarkádi Summit – along the Szarkádi track route back below the Aranyház to Lake Belső. (5 km)

The route for those who are really keen: Kis-erdő Summit – Aranyház – Geyser field – Gubicza Summit – Csúcs Hill – Apáti ruin (7-8 km), then back to the village by bus.

Tailormade specialised tour routes can also be marked out for professionals, university and college students. Such a destination point could be, for example, the abandoned stone quarry on the eastern side of the Apáti Hill. Here also, some minor intervention would be necessary to enhance the spectacle (taking out some bushes and trees).

The already existing Lóczy nature trail serves as a good foundation for directing the movement of tourists in the countryside, supplemented by an information board system which needs to be expanded and also requires some minor changes to be made. This is also the case for the trails, since by changing the current tourist route over a few metres in some places (along 50-100 m stretches) further interesting things could be included. The dense bushy undergrowth hides the rocky outcrops at the moment, but these could be made visible with relatively little effort. On a given stretch of the route if more things are on offer for the visitors, they receive more in depth information – and are slowed down. This has the indirect result of the majority of people only visiting a smaller area, thereby reducing the burden placed on the whole peninsula.

In the case of the Geyser field the aim is to disperse the impact by exposing several cones (taking out bushy plants), since tourists will not climb all of them, but can see them whilst walking under them.

Exposing the cones on the southern and eastern part of the geyser field is also suggested –

from the top of these the neighbouring projections can be seen, looking over the top of the forest, so from the top of a cone one can gain an overview of the whole area, and the group character of the geyser field really becomes apparent.

The clearance and scything practices which have developed to date are good, and the intention is to carry on with this principle and practice in the future; clearing the complete or near complete mantle of the cone from bushes, leaving only a few older trees or individual bushes in order to enhance the spectacle - stone/plant as a pair of opposites.

Occasionally grazing by sheep is permissible, although their constant presence is not desirable, since the trampling of animals mechanically destroys the rock, prone to crumbling and their excretions dissolves and contaminates the carbonate rock. For the same reason grazing by goats is also not recommended, since they also destroy all plants, including the protected ones (a lesson learnt from Mediterranean areas!)

The more sparse, rocky cones which rise from the dense forest make it possible to overview the positioning of the geysers, although the forest would need to be cut a little in some directions and the larger (obstructive) trees taken out.

Several paths should be established up the side of the cones, or single tracks, wherever possible in a spiral – designed individually in each case – reducing damage caused by human trampling.

Detailed demonstration of the individual cones as well as their name, drawing attention to local, well visible details of interest, sketching the place on a diagram.

Enhancing the spectacle: in the case of some cones taking away the debris which has fallen into former crevices, spring channels and holes, thereby manifesting the structure.

To date all of these interventions have been carried out by the staff of the National Park assisted by students attending the summer nature conservation camp. Exposing further areas and regular bush clearance requires further labour force. Increasing the number of student camps would probably have a double benefit. On one hand more people would become acquainted with the natural assets of the Tihany peninsula, on the other hand we would gain additional workforce. In this way it would be possible to strengthen their active attitude to nature conservation and environmental protection.

In the foregoing we have referred to the fact that it would be necessary to have information publications in the interests of effective landscape sectioning. These types of publications must be compiled in such a way that they supplement each other and whilst in part overlapping one another, they should offer increasingly more information and should be adjusted to the readers' level of knowledge. First there should be short, clearly arranged folded brochures containing basic information, then 10-15 page booklets containing more detailed information and 20-50 page informative books to a high standard, covering individual topics or sub-sections, and finally a summarising monograph of Tihany, possibly in topical volumes (geology, botany, zoology, cultural history). With all types of publications besides the text good quality photos and graphs must also be published and it would also be necessary to have a photo album. All of this must also be made available on CD and on the internet.

Monitoring

The geyser cones and the other rock outcrops of volcanic origin are not at risk at present. The damage caused by trampling of visitors is not significant at the moment and with the implementation of impact distribution detailed above it can probably be maintained at this level, even with an increase in tourism. Should damage arise, however, then clearance will cease on the endangered cones and the bushy growth developing within a few years – due to

its impassable nature – will in any case protect the area. The geyser cones which are not cleared from the vegetation will for this reason be protected in the long term from human interference.

The regular presence of nature conservation rangers in the countryside ensures a sufficiently effective protection despite a possible increase in tourism.

This method can presumably stop the lighting of fires, which sometimes occurs now in some of the caves of the geyser cones. The effect of heat and soot on the surface of the rock also damages the formation. Apart from personal on site supervision, it would be practical to take close-up and distant photographs of the current state of the cones, repeating them every 5 years thereby sensing long term changes. Apart from the above it would also be desirable to have the state of the geyser cones and rock exposures visually inspected by a geologist-geomorphologist expert twice a year, before and after the tourist season. Based on his observations he could make proposals for the necessary intervention. It is necessary to consult with a botanical expert during the clearance of vegetation, and also to engage his professional supervision in order to protect the valuable plants so that native, ligneous plants living in their appropriate habitat remain in the area.

The increase of horse-riding tourism poses a potential threat, since apart from breaking up the grassland, horse hooves also damage the rock surfaces. Trails need to be marked where their free movement is possible, and these must be periodically checked for any damage caused by them.

A similar, although far more dangerous possibility is the use of motocross bikes. Unfortunately this sport which does not belong in nature has become very fashionable in the Bakony Hills. It would appear there is as yet no such problem in Tihany, but should it occur, it must be stopped immediately through penalties, since it can cause a great deal of damage to both wildlife and the non-living side of nature.

The detailed breakdown of the concrete proposals outlined in this material and elaboration of the necessary plans require further on site and processing work, however, certain steps can be defined now and intervention can be started to some degree in light of current knowledge.

7.2. BUDGET AND PERSONNEL

The National Park staff in the Tihany Peninsula consists of:

- 1 district principal
- 1 ranger
- 1 professional hunter
- 4 manual workers

The machinery for management consists of a tractor and its machines. Other works are perfomed by a joiner's shop and the manual workers. Field visits can be made with a jeep, a motorcycle and power-boats.

8. <u>MAP OF THE SITE</u>

- **Physical map:**

NATIONAL MAP NUMBER SCALE PROJECTION

REFERENCE TO AVAILABILITY OF BOUNDARIES IN DIGITISED FORM

- **Map of designated sites described in 6.2.**

Provide this information on a map with the same characteristics as above.

- **Aerial photograph(s) included:**

NUMBER AREA SUBJECT COPYRIGHT DATE

9. <u>SLIDES</u>

NUMBER PLACE SUBJECT COPYRIGHT DATE
