BIOSPHERE, ECOSYSTEM

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

Short name	Full name
OTrT	National Spatial Plan
Paks II	Paks Nuclear Power Plant units planned to be constructed on the Paks site
NBmR	National Biodiversity Monitoring System
MME	BirdLife Hungary
IUCN list	International Union for Conservation of Nature and Natural Resources: Red List of Threatened Animals

18 BIOSPHERE, ECOSYSTEM

18.1 LEGAL BACKGROUND

International Conventions

Council Decision 82/72/EEC of 3 December 1981 concerning the conclusion of the Convention on the conservation of European Wildlife and Natural Habitats (Bern Convention)

Bern Convention (1994): Convention on the Conservation of European Wildlife and Natural Habitats. Appendices to the Convention – Council of Europe, Strasbourg, T-PVS (94)

Council Decision 82/461/EEC of 24 June 1982 on the conclusion of the Convention on the conservation of migratory species of wild animals (Bonn Convention).

Council Directive (1992): Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora – Official Journal L 206, 22 July 1992, pp: 7–50.

IUCN (1996): 1996 IUCN Red List of Threatened Animals. – IUCN, Gland, Switzerland, 368 pp.

European Union legislation (Decision, Directive)

Council Decision No. 82/461/EEC of 24 June 1982 on the conclusion of the convention on the conservation of migratory species of wild animals

Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora. – Official Journal L 206, 22 July 1992, pp: 7–50.

93/626/EEC Council Decision of 25 October 1993 concerning the conclusion of the Convention on Biological Diversity

Council Regulation (EC) No. 338/97 of 9 December 1996 on the protection of species of wild fauna and flora by regulating trade therein

Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds

Directive No. 2011/92/ EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment

Statutes

Act LIII of 1995 on the general rules applicable to the protection of the environment

Act LXXXI of 1995 on the promulgation of the Convention on Biodiversity

Act LIII of 1996 on the protection of the environment

Government Decrees

Government Decree No. 314/2005. (XII.25.) on the environmental impact assessment and single environmental licensing procedure

Government Decree No. 275/2004. (X. 8.) on areas of European Community importance designated for nature conservation purpose

Government Decree No. 2/2005. (I. 11.) on the environmental assessment of certain plans and/or programmes

Government Decree No. 348/2006. (XII. 23.) on the detailed rules applicable to the protection, keeping, use and demonstration of protected animal species

Government Decree No. 67/1998. (IV. 3.) on the limitations and prohibitions applicable to protected and highly protected symbioses

Ministerial Decrees

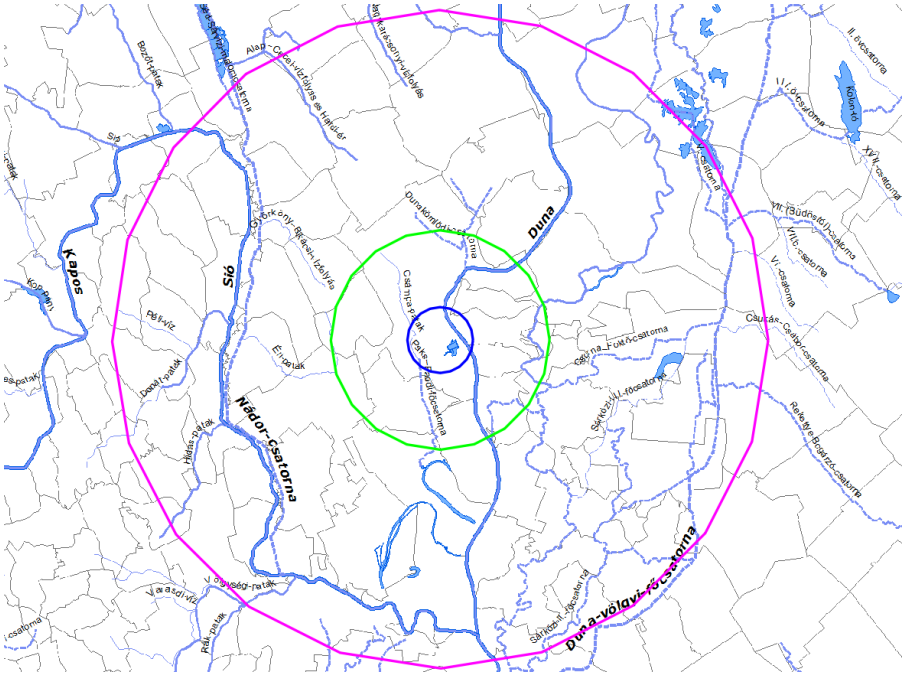
Decree No. 12/2005. (VI. 17.) KvVM on the detailed rules of ordering limitation on the habitats and in the environment of the habitats of highly protected plant and animal species

Decree No. 13/2001. (V. 9.) KöM on the radius of protected and highly protected plants and animal species and highly protected caves as well as on the publication of plant and animal species of European Community importance for nature conservation - Magyar Közlöny, 53: 3446–3511.

Decree No. 14/2010. (V. 11.) KvVM on parts of land affected by areas of European Community importance designated for nature conservation

18.2 LIMITATION OF THE STUDY AREAS

18.2.1 SUMMARY OF STUDY AREA LIMITATION



blue radius: 3 km radius,
green radius: 10 km radius,
purple radius: 30 km radius environment

Figure 18.2.1-1: The studied environment of 3, 10, 30 km radius [18-161]

18.2.2 AREAS OF HIGH IMPORTANCE FOR NATURE CONSERVATION

18.2.2.1 Nature Conservation Sites of Community importance (Natura 2000)

Site code	Site name	Status	Total territory (ha)
HUKN10002	Kiskunsági szikes tavak és az őrjegi turjánvidék	Natura 2000 SPA	35748
HUDD10003	Gemenc	Natura 2000 SPA	19641.18
HUKN20007	Solti ürgés gyep	Natura 2000 SCI	110.21
HUKN20009	Felső-kiskunsági szikes tavak és Miklapuszta	Natura 2000 SCI	19679.72
HUKN20021	Ökördi-erdőtelek-keceli lápok	Natura 2000 SCI	2517.88
HUKN20032	Dél-Őrjeg	Natura 2000 SCI	4585.08
HUDD20020	Közép-mezőföldi löszvölgyek	Natura 2000 SCI	1597.93
HUDD20023	Tolnai-Duna	Natura 2000 SCI	7161.69
HUDD20029	Kisszékelyi -dombság	Natura 2000 SCI	2979.07
HUDD20032	Gemenc	Natura 2000 SCI	20704.09
HUDD20040	Tengelici homokvidék	Natura 2000 SCI	5788.12
HUDD20050	Szenes-legelő	Natura 2000 SCI	380.07
HUDD20069	Paksi ürgemező	Natura 2000 SCI	352.14
HUDD20070	Tengelici rétek	Natura 2000 SCI	466.35
HUDD20071	Paksi tarka sáfrányos	Natura 2000 SCI	91.16
HUDD20072	Dunaszentgyörgyi-láperdő	Natura 2000 SCI	328.03
HUDD20073	Ős-Sárvíz	Natura 2000 SCI	753.01
HUDI20003	Alapi kaszálórétek	Natura 2000 SCI	518.58
HUDI20027	Kelet-mezőföldi löszvölgyek	Natura 2000 SCI	315.5

Table 18.2.2-1 : Nature conservation areas (Natura 2000) of European Community importance within 30 km radius

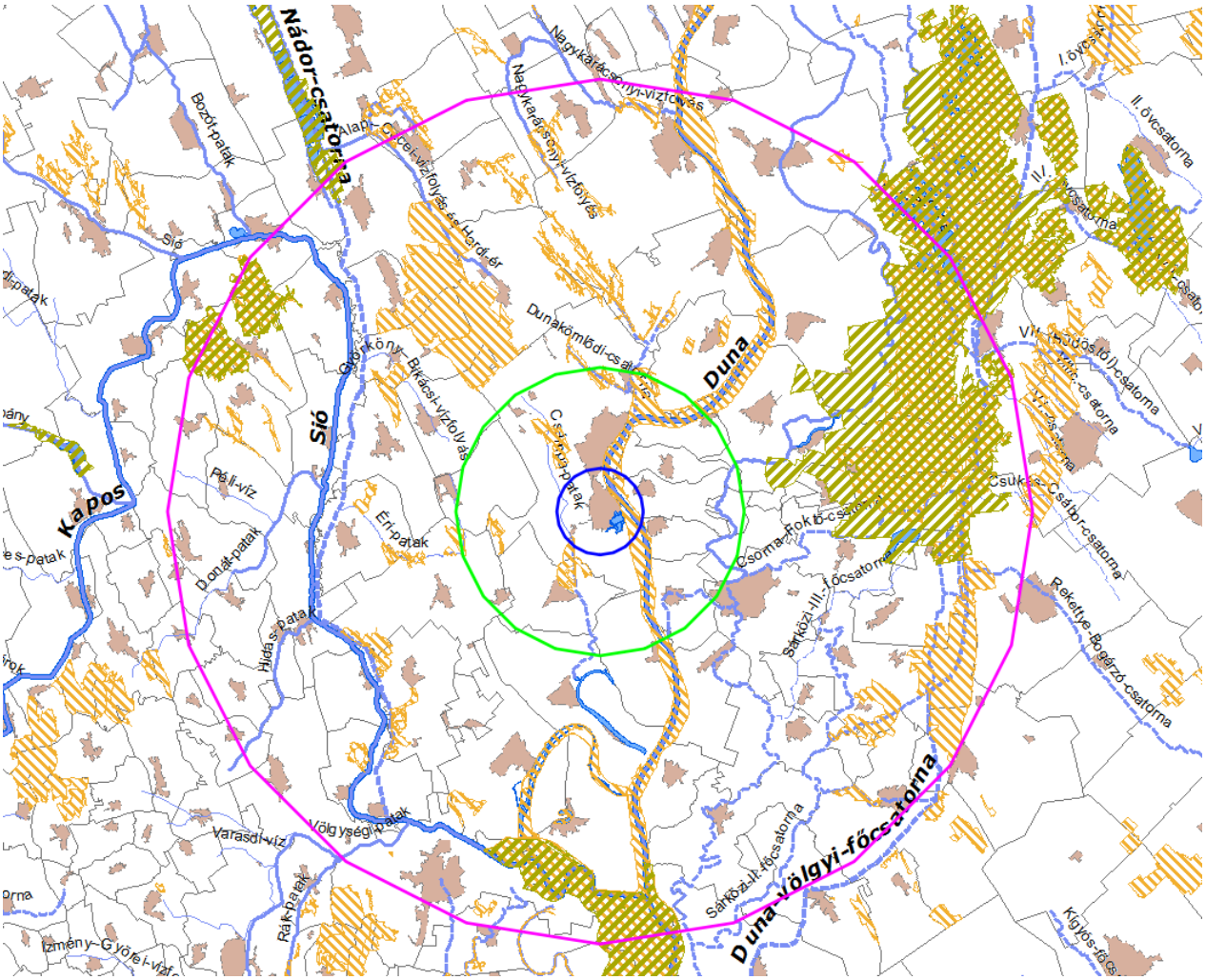


Figure 18.2.2-1.: Natura 2000 sites within the studied area of 30 km radius [18-161]

18.2.2.2 Ramsar Convention Sites

Within the 30 km radius studied, the following three Ramsar sites can be found on the border of the area (Figure 18.2.2-2):

- The Gemenc area of the Danube-Dráva National Park
- Alkaline lakes of Upper Kiskunság
- Fishponds of Rétszilas (Sáregres)

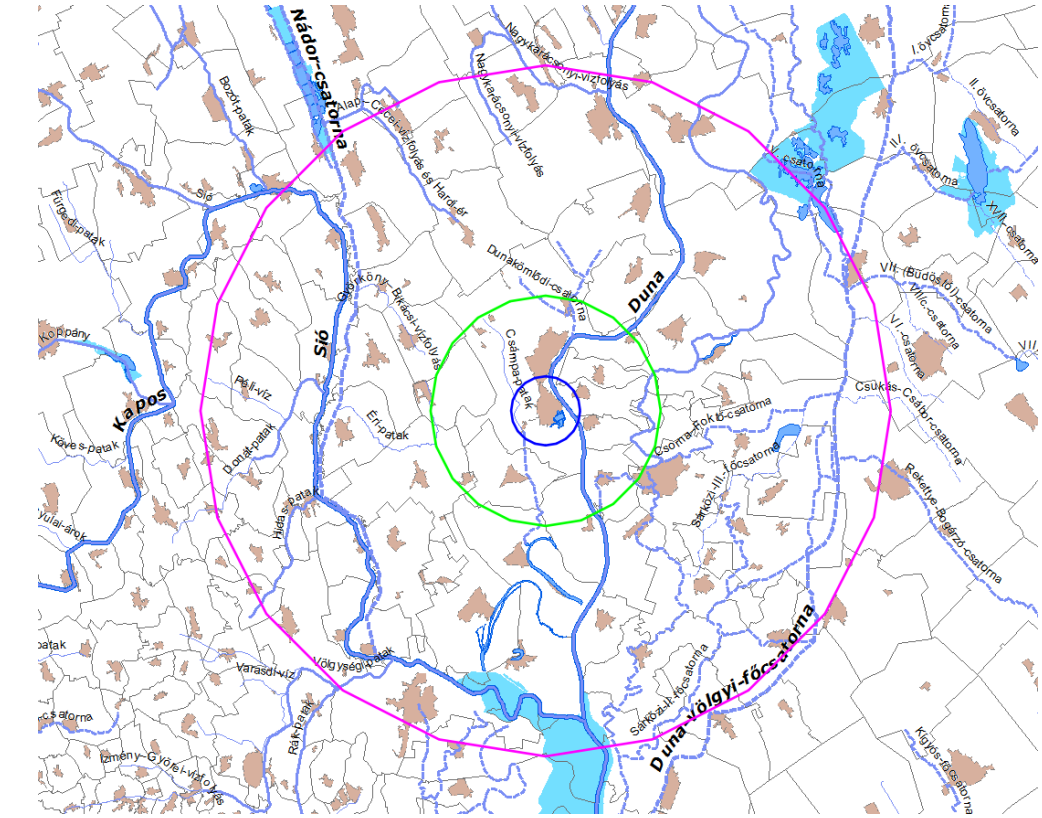


Figure 18.2.2-2. : Ramsar sites within the studied area [18-161]

18.2.2.3 Protected Natural Areas of National Importance

NATIONAL PARKS

Within the 30 km radius studied, 2 national parks can be found.

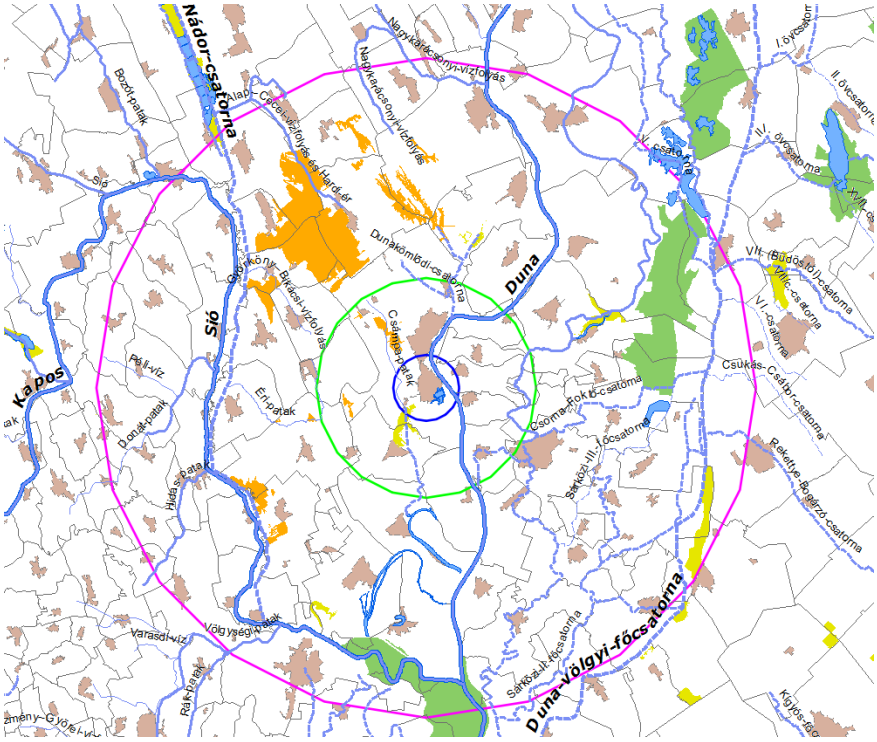
- *Danube-Dráva National Park*
  - planned Biosphere Reserve
  - Natura 2000 and Ramsar site,
  - ecological network
  - and also a landscape protection zone
- *Kiskunság National Park*
  - Biosphere Reserve
  - Natura 2000 site
  - ecological network and also a landscape protection zone

NATURE PROTECTION AREAS, LANDSCAPE PROTECTION AREAS

- Lake Szelidi Nature Protection Area
  - Natura 2000 site
  - ecological network and also a landscape protection zone

- ❖ Lake Kapszeg Nature Protection Area
  - Natura 2000 site
  - ecological network and also a landscape protection zone
- ❖ Iris Field at Bölcske Nature Protection Area
  - Natura 2000 site
  - ecological network and also a landscape protection zone
- ❖ Red Marsh at Császártöltés Nature Protection Area
  - Natura 2000 site
  - ecological network and also a landscape protection zone
- ❖ Swamp Forest at Dunaszentgyörgy Nature Protection Area
  - Natura 2000 site
  - ecological network and also a landscape protection zone
- ❖ South Mezőföld Nature Protection Area
  - Natura 2000 site
  - ecological network and also a landscape protection zone

Protected natural areas of national importance are shown in Figure 18.2.2-3.



Védett természeti területek – Protected natural areas
Nemzeti Park – National Park
Tájvédelmi Körzet – Landscape Protection District
Természetvédelmi Terület – Nature Conservation Area

Figure 18.2.2-3. : Protected natural areas of national importance within the studied area [18-161]

SENSITIVE NATURAL AREA (RECENTLY CALLED AREA OF HIGH NATURAL VALUE, MTÉT)

The sensitive natural areas were designated by the Joint Decree No. 2/2002. (I.23.) KöM-FVM. The objective of the designation of the sensitive natural areas is to preserve and maintain nature friendly farming methods on ecologically sensitive land parcels and to designate further land parcels which, encouraged by grants and by voluntarily accepting limitations, guarantee the protection of habitats and the concerted preservation of biodiversity and landscape and cultural, historical values. Sensitive natural areas primarily include fertile lands of meadows, pastures, reeds and fishpond cultivation type, as well as lands utilised traditionally and in a nature friendly manner, or at risk due to improper utilisation, or lands of arable land, vineyard, garden, orchard, or wooded area cultivation type known as sites of occurrence of significant natural values.

Amendment of OTrT 2008 however, eliminated this national zone and replaced it by the name Areas of High Natural Value (MTÉT).

The public administration area of settlements within the 30 km radius is affected by two MTÉTs:

Danube valley plain MTÉT

on the territory of Solt, Harta, Dunatetétlen, Akasztó, Dunapataj, Újtelek, Szakmár, Öregcsertő, Kecel

Sárvíz valley MTÉT

on the territory of Bikács, Vajta, Cece, Alsószentiván, Németkér, Nagydorog

ECOLOGICAL NETWORK

The new zoning system of the National ecological network was introduced by the National Spatial Plan. It designated the area of the national ecological network which must be indicated in the priority regional and county spatial plans in accordance with data supply from the competent ministry.

Zoning components of the ecological network:

- core area
- ecological corridor
- buffer area

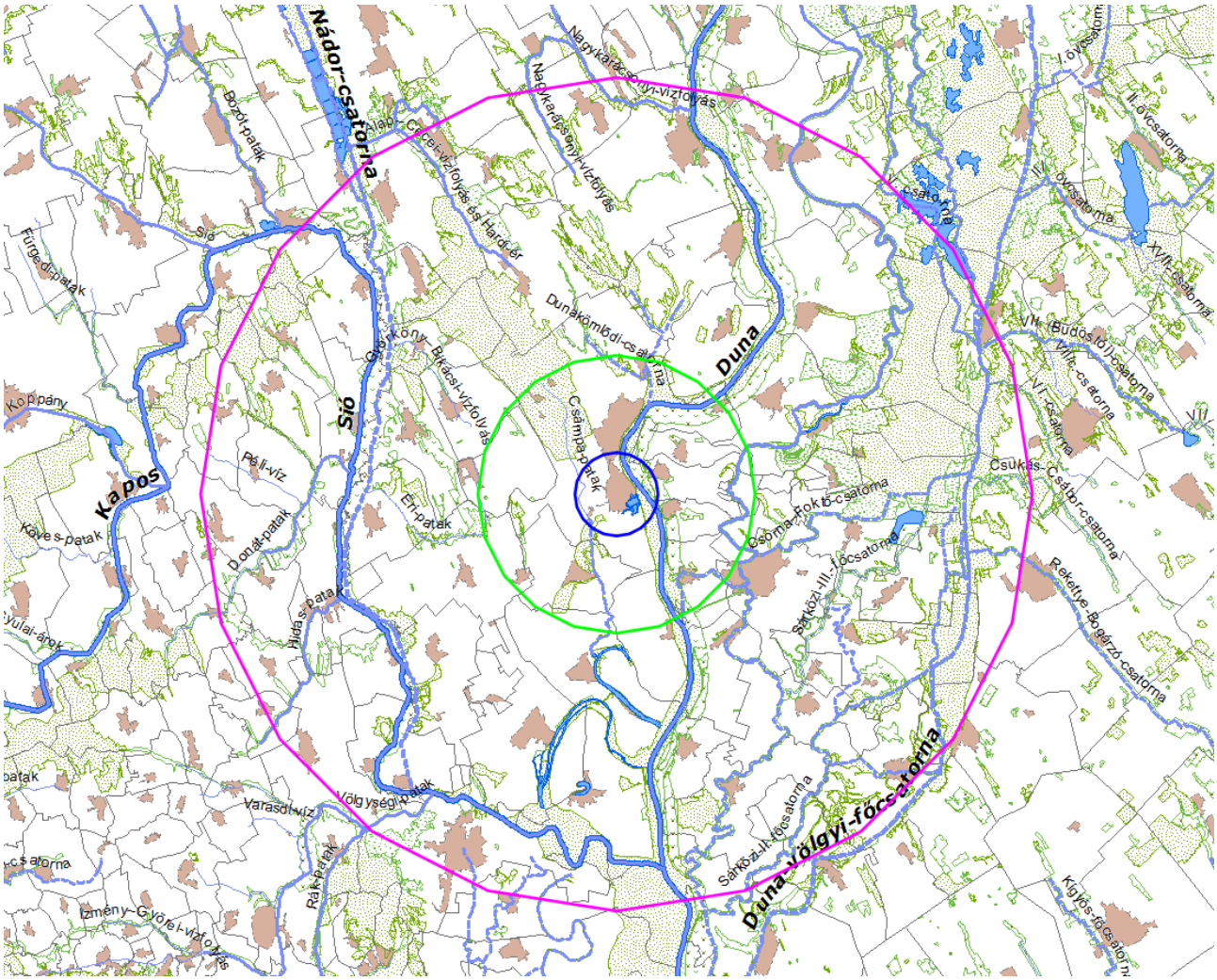
A core area zone includes natural or semi-natural habitats, which are able to ensure in the long-term the maintenance and living conditions of natural biosphere characteristic to the given area and are a home to a number of protected species or species of community importance. Typically these are national parks, landscape protection areas.

An ecological corridor zone includes areas (mostly habitats, habitat belts, habitat mosaics, habitat fragments, habitat chains mostly of linear extension, continuous or interrupted) which, for the most part, are of natural origin, and which are suitable for ensuring the biological relation between other habitats (core areas, buffer areas) belonging to the ecological network. Typical examples are river and stream valleys and their immediate environment.

Buffer area zones include areas which prevent or mitigate the negative impact of activities which may have a detrimental impact on the state of the core areas and ecological corridors or are contradictory to their purpose. Typically it is an area adjacent to a core area, it is an extension, protection zone thereof.

When designating the ecological network zones, Natura 2000 sites and nature conservation areas also have a decisive importance in addition to protected areas.

The ecological network covers the entire area of the area studied and creates connection between valuable habitats (Figure 18.2.2-4).



vízfolyás – water flow
patak – stream
csatorna - canal
Országos ökológiai hálózat – National ecological network
Magterület – Core area
Pufferterület – Buffer area
Ökológiai folyosó – Ecological corridor

Figure 18.2.2-4. : Components of the national ecological network within the studied area [18-161]

18.3 BIO-MONITORING STUDIES OF MODEL VALUE PERFORMED IN THE ENVIRONMENT OF THE PAKS NUCLEAR POWER PLANT - DESCRIPTION OF THE BASE STATE OF THE AREA

For the purpose of conducting an environmental impact study required by the environmental licensing of the new nuclear power plant units to be established on the Paks site, bio-monitoring studies of model value were conducted in 2012 to explore the flora and vegetation as well as the flora of the environment of the Paks Nuclear Power Plant in 3 km radius. The fundamental purpose of the examinations was to survey the current state of the biosphere on the site and in the environment of the Paks site and, based on that, to prepare a description and assessment of the base condition of biosphere. In addition, priority species on the Natura 2000 sites within the 10 km radius have also been surveyed.

The findings of the bio-monitoring studies in 2012 reflected the extreme aridity of the year under examination. In order to have findings about the base conditions of the biosphere, and not only from such extremely dry weather conditions, extension of the bio-monitoring studies to year 2013 was advisable.

18.3.1 BIO-MONITORING STUDIES SITES

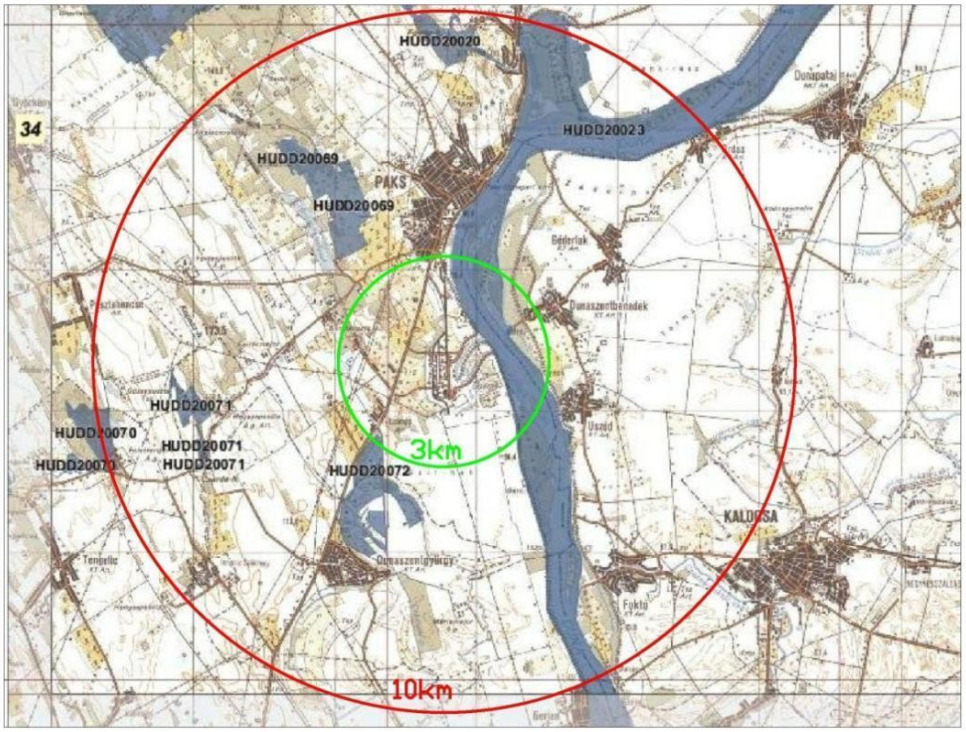


Figure 18.3.1-1: Border lines of the bio-monitoring studies of model value

18.3.2 BASE STATE OF THE AREA IN THE 3 KM RADIUS OF THE PAKS NUCLEAR POWER PLANT

In years 2012-2013, the flora, vegetation and fauna in the 3 km radius of the Paks Nuclear Power Plant has been characterised and evaluated with the following level of details:

- Exploration of the flora and vegetation of the 3 km radius of the Paks Nuclear Power Plant in accordance with the principles and methodological solutions in the National Biodiversity-monitoring System (NBmR):
  - preparation of the list of habitats and vascular plant species to be found on the area
  - characterisation of the habitats in accordance with Á-NÉR-2011
  - preparation of the taxon list of vascular species
  - display of protected species on maps
  - group share diagrams
  - narrative description, assessment of vegetation types occurring on the area
  - elaboration of the vegetation map of the area by displaying the major habitat types and vegetation units
- Exploration of the fauna of the 3 km radius of the Paks Nuclear Power Plant in accordance with the principles and methodological solutions in the National Biodiversity-monitoring System (NBmR):
  - description of certain habitat types based on the group (according to NBmR protocol)
  - preparation of the list of the invertebrates and vertebrates fauna data (taxon list on the species collected)
  - designation of species (if there are any) suitable for indication of habitat types

Furthermore, a general summary is given based on the findings of the above bio-monitoring studies.

18.3.2.1 Botany

18.3.2.1.1 Vegetation

The landscape structure of the 3 km radius of the Paks Nuclear Power Plant is rather mosaic. Deciduous and pine forest plantations as well as the agricultural areas play a major role. The different water surfaces and the valuable sand steppe grasslands more and more exposed to risk also represent a major share of the area. Built-up urbanised areas are also decisive components of the landscape in many parts. Excessive anthropogenic impact is characteristic to all landscape components. Major investments in the area have been carried out in the recent years as well (M6 motorway, industrial establishment constructions, bicycle roads, etc.). Compared to the entire studied area, the Danube River and its banks and the swamp forest at Dunaszentgyörgy are major consistent natural areas. Degradation, reduction and disappearance of the sand steppe grassland spots is a typical feature of the area. Presence of non-indigenous plant species and major proliferation of invasive species is a decisive feature of the area.

The diversity of the area is well-shown by the fact that from the aspect of botany, the following parts of the area can be distinguished based on the vegetation type featuring the landscape which was the basis of the botanic assessment (Figure 18.3.2-1):

Flood plain of the Danube River

Both internal sides of the 1520-1529 river km section of the Danube River, the flood protection dike within the 3 km radius of the power plant, and the cold water and warm water channels.

Flood protection dike

Flood protection dike sections within the 3 km radius on the left and right bank of the Danube River.

Páskom

The southern borderlines of the area are the northern connection road, the road extending from the north gate to the cold water channel avoiding the area covered by buildings, and the area between the plant and the town bordered in the west by main road 6 and in the east by the Danube flood protection dike.

Csámpai side

Includes the areas west of main road 6.

Sand areas in the environment of the Paks Nuclear Power Plant

Sand area west of the power plant. Includes the areas bordered by the north and south gates and main road 6, as well as the area south of the power plant extending as far as the fishing ponds in the east.

Marsh forests at Dunaszentgyörgy

Wetland habitats of three separate patches surrounded by arable land in the south - southwest part of the 3 km radius studied, whose smaller southern-western section is part of the HUDD20072 Natura 2000 site.

Vicinity of the fishponds

System of ponds and the adjacent water shores and wetland areas in the immediate vicinity east and southeast of the power plant.

Agricultural areas

Areas under agricultural cultivation, roads and side roads within the area studied.

Site of the Paks Nuclear Power Plant

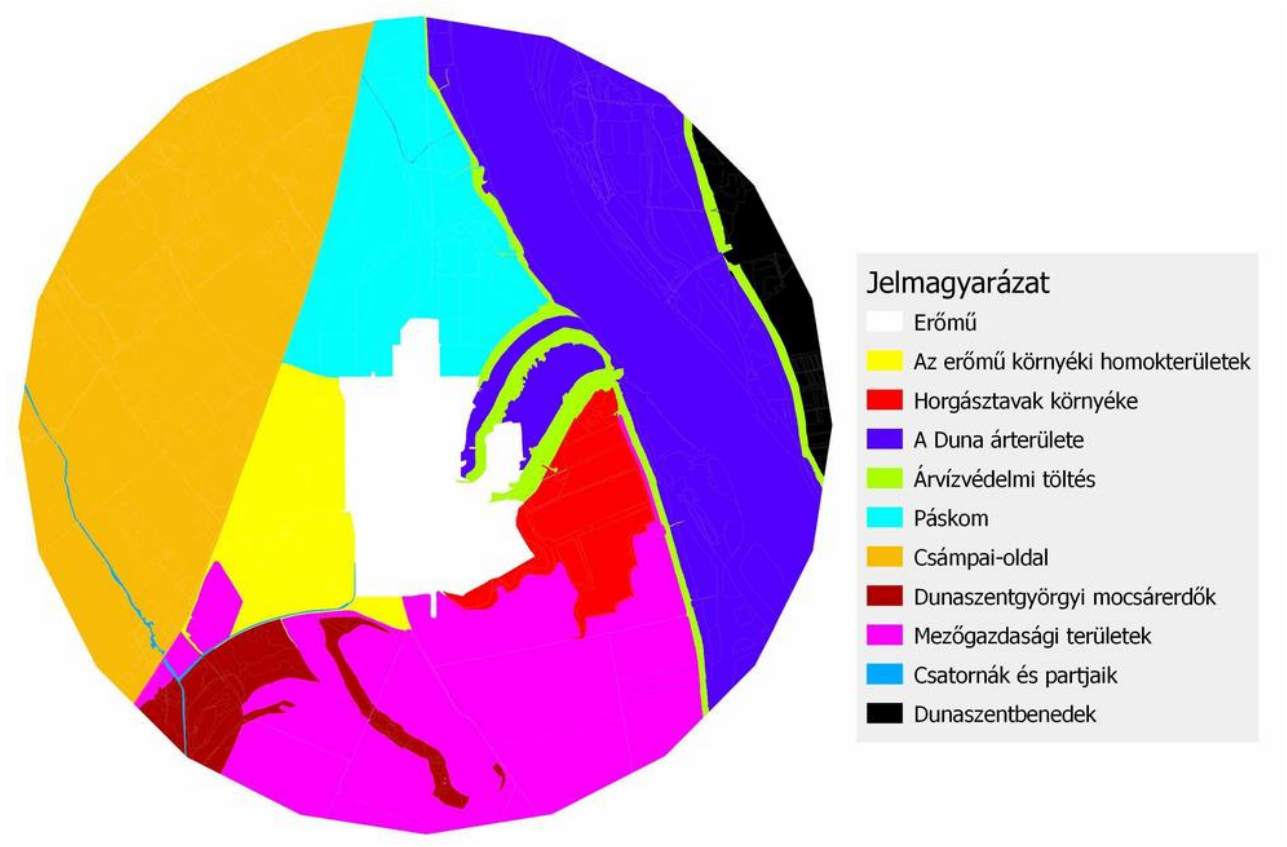
The site of establishment of the new power plant is the internal area of the existing power plant surrounded by a fence as well as the boundaries of the bus stop and parking site at the south gate.

Channels and their shores

Includes the channels, ditches with at least temporary water coverage in the 3 km area, including section of the belt channel outside the fence, the Csámpai stream and the channel flowing into the Danube River in the south of the town.

Dunaszentbenedek

Area of the town within the 3 km radius, falling outside the flood protection dike of the left bank of the Danube River including some of the inner area of Dunaszentbenedek as well as the pastures and forests of the contained site around the village.



Jelmagyarázat – Legend
Erőmű – Power Station
Az erőmű környéki homokterületek – Sand areas in the vicnity of the power plant
Horgásztavak környéke – Vicinity of fishponds
A Duna árterülete – Flood plain of the Danube
Árvízvédelmi töltés – Flood protection dike
Páskom – Páskom
Csámpai-oldal – Csámpa side
Dunaszentgyörgyi mocsárerdők – Swamp forest at Dunaszentgyörgy
Mezőgazdasági területek – Agricultural areas
Csatornák és partjaik – Channels and banks of channels
Dunaszentbenedek - Dunaszentbenedek

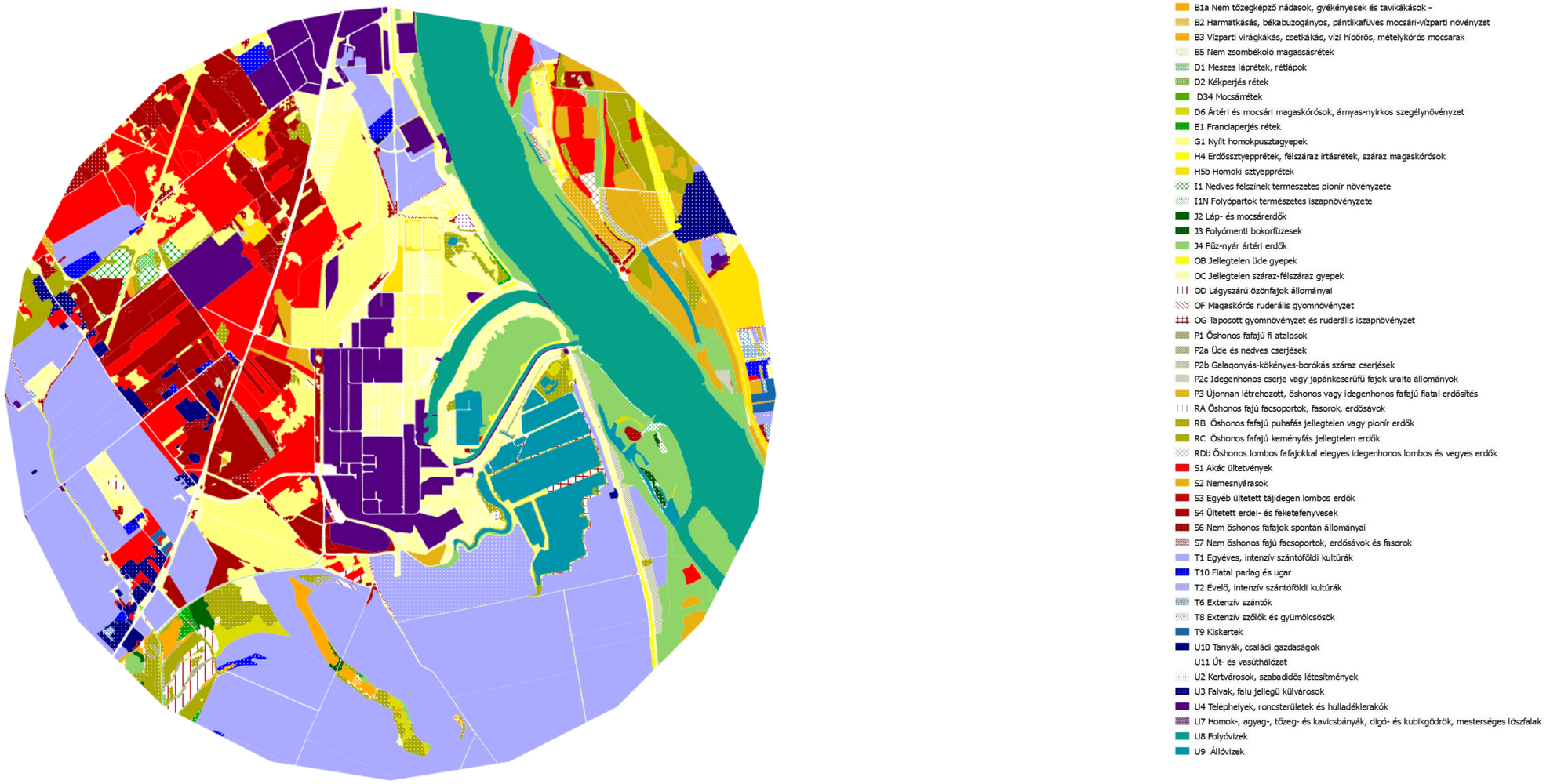
Figure 18.3.2-1. : Breakdown of the environment of the 3 km diameter of the power plant based on vegetation types determining the landscape

DESCRIPTION OF THE ABOVE AREAS

Flood plain of the Danube River

The flood plains of the Danube River are dominated by soft wood gallery forests with a number of populous x. euramericana plantations. At shrub level, often thick growth of common dogwood *(Cornus sanguinea)*, guilder rose *(Viburnum opulus)*, black-berried elder *(Sambucus nigra)*, and the European dewberry crawling very close to the soil *(Rubus caesius)* can be found. From among creeping up lianas, hop *(Humulus lupulus)* generating veil association in the flood plains is worth mentioning. Acacia forest plantations, uncharacteristic hardwood forests, and shrubs of non-indigenous species as well as arable lands are also present to a smaller degree. Degraded sandy grasslands, abandoned arable land changing more and more for sandy steppe meadows can also be observed. In the openings of the forests wet degraded swamp meadow fragments - often not more than a few 100 m^2 – and tall dry herbs can be observed. Composition and actual image of the associations largely depend on the water discharge of the River Danube,

therefore, in more dry years, open water surface draws back and mud associations along the shores and banks become more extensive. Water flow also affects the rate of non-indigenous and invasive species which are able to temporary acquire and flood larger areas in more dry periods. The Danube River as an ecological corridor also promotes the proliferation of invasive weeds posing a threat to natural habitats as a result of which these species are present in almost all habitats in the riparian habitats causing a degradation of their status. Therefore, even the best plant communities have only a medium or good natural status. Homogenous spots of invasive plant species posing a threat to semi-natural habitats have become quite extensive.



B1a – Nem tőzegképző nádasok, gyékényesek és tavikákások - Eu- and mesotrophic reed and Typha beds
B2 – Harmatkásás, békabuzogányos, pántlikafüves mocsári-vízparti növényzet - Glyceria, Sparganium and Schoenoplectus beds
B3 – Vízparti virágkákás, csetkákás, vízi hídőrös, mételykórós mocsarak - Water-fringing helophyte beds with Butomus, Eleocharis or Alisma
B5 – Nem zsombékoló magassásrétek - Non-tussock tall-sedge beds
D1 – Meszes láprétek, rétlápok (Caricion davallianae) - Rich fens
D2 – Kékperjés rétek Molinia meadows
D34 – Mocsárrétek - Mesotrophic wet meadows
D6 – Ártéri és mocsári magaskórósok, árnyas-nyirkos szegélynövényzet - Tall-herb vegetation of floodplains, marshes and mesic shadowed forest fringes
E1 – Franciaperjés rétek - Arrhenatherum hay meadows
G1 – Nyílt homokpusztagyepek - Open sand steppes
H4 – Erdőssztyeprétek, félszáraz irtásrétek, száraz magaskórósok - Semi-dry grasslands, forest-steppe meadows
H5b – Homoki sztyeprétek - Closed sand steppes
I1 – Nedves felszínek természetes pionír növényzete - Natural pioneer vegetetion of wet substrates
I1N – Follyópartok természetes iszapnövényzete – Natural muddy vegetation of riparian sites
J2 – Láp- és mocsárerdők - Swamp woodlands
J3 – Folyómenti bokorfüzesek - Riverine willow scrub
J4 – Fűz-nyár ártéri erdők Riverine willow-poplar woodlands

OB – Jellegtelen üde gyepek - Uncharacteristic mesic grasslands
OC – Jellegtelen száraz-félszáraz gyepek - Uncharacteristic dry and semi-dry grasslands
OD – Lágyszárú évelő özönfajok állományai - Stands of invasive forbs
OF – Magaskórós ruderális gyomnövényzet - Ruderal tall-herb vegetation
OG – Taposott gyomnövényzet és ruderális iszapnövényzet - Trampled and ruderal vegetation
P1 – Őshonos fafajú fiatalosok - Saplings of native tree species
P2a – Üde és nedves cserjések - Wet and mesic pioneer scrub
P2b – Galagonyás-kökényes-borókás száraz cserjések - Dry and semi-dry pioneer scrub
P2c – Idegenhonos cserje vagy japánkeserűfű fajok uralta állományok - Stands of non-native shrubs or Reynoutria species
P3 – Újonnan létrehozott, őshonos vagy idegenhonos fafajú fiatal erdősítés - New afforestations
RA – Őshonos fajú facsoportok, fasorok, erdősávok - Scattered native trees or narrow tree lines
RB – Őshonos fafajú puhafás jellegtelen vagy pionír erdők - Uncharacteristic or pioneer softwood forests
RC – Őshonos fafajú keményfás jellegtelen erdők - Uncharacteristic hardwood forests and plantations
RDb – Őshonos lombos fafajokkal elegyes idegenhonos lombos és vegyes erdők - Non-native deciduous forests and plantations mixed with native tree species
S1 – Ültetett akácosok - Robinia pseudoacacia plantations
S2 – Nemesnyárasok - Populus × euramericana plantations
S3 – Egyéb tájidegen lombos erdők - Plantations of other non-native deciduous tree species
S4 – Erdei- és feketefenyvesek - Scots and black pine plantations

S6 – Nem őshonos fafajok spontán állományai - Spontaneous stands of non-native tree species
S7 – Nem őshonos fajú facsoportok, erdősávok és fasorok - Scattered trees or narrow tree lines of non-natives tree species
T1 – Egyéves, intenzív szántóföldi kultúrák - Annual intesive arable fields
T10 – Fiatal parlag és ugar - New abandonments of arable lands
T2 – Évelő, intenzív szántóföldi kultúrák - Perennial intesive arable fields
T6 – Extenzív szántók - Extensive arable fields
T8 – Extenzív szőlők és gyümölcsösök - Extensive vineyards and orchards
T9 – Kiskertek - Gardens
U10 – Tanyák, családi gazdaságok - Farms
U11 – Út- és vasúthálózat - Roads and railroads
U2 – Kertvárosok, szabadidős létesítmények - Suburbs and recreation areas
U3 – Falvak, falu jellegű külvárosok - Villages
U4 – Telephelyek, roncsterületek és hulladéklerakók - Yards, wastelands, dumping grounds
U7 – Homok-, agyag-, tőzeg- és kavicsbányák, digó- és kubikgödrök, mesterséges löszfalak - Sand, gravel, clay and peat mines, loess walls
U8 – Folyóvizek - Water streams
U9 – Állóvizek - Standing waters

Figure 18.3.2-2. : Map of vegetation map of the environment of 3 km diameter of the Paks power plant

Flood protection dike

The area of the flood protection dike consists of swards difficult to identify, poor in species, cultivated by regular mowing, where the drier parts of the sward are dominated by furrowed fescue *(Festuca rupicola)*, Wallis fescue *(F. valesiaca)* and the false triated fescue *(Festuca pseudovina)*, while the wetter, lower parts of the dike are characterised by dominating false oat grass *(Arrhenatherum elatius)*, common meadow grass *(Poa pratensis)* and meadow foxtail *(Alopecurus pratensis)*. In addition to them, however, a lot of weeds and disturbance tolerant species, such as barren brome *(Bromus sterilis)*, false brome *(Brachypodium sylvaticum)*, cats tail *(Phleum phleoides)* and coach grass *(Elymus repens)* can be found. The roads along are characterised by Bermuda grass *(Cynodon dactylon)*, common hardgrass *(Sclerochloa dura)*, English ryegrass *(Lolium perenne)* and annual meadow grass *(Poa annua)*. Within the area, uncharacteristic dry, semi-dry and uncharacteristic wet grasslands can be found in the largest extension which are in fact the vegetation of the dikes. Habitats to be found here have a poor average natural status.

Páskom

In the Páskom area, open sand steppe grasslands of different level of degradation can be found in largest extension. The proportion of dry, semi-dry grasslands, one year old intensive agricultural areas, and yards, wastelands dumping sites and acacia forest plantations is quite significant. In addition, another 15 habitats occur here, of which the sand steppe meadows and standing waters are semi-natural habitats, the dry shrub fields of hawthorn, sloe, juniper are degraded habitats and the rests are secondary or artificial habitats. Habitats to be found here have varied rate of natural status. While on the sandy grassland spots having a good status protected species can be found, the more extensive acacia forest areas are poor in species and are characterised by weeds and species tolerant to disturbance.

Csámpa side

The area called Csámpa side is of rather mosaic nature with a lot of habitat types. Habitats belonging to the category of one year old intensive arable culture can be found here in largest extension occurring in the southern part of the area. Next, the acacia and Scots and black pine plantations follow. Yards, wastelands, dumping sites, uncharacteristic dry, semi-dry grasslands, road and railway network, and spontaneous stocks of non-indigenous wood species, villages, village type suburban areas, ranches, family farms and uncharacteristic indigenous hardwood forests also cover larger areas. Another 17 habitat types are present in an extension below 10 hectares. Level of natural status of habitats to be found here is rather varied. The relative richness of the open and closing sandy steppe grasslands having survived on the open areas and having grown undisturbed for a longer time must be highlighted, where the number of protected species such as dyer's bugloss *(Alkanna tinctoria),* feather grass *(Stipa pennata)*, sand feather grass *(S. borysthenica*), *Dianthus serotinus*, *Silene borysthenica* and the *Corispermum nitidum* may occur, but the infection of the area with invasive species such as Canadian fleabane *(Conyza canadensis)* and milkweed *(Asclepias syriaca),* is also quite spectacular. The pioneer associations generated on the wet sand surface of the onetime sand valley of the sandy area must be highlighted which preserve a large items population of a number of protected plants such as marsh helleborine *(Epipactis palustris), variegated horsetail (Equisetum variegatum)*, and *Blackstonia acuminata*.

Sand grassland in the environment of the Paks Nuclear Power Plant

Most of the sand grasslands are open sand steppe grasslands degraded. Scots and black pines and acacia plantations also have a significant share. Another 11 habitats occur on this area each of which is an artificial or secondary habitats. Most of the habitats currently to be found on the area have presumably been under cultivation in former times (grapes on sandy soil) and the current picture is the result of abandonment of the area few decades ago. In patches of grasslands having better status, protected plant species such as ball head onion *(Allium sphaerocephalon),* yarrow *(Achillea ochroleuca)* and dyer's bugloss *(Alkanna tinctoria)* occur here as well.

Marsh forests, marshes, swamp meadows at Dunaszentgyörgy

The swamp meadow at Dunaszentgyörgy is highly valuable for botanic aspects. Habitats belonging to the indigenous uncharacteristic soft wood and pioneer forests can be found here in a large extension within the 3 km radius. These are followed by the eutrophic and mesotrophic reed and Typha beds and communities of herbicious invasive species. Tall herb dry weed in the flood plain and swamps, wet border vegetation in the shadows, indigenous hard wood

uncharacteristic forest, marsh and swamp forest, uncharacteristic fresh grassland and fresh and wet shrubs also have a significant extension here. Another 15 habitat types are present in an extension below 3 hectares. An orchid species under protection, the white helleborine *(Cephalanthera damasonium)* and the Natura 2000 priority species called cirsium *(Cirsium brachycephalum)* can also be found here. The habitats are highly varied to be found here but compared to other areas within the 3 km radius their average natural status is the highest here.

Environment of the fishing lakes

Significant parts of the area of the fishing lakes are covered by uncharacteristic soft wood or pioneer forests and uncharacteristic dry, semi-dry grasslands. Areas covered by scarce tree plantation, park like areas, and trampled weeds are also significant. Out of the another 8 habitats also occurring there, 3 can be considered as semi-natural associations, 2 as degraded habitats, while another 3 are artificially established habitats. No major pond weed vegetation can be found in the artificial lake system. Habitats to be found here have a poor average natural status.

Agricultural areas

Not surprisingly, habitats belonging to the category of annual intensive arable cultures to be found on the agricultural areas are dominant. They are followed by the perennial intensive arable cultures, that is 98 % of this area is covered by arable land. In addition, another 11 habitat types occur representing less than 1 % share of the area, which are the grassland and shrub zones along the edges of the arable lands and the earth roads. Habitats to be found here are rather poor in terms of natural status, that is, quite understandably, it is this area within the 3 km radius which has the poorest average natural status.

Site of the Paks Nuclear Power Plant

Industrial facilities, buildings have the largest extension on the territory of the plant. The proportion of grasslands (uncharacteristic dry, semi-dry grasslands) non-built up but disturbed in between the facilities, and the area occupation by the roads and railways are also significant. Out of the another 6 habitat types also occurring on the territory of the Paks Nuclear Power Plant, five are artificial habitats similarly to the previous. The open sand steppe grasslands having a presence of less than 2 % on the area are the only ones that are natural habitats. On areas covered by concrete but less maintained, scarce weeds vegetation can be found.

Channels and their banks

On the banks of the channels, uncharacteristic dry, semi-dry grasslands occur in largest extension. The tall herb and wet edges vegetation in the shadows flood plains and swamps can also be found here. Another 7 habitat types also occur in addition on a smaller area. Habitats to be found here have poor natural status, are poor in species and have no protected plant species.

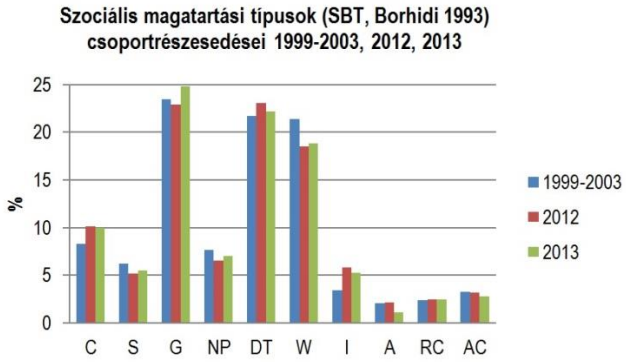
Dunaszentbenedek

This area is characterised to the largest extent by sand, steppe meadows, which is followed in terms of extension by villages, suburbs of village nature, that is, the inner area of Dunaszentbenedek. Populus x. euramericana, indigenous hard wood uncharacteristic forests and annual intensive arable cultures also occur in significant extension. Another 10 habitat types can also be found here on an area under 5 hectares.

18.3.2.1.2 Flora

Comparison with the group share of ecological indices of former surveys (1999–2003, 2012), it can be established that no major change has happened in the flora of the area in the more than 10 years. Species of the ruderal groups dominate the area, but the proportion of stress tolerant species is also significant. This is an evidence of the fact that the area is under strong anthropogenic impact.

The close to 10 % rate of competitor species supports the idea that a large number of species still competitive at low disturbance and stress level are able to find sufficient conditions of living within the 3 km radius, that is, they still find habitats acceptable for them even if not in large proportion.



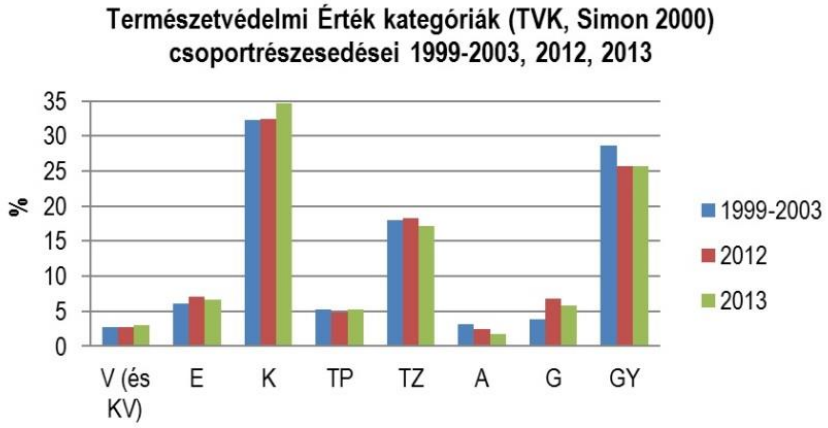
Szociális magatartási típusok - Group shares of Social Behaviour Types

Figure 18.3.2-3.: Group shares of Social Behaviour Types (SBT,[18-14]) 1999-2003, 2012, 2013.

Social behaviour types (SBT) and base value numbers according to A. Borhidi [18-14]:

C = Natural competitors /+5/
ST = Stress tolerant
S = Specialists /+6/
G = Generalists /+4/
R = Ruderal
NP = Natural pioneers /+3/
DT = Disturbance tolerant (in natural production sites) /+2/
W = Native weeds /+1/
Anthropogenic components, alien to the landscape
I = Introduced and escaped cash crops /-1/
A = Adventives /-1/
Competitors of secondary production sites
RC = Indigenous ruderal competitors /-2/
AC = Aggressive competitors non/native to the landscape /-3/

Using a different approach: natural accompanying species, weeds, and disturbance tolerant species are present in the largest proportion, which reflect an area under strong human impact, species representing higher nature protection values are present in significant proportion.



Természetvédelmi Érték katekóriák csoportrészesedései - Group shares of Nature Conservation Value

Figure 18.3.2-4.: Group shares of Nature Conservation Value Categories (TVK, [18-106]) 1999-2003, 2012 and 2013.

According to Nature Protection Value Categories (TVK)– Simon T. [18-106]:

I. Unique species referring to natural status = U

highly protected species = KV
protected species = V
association generating species = E
accompanying species = K
pioneer species = TP
II. Disturbance tolerant species referring to degradation = TZ

adventive species = A
cash crops = G
weed species = GY

Between 1999 and 2013, 832 species were detected in the area, of which 584 were detected between 1999 and 2003, 567 in 2012, and 590 in 2013. Between 1999 and 2003, and 2012-13, a total of 45 species under nature protection disappeared from the 3 km radius of which 32 disappeared between 1999 and 2003, 23 species in 2012 and 34 species in 2013. *See* Table 18.3.2-1.

On the area of the new Paks II. unit, no protected species can be found, on the area to be occupied for construction and along the route of the transmission lines 2 highly frequent and 3 protected species of medium frequency occur.

Note:
1. elegant orchid *(Orchis elegans)*, 2. *Dianthus serotinus*, 3. narrow buckler fern *(Dryopteris carthusiana)*, 4. white helleborine *(Cephalanthera damason)*, 5. feather grass *(Stipa pennata)*, 6. *Centaurea arenaria*, 7. *Blackstonia acuminata*

Figure 18.3.2-5.: Certain protected species of the area of 3 km radius

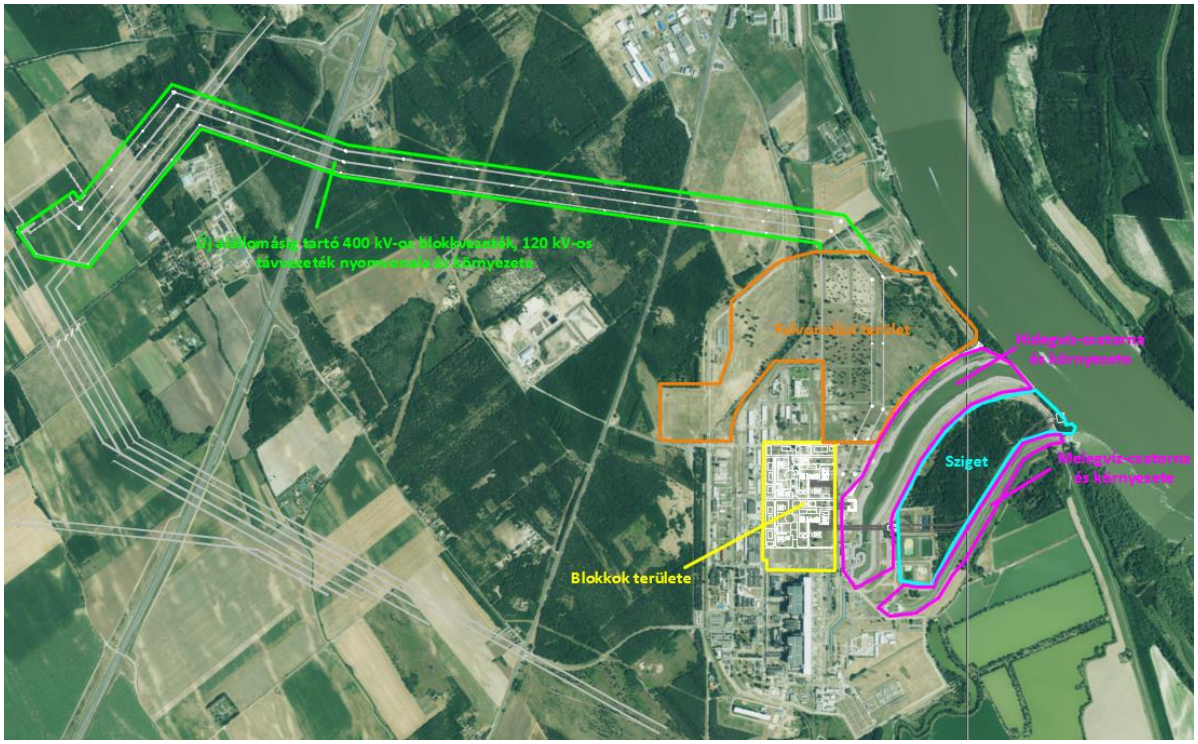
Achillea ochroleuca	Cephalanthera longifolia	Epipactis tallosii	Ornithogalum refractum
Agrostemma githago	Cirsium brachycephalum	Equisetum hyemale	Peucedanum palustre
Alkanna tinctoria	Clematis integrifolia	Equisetum variegatum	Ranunculus illyricus
Allium sphaerocephalon	Corispermum nitidum	Hottonia palustris	Scilla vindobonensis
Bassia sedoides	Dactylorhiza incarnata	Lathyrus palustris	Sedum urvillei subsp. hillebrandtii
Blackstonia acuminata	Dianthus deltoides	Leucojum aestivum	Silene borysthenica
Carex bohemica	Dianthus gigantieiformis subsp. pontederae	Lindernia procumbens	Silene multiflora
Carex paniculata	Dianthus serotinus	Listera ovata	Sorbus domestica
Centaurea arenaria	Dryopteris carthusiana	Lonicera caprifolium	Stipa borysthenica
Centaurea scabiosa subsp. sadleriana	Epilobium palustre L.	Orchis elegans	Stipa pennata
Cephalanthera damasonium	Epipactis palustris	Orchis militaris L.	Thelypteris palustris
			Urtica kioviensis

Table 18.3.2-1.: Protected species of the 3 km radius

18.3.2.1.3 Botanical Description of the Area Intended for Investment and its Direct Environment

Below, we give a detailed description of the areas directly affected by the investment within the 3 km radius.

The areas concerned are shown by the following figure: (Figure 18.3.2-6) The area of the long distance transmission lines within the power plant site are not indicated separately in the figure as it is part of the area to be occupied for construction, therefore, description thereof will be given under that heading.



Legend:
Új alállomásig tartó 400 kV-os blokkvezeték, 120 kV-os távvezeték nyomvonala és környezete - The track of the 400 kV block line and the 120 kV transmission line leading to the new substation and its environment
Felvonulási terület - Temporary construction area
Blokkok területe - Units
Sziget - Island
Hidegvíz csatorna és környezete - Cold water channel and its environment
Melegvíz csatorna és környezete - Warm water channel and its environment

Figure 18.3.2-6.: The site of the investment and its direct environment [18-164]

THE SITE OF THE PAKS II. UNITS

On the site of the planned power plant dry and semi-dry grasslands can be found.

OC – Uncharacteristic dry, semi-dry grasslands

With almost no exception, all grasslands are cultivated by cutting, having a lot of weeds species and although their soil is partly sand, species of sand grasslands are missing. Fresh disturbance of the communities is frequent.

On the construction area, the grassland is characterised by mixed pioneer together with such ordinary species as *Anchusa officinalis, Arrhenatherum elatius, Bromus tectorum, Bromus hordeaceus, Cerinthe minor, Chenopodium album, Convolvulus arvensis, Cynodon dactylon, Dactylis glomerata, Echium vulgare, Equisetum arvense, Erodium cicutarium, Festuca pratensis, Lotus corniculatus, Medicago sativa, Medicago lupulina, Melilotus officinalis, Papaver rhoeas, Poa bulbosa, Portulaca oleracea, Potentilla neglecta, Potentilla reptans, Potentilla arenaria, Potentilla argentea, Rumex crispus, Setaria pumila, Trifolium pratense, Valerianella locusta*. The consistent blanket of *Tortula ruralis* covers about 10% of the area.

No protected species can be found here.

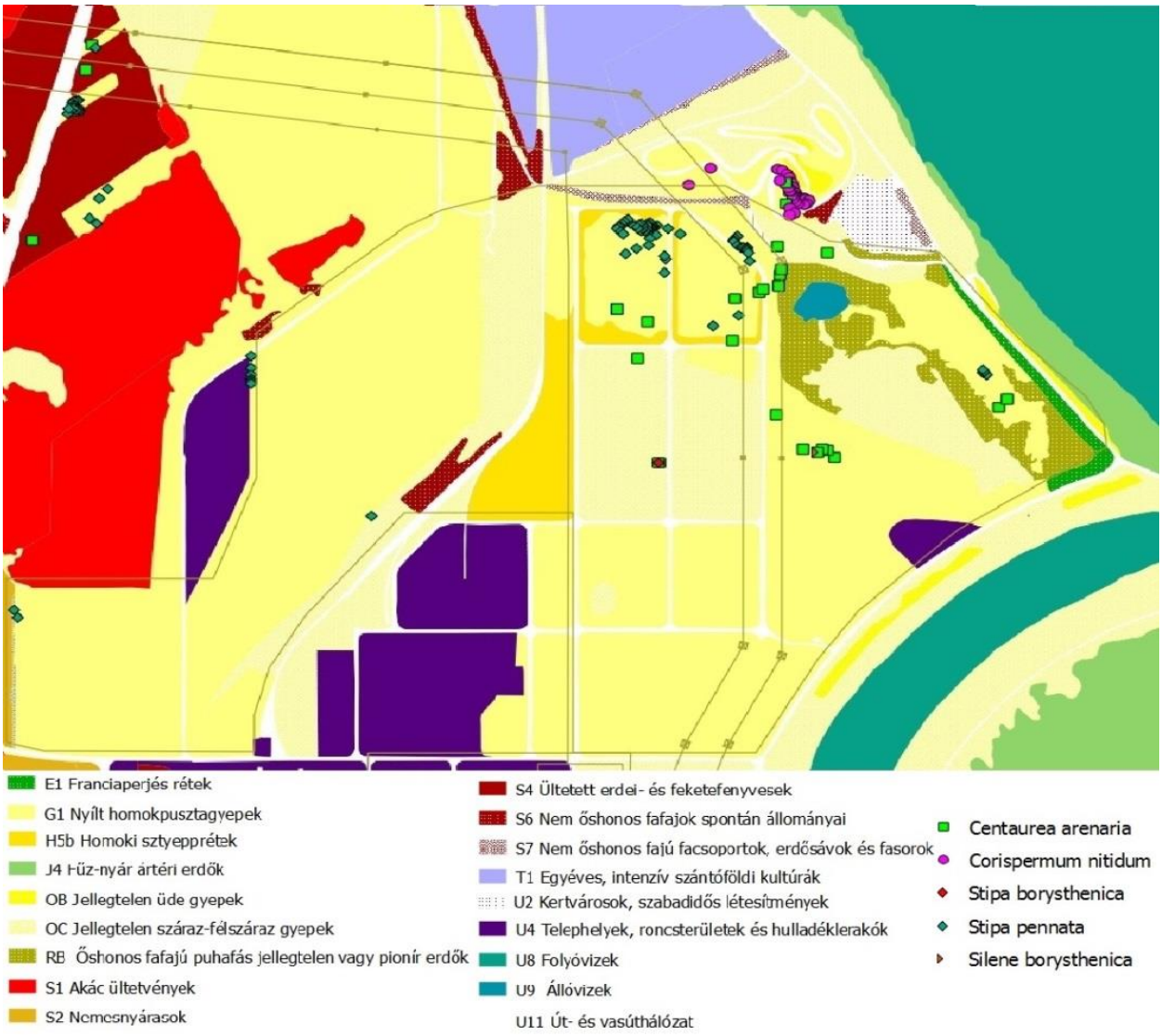
Invasive species: *Asclepias syriaca, Conyza canadensis, Ambrosia artemisiifolia, Erigeron annuus.*

THE AREA TO BE OCCUPIED FOR THE PREPARATION OF CONSTRUCTION OF PAKS II.

The most characteristic plant associations of the area are uncharacteristic dry and semi-dry grasslands, sandy steppe meadows and the indigenous soft wood uncharacteristic or pioneer forests, and open sandy steppe grasslands. In addition, to a smaller extent, non-indigenous and indigenous groups of trees, forest lanes, alleys, standing waters, road and railway networks, uncharacteristic wet grasslands and tall oat grass meadows can also be found.

Figure 18.3.2-7.: Uncharacteristic dry grassland on the area to be occupied for construction

Registered protected plants of the area for the preparation of construction are shown in the vegetation map. *See* Figure 18.3.2-8.



E1 – Franciaperjés rétek - Arrhenatherum hay meadows
G1 – Nyílt homokpusztagyepek - Open sand steppes
H5b – Homoki sztyeprétek - Closed sand steppes
J4 – Fűz-nyár ártéri erdők Riverine willow-poplar woodlands
OB – Jellegtelen üde gyepek - Uncharacteristic mesic grasslands
OC – Jellegtelen száraz-félszáraz gyepek - Uncharacteristic dry and semi-dry grasslands
RB – Őshonos fafajú puhafás jellegtelen vagy pionír erdők - Uncharacteristic or pioneer softwood forests
S1 – Ültetett akácosok - Robinia pseudoacacia plantations
S2 – Nemesnyárasok - Populus × euramericana plantations
S4 – Erdei- és feketefenyvesek - Scots and black pine plantations
S6 – Nem őshonos fafajok spontán állományai - Spontaneous stands of non-native tree species
S7 – Nem őshonos fajú facsoportok, erdősávok és fasorok - Scattered trees or narrow tree lines of non-natives tree species
T1 – Egyéves, intenzív szántóföldi kultúrák - Annual intesive arable fields
U2 – Kertvárosok, szabadidős létesítmények - Suburbs and recreation areas
U4 – Telephelyek, roncsterületek és hulladéklerakók - Yards, wastelands, dumping grounds
U8 – Folyóvizek - Water streams
U9 – Állóvizek – Still waters
U11 – Út- és vasúthálózat - Roads and railroads

Note: representation of the Centaurea and Stipa species is only of indication value because of their presence in large number and the problems with identification due to grass cutting/mowing. They may occur anywhere in the dry grasslands in the area occupied for the preparation of construction.

Figure 18.3.2-8.: Protected plants – area to be occupied for construction and its environment (2013)

OC – Uncharacteristic dry, semi-dry grasslands

Some of the grasslands are degraded with a high rate of weed species (e.g., *Calamagrostis epigeios, Bromus tectorum*) which are quite decisive in the picture of the vegetation. Level of infection by invasive species may also be significant and remnants of former production of non-indigenous species can also be sporadically identified.

Weed species are dominant: *Elymus repens, Ambrosia artemisiifolia, Anchusa officinalis, Apera spica-venti, Bromus inermis, Bromus mollis, Bromus tectorum, Erodium cicutarium, Eryngium campestre, Picris hieracioides, Tragopogon dubius* és *Urtica dioica*. In the grasslands, few character species occur in some individual plants, like *Asparagus officinalis, Carex liparicarpos, Teucrium chamaedrys* and *Verbascum lychnitis*.

Protected species: *Centaurea arenaria, Stipa pennata, Stipa borysthenica*

Invasive species: *Ambrosia artemisiifolia, Erigeron annuus, Asclepias syriaca, Sorghum halepense.*

H5b – Sand steppe meadows

Grasslands are of one level, in addition to the association generating grass species *(Bothriochloa ischaemum, Poa angustifolia, Calamagrostis epigeios)* they are characterised by the occurrence of a number of sandy and dry steppe species.

Characteristic species: *Camelina microcarpa, Chondrilla juncea, Plantago indica, Trigonella monspeliaca, Vicia grandiflora*

Invasive species: *Asclepias syriaca*

RB - Uncharacteristic or pioneer softwood forests of indigenous tree species

Soft wood forests of black poplar *(Populus nigra)* and white poplar *(Populus alba)* with dry uncharacteristic undergrass occur on this area.

Stands are 15-20 m tall with sparse trees of rather different height. Their shrub level is thick, mainly consisting of the species of the foliage (crown) level, grassland level is uncharacteristic.

Characteristic species: In addition to foliage crown level species, weed species are also quite widespread.

Invasive species: *Asclepias syriaca*

S6 – Spontaneous stands of non-native tree species

Exclusive species of the crown and shrub level is the acacia *(Robinia pseudoacacia)*, some white poplar trees *(Populus alba)* can be spotted only in one stand. Grassland level is identical with that of the acacia plantation.

Characteristic species: *Allium scorodoprasum, Asclepias syriaca, Bromus sterilis, Bromus tectorum, Calamagrostis epigeios, Celtis occidentalis, Crataegus monogyna, Cynodon dactylon, Festuca pseudovina, Galium aparine, Glechoma hederacea, Lamium purpureum, Pinus nigra, Pinus sylvestris, Poa pratensis, Populus × canescens, Prunus spinosa, Robinia pseudoacacia, Rosa canina, Rubus caesius, Sambucus ebulus, Sambucus nigra, Urtica dioica.*

Invasive species: *Asclepias syriaca*

S7 – Scattered trees or narrow tree lines of non-native tree species

Acacial lines along roads have been included in this habitats category, which may often include poplar trees.

Characteristic species:

Robinia pseudoacacia, Acer negundo, Populus × euramericana, Gleditsia triacanthos, Populus × canescens, Celtis occidentalis, Pinus nigra, Crataegus monogyna, Sambucus nigra, Rubus caesius, Rosa canina, Prunus spinosa, Calamagrostis epigeios, Poa pratensis, Festuca pseudovina, Cynodon dactylon, Bromus sterilis, Bromus tectorum, Allium scorodoprasum, Glechoma hederacea, Lamium purpureum, Urtica dioica, Galium aparine, Sambucus ebulus.

Invasive species: acacia *(Robinia pseudoacacia),* green maple *(Acer negundo)*

U9 – Standing waters

The standing water in the east part of the area in the uncharacteristic black poplar forest of spontaneous growth belongs to this category.

The pond of limited surface that has developed in a one time clay ditch becomes dry in dry periods, while at other times it has rather high water level due to the high water level of the Danube River. Most of the pond is under shadow due to the poplar trees along its shore, there it has poor vegetation of sparse reeds and individual plants *(Phragmites australis)*.

No invasive species can be found in it.

OB – Uncharacteristic mesic grasslands

These are grasslands in the wet ditches along the routes of the motor cross race field along the bank of the Danube.

Grassland generated on the wet sands not closing due to continuous disturbance, containing weeds in a high proportion.

Characteristic species: *Echinochloa crus-galli, Trifolium pratense, Lotus corniculatus*

No invasive species can be found there.

G1 – Open sand steppes

Some of the steppes are degraded with a high rate of weed species determining the sight of the area. Level of infection by invasive species may also be significant and remnants of former production of non-indigenous species can also be sporadically identified. In some assemblages, species of sand grasses are dominant both in terms of their abandonance and volume, and weeds are less dominant.

In better assemblages, each characteristic species is a sand character species *(Stipa pennata, Kochia laniflora, Fumana procumbens, Festuca vaginata, Koeleria glauca, Centaurea arenaria)*. In more degraded communities, in addition to weeds, the following can also be found: *Silene otites, Euphorbia seguieriana, Bromus tectorum, Medicago minima, Erysimum diffusum, Polygonum arenarium, Secale sylvestre, Plantago indica, Minuartia fastigiata, Carex liparicarpos, Silene conica, Berteroa incana, Salsola kali, Veronica triphyllos, Tribulus terrestris, Anthemis ruthenica*. Not specifically sand plant species present in the grasslands are: *Anthemis ruthenica, Artemisia campestris, Bothriochloa ischaemum, Bromus hordeaceus, Bromus squarrosus, Bromus tectorum, Carex praecox, Carex stenophylla, Cerastium glomeratum, Cerastium semidecandrum, Chrysopogon gryllus, Crepis rhoeadifolia, Cynodon dactylon, Descurainia sophia, Elymus repens, Erodium cicutarium, Euphorbia cyparissias, Festuca rupicola, Koeleria cristata, Linaria genistifolia, Marrubium peregrinum, Marrubium vulgare, Medicago falcata, Medicago minima, Melica transsylvanica, Minuartia glomerata, Myosotis ramosissima, Myosotis stricta, Petrorhagia prolifera, Petrorhagia saxifraga, Plantago indica, Poa bulbosa, Polygonum arenarium, Pseudolysimachion spicatum, Scabiosa ochroleuca, Teucrium chamaedrys, Thesium ramosum, Trigonella monspeliaca, Verbascum lychnitis, Verbascum phlomoides, Veronica hederifolia subsp. hederifolia, Veronica polita, Veronica prostrata, Veronica verna*.

Milkweed *(Asclepias syriaca)* being present in most communities can also be considered a characteristic species, as well as species that are the remnants of the former vine cultivation such as the wine growing grapes *(Vitis vinifera),* peach *(Persica vulgaris)* and quince *(Cydonia oblonga)* represented by a few plants in a scattered manner.

Protected species: *Stipa pennata, Corispermum nitidum, Centaurea arenaria, Silene borysthenica*

Invasive species: The invasive milkweed *(Asclepias syriaca)* is dominant in every aspect, as it is present in all assemblages. In addition the following also occur: *Oenothera biennis, Conyza canadensis, Ambrosia artemisiifolia, Apera spica-venti, Robinia pseudoacacia, Celtis occidentalis, Elaeagnus angustifolia, Ailanthus altissima* and *Ribes aureum.*

Figure 18.3.2-9.: Fumana procumbens on the sandy steppe grassland

U11 – Road and railway network

Some weeds vegetation occurs in a narrow lane along the edges of the asphalt covered roads.

Characteristic species: Almost exclusively weeds and disturbance tolerant species occur: *Descurainia sophia, Conyza canadensis, Minuartia fastigiata, Myosotis stricta, Sorghum halepense, Tribulus terrestris, Veronica triphyllos*

Invasive species: *Conyza canadensis, Sorghum halepense*

RA – Scattered native trees or narrow tree lines

One single forest belt of native and introduced tree species to be found in the vicinity of the motor cross race field belongs to this category.

In a narrow belt, mix stand of black poplar *(Populus nigra)* and acacia *(Robinia pseudoacacia)* with uncharacteristic grassland and shrub level.

Characteristic species: *Populus nigra, Robinia pseudoacacia*

Invasive species: *Robinia pseudoacacia*

E1 – French rye grass meadows

Degraded steppe communities to be found on the east side of the Paks Nuclear Power Plant, on the contained site of the dike must be mentioned.

Steppe grasses of medium height (60-80 cm), closed, poor in dicotyledons.

Grassland characterised by French rye grass *(Arrhenatherum elatius),* with an occurrence of cock's foot *(Dactylis glomerata),* rate of colourful components is insignificant.

No protected or invasive species can be found.

ENVIRONMENT OF THE COLD AND WARM WATER CHANNEL

Figure 18.3.2-10.: Uncharacteristic grassland cultivated by cutting at the cold water channel

OC – *Uncharacteristic dry and semi-dry grasslands*

Dry steppe grasses, usually cut to low height or having a growth on secondary surface.

Characteristic species: *Anchusa officinalis, Arrhenatherum elatius, Bromus tectorum, Bromus hordeaceus, Cerinthe minor, Chenopodium album, Convolvulus arvensis, Cynodon dactylon, Dactylis glomerata , Echium vulgare, Equisetum arvense, Erodium cicutarium, Festuca pratensis , Lotus corniculatus, Medicago sativa , Medicago lupulina, Melilotus officinalis, Papaver rhoeas, Poa bulbosa , Portulaca oleracea, Potentilla neglecta, Potentilla reptans, Potentilla arenaria, Potentilla argentea, Rumex crispus, Setaria pumila, Trifolium pratense, Valerianella locusta .* No protected species can be found. Invasion species: *Asclepias syriaca, Conyza canadensis, Ambrosia artemisiifolia, Erigeron annuus*

OB – *Uncharacteristic mesic grasslands*

Grasslands that cannot be classified among weedy, wet, semi-natural grassland associations belong to this category.

These are grasslands of high stand, poor in species cultivated by regular cutting on the sides of the channels.

These associations are dominated by the species of pasture meadows (*Festuca pratensis, Cynodon dactylon, Arrhenatherum elatius, Elymus repens)*, with a limited number of decotiledons. Invasive species: *Amorpha fruticosa*

U4– Yards, wastelands, dumping *sites*

The covered, bare side of the outflow of the Paks Nuclear Power Plant and the building with its environment to be found at its discharge point into the Danube belongs to this category.

On the steep, concrete covered side of the outflow channel, no higher plants could grow, only cryptogam species occur in abundance together with a few annual flowery plants.

AREA BETWEEN THE COLD AND WARM WATER CHANNEL AFFECTED BY THE INVESTMENT (ISLAND)

Figure 18.3.2-11.: Flood plains willow and poplar forests on the Island in between the channels

J4 – Riverine willow, poplar woodlands

Most of the crown level consists of *Populus nigra* and *Salix alba*, the latter is more characteritic along the edges and directly along the bank. Hybrid *Populus canescens* can also be found.

At lower crown level *Ulmus laevis*, and from among the adventive species *Acer negundo, Fraxinus pennsylvanica, Morus alba*, and in some places *Juglans regia, Pyrus pyraster, Acer campestre* can be found.

At shrub level *Rubus caesius*, along the edges *Amorpha fruticosa* occurs in large numbers, and *Cornus sanguinea*, *Sambucus nigra*, and *Crataegus monogyna* are also frequent.

Along the section directly affected by the investment, in addition to *Solidago gigantea*, the grassland level is dominated almost exclusively by nitrofrequent species: *Urtica dioica, Galium aparine, Stellaria media, Lamium purpureum*.

During springtime, the undergrowth of the flood plain forest is striking yellow in small spots due to the yellow flowers of the *Ranunculus ficaria*.

OC – Uncharacteristic dry and semi-dry grasslands

Associations affected by the planned recuperation power plant and the route of the related channel belong here. Secondary grasslands containing weeds at the side of the dike and along the roads.

Characteristic species:

Dactylis glomerata, Cirsium arvense, Bromus hordeaceus, Ranunculus acris, Plantago lanceolata, Bromus sterilis, Bromus tectorum, Convolvulus arvensis, Poa bulbosa, Lamium purpureum, Silene alba, Poa bulbosa, Arrhenatherum elatius, Capsella bursa-pastoris, Festuca arundinacea, Anchusa officinalis, Cruciata laevipes, Ornithogalum umbellatum, Ornithogalum boucheanum, Alopecurus pratensis, Medicago sativa, Valerianella locusta, Erodium cicutarium, Thalictrum flavum, Taraxacum officinale, Galium aparine, Thlaspi perfoliatum, Medicago lupulina, Reseda lutea, Carduus acanthoides, Lactuca serriola, Buglossoides arvensis, Rumex acetosa, Myosotis arvensis, Vicia angustifolia, Viola arvensis, Veronica persica, Sclerochloa dura, Descurainia sophia, Sisymbrium orientale, Poa pratensis, Euphorbia cyparissias, Cynoglossum officinale, Eryngium campestre

No protected species occur here.

Figure 18.3.2-12.: Ornithogalum species on the slope of the dam on the island (Ornithogalum boucheanum, O. umbellatum)

U9 – Standing waters

Sedimentation ponds situated on the Island east of the plant and their border zones have been classified into this category. Open water surface, free of vegetation. No protected species occur here.

ENVIRONMENT OF LONG DISTANCE TRANSMISSION LINES RELATED TO THE POWER PLANT INVESTMENT

The associations characterised above of the long distance transmission lines route section cutting across the area for preparation of construction are the following: Annual intensive arable fields (T1), open sand steppes (G1), uncharacteristic dry and semi-dry grasslands (OC), closed sand steppes (H5b), uncharacteristic or pioneer soft wood forests of native species (RB), scattered trees or narrow tree lines of non-native tree species (S7), scattered native trees or narrow tree lines (RA).

Associations affected by the route section outside the temporary construction area for construction are characterised by the following:

S4 - Scots and black pine plantations

Coniferous forests are old aged scots *(Pinus sylvestris)* or black pine *(Pinus nigra)* stands, but some stands also include white poplar *(Populus alba)*. Former sand mines have thick young stands with some *Populus alba* mixed in. Their shrub level is mostly missing or is poor, with scarce grassland level with a high rate of cryptogams. Grassland level of the stands shows a lot of similarity with that of the acacia stands but nitrophil species are mostly missing.

S1 – Robinia pseudoacacaia *plantations*

Representatives of different age groups of the acacia stands can be found from the young ones of 6-8 m height to the older of 20 m height. Recently cleared and replanted as well as the spontaneously shooting stocks can also be found. All stands are characterised by the monodominance of acacia *(Robinia pseudoacacia)*. Their shrub level is poor or missing. In grassland level, weeds and disturbance tolerant species are decisive, invasive species are: *Asclepias syriaca, Robinia pseudoacacia.*

OC – Uncharacteristic dry and semi-dry grasslands

With the semi-natural grasslands occurring sporadically on the entire territory, stands not suitable for identification due to the lack of character species have been classified into this category.

Stands: Degraded stands with low height grasses mostly with a significant share of weeds.

Characteristic species: *Achillea collina, Anchusa officinalis, Arrhenatherum elatius, Artemisia vulgaris, Ballota nigra, Bromus hordeaceus, Bromus squarrosus, Bromus sterilis, Bromus tectorum, Calamagrostis epigeios, Cannabis sativa, Chenopodium album, Chondrilla juncea, Cynodon dactylon, Cynoglossum officinale, Dactylis glomerata, Echium vulgare, Elymus repens, Conyza canadensis, Erodium cicutarium, Erophila verna, Eryngium campestre, Euphorbia cyparissias,*

Festuca pseudovina, Galium aparine, Holosteum umbellatum, Lactuca serriola, Lactuca viminea, Lappula squarrosa, Linaria genistifolia, Lotus corniculatus, Melandrium album, Poa angustifolia, Poa pratensis, Polygonum aviculare, Portulaca oleracea, Reseda lutea, Setaria pumila, Setaria verticillata, Taraxacum officinale, Valerianella locusta, Verbascum lychnitis, Verbascum phlomoides, Veronica polita, Veronica triphyllos, Veronica verna, Viola arvensis.

There are no protected species, invasive species: *Ambrosia artemisiifolia, Asclepias syriaca, Conyza canadensis*

G1 – *Open sand steppes*

Associations: Degraded associations with low height grasses mostly with a significant share of weeds.

Characteristic species: In addition to the sand species enabling the identification of the species composition *(Centaurea arenaria, Corispermum nitidum, Corynephorus canescens, Dianthus serotinus, Euphorbia seguieriana, Festuca vaginata, Fumana procumbens, Kochia laniflora, Medicago minima, Plantago indica, Polygonum arenarium, Secale sylvestre, Silene conica, Stipa borysthenica, Stipa pennata, Syrenia cana, Tribulus terrestris)* there are a lot of weeds *(Apera spica-venti)* and invasive *(Ambrosia artemisiifolia, Asclepias syriaca, Parthenocissus inserta)* plant species. Similarly to the acacia plantations and coniferous forests in the environment, fruit trees and ornamental plants remaining from former cultivation can also be found here.

Protected species: *Centaurea arenaria, Corispermum nitidum, Dianthus serotinus, Stipa borysthenica, Stipa pennata, Silene borysthenica*

Invasive species: *Ambrosia artemisiifolia, Asclepias syriaca, Parthenocissus inserta*

U11 – Roads and railroads

Asphalt roads, earth roads and agricultural roads cutting across the area have been classified into this category.

There is no actual vegetation cover in this group as the weeds along the edges of the roads have been classified into the group of 'Uncharacteristic dry and semi-dry grasslands'.

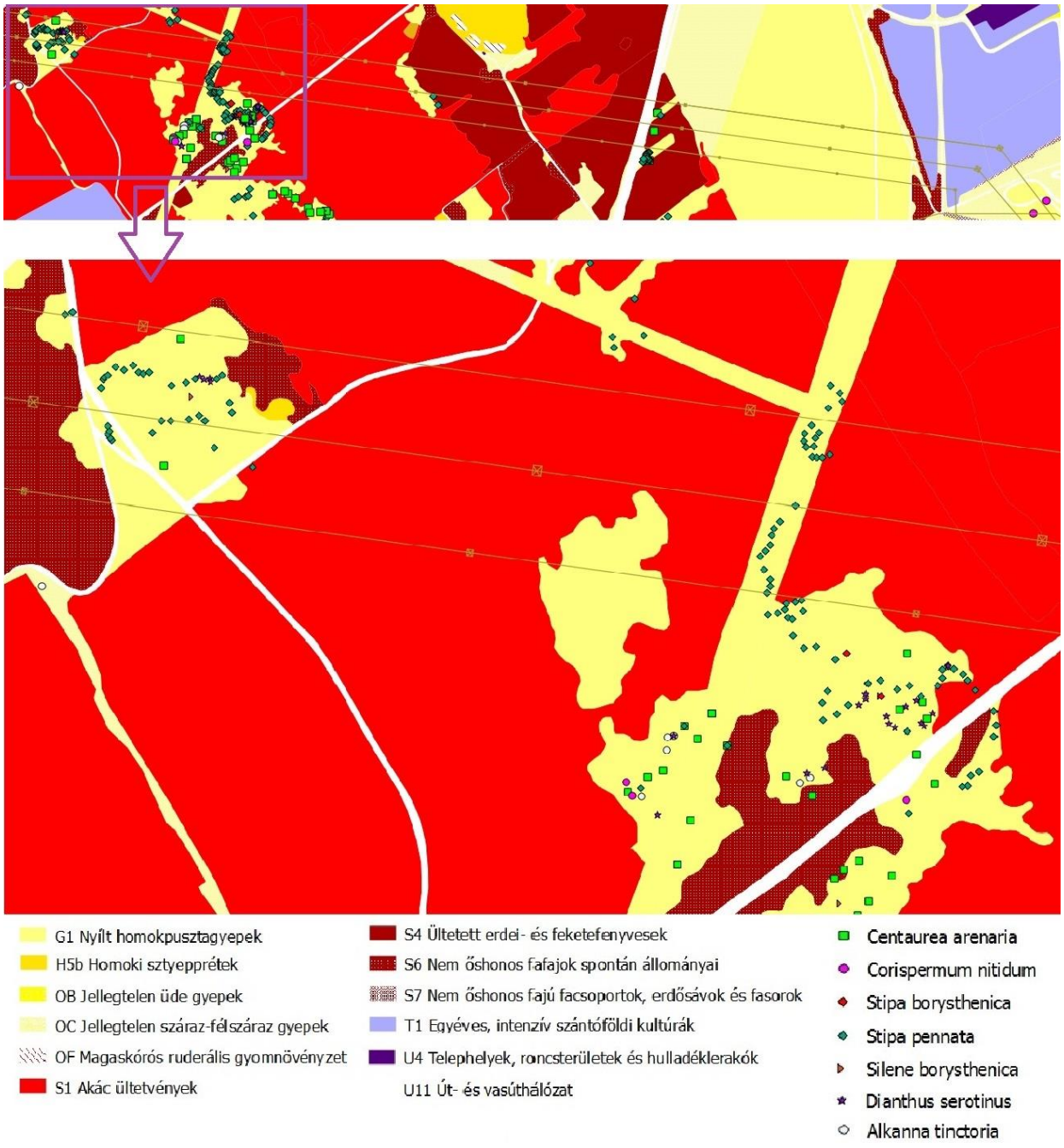
S6 – Spontaneous stands of non-native tree species

Stands: Mostly young stands containing acacia trees of different ages, with grassland level similar to that of acacia plantations. Grey poplar plantations have a similar structure, with a continuous transition between shrub and crown level, both consisting of grey poplar *(Populus x canescens).* Due to the strong canopy impact of the shrub and crown level, grass level is insignificant.

Characteristic species: *Anthriscus cerefolium, Bromus sterilis* and *Calamagrostis epigeios* are rather wide-spread in acacia plantations, but in a small number remnant species of sand steppe *(Bromus squarrosus, Festuca vaginata)* and the fruit trees of the former vineyards *(Armeniaca vulgaris, Cerasus vulgaris, Cydonia oblonga, Morus alba, Prunus domestica)* can also be found there.

There are no protected species, invasion species: *Asclepias syriaca, Conyza canadensis*

Protected plants registered on the route of long-distance transmission lines are shown on the map of vegetation. *See* Figure 18.3.2-13.



G1 – Nyílt homokpusztagyepek - Open sand steppes
H5b – Homoki sztyeprétek - Closed sand steppes
OB – Jellegtelen üde gyepek - Uncharacteristic mesic grasslands
OC – Jellegtelen száraz-félszáraz gyepek - Uncharacteristic dry and semi-dry grasslands
OF – Magaskórós ruderális gyomnövényzet - Ruderal tall-herb vegetation
S1 – Ültetett akácosok - Robinia pseudoacacia plantations
S4 – Erdei- és feketefenyvesek - Scots and black pine plantations
S6 – Nem őshonos fafajok spontán állományai - Spontaneous stands of non-native tree species
S7 – Nem őshonos fajú facsoportok, erdősávok és fasorok - Scattered trees or narrow tree lines of non-natives tree species
T1 – Egyéves, intenzív szántóföldi kultúrák - Annual intesive arable fields
U4 – Telephelyek, roncsterületek és hulladéklerakók - Yards, wastelands, dumping grounds
U11 – Út- és vasúthálózat - Roads and railroads

Note:
In the figure, poles of the planned long distance transmission lines have also been indicated, as a result it is quite apparent that the location of the poles does not pose a threat to protected plants.

Figure 18.3.2-13.: Protected plants – long distance transmission lines and their environment (2013)

18.3.2.2 Zoology

In the 3 km radius of the Paks Nuclear Power Plant, the mosaic landscape and flora are well-reflected by the mosaic fauna. In terms of zoology, the anthropogenic areas are less valuable, they are under major human impacts. The sand steppe grassland spots being a home to valuable fauna are exposed to threat, their area is under decrease and fully disappeared at some points. The Danube River, fishponds, Kondor Lake and channels are the habitats for the aquatic fauna. The aquatic habitats are significant in terms of maintaining the biodiversity of the area (although to a different degree).

In 2012-2013, the zoological samples of model value were taken in six terrestrial and three aquatic areas in the 3 km radius of the power plant. Therefore, descriptions of certain characteristic habitats are provided on the basis of surveys carried out on sampling areas. The following habitats were designated for sample taking:

Aquatic sampling sites:
- Danube River
- Fishponds
- Kondor Lake

Terrestrial sampling sites:
1. Arable land
2. Soft wood gallery forest
3. Site of the power plant (steppe, grasslands)
4. Forest plantation (pine forests)
5. Dry steppes
6 Natural forest

Legend:
Atomerőmű - Nuclear Power Plant
Halastavak - Fishponds
Kondor-tó - Kondor Lake

Note:
Terrestrial sampling sites are indicated by a number, the aquatic ones by a name. 1. Arable land, 2.a and b. (2.a: Island) Soft wood gallery forest, 3. Site of the power plant (steppe, grasslands), 4. Forest plantation (pine forests), 5. Dry steppes, 6. Natural forest

Figure 18.3.2-14.: Location of sampling sites of terrestrial habitats examined [18-168]

Based on the provisions of the appropriate NBmR protocols, the following groups have been studied:

Aquatic macroscopic invertebrates
Orthoptera
- Species
- Communities

Dragonflies
- Flying adders
- Cordulegastridae
- Leucorrhiniae
- Communities

Butterflies
- Day butterflies
- Night butterflies

Soil surface anthropoda
Fish
Amphibians, reptiles
Birds
Mammals
- Tundra vole
- Mound-building mouse
- Bats
- Ground squirrel

Brief general description of the areas studied is given on the basis of the reports by MVM PAKS II. Zrt. [18-85], [18-86], [18-87]

18.3.2.2.1 Description of aquatic habitats

DANUBE

Atomerőmű - Nuclear Power Plant
Duna - Danube

Figure 18.3.2-15.: Danube section within the 3 km radius [18-168]

Aquatic macro invertebrates

On the Danube section at Paks studied, the characteristic direction of water flow is north to south. Overall, the section studied includes a full meander section which starts a slight right curve at the warm water outflow point from the Paks Nuclear Power Plant. In addition to the main river bed, artificial and natural side branches partly closed by stone blocks can be found. A number of different type of dead channels can be found in the flood plain. As a characteristic of the deposit carrying conditions, the section above Paks provides continuous transfer of the deposit in the gravel covered river bed. The river section under Paks stops carrying the deposit, the river bed is sandy, areas are more closed with sludge in the side branches. In accordance with that, the section is characterised by a gravel river bed in the main stream, while in other parts of the main river bed, it is sandy. In more closed areas, and back turning points, the bed is of clay and occasionally covered by detritus mainly in the side branches.

Shorter, longer stone spreadings can be seen on the eroded sides of the curves on the right and left banks under the warm water inflow. On the right bank of the river bed, a number of streamers (stone piles) can be found. The stone work shows homogeneous micro-habitats type where other environmental impacts (e.g., such as the impact of warm water) can be better detected. Habitats conditions of areas with a natural bedding are more varied overall. The banks of natural bedding are bordered by flood plain forest willows and young trees of willows. At times of medium or higher water levels, trees leaning into the water and roots of riparian vegetation reaching into the water provide habitats. Collapsing banks can only be found at 1,525.5 river km height.

The designated Danube section is part of the Natura 2000 network, the special area of conservation of high importance called 'Tolnai-Duna' HUDD20023 published in the Annex of Government Decree No. 275/2004. (X.8.) on the nature conservatiomn areas of European Community importance. In accordance with VKI, the water body code of the section studied is HURWAEP444.

The free flow, 17 km long section of the Danube between 1,533.0 and 1,516.0 river km used as green corridor (examined in 4 cross-sections and 7 sampling districts) is flowing across almost diagonally directly the 3 km and 10 km radius of the Paks Nuclear Power Plant and its Natura 2000 habitats conservation areas. Due to the continuous nature of the river, exploration of the macro-invertebrate communities in the riparian belts on the two types of areas has been carried out by identical methodological approach and evaluation was done in a unified structure. Strictly taken, the 3 km radius is represented by the right-side bank sampling area under the estuary of the Paks Nuclear Power Plant (PA) warm water channel and the left-bank sampling site on the opposite side. The sampling sites to be found on the right bank above and under the warm water channel serve as upstream and downstream references, while the sampling sites examined on the left bank are used for comparison with cross sections.

On the Tolnai-Duna section studied 17 higher categories, including 67 taxons (determined up to the level of 1 subclass, 6 families and 60 species) were found: moss animals (*Bryozoa*), amphipoda (*Amphipoda*), non-biting midge (*Chironomidae*), *Decapoda*, other diptera (*Diptera*), may-flies (*Ephemeroptera*), snails (*Gastropoda*), bed-bugs*Heteroptera*), blood-suckers (*Hirudinea*), isopods (*Isopoda*), mussles (*Lamellibranchiata*), *Mysida*, dragonflies (*Odonata*), *Oligochaeta*, *Planaria*, soksertéjű gyűrűsférgek *Polychaeta*, caddisflies (*Trichoptera*).

The summary faunistic findings of the Tolnai-Duna 1533,0 and 1516,0 river km section give a general and characteristic fauna picture of the macrozoobenthos associations populating the downstream section of the Danube in Hungary (under Budapest). It is dominated by *Amphipoda with a frequency of* 100 %. Ranked 2nd, 3rd and 4th, with 96 % frequency are the family of non-biting midge (*Chironomidae*), the class of snails (*Gastropoda*) and mussel (*Lamellibranchiata*). Fifth is the subclass of *Oligochaeta* (89 %), sixth is the order of *Mysida* (79 %). In addition to groups playing a major role in dominant and benthic turnover, taxons appearing rarely and in small number of items are colourful components of the benthic community. The occurrence of the latter shows a varied picture in space and time behind which we find the fluctuation of water levels, which is the result of the current combination of the habitats heterogenity and seasonal changes.

Characteristic of the fauna of the section studied is that 22 species are invasive (37 % of the species), of which 14 have their origin in the ponto-caspic area. Protected species include: 3 water snails, 4 mussles, of which 3 are rare, 3 are protected, 2 dragon flies and 1 may-fly.

Of the water snails, 3 species, the fagotia (*Fagotia acicularis*), the fagotia esperi (*Fagotia esperi*) and the Valvata (*Borysthenia*) *naticina* are protected. Of the mussels, the river pea mussel *(Pisidium amnicum)*, the nut orb mussel

(*Sphaerium rivicola*) and the solid orb mussel (*Sphaerium solidum*) are rare, the river pea mussel (*Pisidium amnicum*) and the nut orb mussel (*Sphaerium rivicola*) are at the same time also under protection.

The thick shelled river mussel *(Unio crassus)* of high community importance which the priority species of the Tolnai-Duna Natura 2000 site is under protection, which enjoys national level protection pursuant to Decree No. 13/2001. (V.9.) KöM. During the survey performed in 2001-2003 [18-94], it was detected, at the survey in 2009-2010 [18-65] is was not detected, and during the survey of 2012 one item was found [18-85], [18-87]. During our collection in July and October 2013, it was not detected. All this supports the idea that it would be important to carry out targeted monitoring of high frequency in space and time in the future in order to follow up the development of the thick shelled river mussel population on the section examined.

From among dragon flies, the yellow-legged dragonfly *(Gomphus flavipes)* and the fcommon club-tail *(Gomphus vulgatissimus)* are under protection. The yellow-legged dragonfly *(Gomphus flavipes)* is an indicator species of the anthologised or less polluted downstream sections of larger rivers. This species is under decrease in all countries of Europe.

Therefore, this Natura 2000 priority species enjoys a number of protections: Red Book; Bern Convention; Decision on Natura 2000 Habitats; IUCN; NBmR. Of the may-fly, the Danube may-fly (*Ephoron virgo*) is also under protection.

Dragon fly

In the 3 km radius of the power plant, the Dunaszentbenedek section of the Tolnai-Duna HUDD20023 must be highlighted from among the sites studied as the habitats of the yellow-legged dragon fly - *Gomphus flavipes* of the river dragon flies. This species is under protection in Hungary and it is included in List IV of the Decision on Natura 2000 Habitats. Although its stock is not the strongest in this area (Géderlak - Foktő), but can be considered stable. The middle lower section of the Danube cannot be considered as the home of a strong population but it is quite gratifying that in spite of the hydro morphological transformations and pollutions carried by the river, it is still suitable for a breeding site of the yellow-legged dragon fly. From among our rivers in Hungary, the less polluted Tisza, Mosoni-Duna and the Rába and the Dráva lower sections of lower speed flow are the most important habitats of this species. The stone spreading which is used for the purpose of the security of the banks but decreases the natural status of the Danube and the diversity of the habitats should be avoided. The presence and number of the species should be continuously examined (annually) and the most suitable method would be counting the larval exuviums left behind by the imagos slipping out of them.

Fish

On the Danube section studied, we collected a total of 1,989 individual fish item of 9 Natura 2000 fish species (*Aspius aspius* – asp, *Gymnocephalus baloni* – ballon's ruffe, *Gymnocephalus schraetser* – striped ruffe, *Pelecus cultratus* – sabre carp, *Romanogobio vladykovi* – Danube whitefin gudgeon, *Rutilus pigus* – Danube roach, *Sabanejewia aurata* – golden loach, *Zingel streber* – Danube streber, *Zingel zingel* – common zingel) during the survey in 2012-2013. Each of these generally occur on the Hungarian section of the Danube, with respect to abundance, they are relatively rare or of medium frequency with the exception of Danube whitefin gudgeon and asp, which are frequent both in the Tolnai-Duna Natura 2000 site (HUDD2023) as well as in other Hungarian sections. Our surveys have provided evidence to prove that the size of the stocks of the Natura 2000 species in the sections under and above the warm water outflow is in practice identical, the difference between the findings of the two sections is so small that it may be due to accidental sampling mistakes. Therefore, it can be established that the outflow cannot be considered as a disturbing factor from point of view of the survival of the populations. Compared to survey data of 2002-2005, no decline can be detected in the fish stock.

Amphibians and reptiles

At the southern end of the Paks Nuclear Power Plant, south of the warm water channel, a characteristic typical soft wood gallery forest is trenching along the Danube River. This is the Uszódi Island area, which is part of the Tolnai-Duna Natura 2000 site. Adjacent to the Danube, the forest has poor undergrowth, it is richer at higher levels but even there it is mainly characterised by willow bushes and young poplar shoots. Water coverage of the area depends primarily on the actual water level of the Danube therefore, the area can easily be covered by water in a short time. This means that it can be a home only of amphibian or reptile species which are able to tolerate and follow some drastic changes. If flooding takes place during the breeding period of the amphibians, the eggs laid may be carried by water to dry area or may be drifted away at high water level. The occurrence of such species can be expected which at low water level are able to travel from the surrounding higher areas to the remaining dead channels shallow waters. At this section of the Danube, water temperature is higher which is not a definite disadvantage during the breeding period of the amphibians

and the development of the larvae. The slope of the dike is covered by grass associations which is a territory for the lizards.

The survey of the gallery forest and slope of the dike in 2012 provided evidence of the presence of 3 amphibians (fire bellied toad, toad, large frog) and 3 reptile species (green lizard, sand lizard, grass snake). From among the amphibians, the red bellied toad is a species of community importance, though we manage to observe only one item which is an indication of the fact that it is not present in abundance and is not having permanent presence. We have found only one calling male of the toad but it may be presumed that in more favourable years, it uses the shallow water dead channel sections for breeding. The two lizard species use the grassland of the dike slope as their home. We could observe a grown hunting item of the grass snake. This species is a frequent member of the gallery forest. In 2013, further new species have been observed on the area (wood frog, green toad, chequered keel back, European pond terrapin). We were lucky to see a number of individuals of the European pond terrapin and several times.

The Uszódi Island soft wood gallery forests are directly exposed to the water level fluctuations of the Danube River. The number of species occurring here is high but their number of individuals is relatively low, the recently transformed young individuals represented the majority among the amphibians. The number of lizard and turtle/terrapin individuals was also low. The presence of the two priority species (the fire bellied toad and the European pond terrapin) also augments the natural value of the area. Under the outflow of the warm water channel into the Danube at the bank zone, because of the large number of anglers being present (with almost continuous camping on certain sections) human disturbance is quite significant, which is impacting not only the bank lane but extends as far as the gallery forest in the neighbourhood. It would be worth decreasing the rate of the load, which would be favourable not only for the herpetofauna but even for the community of the birds.

Summary description of the area

The aquatic macro-invertebrates fauna shows the general and characteristic picture of the macro-zoobenton associations populating the downstream section of the Danube in Hungary (under Budapest). The protected thick shelled river mussel *(Unio crassus)* of high community importance species has been found in the area. Of the may-flies, the protected Danube may-fly (*Ephoron virgo*) and the also protected species, the yellow/legged dragon fly *Gomphus flavipes* has been found here. We have found a total of nine Natura 2000 priority fish species (*Aspius aspius* – asp, *Gymnocephalus baloni* – ballon's ruffe, *Gymnocephalus schraetser* – striped ruffe, *Pelecus cultratus* –sabre carp, *Romanogobio vladykovi* – Danube whitefin gudgeon, *Rutilus pigus* – Danube roach, *Sabanejewia aurata* – golden roach, *Zingel streber* – Danube streber, *Zingel zingel* – common zingerl). Each of these have general occurrence on the Hungarian section of the Danube, with respect to abundance, they are relatively rare or of medium frequency with the exception of Danube whitefin gudgeon and asp, which are frequent both in the Tolnai-Duna Natura 2000 site as well as in other Hungarian sections. Compared to survey data of 2002-2005, no decline can be detected in the fish stock.

FISHPONDS

Halastavak = Fishponds
Atomerőmű - Nuclear Power Plant

Figure 18.3.2-16.: Location of the fishponds [18-168]

Dragon flies

Managed standing waters of artificial origin loaded by intensive angling activity. They are characterised by organic nutrient surplus and the high number of predators – fish – consuming dragon fly larvae. Their shores are stone or concrete covered for the most part, vegetation is limited to the edge of the shore, floating aquatic vegetation is missing (which means low micro-habitats diversity). Their fauna is rather poor not including protected dragon flies and the five species known from there have broad tolerance ability, are generally widespread and frequent. If angling activity is continued, there is no chance for a positive change in the dragon fly fauna.

Amphibians and reptiles

The lakes of the Paks Nuclear Power Plant Anglers' Association represent a significant and permanent water surface of the neighbourhood. The Paks Nuclear Power Plant Anglers' Associations lakes include the artificially developed Füzes lakes (lakes 4., 5., 6) which are water areas with a uniform shore structure and an average water depth of 1.5 m. Along the shores, willow, poplar and maple trees provide shadow and the slopes of the dikes in between the lakes are cultivated by regular cutting. The Kondor Lake, remaining from a former curve of the Danube is also one of the fishing ponds. It has a water depth of 4-5 m, and its shore has been developed by preserving its natural image at a number of places. Human presence at the lakes is almost continuous which poses more serious disturbance to species living there only at weekends or holidays. In 2012, a total of only 1 amphibian (large frog) and 4 reptile species (European pond terrapin, green lizard, sand lizard and grass snake) have been found. The survey has found less frog species than expected, only the large frog tolerates disturbance and continuous predator presence due to regular fish introduction, characteristic to fishing ponds. The large frog is certainly having reproduction in the lakes as a number of young individuals have been found but there is a very strong pressure on the stock living here. Its tadpole is a prey not only to predators but even to the so-called 'peaceful fish' and its adult items are consumed by both the large body predator fish as well as the heron hunting on the lakes. The chequered quillback was found anew in year 2013. The European pond terrapin was not found in the fishing ponds in any of the years but it has a stronger stock in the Kondor Lake. Not only old but even a young item was found in 2012. Usually a number of items share the better sunbathing sites. They relatively well tolerate the presence of anglers, they are used to them and there is no intentional disturbance against them. Although we have not managed to see any, but in 2012, some anglers said that turtles also live in the fishponds. In 2013, we managed to observe some of the sizeable item of this species. The two lizard species and the grass snake

occur in the grasslands, reed patches and edges of the shores. The presence of a number of young lizards is a sign of steady reproduction. The artificial lakes of the Paks Nuclear Power Plant Anglers' Association provide habitats and reproduction sites to a number of amphibian and reptile species in spite of the almost continuous human presence.

The Paks Nuclear Power Plant Anglers' Association provides a model maintenance of the facility and provides civilised conditions for entertainment for people visiting the place. As a rather positive feature, it is prohibited to drive in by car, people arriving here can approach the lake shore only on foot. During the time of study, we did not experience any activity by the anglers staying there which would have been directly to the detriment of the amphibians and reptiles occurring there. We would recommend, however, that the extensive unified grass surface should not be mowed at once but mowing should be done in a mosaic manner, that is by dividing it into parts and mowing the parts at different points of time. That would enable the insect community of the grassland to survive and have reproduction which would provide continuous food to animal feeding on them on the area.

Summary description of the area

The area is under human intervention, fishing lake management. Accordingly, its fauna is not excessively rich and rather varied due to the intervention (e.g., fish introductions). The artificial lakes of the Anglers' Association provide habitats and reproduction sites to a number of amphibian and reptile species in spite of the almost continuous human presence.

KONDOR LAKE

Kondor-tó = Kondor Lake

Figure 18.3.2-17.: Location of the Kondor Lake [18-168]

Dragon flies

Standing water of natural (dead channel) origin loaded by intensive angling activity. Similarly to fishponds, it is characterised by organic nutrient surplus and the high number of predators - fish - consuming dragon fly larvae. Their shores are stone or concrete covered for the most part, vegetation is limited to the edge of the shore, floating aquatic vegetation is missing (whith low micro-habitats diversity). Their fauna is rather poor (almost identical with hat of the adjacent fish ponds) not including protected dragon flies and the four species known from there have broad tolerance ability, are generally widespread and frequent. If angling activity is continued, there is no chance for a change in the dragon fly fauna.

Fish

The only Natura 2000 fish species of the Kondor Lake under management for angling purposes was the asp (*Aspius aspius*). The size of the population changes in accordance with the number of catches by anglers and the rate of introduction, therefore, the threat the species is exposed to is not worth evaluating. The contribution of the lake to the maintenance of the domestic stock is insignificant.

Amphibians and reptiles

The former Danube band is also one of the lakes of the Paks Nuclear Power Plant Anglers' Association which is operated today as a fish pond. Its deep water built-up shores section is used for angling purposes. The European pond terrapin of community importance occurring here has a stable number. The south-west end of the Kondor Lake, however, is separate from the deep water area with very low water level swampy parts where no human presence can be found. Most of its area is covered by reed and sedge and the open water space is under decrease. As a result of trapping pursued on this site in 2013, the Danube crested newt and in addition the fire bellied toad have been found which are species of community importance.

The Kondor Lake being part of the Paks Nuclear Power Plant Anglers' Association lakes has a special place among the fishponds. Three species of community importance occur on this area (the Danube crested newt, the fire bellied toad and the European pond terrapin). The long-term maintenance of its current status is by all means justified. Special attention should be paid to the swamp that has developed at the south-west end of the Kondor Lake, which is a home to two species of community importance. Proper water depth, maintenance of the current size of water surface and undisturbed conditions may be important.

Summary description of the area

Disregarding amphibians and reptiles, the same can be told about this area as about fishponds from the faunistic aspect. But three amphibian and reptile species of community importance occur on this area (the Danube crested newt, the fire bellied toad and the European pond terrapin). Therefore, maintenance of the current ecological status is justified. A special attention should be paid to the preservation of the swamp that has developed in the south-west end of the Kondor Lake.

18.3.2.2.2 Description of the terrestrial habitats

ARABLE LAND

Figure 18.3.2-18.: Location of sampling site 1 (arable land) [18-168]

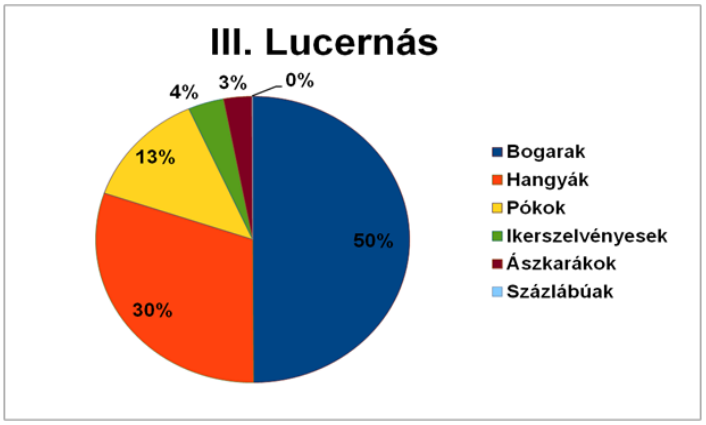
Orthoptera

Areas under agricultural cultivation usually have relatively poor orthoptera fauna. Among these, perennial cultures like alfalfa are able to maintain a slightly richer associations of species, but species occurring here are mostly tolerant to disturbance which colonise arable lands from the adjacent semi-natural grassland habitats. The *Orthoptera* associations of the alfalfa field near the power plant cannot be considered stable as they show rather significant difference in structure in the two years. In total, only one item of a rare species, the orange grasshopper was seen. Overall, the area does not represent significant value with regard to orthoptera.

Butterflies

The Uszód Island light trap throws sufficient light on this area. The trapped species include a number of agricultural pests as well. They have low number of items but that may be rather due to the applied plant protection methods. The daily butterfly fauna is limited to one or two ordinary, broadly spread euryecious species of high dispersion with broad tolerance from the ecological point of view.

Soil surface anthropoda



III. Lucernás – Alfalfa field
Bogarak – Beetles
Hangyák – Ants
Pókok – Spiders
Ikerszervényesek – Diplopoda
Ászkarákok – Isopods
Százlábúak – Centipedes

Figure 18.3.2-19.: Distribution in percentage of anthropoda of soil surface collected on arable land

Beetles (Coleoptera)

In spite of the strong anthropogenic impact, this area has the most diverse ground beetle community. A number of reasons for this may be presumed. The explanation in part may be that the beetles feed on the monoculture crop as a result of which their number is abundent, due to which favourable conditions are created for predators feeding on them, and in part the large number of voles, often falling into the traps and dying there in spite of the preventive measures and occurring in abundance in the alfalfa field. Abundance of species may also be explained by the fact that for practical reasons, sampling was not done in the monoculture itself but on the island within the habitats (at the base of the high voltage poles). The beetle fauna is represented for the most part by the characteristic species of the agricultural areas and for a smaller part, by species migrating here from the neighbouring wet areas. The different brisk bugs (*Anthicus spp., Anthlephila sp*.) have been seen in the largest number, while from among the ground beetles, *Anchomenus dorsalis* and *Calathus fuscipes* have been seen in significant numbers. We managed to detect one single item of one single protected species, the leather beetle (*Carabus coriaceus*) in the area. This species cannot be considered rare as it often occur even on human settlements (synantropic habitats).

Ants (Formicidae)

The area studied is under strong anthropogenic impacts and is situated on an alfalfa field under cultivation and partly on its edge zone. In spite of that, the collected fauna was the richest here due to the known diversity increasing impact of medium level disturbance and the edge zone situation of sampling points (whose impact on increasing the number of items of the species is also known). From diversity aspect, however, the area shows high similarity with the ‘Area to be

occupied for the preparation of construction' (I.) and with the 'Coniferous plantations' (V.). The *Anergates atratulus* found on the area is a real curiosity included among the vulnerable species of the list of the World Conservation Union (IUCN). We managed to catch it twice, a total number of six items. Its occurrence in Hungary has been known so far from a few places.

Spiders (Areneae)

Although this is the area with the largest number of species, but it is difficult to make a comparison with the other because of the superdominance of the wolf spider (*Pardosa agrestis*) and the *Aulonia albimana*. Although a number of species occur here but most of them do not indicate closing communities - just the opposite, in accordance with the nature of the agricultural area - but it indicates slightly but continuously disturbed habitats. Each spider guild group is represented by a number of species (soil surface predators, web spiders, predators on the vegetation).

Amphibians and reptiles

On the southern side of the Paks Nuclear Power Plant, arable fields can be found. Most of the fields are used for producing annual crops or rape but the field selected by us was an alfalfa field, more precisely its edge zone having continuous coverage of a number of years providing relative quietness among cultivated agricultural areas. Our preliminary surveys have shown that the internal parts of the alfalfa field did not provide sufficient space for life neither for the amphibians nor for the reptiles, but the ruderal weed associations of the edge zone and the line of trees consisting of primarily white acacia provided space for certain reptiles to find a home there.

Some items of the green lizard *(Lacerta viridis)* were found in 2012 not in the alfalfa field but in the rudeal vegetation of the edge zone where bushes and trees are lining. In April 2013, no animals could be observed during any of the two sampling times. At the time of sampling in early May, we noticed that the trees of the edge zone were cleared which was a drastic intervention for the reptiles living there. We could not observe lizards during the two sampling occasions in May. At that time we also carried out a survey in the edge zone of the close wheatfield being at a distance of some 30-40 m and having trees therein, we observed one single green lizard during the examination of the 100 m belt. At the time of sampling in August, a total of two green lizards could be observed in the edge zone of the alfalfa field. In 2012, we saw a young grass snake run over by car on the earth road next to the edge zone, most certainly after hatching at the fishing lakes nearby it was looking for a new habitat and feeding site. The one or two green lizards observed occasionally are an indication of the fact that this species can occur even under very harsh conditions.

During the two years study, the arable fields and its edge zone did not show favourable living conditions neither for the amphibians nor for the reptiles. Cultivated arable lands can only be suitable for some amphibian or reptile species occasionally. From nature protection aspect, its value is not significant.

Birds

During 2012-2013, 700 items of a total of 37 species were observed on agricultural areas. Highly protected species observed were: great white egret, white stork, black kite, white tailed eagle, the European bee-eater. The highly protected birds visit the area studied primarily for the purpose of feeding, no clear evidence has been found for their breeding there. We believe that black kite may be nesting on the model area marked 2B to be found adjacent to the area studied and may visit the nearby agricultural areas only for feeding.

According to protection

Year	2012	2013	2012-2013
Highly protected	4	3	5
According to protection	23	23	28
Non-protected	3	4	4
Total	30	30	37

Note: the values stand for the number of items of species

Table 18.3.2-2.: Distribution of bird species observed/heard on agricultural areas according to category of protection

We find it important to mention that the little patch of forest situated along the borders of the area studied increases the number of birds by all means as a number of bird species are breeding on this little line of trees (great spotted wood packer, common chaffinch, common buzzard, common blackbird, song thrush, etc.). The number of bird species and their number of items observed during the two years largely depended on the cash crop sown in the given year. For example, in year 2012, rape attracted a lot of species to the area such as the African stone chat, the whinchat, white wagtail, western yellow wagtail that were missing almost totally from the area in 2013.

As a summary of the results, we may say that the avifauna of the area studied fundamentally does not differ from the avifauna of other areas under agricultural cultivation, the occurrence of species was mostly influence by the agricultural cultivation of the given year. As a number of high voltage poles can be found on the area, we would find it important for the future to examine what level of disturbance or destruction it may cause to the predatory birds feeding on the area.

Mammals

Tundra vole, Mound-building mouse, Bats, Ground squirrel

They do not occur on the area.

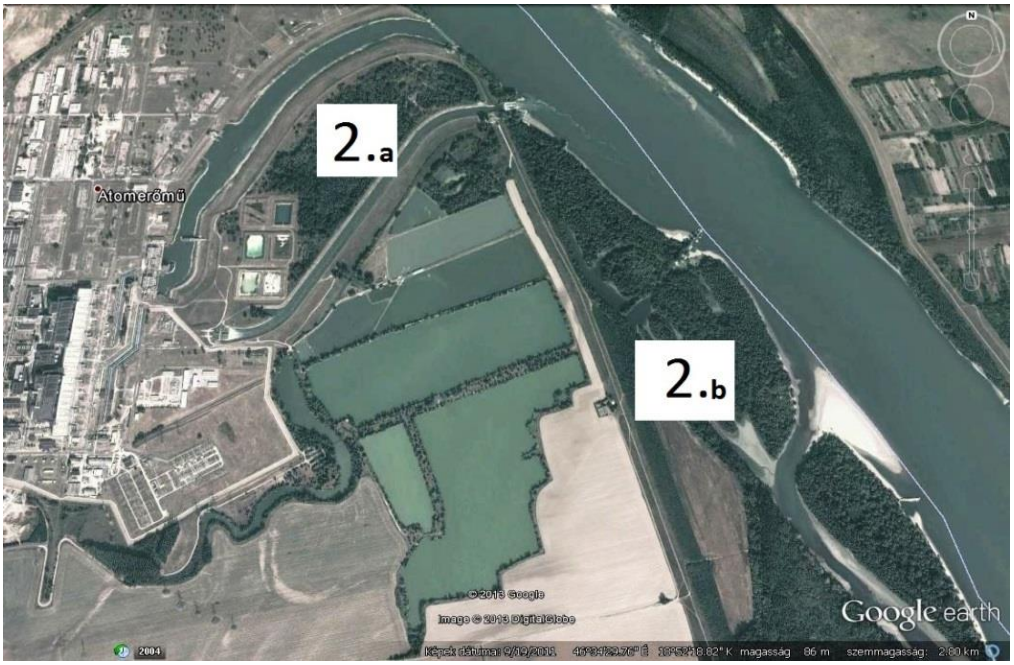
Small mammals from owl pellets

The area is not suitable for the collection of owl pellets.

Summary description of the area

The faunistic value of the area is in line with the value of an average agricultural area. Its only major value is the *Anergates atratulus* ant species found on the area that is included among the vulnerable species of the list of the World Conservation Union. We managed to catch it twice, a total number of 6 items. Its occurrence in Hungary has been known so far from a few places.

SOFT WOOD GALLERY FOREST



Note:
2.a: Island
2.b: Between the Danube and the fishponds

Figure 18.3.2-20.: Location of sampling site 2 (soft wood gallery forest) [18-168]

Orthoptera

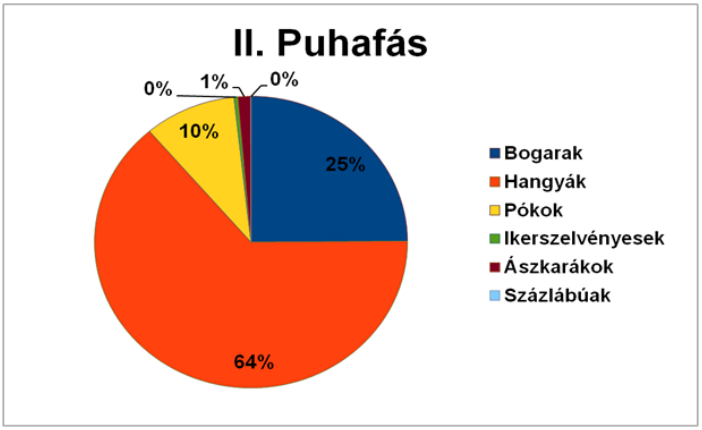
One of the sampling site of the two soft wood gallery forests can be found on the site of the power plant on the Island. This is a relatively disturbed habitats rich in invasive species, which still shows however, characteristics of a real forest in terms of the orthoptera. The majority of the species including e.g., the meadow grasshopper and the tiny shirt horned grasshopper are to be found in the drier grasslands neighbouring the opening forests which are able to live on sunny patches in the forests. In addition to the species giving preference to the more shadowy and wetter micro-climate parts of the grassland level and the originally fresher grasslands of the forest undergrowth (e.g., striped bush cricket, minor meadow katydids), species tied to the forest such as the drumming katydid or the dark bush cricket also occur. A rich community not outstanding overall consisting in part of disturbance resistant species but also showing forest characters can be found here. Presumably it will be continued to be maintained even in case of more significant temporary disturbance. It requires no special protection or intervention.

Butterflies

In spite of the high sampling intensity, the number of species was low (323 Macro- and 261 Microlepidoptera). From fauna geographic aspect, it can be noted that the area studied was dominated by Eurosyberian fauna types as 60% of the species belong to this category. Species of Mediterranean and Boreo-continental fauna types have a smaller share compared to the domestic average as even together they do not amount to the number of Eurosyberian fauna species. Considering the ecological classification of the different species, the euryecious, the silvicol-nemoral and the poplar-willow consuming species make up half of the total number of species. The majority of the species interesting for nature conservation aspects belong to the poplar-willow (e.g., *Apatura metis*, *Neptis sappho*, *Catocala fraxini*), swamp forest-swamp meadow (*Hyles gallii*) and the tall herb weeds (*Diachrysia chryson*) ecological group.

Soil surface anthropoda

Data are from sampling site 2.a.



II. Puhafás – Soft wood
Bogarak – Beetles
Hangyák – Ants
Pókok – Spiders
Ikerszervényesek – Diplopoda
Ászkarákok – Isopods
Százlábúak - Centipedes

Figure 18.3.2-21.: Distribution in percentage of anthropoda of soil surface collected in the Soft Wood Gallery Forest

Beetles (Coleoptera)

The area can be characterised by the beetle fauna characteristic of the flood plain soft wood forests. Its dominant species are *Limodromus assimilis*, *Asaphidion flavipes* and *Elaphrus aureus* that are tied to areas with good water supply. In large item number species like *Pterostichus*, *Bembidion, Agonum, Anisodactylus* characteristic to flood plain forests have been found. From beetle fauna aspect, the area can be considered typical. We identified two protected species on the area: the hygrophil granulated ground beetle moving on the soil surface (*Carabus granulatus*) in a relatively large number (121), which is broadly spread and frequent in flood plain forests in Hungary, and the stag beetle (*Dorcus parelellipipedus*) also under protection caught in the soil trap only accidentally, which is also widespread nationally and considered rather frequent.

Ants (Formicidae)

The fauna explored here shows the typical ant fauna of soft wood forest mixed with flood plain oak, where in addition to the varied species of the foliage level (*Dolicoderus quadripunctatus, Lasuis fuliginosus, Liometopum microcephalum, Temnothorax affinis*), *Myrmica rubra* dominates the soil level. The diversity of the area shows a picture very similar to what was seen in case of the 'Natural forest' (VI.).

Spiders (Areneae)

Very strong wolf spider (*Lycosidae*) dominance can be noted on the area. Over 80% of the specimen collected belonged to this taxon and within this, half of the specimen collected belonged to the *Pardosa lugubris* group. The dominant species is *P. lugubris*, which, in contrast with *P. alacris* species, prefers habitats of better natural status. This shows that it is a better quality habitat. The presence of pirate spider is a sign of wet habitats in the vicinity. In addition to the wolf spider the linyphia – although of frequent disturbance tolerant species – is present which his frequent in more open grassland level forests.

Amphibians and reptiles

Due to the major transformation of habitats during the period of establishment, the territory of the Paks Nuclear Power Plant, with the exception of the forest between the cold and the warm water channel, hardly shows any natural status. This gallery forest was an extremely dry area in years 2012-2013 and was not covered by water even at high Danube water level. During years before that, it may have happened however as signs of flooding can be seen.

Amphibians and reptiles were found only in the edge zones of the flood plain gallery forest ('Island') between the cold and warm water channels of the Paks Nuclear Power Plant. In 2012, we found items of two amphibian and four reptile species, in 2013 of one amphibian and two reptile species. Frogs were detected in the little pond in the clay mine close to the place where the warm water channel comes to the surface and also in the shallow water of the bird observation site established next to it. The number of items is insignificant of the fire bellied toad, only one item was found in 2012 (and not even one in 2013) and not at every sampling occasion. The water space of the bird observation site soon became dry in 2012 and toads left the place. In 2013, this little water area was totally dry in early spring. The fire bellied toad (*Bombina bombina*) is a species of community importance, therefore, its presence in 2012 deserves attention in any case although on the given area it presumably occurs only occasionally or with a smaller stock. Although the little lake with deeper water may be suitable for reproduction but no signs of it could be observed and the bird observation site is only a temporary and rather shallow water space where no reproduction can be expected. Representatives of the marsh frog (*Pelophylax ridibundus*) in the deep lying lake were found in both years. From among reptiles, a species of community importance, the European pond terrapin *(Emys orbicularis)* was also found in 2012. Although it was only one young item, which tried to proceed across the road next to the warm water channel dike and was was run over by a vehicle. Its presence may be due to the fact that the nearby fishpond at a distance of a couple of hundreds of meters is a home and reproduction site to a stable European pond terrapin community and most certainly the young item left the lakes and went up to the dike. The 'Island' gallery forest does not seem to be a suitable habitats for the European pond terrapin in the two bordering channels, water flow is excessively fast and difficult for them to cope with it. In the edge zone of the gallery forest and on the two sides of the road cutting across the forest, items of the brisk and green lizard could be found in both years. For them the trunk of the fallen trees and branches are excellent hiding, feeding and sunbathing sites.

We recommend leaving the fallen, dried out trees in the edge zone of the forest between the warm and cold water channels as they serve as excellent 'fortresses of lizards', keep lizards there looking for sunbathing sites and provide excellent rescue opportunities in emergencies. It is worth maintaining the little pond at the opening of the warm water channel as it may be a reproduction or even hibernation site for the amphibians. The shallow water of the bird watching site has attracted the amphibians (e.g., the fire bellied toad of community importance), but at the same time it also functions as an 'ecological trap', as with no water replenishment, it quickly dries out and forces attracted species items to start migration in an unfavourable dry period. In terms of amphibians and reptiles of permanent stay the flood plain gallery forest between the cold and warm water channel of the Paks Nuclear Power Plant can be considered rather poor, but a number of species may arrive here occasionally from the adjacent fishponds or from the Danube banks (even species of community importance). Therefore, long-term maintenance of the area may be justified.

Birds

On the sampling site called Island marked 2A, we observed 1,426 items of 65 bird species during the two years or heard them sing. The area studied is not a classical soft wood gallery forest but because of the flood plain forests situated below and above this is where they have been classified. Observed, highly protected bird species on sampling site 2A: little egret, while stork, black stork, red kite, black tern, European bee-eater. Most of the highly protected birds have been observed on the area studied several times but we believe that the enlisted highly protected bird species visit the area studied primarily for feeding purposes and within this they visit mainly the waters and the banks of the cold and warm water channels. We saw black storks flying into the area several times but found no evidence of its breeding there.

According to protection

Year	2012	2013	2012-2013
Highly protected	2	6	6
According to protection	33	45	48
Non-protected	8	11	11
Total	43	62	65

Note:
the values stand for the number of species

Table 18.3.2-3.: Distribution of bird species observed/heard on the 'island' area of indication 2A according to category of protection

Based on the observations of the two years, we may say that a number of protected and highly protected bird species may feed (highly protected), and breed (protected bird species) on the area studied, but the reasons for this is mainly the intact nature of the area and not the special conditions of the area. We would advise to have a night time survey conducted as well in the future as the conditions of the area are suitable for the breeding of the night jar. We find it important also because at a distance of 3-400 m from the warm water channel (2B- part of the Tolnai-Duna Natura 2000 site) we heard a night jar during a night survey.

In years 2012-2013, on the sampling site 2B, we observed a total of 1,687 items of 82 species during our surveys. Highly protected bird species observed on the sampling site 2B: great white egret, little egret, while stork, black stork, red kite, black kite, corn crake, black tern, European bee-eater, white tailed eagle. From among these, the following are presumably breeding on the area: red kite, black stork (Géderlak side), black kite.

According to protection

Year	2012	2013	2012-2013
Highly protected	8	9	10
According to protection	45	55	60
Non-protected	10	12	12
Total	63	76	82

Note
the values stand for the number of species

Table 18.3.2-4.: Distribution of bird species detected in the soft wood gallery forest marked 2B according to category of protection

The flood plain gallery forest is a home to a number of bird species breeding in holes in tree trunks, such as the great spotted wood packer, black wood packer, European green wood packer and the lesser spotted wood packer observed in large numbers. Frequent breeding species are the Eurasian nuthatch, the Eurasian golden oriole, the common chaffinch, the marsh tit, the common chiffchaff, the sooty tit, the family Turdidae, and so on. South of the warm water channel a number of dead channels can be found that are feeding sites for the waders, the family anatida, the seagull and the common king fisher. This year in early spring at the beginning of leafing, we made a tour of the area primarily looking for white tailed eagle nest as in 2012 on one occasion we saw one flying off from the area studied. During our tour of the area we did not find the nest but we heard black wood packers 'signing' in a significantly larger number and a little bit

further on than in 2012. We did not have a chance to tour the dead channels in a boat which might be worth doing in the future and look for areas potentially which may be suitable for the hatching of not only the white tailed eagle but even the black stork.

Mammals

Tundra vole, Mound-building mouse, Ground squirrel

They do not occur on the area.

Bats

The Island has a relatively rich bat fauna. We detected six species and the lesser noctule was also found indicating good condition forests from nature conservation point of view. The recording of the ultrasound of Savi's pipistrelle was an interesting result. Water is important for bats both as a place for drinking as well as feeding. The Island is covered by spontaneous forestation, where, due to the vegetation, abundance of insects is larger than in the neighbourhood which is an attraction for the bats and all the trees also offer them accommodation.

Small mammals from owl pellets

No owl pallet was found.

Evaluation - Summary description of the area

The fauna of the area is in line with the fauna of an average soft wood gallery forest along the Danube. A number of protected and highly protected bird species may feed (highly protected), or hatch (protected bird species) on the area, but the reasons for this is mainly the intact nature of the area and not the special conditions of the area. A relatively large number of bat species occur on the Island. Sporadic occurrence of the lesser noctule and the Savi's pipistrelle is rather noteworthy.

SITE OF THE POWER PLANT (GRASSLAND, GRASSES)

Figure 18.3.2-22.: Site of Power Plant 3, location of the area to be occupied for construction (grassland, grasses) and of the sampling site [18-168]

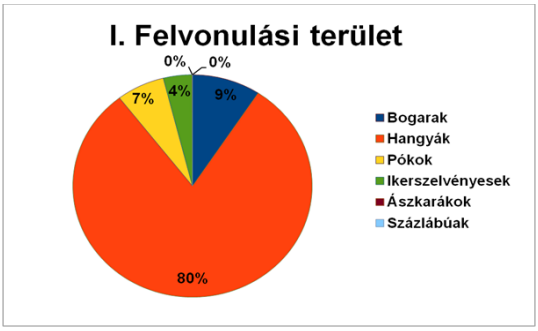
Orthoptera

The dry sand steppe type of habitats to be found on the site of the power plant which some time ago was used as a temporary construction area and since then has been maintained by mowing, is an outstanding area in terms of orthoptherology both in terms of the richness of species as well as the number of valuable species, and it is the most valuable site from among the ones that have been studied. In addition to two protected locust species (slant faces grasshopper and Eurasian pincer grasshopper), another six valuable species have been found including the nationally rather rare field grasshopper a significant population of which was detected in both years of the study. The orthoptera living here constitute a community rich in species characteristic to the sand steppe of the plain, but the presence of the small size field grasshopper make this area unique, valuable on national level as well. It is interesting to see that in spite of the relatively intensive mechanised mowing such a diversity was maintained, although it may be true that the permanent management has made it into such an area and maintains it in that form. The tuberous bush cricket rare orthoptera was found only here and the most abundant population of a number of species was detected only here (e.g., short horned grasshopper, oedaleus decorus, slant faced grasshopper). Their preservation, at least in the smaller patches, would be desirable for nature conservation aspects in the future as well.

Butterflies

The area is strongly secondary, uncharacteristic, frequently mowed, trampled. Due to this, the nutrient plants of species characteristic to sand areas could hardly be found, and the nectar sources were in practice not available. This is the explanation for the fact that from entomology point of view, the small size area does not provide breeding site for butterfly species valuable for nature conservation. Some common species observed occur in much larger number in the neighbouring, less disturbed habitats patches.

Soil surface antrophoda



I. Felvonulási terület – Temporary construction area
Bogarak – Beetles
Hangyák – Ants
Pókok – Spiders
Ikerszervényesek – Diplopoda
Ászkarákok – Isopods
Százlábúak - Centipedes

Figure 18.3.2-23.: Distribution in percentage of the antrophoda of soil surface collected on the site of the power plant

Beetles (Coleoptera)

The area is dominated by xerophilous species, the different *Harpalus* species (H. *autumnalis, H. subcylindricus*), and the species of the family of the darkling beetle family (*Crypticus quisquilius, Opatrum sabulosum*). From among the large size holyvas (*Staphylinina*), the xerophilous *Ocypus ophtalamicus* occurs. Although the diversity of the area can be considered relatively low compared to the other sampling sites, but it is comparable with the diversity of the more natural grasslands included in the study.

Ants (Formicidae)

Dominant species of the area which are present in the largest number are *Tapinoma ambiguum*, *Plagiolepis pygmaea* and *Lasius psammophilus*, which are the typical dominant species of dry loess grasslands and sand grasses. From the aspect of diversity, the fauna of this area is different from that of the other areas studied, but with respect to the frequently occurring species, it is more complex and more diverse.

Spiders (Areneae)

This area has the smallest total number of species, and based on the species there, this may be the least natural habitats with limited vegetation cover. Occurrence in large number of species preferring mainly rocky and natural habitats (*Euryopis quinqueguttata*, *Thanatus arenarius*) together with disturbance tolerating species (*Xysticus kochi*) is somewhat unusual. The presence of *Aelurillus v-insignitus* and *Zelotes longipes* species indicate xerotherm habitats. The protected species was found here in 2013.

Amphibians and reptiles

The area planned for the extension still bears the remnants of the former construction. Significant concrete surfaces, debris piles, holes collapsed and channels can be found. Open surfaces are mostly covered by grassland which are cultivated by regular mowing. All these together promote the settlement of only a few amphibian and reptile species. The direct environment of the sporadic older poplar trees may be a hiding place for the lizards. The planned temporary construction area was exposed to a significant transformation of its surface but as there are no current interventions, the sandy soil with the steppe associations, bushes and trees in patches is a good feeding and hiding place for the lizards. Water flow velocity in the two channels, especially in the warm water channel is so high that it makes the stay of the amphibians and reptiles there rather difficult and can even prevent it. The belt channel near the fishponds is used for adjusting the water level of the lakes, the water flow velocity in the small channel is rather fast not suitable or less suitable for laying egs or staying there.

On the site of the Paks Nuclear Power Plant, on the area designated for extension and for the preparation of construction two amphibian species (green toad and European tree frog) and two reptile species (green lizard and brisk lizard) were found in 2012. Only one item of each frog species was observed, which means that these may have been wandering items, a larger stock cannot be presumed. The extremely dry area may be tolerable for both species temporarily, the hiding places may ensure their survival. Feed is abundant in terms of mainly the orthoptera on the extensive grass surfaces. In both years, only a few items of the brisk lizard was found and they were found mainly in the wet edges of the forest belt close to the River Danube. Green lizard occurs in a surprisingly large number which we could prove in both years. They were found even on barren part of the extension area, where temporary piles of wood and lonely old trees can be found. They took into possession almost all lonely trees, mainly the adult items did so, where they found an adequate feeding, hiding and sunbathing site at the base or on the trunk of the trees. These patches of habitats enable them to survive in spite of regular mowing. Young items have also been seen in a significant number, this is an indication of the fact that they found places suitable for laying their eggs. Significantly more green lizards can be found on the temporary construction site; the habitats here is much more varied ad mosaic. Nutrient supply is abundant here as well. In 2013, we could prove the reproduction of a number of amphibians in the basin of the pump house filled up with water. Tadpoles of the agile frog, common toad, and European tree frog were found (an adult item was found run over by a vehicle on the road leading up to the north gate), but we have also found an adult item of the marsh frog and we also identified the presence of the fire bellied toad. In 2012, we did not manage to find the enlisted species on this area. In the northern end of the temporary construction area, in a ditch, shallow water was collected due to the melting of snow and at the end of the winter and springtime rain in 2013, where the fire bellied toad also appeared. By the middle of summer, the ditch became dry. The fire bellied toad (*Bombina bombina*) is a species of community importance but altogether only one item was found. In spite of its small size, it seems to have a good colonisation capacity. Most probably they get into the internal areas of the Paks Nuclear Power Plant from the direction of the Danube flood plain areas, from the northern end of the temporary construction area situated close to it or along the cold water channel where they are able to maintain a small breeding stock if waters are permanent.

The southern part of the extension area of the Paks Nuclear Power Plant is covered by concrete for the most part but the poplar trees here and in the more northern part of the extension area are sufficient hiding place for the green lizards, the pioneer and dry grasslands provide sufficient insect food, therefore, the number of species may be considered stable. The temporary construction area has a much more varied habitats mosaic, which also has a stable green lizard stock. The number of young items are a sign of successful reproduction. The water covered areas are reproduction site for a number of frog species, but successful metamorphosis takes place only in the water of the pumping site. The herpetofaunistic value of the area is highlighted by the occurrence of the fire bellied toad of community importance.

The most important impact on the site of the Paks Nuclear Power Plant is produced by the temporary mowing of the grasslands. During sampling we saw that the cutting height of the mowing machine is very low, in practice it reaches soil surface. This affects not only the amphibians and reptiles hiding there but even the invertebrates, the insects for the most part. And this may be a significant detriment to the food supply of the other animal species. Our recommendation is

that they should apply a much higher cutting height as it would assist the regeneration of the grassland and give a large chance for rescue of the animals.

The extension of the Paks Nuclear Power Plant exercises its strongest impact primarily on its current area. On the extension area, most certainly the current living space will come to an end it will be built-up and re-arranged. Most probably the items of species occurring there will be destroyed during earthworks. This is more intensively true if works are conducted during their resting period (from November to March). If smallest scale re-arrangement of the terrain is started during their active period, some of the items may flee from the area and hide in the edges to find living area there. The number of lizards on the temporary construction area is significantly higher, therefore, the unfavourable impact, the loss may be of larger extent. It is not a perfect solution but catching most of the items and resettling to nearby habitats may be justified for nature conservation aspects. This operation may be carried out by activists under expert control.

Birds

Our sampling site marked area 3 is situated on the territory of the planned Paks II Paks Nuclear Power Plant from the cold water channel up to unit 2. During the tours in the area in the past two years, we observed or heard a total of 1,329 items of a total of 63 bird species by applying combined method assessment (line transect and score counting). Highly protected species observed were: great white egret, white stork, black stork, black kite, black tern, whiskered tern, European bee-eater. The relatively high number of species is mostly due to the long-term intactness of the area and the mosaic nature of the habitats as a result of which bird species favouring forest, grassland and water habitats find favourable habitats conditions here. This is why a number of times we could see black stork flying into the most undisturbed part of the area.

According to protection

Year	2012	2013	2012-2013
Highly protected	5	6	7
According to protection	35	41	45
Non-protected	10	10	11
Total	50	57	63

Note: The values stand for the number of species.

Table 18.3.2-5.: Distribution of bird species detected on areas marked 3 on the site of the power plant according to category of protection

From among the most interesting bird watches, we would like to highlight the observation of the tawny pipit on two occasions +(2013), which does not exclude the option that this species is breeding within the area studied. Another interesting feature to mention is the common house martin colony of almost 100 pairs which evolved on the huge loading machine next to the cold water channel.

Mammals

Tundra vole, Mound-building mouse, Ground squirrel

Bats

A relatively high number of bat species have been detected on the area. Six bat species have been identified on the area. These species may use the temporary construction area as a feeding site. Results of surveys conducted in the two years show significant differences which is a sign of the significant impact of the years. Two highly protected species, the western barbastelle bat and the pond bat were found in 2012 which probably come to the area for hunting.

Small mammals from owl pellet

No owl pellet was found.

Summary description of the area

As a consequence of no disturbance for a long time fauna rich in species evolved. The orthoptera fauna is outstanding, it is the most valuable from among all the sites studied. In addition to two protected locust species (slant faces

grasshopper and Eurasian pincer grasshopper) another 6 valuable species have been found including the nationally rather rare small field grasshopper, a significant population of which was detected in both years of the study. The ant species *Plagiolepis ampeloni* found on the area is a real curiosity, its occurrence so far has been known only from one place in Hungary. But only one single item of this parasite ant species was found. Green lizard has a surprisingly large abundance on the area. A total of 63 bird species were observed, such as great white egret, white stork, black stork, black kite, black tern, the whiskered tern and the European bee-eater. Six bat species have been detected on the area. These species may use the temporary construction area as a feeding site. Results of surveys conducted in the two years show significant differences. Two highly protected species, the western barbastelle bat and the pond bat were found in 2012 which probably come to the area for hunting.

FOREST PLANTATIONS (POPLAR)

Figure 18.3.2-24.: Location of sampling site 4 Forest plantation (pine forest) [18-168]

Orthoptera

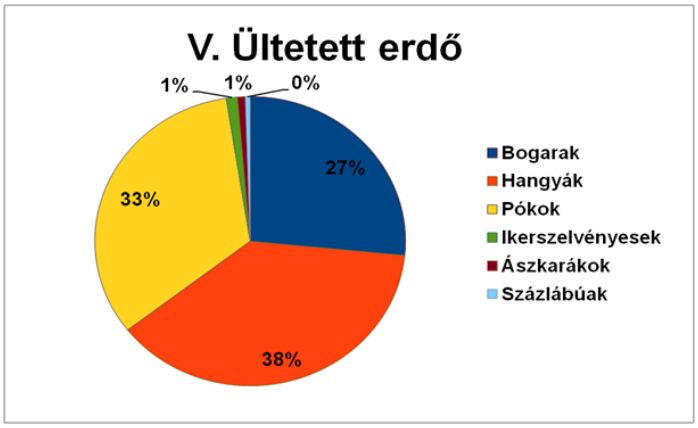
The orthoptera of the pine forest plantation can be best characterised as the community of an impoverished dry grass area. During the two years, a total of ten species were found including one item of the Eurasian pincer grasshopper under protection. Most of the species here have a larger tolerance capacity, they tend to be tolerant to drought (e.g., the sand and common grasshopper, lesser mottled grasshopper, and the Platycleish Grisea). As the sampling site was close to the electricity lines, although the samples were always collected from under the trees, it was quite apparent that most of the items visited the undergrowth of the forest plantation from the adjacent dry steppe belt. In the somewhat thicker undergrowth with less canopy cover some of them may even live permanently there. As it is a pine forest plantation in place of a sand steppe maintained earlier for centuries by grazing of presumably forest steppe or steppe nature, it is mostly unsuitable for the orthoptera originally living in the grasslands, no abundance of species or even valuable species can be expected to be found there. In general, fauna is not representing special value there. It is to be noted however, that on the pine forest plantation planted on the sand steppe, smaller remaining patches of sand steppe can still be found whose extension would have been a fortunate development for nature conservation aspects as these plantations can probably be reconverted to sand steppe relatively easily.

Butterflies

172 species (93 of *Microlepidoptera*, 79 of *Macrolepidoptera*) have been detected by collection on the area. Its butterfly fauna is not very much distinct from that of the dry sand steppe as that was its original vegetation prior to the plantation. The daily butterfly fauna is limited to one or two ordinary, broadly spread euryecious species of high dispersion with broad tolerance from theecological point of view. The vast majority of the items caught were agricultural, forestry pests.

From among the species trapped only *Zerynthia polyxena* and *Euplagia quadripunctaria* were under protection but similarly to *Scopula nigropunctata* and *Cryphia raptricula*, more interesting from faunistic point of view, these could be have only wandering items. It has not proved to be valuable area neither from faunistic nor animal husbandry, nor from nature conservation aspect.

Soil surface anthropoda



V. Ültetett erdő – Forest plantation
Bogarak – Beetles
Hangyák – Ants
Pókok – Spiders
Ikerszervényesek – Diplopoda
Ászkarákok – Isopods
Százlábúak - Centipedes

Figure 18.3.2-25.: Distribution in percentage of the soil surface anthropoda collected on the site of the Forest plantation (pine wood)

Beetles (Coleoptera)

Among the areas included in sampling, this area seems to be the less valuable based on its beetle fauna. This may be due to the non-native tree species of the monoculture forest plantation. Dominant species are the *Syntomus pallipes, Notiophilus sp*., *Calathus fuscipes*, *Amara familiaris*. Its beetle fauna mostly consists of drought tolerant species migrating in from the adjacent areas. The leather beetle (*Carabus coriaceus*) was also detected on the area on the basis of one item. This does not increase the value of the area although it is a protected species which occurs mainly in forests but can often be seen on residential areas, in gardens, on arable lands. In Hungary it is relatively widespread and it is not rare.

Ants (Formicidae)

On these areas, the pine forest plantation is able to maintain surprisingly rich ant fauna. There is no outstanding value of this area but the number of species exceeds expectations. From diversity aspect, this area shows high similarity with the 'Alfalfa field' (III.)

Spiders (Areneae)

In addition to the occurrence in abundance of the wolf spider *(Pardosa alacris)*, the larger item number of *Asagena phalerata* is also worth mentioning. This species can be considered common on edges of forests. Most of the species have medium or even stronger tolerance to disturbance.

Amphibians and reptiles

Opposite to the south gate of the Paks Nuclear Power Plant, a pine forest plantation of large extension can be found. Pine forest is not an optimal life space for reptiles but certain species may occur in edge zones and openings. Our choice fell on a broad opening of this kind to carry out the survey there, where we expected occurrence of lizards on the extremely dry habitats. The water flowing out from the Csámpai Waterworks No. 1 of the Paks Nuclear Power Plant is the almost only permanent water body in the vicinity. It is a shallow water channel next to the earth road.

Amphibians were studied in the outflowing water channel of Waterworks No. 1 of the Paks Nuclear Power Plant, in the neighbourhood of the pine forest plantation. Some items of the marsh frog were found here only in year 2012, in 2013, they were not seen anymore. In the broad opening in the pine forest plantation, only two lizard species (green lizard, brisk lizard) occurred. Both species were detected only in year 2012, in 2013 only one item of the green lizard was seen. In the dry hiding places, the not too rich edge zone was a more favourable living space primarily for the green lizard.

From herpetofaunistic aspect, the edge zone of the pine forest plantation does not represent a significant value, the two lizard species occurring here are of frequent occurrence nationally.

Birds

Sampling area 4 along road 6 includes the forest plantation which for the most part in fact is a pine forest plantation located close to the north entrance to the Paks Nuclear Power Plant. During the surveys in 2012-2013, we saw and we heard 961 items of 48 bird species during our investigation. Highly protected species observed: the European bee-eater. Of the almost 40 protected bird species observed, we wish to highlight the European bee-eater which enjoys high protection and was seen several times on the area studied. The European bee-eater has special requirements concerning hatching which are not available on the area under investigation (loess sandy river wall), therefore, it may visit the area only for feeding purposes. From among the bird species observed during the two years, we would like to highlight the mistle thrush, the collared fly catcher, the spotted fly catcher, the Eurasian golden oriole, the European green wood packer, the great spotted wood packer and the tree pipit and the proof to their hatching within the area was the number of young birds observed during our surveys in July and August.

According to protection

Year	2012	2013	2012-2013
Highly protected	1	1	1
According to protection	33	35	40
Non-protected	5	7	7
Total	39	43	48

Note:
the values stand for the number of species

Table 18.3.2-6.: Distribution of bird species detected in pine forest plantation marked 4 according to category of protection

The richness of species of the area is not different from the richness of species of other areas having similar ecological parameters. Apart from the damage to the picture about the environment, the dumping site in the direct environment does not have any special impact on the species hatching on the area.

Mammals

Tundra vole, Mound-building mouse, Ground squirrel

They do not occur on the area.

Small mammals from owl pellet

No owl pellet was found.

Evaluation - Summary description of the area

Although more interesting, rare, protected species may occur on the area, the pine forest is not having any special importance from the point of view of faunistics.

DRY GRASSLAND

Figure 18.3.2-26.: Location of sampling site 5 (dry grassland) [18-168]

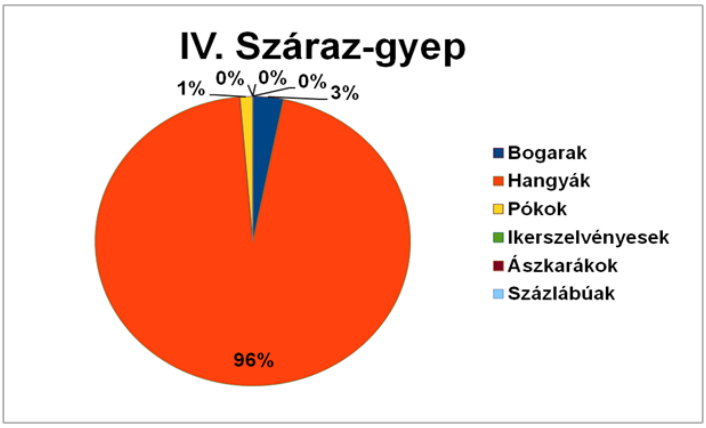
Orthoptera

Extensive sand steppes have been preserved south-west of the Paks Nuclear Power Plant with varied natural status. Sampling of semi-natural dry grasses was conducted on one of its patches. A very similar composition of species to sampling site 3 (power plant site), although with a slightly different structure, was found here. Again the dry steppe species are dominant including a number of rare or protected species. Both protected locusts were found and especially the Eurasian pincer grasshopper was sometimes found in a relatively high abundance. At the autumn sample taking the dominant species was the yellow-winged digging grasshopper that can also be considered valuable. The presence of the blue-winged grasshopper, which was found only here during the studies, as well as that of the small size field grasshopper detected in 2012 is outstanding in the area. In the summary ranking for Orthoptera assets, this habitats was ranked second being just a little bit behind the area of the power plant. Eight protected and rare species were detected on this area as well, but the total number of species was somewhat behind that of the site of the power plant (21, and 18 species respectively). This habitats therefore is by all means valuable locally but it is having a good ranking also in national comparison among sand steppes. In addition, the area is exposed to high threat as, on the one hand, it is in the direct neighbourhood of a sand mine, and on top of that, traces of illegal waste deposition can be identified on areas close to the road and the intensive proliferation of milkweed is at least as serious a problem of the same scale. Unfortunately milkweed invasion of the sand steppe not covered by pine forest yet in the environment of the power plant is a general characteristic which is a strong threat to the entire habitat type even in the middle-term. In order to preserve the habitat, it would be desirable to supress milkweed in the targeted manner and perform its impact monitoring with respect to different sand steppe plant and animal species as, without this, these habitats will certainly be strongly degraded in the long-term and will become fully unsuitable for most valuable sand steppe species.

Butterflies

A total of 168 species were found (96 *Microlepidoptera*, 72 *Macrolepidoptera*). The daily butterfly fauna is limited to one or two ordinary, broadly spread euryecious species of high dispersion with broad tolerance from the ecological point of view similarly to pine forest plantations. The vast majority of the items trapped were agricultural pests. No protected species was found. Some species interesting from faunistic point of view are tied to the Kiskunság sand areas but they all occur on sand steppes of much better condition of the area (e.g., *Oporopsamma wertheimsteini*). This area is not valuable neither for faunistic nor for animal geography nor for nature conservation aspect.

Soil surface anthropoda



IV. Százaz-gyep – Dry grassland
Bogarak – Beetles
Hangyák – Ants
Pókok – Spiders
Ikerszervényesek – Diplopoda
Ászkarákok – Isopods
Százlábúak - Centipedes

Figure 18.3.2-27.: Distribution in percentage of the sol surface anthropoda collected on the area of dry grassland

On dry grasslands, in line with its characteristics, ants are superdominant in terms of their number.

Beetles (Coleoptera)

From the aspect of beetle taxons processed, this area can be considered relatively poor both in terms of the number of species and number of items. For the most part it is due to the features of the area, the fauna detected are characteristic species of the sand steppe. Its dominant species are the drought tolerant darkling beetles (*Crypticus quisquilius, Opatrum sabulosum, Gonocephalum granulatum pusillum*) and the carabid beetle species characteristic to open sand steppes. Two of these, the northern dune tiger beetle (*Cicindela hybrida*) and the *Cicindela soluta* are protected.

Ants (Formicidae)

The area has a definite dry character due to soil scientific reasons. From among the sites studied during the assessment, this area comes closest to the original sand steppe vegetation type in terms of ant faunistics. The joint occurrence of the *Tetramorium* species (*T. ferox, hungaricum and moravicum*) which is rare in Hungary is to be highlighted.

Spiders (Areneae)

Although few spider species occur on the area, they include some interesting ones. The *Xysticus mongolicus* is worth mentioning for whom these steppe patches may be the most western borders of its occurrence. *Zelotes segrex* is also a typical steppe species (was found in 2012) and although it is not rare, it cannot be considered regular either. Besides the more interesting species, species being present almost everywhere and tolerating disturbance very well, such as the nursery web spider (*Pisaura mirabilis*), also occurred.

Amphibians and reptiles

An abandoned sand mine can be found south-west of the Paks Nuclear Power Plant, separated from the protective fence only by a narrow forest belt on part of which a secondary sand steppe association evolved. But on a large part of the area, it is strongly loaded by invasive plant species. White acacia plantation surrounds the grass association, trees on the edges are scarce forming smaller groups of trees. As we presumed the presence of lizards on this extremely dry area in the edge zone, we pursued surveys there.

On the open sand steppe surrounding the one time sand mine, we found no amphibians in 2012, we only found one species of reptiles, the green lizard. In 2013, on the earth road running along the grassland, a young item of the common

toad run over by a car was found. The green lizard can be considered as species of permanent occurrence in 2013 as well. We could not observe them on the mine territory and on the grassland free of trees, but we did observe them in the edge zone. Their strong loyalty to the area tied them to the white acacia tree and almost every single item stayed at the base or on the trunk of a tree.

Only one lizard species, the green lizard (*Lacerta viridis*) has a permanent stay on the dry sand steppe whose stock can be considered stable, with successful reproduction, as its young items have also been seen in a high number. The current lizard stock cannot be considered of outstanding importance from nature conservation aspect, but its maintenance is justified. The status of the area can only be maintained by maintaining the current relative undisturbed nature of the area. The grass association and, through this, the food supply of the lizards living in the edge zones is threatened by the rapid proliferation of invasive plant species.

Birds

Sampling site 5 contains the grassland stretching along the southern entrance to the power plant where during the 2012-2013 surveys, we observed 544 items of 48 bird species. Highly protected species observed: white stork, black stork, European bee-eater. Occurrence of the white stork and black stork on the area is for feeding purposes, they are not breeding there. Concerning the hatching of the European bee-eater we only have presumptions as on the area under study, there are two sand loess slopes which might be useful for the hatching of these species but access to the nests on the declivous side by the predators is easy which may lead to their destruction. It is interesting that in 2012, relatively larger number of African stone chat, whin chat and red-backed shrike were observed compared to 2013. The difference is due to the annually changing cash crops of the neighbouring agricultural areas.

According to protection

Year	2012	2013	2012-2013
Highly protected	3	2	3
According to protection	27	32	37
Non-protected	6	6	8
Total	36	40	48

Note:
the values stand for the number of species

Table 18.3.2-7.: Distribution of bird species detected on grasslands marked 5 according to category of protection

As a number of high voltage poles can be found on the area, it would be important to examine in he future what level of disturbance or destruction they may cause to the predatory and other larger body birds feeding on the area. During the last two years, a couple of times we found dead birds on the high voltage poles (common buzzard, wood packer, Eurasian collared dowe), but the reason for the destruction was not clear in every case and electric shock could not be clearly pointed out as the reason.

Mammals

Tundra vole, Mound-building mouse, Ground squirrel

They do not occur on the area.

Small mammals from owl pellet

No owl pallet was found.

Summary description of the area

From the aspect of the orthoptera, the habitat is valuable locally by all means, but it is true even in national comparison. From among the soil surface antrophoda, a number of relatively rare interesting species occur on this area. In addition, the area is exposed to high threat as on the one hand, it is in the direct neighbourhood of a sand mine, and on top of that, traces of illegal waste deposition can be identified on areas close to the road and the intensive proliferation of milkweed is at least as serious a problem of the same scale.

NATURAL FOREST

Figure 18.3.2-28.: Location of sampling site 6 (natural forest) [18-168]

Dragon flies

The dragon fly fauna shows large differences in the two sampling years. At the first sampling in 2012, in the fast velocity channel, only two white legged damsel flies (*Platycnemis pennipes*) larvae were found. In late August 2013, larvae of 6 species were found (common blue tail - *Ischnura elegans pontica*, scarce blue tailed damsel fly - *Ischnura pumilio*, broad bodied chaser - *Libellula depressa*, southern skimmer - *Orthetrum brunneum*, keeled skimmer - *Orthetrum* coerulescens, white-legged damsel fly - *Platycnemis pennipes*) were found. Of these, *O. brunneum* (under protection in Hungary) has been found only in the Vörösmalmi árok near Dunakömlőd. The exponential increase of the number of species of dragon flies living in the channel may have been caused by the better water supply of this year, but the option of the water drifting down larvae from the upper section of better ecological status cannot be excluded either.

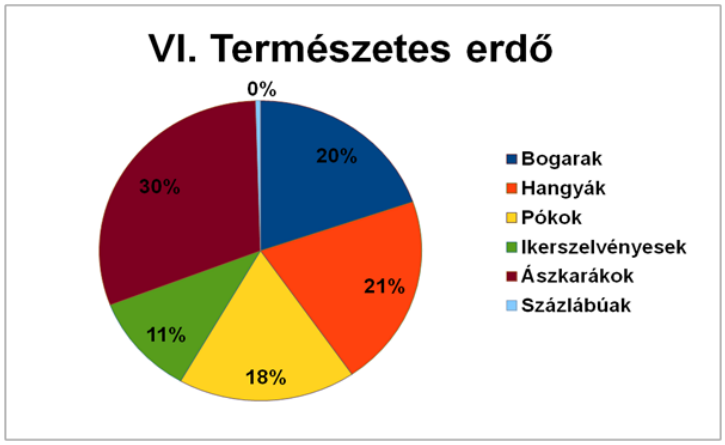
Orthoptera

Sampling site 6 was to be found in the fresh forest block of the Dunaszentgyörgy swamp forest nature protection area in the direction of Dunaszentgyörgy from the power plant (Brinyó forest). Similarly to gallery forest, no high variety could be expected with regard to the orthoptera, but the occurence of some real forest species could be hoped for. During the two years sampling, 10 species were detected. No protected species were found, but there were two, which are more rare and more valuable. The four spot bush cricket is a Mediterranean species, with preference for habitats of warmer micro-climate. Often it is able to live permanently on human settlements (e.g., in city parks or even on bushes, small trees held in buckets), but it can also be found in warmer, drier, semi-natural habitats. It may occur in the gallery forest of our plain countryside rivers, just as well as in a wetter plain area forest. These habitats are characteristic to the valley of both the Danube River and the Tisza River. It can be found in the undergrowth bushes and trees of opening of forests. The other species, tetrigidae, is more tied to the opening part of marsh forests. It lives on the scarce soil surface patches of fresher plain grasslands, where it feeds on moss and algae. Several items were found here and in the habitats of the gallery forest. The marsh cricket favours the same type of habitats which was evidenced here as well. From among the forest dwelling species, the dark bush cricket was found in abundance a couple of times but we detected drumming katydid as well as great green bush cricket tied to trees as well. For orthoptera living in forest habitats, sufficient coverage by undergrowth and sufficient shrub growth for certain species is of primary importance. If forest coverage can be maintained permannetly, the presence of these habitats will ensure the diversity of these communities.

Butterflies

A total of 794 species were found (336 *Microlepidoptera*, 358 *Macrolepidoptera*). Almost 75% of the fauna belong to the Eurosyberian and Boreocontinental fauna type. From the ecological point of view, the silvicol, nemoral, marsh forest, marsh meadow and poplar - willow fauna components represent a large proportion in addition to the euryicous species. The number of moisture loving species was the highest here. Only a few steppe and migrating species were found. From nature protection aspect, in the 3 km radius of the power plant, this area had the most natural and at the same time most valuable butterfly fauna.

Soil surface anthropoda



VI. Természetes erdő – Natural forest
Bogarak – Beetles
Hangyák – Ants
Pókok – Spiders
Ikerszervényesek – Diplopoda
Ászkarákok – Isopods
Százlábúak - Centipedes

Figure 18.3.2-29.: Distribution in percentage of the anthropoda of soil surface collected on the site of natural forest

One of the dominant groups is the isopods *(Isopoda)*, which is fully in harmony with the characteristics of the area: the high moisture content soil of the ash-alder swamp forest at Dunaszentgyörgy is rather favourable for this taxon requiring moisture and high humidity. Although the taxon isopods *Isopoda* is not a group to be determined on species level but it can be ascertained that the species abundance includes species of high and narrow tolerance and high moisture demand.

Beetles (Coleoptera)

Based on the diversity of the samples collected and the characteristics of the habitats, it can be best compared to soft wood forests. In contrast with that, the community consists of less species but the numbers of items are much more balanced and we found no ground beetle species of really high occurrence. Of this family, the granulated ground beetle under protection (*Carabus granulatus*; 31 items), the leather beetle (*Carabus coriaceus*; 39), and the eurytopic hygrophil *Stomis pumicatus*; 30 items were collected in the largest number of items. Based on the traps, which also contained dead small mammals, a relatively large number and varied burying beetle fauna was found (Nicrophorus spp., *Silpha spp*., *Oiceoptoma sp.*). In addition to the ones mentioned above, *Ocypus mus* (22) and *Platydracus fulvipes* (92) holyva species were also found in larger item number. Interestingly the previous species has preference for warm areas, while the latter is a typical holyva species of the wet forest areas.

Ants (Formicidae)

Dominant species of the area are *Myrmica rubra* and *Lasius niger*. The ant fauna of the area studied is fully in line with the fauna of our domestic forests of similar character. It is an average area with no special species to be highlighted, with no special value. Diversity of the area is similar to the fauna of soft wood forest (II.).

Spiders (Areneae)

Trachyzelotes pedestris and *Piratula hygrophyla* indicate more moisty habitats while *Liocranoeca striata* and *Clubiona terrestris* not too frequent and less disturbance tolerant species indicate the relatively good natural status.

Amphibians and reptiles

The remnant of the one time soft wood gallery forest fragmented by arable land parcels has a relatively high extension south of the Paks Nuclear Power Plant. The northern end of the Dunaszentgyörgy forest which is part of the Natura 2000 sites falls within the 3 km radius, therefore, it has also been toured. In the shallow water of the Új-Brinyó forest being closest to the Paks Nuclear Power Plant we presumed the presence of amphibians, while in the drier edge zones, we expected the occurrence of reptiles. Although the channel stretching along the eastern side of the northern end of the Dunaszentgyörgy swamp forest has been toured, but as the temporary water did not provide sufficient life space neither for the amphibians nor for reptiles tied to waters, no regular assessment was performed. Temporarily water is let from the Paks Nuclear Power Plant site to the channel stretching along its western side, which is running along the eastern side of the Dunaszentgyörgy swamp forest. Therefore, temporarily the channel may be a favourable aquatic environment but when water supply comes to an end, it dries out and most of the aquatic community dies. We recommend that in case it can be integrated into the technological order, in between larger temporal discharges, continuous low water level should be maintained in the channel permanently. This would give more chance for the biosphere of the water body for survival.

On the western side of the forest, along the Csámpa road however, certain sections of the brook are broader or have been converted into smaller ponds by the local land owners which are permanent water spaces where the members of the herpetofauna of the area have become concentrated.

In the northern part of the Dunaszentgyörgy forest which is closest to the Paks Nuclear Power Plant we found temporary small water spaces and wet swamp forest patches in 2012, with the occurrence of 3 amphibians (fire bellied toad, European tree frog, agile frog) and 2 reptile species (grass snake, green lizard). We did not find any young or adult items of the agile frog in any of the two years, we only found the eggs and the tadpoles of the agile frog. In 2012, the European tree frog was found in one of the sedges, reeds, hatches of these small water spaces. The fast drying out water covered areas did not provide a permanent living space and reproduction site for the fire bellied toad of community importance still occurring here, therefore, they did not stay. In 2013, a significant part of the swamp forest was under water, the deeper parts provided the continuous water space necessary for laying the eggs and for the metamorphosis of tadpoles. In this extended water area, in 2013, the common newt and the Danube crested newt also appeared with the spade food toad having successful reproduction. In 2013, along the edges of the road, another lizard species, the brisk lizard was found.

In 2012, in the more southern areas of Dunaszentgyörgy swamp forest, 6 amphibians (the Danube crested newt, the common newt, the European tree frog, the fire bellied toad, the agile frog, and the marsh frog) and 3 reptile species (grass snake, brisk lizard, green lizard) were found. The two lizard species were found in the edge zone of the forest. In 2013, ponds were generated in other parts of the forests as well, it may be due to this that in contrast with the former years, neither the fire bellied toad, nor the Danube crested newt were found. On the edges of the area, weekend parcels can be found where during the survey, the landowners explained that grass snakes have a preference for their compost piles to use it for laying their eggs and sometimes they have seen even European pond terrapins. The latter species is also of community importance, it is a priority species, but we were not able to observe it any of the years on this area.

At the northern end of the Dunaszentgyörgy forest, therefore, from among the amphibians, two species of community importance were observed (and indicated by the local residents) (priority species on Natura 2000 site). Although they had a low number of items but in 2012 it was due to the extremely unfavourable water deficient spring and summer period, while in 2013, they were scattered in the water covered areas which decreased the potential of their observation. The area represents high nature conservation value. Important components of protection are maintenance of the mosaic structure, provision of water supply and 61uppression of the invasive species.

Birds

From among the natural forests, the Dunaszentgyörgy swamp forest marked 6 must be highlighted as based on the assessments of the last two years, this is the area, where most birds were observed and this area is ranked second in the list of areas with a largest number of species. Highly protected bird species observed: great white egret, black crowned night heron, black kite, white tailed eagle, the European bee-eater. From among these, great white egret and the black kite are presumably breeding on the area.

Regarding protection

Year	2012	2013	2012-2013
Highly protected	3	4	5
Regarding protection	46	57	61
Non-protected	8	8	8
Total	57	69	74

Note:
Distribution of bird species detected in natural forest marked 6 (Dunaszentgyörgy swamp forest) according to category of protection. The values stand for the number of species

Table 18.3.2-8.: Bird species detected in natural forests marked 6

As it is a Natura 2000 site, we examined which priority species (red backed shrike, black wood packer, night jar) may have hatching on the area. Based on the assessment findings of both years, all three bird species on the list are breeding on the area studied. It is necessary to maintain the continued protected status of the Dunaszentgyörgy swamp forest and direct intervention is not recommended on the area at all. The distance between the central area of the power plant and the edge of the swamp forest is almost 2.5 km, therefore, we do not believe that the eventual power plant development works would have any direct impact on the area. In spite of that, it should be considered whether it would be worth providing continuous monitoring of both the Tolnai-Duna Natura 2000 sites and the Dunaszentgyörgy swamp forest during the entire term of the development.

Mammals

Tundra vole, Mound-building mouse, Ground squirrel

They do not occur on the area.

Small mammals from owl pellets

No owl pallet was found.

Evaluation – Summary description of the area

We found an interesting dragon fly fauna on the area. With respect to butterflies, fauna was most natural on this area from among the area studied. This is where we observed birds in the largest number. Highly protected bird species of the area are the great white egret, the black crowned night heron, the black kite, the white tailed eagle, the European bee-eater. From among these, great white egret and the black kite are presumably breeding on the area. The area represents high nature conservation value. Important components of protection are maintenance of the mosaic structure, provision of water supply and suppression of the invasive species.

18.3.3 BASE STATE OF THE NATURA 2000 SITES TO BE FOUND WITHIN THE 10 KM RADIUS

Natura 2000 sites to be found within the 10 km radius of the Paks Nuclear Power Plant:

- *Area of the Tolnai-Duna (HUDD20023) within the 10 km radius:*
- *Dunaszentgyörgy swamp forest (HUDD20072): 328.03 ha*
- *Crocus repiculatus fields at Paks (HUDD20071): 91.16 ha*
- *Meadows at Tengelic (HUDD20070): Area falling within the 10 km radius*
- *Ground-squirrels field at Paks (HUDD20069): 352.14 ha*
- *Loess valleys of Middle Mezőföld (HUDD20020): Few ten hectares area in the southeast within the 10 km radius*

[18-160], [18-154]

Of the sites enlisted above and described below, the Paks II investment directly affects only one Natura 2000 site, the Tolnai-Duna site. *See* Figure 18.3.3-1.

Közép-mezőföldi löszvölgyek = Loess valleys of Middle Mezőföld
Tolnai-Duna = Tolnai-Duna
Paksi ürgemező = Ground-squirrels field at Paks
Paksi tarka sáfrányos = Crocus repiculatus fields at Paks
Tengelici rétek = Meadows at Tengelic
Dunaszentgyörgyi láperdő = Dunaszentgyörgy swamp forest

Figure 18.3.3-1.: NATURA 2000 sites within the 10 km radius [18-159]

18.3.3.1 Tolnai-Duna (HUDD20023)

Priority habitats types

3130 Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or *Isoëto-Nanojuncetea*

3270 Rivers with muddy banks with *Chenopodion 64onoco* p.p. and *Bidention* p.p. vegetation

6430 Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels

6440 Aluvial meadows of river valleys of the *Cnidion dubiihoz*

91E0 Gallery forests of *Alnus glutinosa* and *Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)*

91F0 Hard wood gallery forest along large rivers with *Quercus robur, Ulmus laevis and Ulmus minor, Fraxinus excelsior* or *Fraxinus angustifolia* species *(Ulmenion minoris)*

Figure 18.3.3-2.: White willow flood plain forest with herbaceous plants at subnudum level

Priority species

Creeping marshwort *(Apium repens)*

Based on the tours of the area, the following can be established:

The priority species cannot be found within the 10 km radius of the Natura 2000 site.

All priority habitats types above occur within the 10 km radius.

Uncharacteristic wet grasslands (Natura 2000 code: 3270) can be observed on the Dunaszentbenedek side on the drying out shelves and in the ditches.

Flood plain and marsh tall weeds with wet fringe plantation (Natura 2000 code: 6430) occurring sporadically on areas between shelves regularly flooded, south of the Imsós forest, on the fringes of former clay mines and smaller dead channels.

Natural pioneer vegetation of wet surfaces on wet muddy surface of dead channels (Natura 2000 code: 3130), and short lifecycle (ephemeral) communities on the banks of the Danube.

Rather large part of the treeless, regularly mowed areas between the dikes of the Danube belong to the category of swamp meadows. (Natura 2000 code: 6440)

The most frequent semi-natural wooded habitats of the Danube section flood plain studied are the willow-poplar flood plain forests and the riparian bush willows (Natura 2000 code: 91E0), which is associated with the shrub size soft wood vegetation of the flood plain along the banks and shelves and which are frequent habitats on the area studied.

The largest and most beautiful stands of the hard wood flood plain forest (Natura 2000 code: 91F0) can be found in the Imsós forest, but fragments of the stand also occur on the eastern bank of the Danube River.

The largest part of the Tolnai-Duna Natura 2000 site within the 10 km radius is covered by willow poplar flood plain forests, accompanied by flood plain bush willows to a varied extent on the river side. Hard wood gallery forests can only be found sporadically with the exception of one larger block in good condition in the Imsós forest. A number of protected plant species including the wild hyacinth *(Scilla vindobonensis)* can be found in the forest in millions of items. Invasive species are also present in large number, among others, at foliage level, the green maple *(Acer negundo)*, while from among the herbaceous plants, the tall white aster *(Aster lanceolatus)* is spreading fast. The indigobus *(Amorpha fruticosa)* is having consistent large stands along the fringes.

Presence of herbaceous vegetation strongly depends on long-term inundations, if this is the case, the different communities cannot evolve on a large part of the area or appear only in small patches. In case of inundation of long duration, natural pioneer vegetation of the wet surface appears only during autumn, while during drier years, they acquire much larger area. At permanent high water level of the Danube, less time is available for the development of taller vegetation in the flood plains. Communities classified as uncharacteristic wet steppe appear only in small area within the 10 km radius.

Aquatic macro invertebrates

Thick shelled river mussel (*Unio crassu*s)

The thick shelled river mussel is the only macroscopic aquatic invertebrate priority species of the Tolnai-Duna. It is a species of Palearctic spreading which is to be found west of the Ural Mountains almost all over Europe. A smaller community of *Unio crassus* occurs at a number of places on the area but in every case, only in one or two items.

Butterflies

Large copper butterfly (*Lycaena dispar*)

In Hungary, they have two genus in some years even three. At end of the summer, early autumn, they have a larger population and then the items are wandering a lot. They occur at a lot of places in marsh and swamp meadows and wet habitats but with a low number of items.

Freyer's purple emperor (*Apatura metis*)

It has two generations, sometimes overlapping. A species broadly widespread along the downstream of the Danube River in Hungary and along the flood plain areas of the Dráva River, feeding on willow. It is a species of riparian soft wood and hard wood gallery forest. This species has a very good capacity of flying, it is very mobile, able to fly for a distance of 10 km.

Fish species

Aspius – asp

Asp is a frequent fish species generally spread in the Danube River and in other larger rivers of Hungary. The site of the population in the Tolnai-Duna section is identical with that of other sections of the Danube River. Its community currently cannot be considered endangered. It is a species used for angling and fishing, therefore fishing/angling potentially influences the size of its population. Preservation of natural banks (gravel shelves) is important in preserving its stock.

Gymnocephalus baloni – balon's ruffe

Balon's ruffe is a protected, endemic fish species (of the Danube River basin) occurring primarily in sections with stone covered banks. Our assessments have found that its population has a relatively small number of items on the Tolnai Danube section, but this statement is generally valid for the entire Danube section in Hungary: this species has a general occurrence but nowhere in abundance. The Tolnai-Duna fulfils a major role in the preservation of its stock in proportion of its area compared to other sections. Currently its stock cannot be considered endangered. Preservation, protection of its stock in the Danube, however, is of outstanding importance as balon's ruffe occurs in few other rivers and nowhere in abundance.

Gymnocephalus schraetser – striped ruffe

Striped ruffe is a protected endemic fish species occurring primarily on natural gravel sand bank sections. It has general occurrence in the Hungarian section of the Danube River and had frequent occurrence on the Tolnai-Duna section as well. It is difficult to make an estimation of the size of its stock, however, because it lives primarily in the deeper sections of the river bed and comes close to the banks in large numbers only during the night. The Tolnai-Duna fulfils a major role in the preservation of its stock in proportion of its area compared to other sections. Currently its stock cannot be considered endangered.

Pelecus cultratus – sabre carp

Sabre carp has rare occurrence in the Danube River and other watercourses of Hungary, the vast majority of its national stock is given by its population in the Lake Balaton. The size of the population in the Tolnai-Duna section is identical with that of other sections of the Danube River. Currently its stock cannot be considered endangered.

Romanogobio vladykovi – Danube white fin dudgeon

The Danube white fin dudgeon is a species of abundance along the natural gravel sandy banks of the Danube River. The Tolnai-Duna fulfils a major role in the preservation of its stock in proportion of its area compared to other sections. Currently its stock cannot be considered endangered.

Rutilus pigus – Danube roach

The Danube roach is a protected endemic fish species with general occurrence in the Danube River but may be characterised with a medium size or scarce stock. Danube roach can be collected close to the banks with a larger potential during night than during day. The exact ecological demand of this species is less known. Currently its stock cannot be considered endangered. The Tolnai-Duna fulfils a major role in the preservation of its stock in proportion of its area compared to other sections.

Sabanejewia aurata – golden loach

Golden loach is a protected species of rare occurrence and less abundance in the Danube River, and it is frequently mainly in the mountainous rivers. Currently its stock cannot be considered endangered. The Tolnai-Duna does not fulfil a major role in the preservation of its fish stock.

Zingel streber – Danube streber

The Danube streber is a highly protected endemic fish species which has frequent occurrence primarily in the mountainous rivers similarly to the golden loach. It was known to be rare in the Danube River, but the recent years have provided evidence that the Danube streber is a frequent species in the deep sections of the river bed far from the river banks. Currently its stock cannot be considered endangered. The Tolnai-Duna section fulfils a small role in the maintenance of its national stock.

Zingel zingel – common zingel

The common zingel is a highly protected endemic fish species occurring in larger rivers, watercourses. It can be considered rare in the Danube, but it is difficult to collect, the size of its stock is presumably underestimated. The Tolnai-Duna fulfils a major role in the preservation of its stock in proportion of its area compared to other sections.

Amphibian and reptile species

In the Dunaszentbenedek forest the fire bellied toad (*Bombina bombina)* and the European pond terrapin (*Emys orbicularis),* at the Uszódi Island, the fire bellied toad, in the Imsósi forest the fire bellied toad, the European pond terrapin and the third priority species, the Danube crested newt *(Triturus dobrogicus)* were found, while in the Foktői forest, none of the priority species could be found.

Bird species

On the list of priority species of the area, three bird species are included, the European night jar (*Caprimulgus europeus*), the black wood packer (*Dryocopus martius*) and the red backed shrike (*Lanius collurio*). Evidence of breeding of all three bird species has bee found on the area. We heard the European night jar several times during our late night surveys in the forests towards the Danube fringing the Imsósi forest, a bit further north in the Dunakömlőd forest, along the dead channels of the Uszódi forest (along the dead channel close to the camping site), in the flood plain gallery forest south of the warm water channel, and on one occasion even in the pine forest of the power plant parking site. We

had similar experiences with the black wood packer, the difference being that it is hatching in a significantly larger number on the area mentioned than the European night jar does. The red backed shrike occurs in a large number and may be breeding along the edges, bushes and hawthorn bushes fringing the above mentioned areas.

18.3.3.2 Dunaszentgyörgy swamp forest (HUDD20072)

Priority habitats types

6430 Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels

6510 Lowland hay meadows *(Alopecurus pratensis, Sanguisorba officinalis)*

91E0 Alluvial forests of *(Alnus glutinosa)* and *(Fraxinus excelsior) (Alno-Padion, Alnion incanae, Salicion albae)*

91F0 Hard wood gallery forest along large rivers with *Quercus robur, Ulmus laevis and Ulmus minor, Fraxinus excelsior* or *Fraxinus angustifolia* species *(Ulmenion minoris)*

Note:
Open white willow swamp forest in the south of the Dunaszentgyörgy swamp forest with mosaics of tussock, duckweed and glyceria

Figure 18.3.3-3.: Open white willow swamp forest in the south of the Dunaszentgyörgy swamp forest

Priority species

Cirsium *(Cirsium brachycephalum)*

Based on the tours of the area, the following can be established:

The priority species, cirsium, occurs in a number of habitats types on the area, it is characteristic of the non-sedge communities, and in its transitional forms with swamp meadows, but it also appears in tall herb vegetation, willow poplar swamp forests and wet shrub vegetation as well. It cannot tolerate regular mowing, on mowed swamp meadows it occurs only along the fringes.

The entire area of the Dunaszentgyörgy swamp forest Natura 2000 site falls within the 10 km radius, and within this, its northern part falls within the 3 km radius. 2% of this area is covered by standing water and water streams, 3% by swamp and marsh meadows, 30% by wet and mesophilic grasslands, 60% by deciduous forests and 5% by monocultures of artificial woodland plantations.

All priority habitats types occur on the area studied.

The mesotrophic wet meadow (Natura 2000 code: 6510) is one of the most frequent habitats type of the Dunaszentgyörgy swamp forest, its most beautiful and largest consistent stocks can be found in the south of the area but sporadically it is present on the entire area. It is a grassland type of two levels, dominated by high swards in the upper herbaceous level mixed with sedges and dicotyledons of conspicuous colour flowers. The swamp and marsh forests (Natura 2000 code: 91E0) can be found in the standing water parts, lying in the deepest part of the Natura 2000 site. On the deepest areas covered by water for the longest time elder sub-types, on areas covered by water for a shorter while white willows, on the highest areas regularly drying out in early summer white poplar and on even higher areas black poplar sub-types can be observed. Only remnant spots of the hard wood flood plain forest (Natura 2000 code: 91F0) occur in the Dundaszentgyörgy swamp forest. The riparian and marsh tall herb, shadowy wet fringe vegetation are frequent characteristic habitats type category heavily loaded with invasive species (Natura 2000 code: 6430), characterised by a plant community dominated by high dicotyledons.

Soil surface anthropoda

Great Capricorn beetle (*Cerambyx cerdo*)

Its presence was not observed on the area.

Stag beetle (*Lucanus cervus*)

Its presence was not observed on the area.

Amphibian and reptile species

Fire bellied toad (*Bombina bombina)*

The fire bellied toad (*Bombina bombina*) was found at an artificial lake ('Big Lake' – „Nagy tó") and in the tussocky, shallow water area in its vicinity. In summer time, when the tussock sedge wet area becomes dry, they leave the area.

Bird species

On the list of priority species of the swamp forest, three bird species are included, the European night jar (*Caprimulgus europeus*), the black wood packer (*Dryocopus martius*) and the red backed shrike (*Lanius collurio*). All three bird species are breeding on the area studied and not surprisingly, the red backed shrike does so in the largest number.

18.3.3.3 Crocus repiculatus field at Paks (HUDD20071)

Priority habitats types

6250 Pannonic loess steppic grasslands

Based on the tours of the area, the following can be established:

The entire area of the Natura 2000 site crocus repiculatus field at Paks is within the 10 km radius. It is 130-170 m above sea level. Based on our up-to-date estimation, some 30% of its area is covered by dry grasslands, 45% by closing thorny shrubs (primarily 68onocoty hawthorn and blackthorn), and 25 % is covered by deciduous woody vegetation.

One single Natura 2000 priority habitats can be found here, the loess steppic grassland, 'steppe meadows of compact soil of pannonic loess steppic grasslands' (Natura 2000 code: 6250). The largest value of the area is represented by the crocus repiculatus occurring here in a largest number of items (several thousands of stems), one of the largest stock of which was destroyed in 2013 when the grassland was ploughed up.

Figure 18.3.3-4.: Crocus reticulatus

None of the priority bat species was found : mouse eared bat (*Myotis myotis*), bechstein's bat (*Myotis bechsteini*), western barbastelle bat (*Barbastella barbastellus*).

The presence of neither the great Capricorn beetle (*Cerambyx cerdo*), nor of the stag beetle (*Lucanus cervus*) was observed on the area.

18.3.3.4 Meadows at Tengelic (HUDD20070)

Priority habitats types

6260 Pannonic sand steppes

91E0 Alluvial forests of *(Alnus glutinosa)* and *(Fraxinus excelsior) (Alno-Padion, Alnion incanae, Salicion albae)*

6510 Lowland hay meadows *(Alopecurus pratensis, Sanguisorba officinalis)*

6440 Alluvial meadows of river valleys of the *Cnidion dubiihoz*

Priority species

Sand iris *(Iris humilis ssp. Arenaria)*

Based on the tours of the area, the following can be established:

The priority species cannot be found on the Natura 2000 site within the 10 km radius.

A very small (0.43 hectares) eastern part of the area falls within the 10 km radius. Most of this area is on sandy soil. It is dominated by 'forest' plantations and spontaneous forest characterised by the dominance of non-native tree species. The most characteristic habitats are: plopi eur americani, acacia plantations, other non-native deciduous forest plantations, mainly common hachburry *(Celtis occidentalis)*, in a smaller part honey locust *(Gleditsia triacanthos)*, scots and black pine plantations, spontaneous stands of non-native tree species (common hachburry – *Celtis occidentalis*, honey locust – *Gleditsia triacanthos*, tree of heaven – *Ailanthus altissima*, green 69onoc – *Acer negundo*), and all kinds of mixture of these, that is, pine forest mixed with indigenous deciduous tree species and non-native deciduous and mixed forests mixed with indigenous deciduous tree species. They have preserved indications of former English oak (pedunculate oak) forests like the lily of the valley *(Convallaria majalis)*, herb bennet *(Geum urbanum,* the male fern *(Dryopteris filix-mas)* and giant fescue *(Festuca 69onocotyl).*

Figure 18.3.3-5.: Alder swamps at Hotel Orchidea

More natural vegetation can be better found under the channel with better water supply and the deeper lying plopi euramericani and black poplar clone plantations in the standing water areas as well as along the channels and in the southern part of the area, in the artificial fishpond and on the fringes thereof of Hotel Orchidea. In largest extension unfortunately the uncharacteristic wet grasslands, uncharacteristic dry and semi-dry grasslands and communities of herbaceous invasive species can be found here as well. Habitats, which can be considered close to natural are the non-tussocky high sedge meadows of small extension *(Caricetum gracilis, Caricetum acutiformis, Galio palustris – Caricetum ripariae)* and the pondweed of standing waters of water of low velocity flow. More valuable for nature conservation aspect is a marsh white poplar stand with non-tussocky weedy undergrowth poor in species in the vicinity of the channel cutting across the area.

During our tour of the site, we found an alder swamp forest which is a priority habitats type (Natura 2000 code: 91E0) of about half a hectare with standing water in the northern part of the artificial lake of Hotel Orchidea.

Soil surface anthropoda

We observed neither the great Capricorn beetle (*Cerambyx cerdo*), nor of the stag beetle (*Lucanus cervus*) on the area.

Amphibian and reptile species

Fire bellied toad (*Bombina*)

The fire bellied toad could be observed on the sampling site north of the Orchidea Lake in both years, it can be considered as a permanent component of the fauna there. Its number of items can be considered high compared to the small water body, the period from the middle of April to middle of May prove to be the most suitable period for their observation. Beyond the Orchidea Lake, the species also occurred in the adjacent Bogárzó Lake and its downlet channel (neighbouring the Natura 2000 site) as well as in a number of water spaces of the Nyulas Lake.

Bird species

On the priority species list, three bird species are included (the European night jar, the black wood packer, red backed shrike), of which we could observe the breeding of only the red backed shrike in the environment of Hotel Orchidea (the lake, the surrounding forest and the grasslands along the road). Naturally it does not exclude the possibility of the European night jar and the black wood packer breeding on the territory of the meadows at Tengelic but they do not breed on the areas we have studied.

Mammals

We found neither the mouse eared bat (*Myotis myotis*) nor the Bechstein's bat (*Myotis bechsteini*) nor the western barbastelle bat (*Barbastella barbastellus*).

18.3.3.5 Ground-squirrels field at Paks (HUDD20069)

Priority habitats types

6260 Pannonic sand steppes

6440 Alluvial meadows of river valleys of the Cnidion dubii

Priority species

Creeping marshwort *(Apium repens)*

Based on the tours of the area, the following can be established:

In the northern part of the area, the creeping marshwort is breeding in a recess surrounded by European meadow rush *(Juncus inflexus)*, while in its southern habitats, it is breeding in a recess surrounded by tussock sedges. These habitats are intensively grazed and trampled, probably this is what maintains the appropriate conditions for the long-term maintenance of creeping marshwort on the ground squirrel field at Paks.

The pannonic sand steppe habitats cover 60% of the Natura 2000 site. The open sand steppes and sand steppe meadows are also included here. The open sand steppes are larger, bare, open steppes dominated by tussocky swards on a soil surface covered to a small or large degree by mosses and lichen. Sand steppe meadows are closed sand steppe grasses where the soil is fully covered by herbaceous plants. Its dominant sward is the meadow fescue growing in bunches, but much larger polikormon of the holoschoenus romanus can be seen in it. More or less conspicuous dicotiledons determine its physiognomy. Priority habitats taking 5% of the Natura 2000 site are alluvial meadows of river valleys of the *Cnidion dubii.* The landscape is determined by high grassland generating and tussocky 71onocotyledon species and colourful flowering dicotiledons.

Note:
In the forefront, grazed marsh meadow surrounded by tussocky sedges, the habitats of the protected creeping marshwort, in the background mounds covered by open sand steppes

Figure 18.3.3-6.: Habitats of the protected Apium repens

Mammals

The ground squirrel stock (*Spermophilus citellus*) of the ground squirrel field at Paks is more and more limited to the direct environment of the earth road of frequent use cutting across the area in the middle. Beyond a distance of 100 m from the road, squirrel hole in use can hardly be found. In addition, grazing the ground squirrel field at Paks has visibly decreased which is unfavourable for the ground squirrels.

Steppe polecat (*Mustela eversmannii*) – This species was not found.

18.3.3.6 Loess valleys of Middle Mezőföld (HUDD20020)

Priority habitats types

6250 Pannonic loess steppic grasslands

91E0 Alluvial forests of *(Alnus glutinosa)* and *(Fraxinus excelsior) (Alno-Padion, Alnion incanae, Salicion albae)*

3260 Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation

Priority species

Greater pascque flower *(Pulsatilla grandis)*

Crambe tataria

Based on the tours of the area, the following can be established:

No priority species can be found within the 10 km radius of the Natura 2000 site.

Only a small southern piece of about 70 hectares (part of the red mill valley system) of the Natura 2000 site called 'Middle Mezőföld loess valleys' consisting of several parts falls within the 10 km radius.

Loess steppic grasslands (Natura 2000 code: 6250) have the largest extension, their natural status is on a broad scale depending on their level of degradation. Steppic grasslands of better status are rich in species with a high item number of sternbergia colchiciflora *(Sternbergia colchiciflora)* and dandelion *(Taraxacum serotinum)* as protected species. The area is grazed (by horse, cattle), on areas that have not been managed for years shrub growth is intensive. No other priority habitats is known on the Natura 2000 site affected. Other major habitats types also occurring in the valley are the uncharacteristic dry and wet meadows, tall herbs with ruderal weed growth, dry shrub growth, uncharacteristic soft wood forests and acacia.

Figure 18.3.3-7.: Southern slopes of loess valleys in middle Mezőföld, shrub vegetation removed, slopes eroded on a number of sites

Bird species

Priority species are the European night jar (*Caprimulgus europeus*), the black wood packer (*Dryocopus martius*) and the red backed shrike (*Lanius collurio*). The two priority species of the area, the black wood packer and the European night jar are breeding in the forest fringing the area at Dunakömlőd. Along the edges, the third priority bird species, the red backed shrike also appears.

Mammal species

Ground squirrel (*Spermophilus citellus*)

On this Natura 2000 area, the ground squirrel stock is extensive and abundant. This may be due to the large-scale shrub removal. Several hundreds of hectares of grassland have been restored including the 30 m hawthorn belt which separated the ground squirrel site supressed to a former couple of hectares grassland from the hundreds of hectares grazed grassland where we found them during the survey in 2013.

18.4 IMPACT OF THE CONSTRUCTION OF PAKS II ON THE BIOSPHERE

18.4.1 AREAS OCCUPIED

The area to serve the construction of the Power Plant

Temporary construction area

Power plant

Operational site of the power plant
Cold water channel
Warm water channel

Branching off of the new warm water channel

The Island area surrounded by the cold and warm water channels

Block lines

Route of block lines up to the new Sub-station

Maps of the areas above can be found on the following figures (Figure 18.4.1-1., Figure 18.4.1-2).

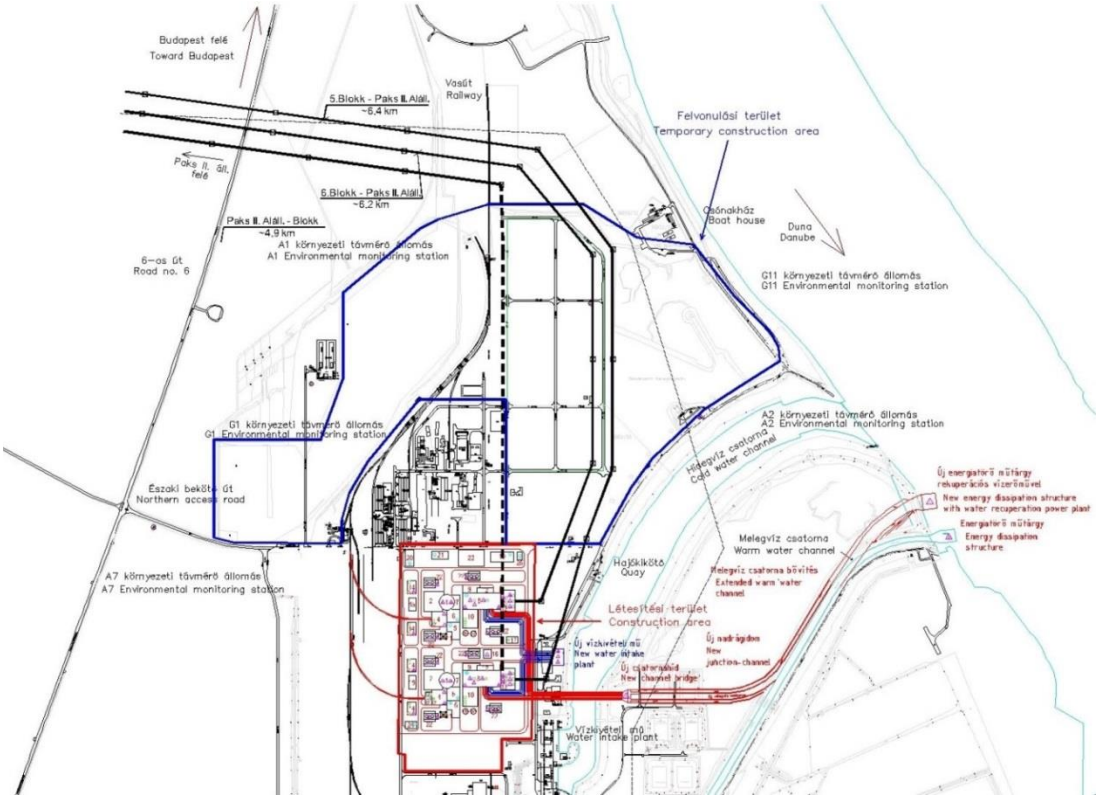
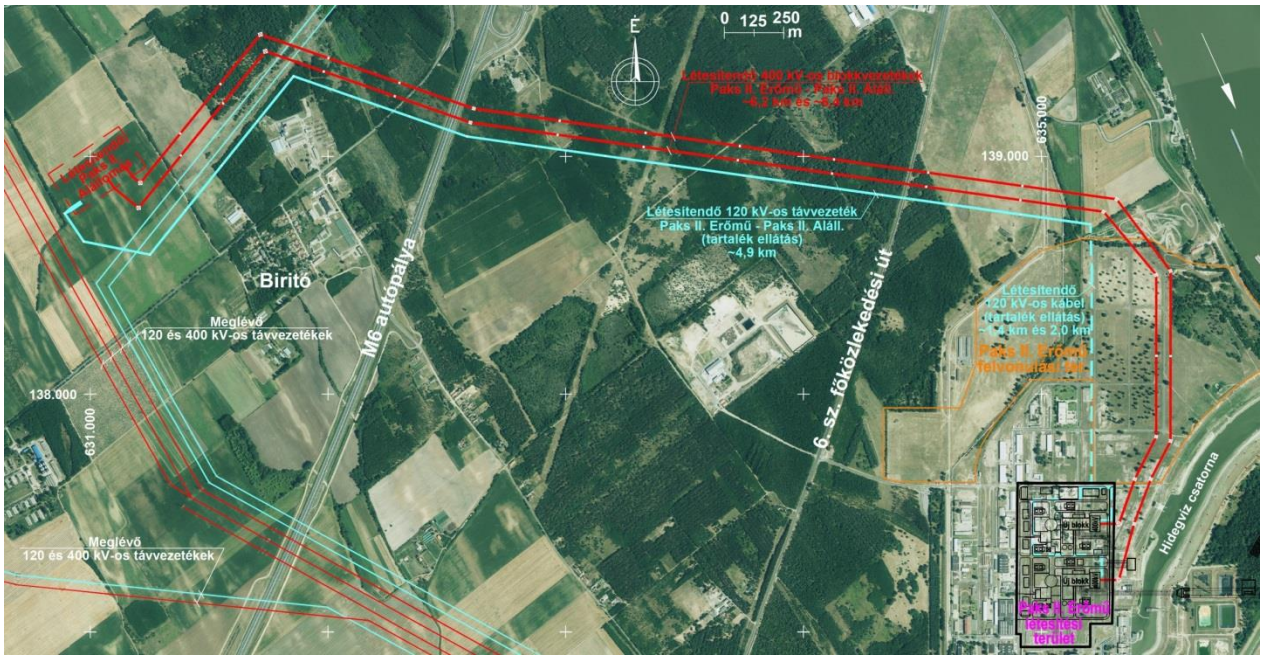


Figure 18.4.1-1.: Areas to be occupied by Paks II on the site of the Paks Nuclear Power Plant



Meglévő 120 és 400 kV-os távvezeték - Existing 120kV and 400 kV transmission lines
Létesítendő 400 kV-os blokkvezetékek, Paks II Erőmű–Paks II alállomás - 400 kV block wires to be constructed, Paks Nuclear Power Plant and Paks II substation
Létesítendő 120 kV-os blokkvezetékek, Paks II Erőmű–Paks II alállomás (tartalék ellátás) - 120 kV block wires to be constructed, Paks Nuclear Power Plant and Paks II substation (reserve supply)
Létesítendő 120 kV-os kábel (tartalék ellátás) - 120 kV cable (reserve supply) to be constructed
Paks II Erőmű felvonulási tér - the temporary construction area of Pask II
Paks II Erőmű létesítési terület - the construction area of Paks II
M6 autópálya = Motorway M6
6. sz. főközlekedési út = Main Road No. 6
Hidegvíz csatorna = Cold water channel

Figure 18.4.1-2.: Areas to be occupied by the new long distance transmission lines

18.4.2 FACTORS NOT INVOLVING RADIOACTIVE EFFECTS

The area to serve the construction of the Power Plant

Temporary construction area

Longer-term but temporary occupation of the temporary construction area
Removal of vegetation
Excavation and deposition of fertile soil
Air polluting substance emissions
Noise emissions
Traffic impacts

Power plant

Operational site of the power plant

Demolition/replacement of buildings, surface covers and lined facilities on the operational area of the power plant
Removal of vegetation
Excavation and deposition of fertile soil
Laying the foundation
Air polluting substance emissions
Noise emissions
The final occupation of operation site of the power plant

Cold water channel

Extension of the cold water channel section

Warm water channel

Extension of the warm water channel section

Branching off of the new warm water channel

The Island area surrounded by the cold and warm water channels

Branching off of the new warm water channel on the Island
Removal of vegetation
Excavation and deposition of fertile soil
Laying the foundation
Air polluting substance emissions
Noise emissions

Block lines

Route of block lines up to the new Sub-station

Removal of vegetation
Excavation and deposition of fertile soil
Laying the foundation
Air polluting substance emissions
Noise emissions
Final area occupation by the long distance transmission line poles
Occurrence of invasive species
Electromagnetic fields

Delivery of supplies on-site, traffic

Air polluting substance emissions
Noise emissions

18.4.3 IMPACT PROCESSES, IMPACTS

18.4.3.1 Direct impacts

18.4.3.1.1 Botany

Vegetation affected

Due to works on the construction area, the current uncharacteristic dry, semi-dry grasslands will disappear. These habitats are covered by weeds, degraded and disturbed, their level of natural status hardly exceeds the lowest category, category 1. Bio-monitoring did not explore any protected species there. On areas classified into the category of 'yards, wastelands, dumping grounds' also directly affected by the investment, no nature conservation value can be found.

Occupation of the area between the cold and warm water channels and the development of the recuperation power plant and the energy dissipation structure on the bank of the Danube entails the partial removal of the current willow, poplar flood plain forest - a narrow riparian zone of which is Natura 2000 site. This forest is not under protection but has a good natural status, a community of fast dynamics with a favourable forecast for regeneration under unchanged water flow conditions.

Major plant associations affected by the implementation of the long distance transmission lines related to the investment: annual intensive arable land cultures, uncharacteristic dry, semi-dry steppes, spontaneous stands of non-native tree species, acacia plantations, scots and black pine plantations, weedy degraded open sand steppes. Location of poles have been designated with attention to nature conservation aspects, therefore, plant associations, valuable for nature conservation must be reckoned with when constructing the poles.

Damages to habitats

On the temporary construction area of Paks II and in the construction zone of the long distance lines, habitats become less favourable due to the compaction of the soil and trampling, and partial damage to the plantation during the construction works must be taken into account. Drainage of compacted soil is less favourable, plants will find it more difficult to cope with e.g., drought. Main habitats affected:

Temporary construction area: uncharacteristic dry, semi-dry steppes, open sand steppe grasses, sand steppe meadows, uncharacteristic soft wood or pioneer forests of indigenous tree species, spontaneous stands of non-native tree species, false oat grass meadows.

Along long distance lines route: annual intensive arable cultures, uncharacteristic dry, semi-dry steppes, spontaneous stands of non-indigenous tree species, acacia plantations, scots and black pine plantations, open sand steppe grasses, uncharacteristic soft wood or pioneer forests of indigenous tree species, tree groups plantations of non-native species, forest belts and lines of trees, sand steppe meadows, road and railway network.

More valuable areas for nature conservation are the open sand steppe grasses and sand steppe meadows. Grasslands have become degraded to a different degree and that determines their ability to regenerate. Patches of more natural status can get better regenerated especially if there is a propagulum source, a patch of a forest nearby (of indigenous tree species). It is more difficult or difficult for more degraded grasslands to get regenerated. In addition to trampling, drought and the proliferation of invasive species is also an impedimental factor.

Affected protected plants

Potential affected species on the habitats of open sand steppe grassland and sand steppe meadows.

On the site of the power plant: feather grass *(Stipa pennata)*, sand feather grass *(Stipa borysthenica), (Centaurea arenaria), (Silene borysthenica)*

Along the route of the transmission lines: *(Centaurea arenaria)*, *(Corispermum nitidum),* feather grass *(Stipa pennata),* sand feather grass *(Stipa borysthenica), (Dianthus serotinus)*, *(Silene borysthenica)*

18.4.3.1.2 Zoology

Summary faunistic results of the bio-monitoring of aquatic macroscopic invertebrates on the 1,533.0 and 1,516.0 river km sections of the Tolnai-Duna in 2012-2013 have shown the general and characteristic fauna of the macrozoobenthon communities populating the downstream section of the Danube River (under Budapest) [18-85], [18-86], [18-87]. It is dominated by the order *Amphipoda* with a 100 % frequency. Ranked second, third and fourth we find with 96 % frequency the family *Chironomida)*, the class *Gastropoda* and the class *Lamellibranchiata*. The sub-class of *Oligochaeta* (89 %) is ranked 5th and the order *Mysida* (79 %) is ranked 6th. In addition to dominant groups and to groups playing major importance in the benthic metabolism, taxons occurring rarely and in small number of items are also colourful components of the benthic community. The occurrence of the latter shows a varied picture in terms of space and time behind which the fluctuation of the watercourse can be found which is a result of the combination of habitats heterogeneity and seasonal aspect changes.

Characteristic of the fauna of the section studied is that 22 species are invasive (37 % of the species), of which 14 have their origin in the ponto-caspic area. Protected species include: 3 water snails; 4 mussels, of which 3 are rare, 3 are protected, 2 dragon flies and 1 may-fly. Of the water snails, 3 species, the *Fagotia acicularis*, the *Fagotia esperi* and the Valvata (*Borysthenia*) *naticina* are protected. From among the mussels, the river pea mussel *(Pisidium amnicum)*, the river orb mussle (*Sphaerium rivicola*) and the solid orb mussel (*Sphaerium solidum*) are rare, the river pea mussel (*Pisidium amnicum*) and the nut orb mussel (*Sphaerium rivicola*) are at the same time also under protection.

The thich shelled river mussel *(Unio crassus)* of high community importance which is the priority species of the Tolnai-Duna Natura 2000 site is under protection, which enjoys national level protection pursuant to Decrees No. 13/2001. (V.9.) and 23/2005. (VIII.31.) KöM. During the survey performed in 2001-2003 [18-94] it was detected, at the survey in 2009-2010 [18-65] is was not detected, and during the survey of 2012 one item was found [18-85], [18-87]. During our collection of data in July and October 2013, it was not detected. All this supports the idea that it would be important to carry out targeted monitoring of high frequency in space and time in the future in order to follow up the development of the thick shelled river mussel population on the section examined.

From among dragon flies, the yellow legged dragon fly *(Gomphus flavipes)* and the common club-tail dragon fly *(Gomphus vulgatissimus)* are under protection. The yellow legged dragon fly *(Gomphus flavipes)* is an indicator species of the anthologised or less polluted downstream sections of larger rivers. This species is under decrease in all countries of Europe.

Therefore, this Natura 2000 priority species enjoys a number of protections: Red Book; Bern Convention; Decision on Natura 2000 Habitats; IUCN; NBmR. Of the may-fly found, the Danube may-fly (*Ephoron virgo*) is also under protection.

When the extension of the cold and warm water channel is constructed, the habitats of the river bed dwelling macroscopic invertebrates will temporary disappear or get reshuffled. When the disturbed mixed river bed bottom material gets stirred up, it will increase the flocculating material content, will cause turbidity, and nutrients, pollutants trapped in the sediment earlier will get released into the water body and will change water quality. When dredging is being done, the stirred up river bed material may get sedimented in other parts of the channel covering non-dredged channel bed parts and causing physical disturbance to channel bed living organisms and their communities. Shadowing impact of the stirred up sediment may change the light climate of the water body and may, for example, decrease the production by primary producing algae. Released nutrients on the other hand may increase the production by primary producers (algae, eventual cauliferous macrophitons). Released polluting substances may exercise acute, and in the long-term toxic impact by way of accumulation on the biosphere.

The abovementioned impacts affecting the water quality and the biosphere are limited to the duration of the construction.

From the point of view of the cooling of the Paks Nuclear Power Plant the ideal cooling water must be 'as much free of biosphere as possible', the cold water channel can be considered as a strongly modified water body, while the warm water channel can be considered explicitly as an extreme 'habitat'. Examination of the cold and warm water channel in this direction can be interesting by all means but the exploration of the affected section of the Danube bank (ecological corridor) classified as Natura 2000 nature conservation area terminated by the construction of the estuary structure of the new warm water channel is recommended to be surveyed in terms of its status before the extension of the channel. During operation, monitoring may provide data about the direction and extent of changes and eventually necessary interventions in the future.

Although no samples were taken in the specific area, where the cold and warm water channels will be transformed in relation with Paks II, but based on the assessments conducted so far [18-85], [18-86], [18-87] it may be presumed that the yellow-legged dragon fly occurring on this section of the Tolnai-Duna (HUDD20023) (specific data on the place of detection: Géderlak, Paks, Dunaszentbenedek, Uszód, Foktő) *(Gomphus flavipes)* is present in function of the micro-habitats developed there. This species is included in Annex IV of the Natura 2000 Habitat Directive [18-23], it is under protection in Hungary as well, and its nature conservation value expressed in currency is 10,000 HUF, and it can be found in the Red Book [18-125] as well as in the National Biodiversity Monitoring System. Therefore, interventions affecting the river bed of the Danube (e.g., construction of an inflow of the new warm water channel) will cause the destruction of the items of species there. It is to be noted, however, that the new location of the warm water channel will entail the destruction of less dragon fly items, species and habitats than the route planned earlier at the Uszódi Island [18-86].

The works performed during the construction will presumably have only a local impact on the fish stock of the Danube River. To the disturbance of the bank region, the fish will respond by migrating to other parts of the river. The hydrological and morphological changes accompanying the construction of the new warm water channel and primarily the introduction of warm water into the river may create varied habitat conditions for the fish. Areas of slow water flow and deposition as well as areas of fast water flow and erosion may both occur in the area concerned, and they will alternate on smaller areas which will be favourable for a number of fish species. A good example is the diverse hydrological and geo-morphological conditions established by the current warm water inflow where for example the organic debris accumulated in deposition patches is able to maintain a rich fish stock due to the dense macroscopic invertebrate stock and hiding places (mussel pieces, branches, etc.) providing food for fish.

Because of its occupation of the area, the construction of Paks II will have an impact on the insect communities strongly tied to the vegetation there, therefore, on the orthoptera as well. If during the works, the vegetation remains on areas adjacent with the habitats affected, there these communities, species may survive the duration of the construction and the pioneer vegetation resistant to disturbance growing in place of the vegetation removed may serve as a temporary habitats for some of the species, although it may be negatively affected by the poliferation of invasive species (*see* indirect impacts). The value of the orthoptera communities living on the different impact areas is varied, therefore, the rate of damage would also varied on the different areas affected.

On the temporary construction area currently an orthoptera community rich in species and containing valuable and protected species lives where, in the course of bio-monitoring studies [18-85], [18-87], protected species characteristic to sand steppes (slant faced grasshopper - *Acrida ungarica*: about 500-5,000 items, abbreviation: pld, Eurasian pincer grasshopper - *Calliptamus barbarus*: about 50-500 items), a very rare species nationally (the small sealed grasshopper -

Omocestus minutus: 100-1,000 items), and a number of further species that may be considered valuable locally but not under protection, and species frequent in other parts of the country (European locust - *Acrotylus insubricus*: about 50-500 items, *Chorthippus dichrous* 1,000-10,000 items, *Oedaleus decorus* about 100-1,000 items, short horned grasshopper - *Pezotettix giornae* about 50-500 items, tuberous bush cricket - *Platycleis affinis*: about 50-500 items) were found. Further monitoring studies[18-79] also detected these two protected orthoptera species in the 3 km radius of the Paks Nuclear Power Plant. The number of items indicated in an approximation of the magnitude based on the extension of the area and the characteristics of the habitats as well as the findings of the year 2012-2013 bio-monitoring studies, as each of these species shows highly fluctuating population size each year, therefore, there is no point in carrying out more precise estimation. The two protected species occurring here do not belong to the endangered species as they are not rare especially in the sand areas of the Great Plain, moreover, locally they may even be the dominant species of orthoptera communities. In the vicinity of Paks, most of them occur on sand steppe grassland remnants of better status, the slant faced grasshopper occurs even on disturbed stand steppes (what is more, even on sandy fallow land) [18-79]. Although the small field grasshopper is not under protection, but beyond its occurrence in the neighbourhood of Paks, it is known only from two areas of Kiskunság. Besides the temporary construction area it was found in other sand steppe grassland patches and on a number of degraded sand steppes as well [18-85], [18-87], [18-95]. On the basis of all that, the habitats on the entire temporary construction area will come to an end and although the populations of species of the indicated sites here will be destroyed, but probably they will continue to live on similar adjacent habitats not affected by such impacts.

During the works performed on the Island surrounded by the two channels, the full vegetation of some areas will be removed. Based on former bio-monitoring studies, no protected value will be damaged with respect to orthoptera as on the area dominated by degraded gallery forests, orthoptera community not containing protected species can be found. Although some locally more valuable species can be found here (short horned grasshopper- *Pezotettix giornae*: about 10-100 items, four spot bush cricket - *Phaneroptera nana*: 50-500 items as the maximum estimated stock on the area affected), but they also occur on the neighbouring, similar habitats, therefore, their local population will suffer only a small rate of decrease.

Along the route of the transmission lines to be constructed three different area types will be affected. Along the first section of the 400 kV block line cutting across the temporary construction area (on a length of about 1 km) the construction will affect valuable orthoptera communities, the total removal of the vegetation will destroy the community affected. The further 4 km section where the 120 kV long distance transmission line is also together with these, includes grasslands of about 800 meters length (sand steppe grasslands and grassland plantation degraded to a varied degree), as well as arable land on a length of 750 meters. On patches of disturbed sand grasses, communities similar to the ones mentioned above live, including probably the slant face grasshopper - *Acrida ungarica* and the Eurasian pincer grasshopper - *Calliptamus barbarus,* but further non-protected, nationally (the small field grasshopper - *Omocestus minutus*), or locally valuable species (European locust - *Acrotylus insubricus*, *Chorthippus dichrous*, - *Oedaleus decorus*, the short horned grasshopper - *Pezotettix giornae*, the tuberous bush cricket - *Platycleis affinis*, the sand blue-winged grasshopper - *Sphingonotus caerulans*, the Siberian straw grasshopper - *Euchorthippus pulvinatus*) may also live, while on cultivated arable land valuable species probably do not occur.

Attention was paid to the more valuable sand steppe grasslands when designating the location of poles of the long distance transmission lines during planning, the removal of the vegetation here will presumably be not accompanied by a significant damage to valuable population. With respect to the poles to be established on the arable land, no damage whatsoever to natural value can be expected, while as a result of removal of vegetation in tree plantations, former valueless habitats can be converted into suitable, what is more, valuable sand steppe-type habitats by appropriate management in the long-term for the orthoptera. The planned location of the sub-station to be constructed is currently used as a large parcel arable land, which presumably has no nature conservation values with regard to the orthoptera. Therefore, removal of the vegetation there will not cause damages.

According to our current knowledge on the would be construction site of Paks II an extremely poor, disturbed vegetation can only be found on the smaller Island in between the vegetation free area parts, where no orthoptera insect communities of high nature conservation value can be found. Only a few ordinary species most tolerant to disturbance can live there. Therefore, during construction no damage to natural assets can be expected with regard to the orthoptera. Where, as part of the works, not only the vegetation but also the fertile soil layer will be excavated and deposited, there not even temporary vegetation can be expected to grow and consequently not even temporary rescue can be found there for the orthoptera communities. After the removal of the vegetation it will not cause essential changes

as in line with what was described above, the orthoptera will be eliminated from there. Therefore, no impact of this activity exceeding the impact of the previous one can be expected.

Where, as a result of works, new facilities will be established, the orthoptera communities originally to be found there will ultimately disappear. This can be expected on the operation area of the power plant (it did not have orthoptera of nature conservation value originally either), on some of the Island surrounded by the cold and warm water channels (in terms of the orthoptera, natural values to be ultimately destroyed due to construction will be at a minimum), and on the area of the Paks II new substation (no natural value can be found here) and on the area of the poles along the route of the long distance transmission lines leading up there (due to careful selection of the site, their area occupation will not cause damages in natural values). In summation, this impact factor has no significant impact on the orthoptera.

When presenting the impacts on butterflies, it must be mentioned that a significant proportion of environmental impacts on the butterflies as primarily phytophagous group is exercise indirectly through the nutrition plants. In light of that, separation of the indirect and direct impacts of power plant extension is difficult. It is important to note that hardly any studies of former times supported by on-site data are available and even the ones available have severe methodological mistakes.

From the aspect of butterflies, the most important impact factor of the arrangement of the temporary construction area and the operational area for the would be power plant is the removal of the existing vegetation. In our case, however, the area in its current state before the intervention is already characterised by extreme poverty of species, highly destroyed fauna with no protected species to be expected or to be found on these parts [18-85], [18-87]. In light of that, due to intervention, further damage to the butterfly fauna will not change the character of the area.

Following rehabilitation, further proliferation of invasive plant species can be expected on the temporary construction area (this is not relevant on the area of the power plant), which will further impoverish the butterfly fauna of the area. Although increased vehicle traffic will increase air polluting substance emission (exhaust gas, dust) and will increase noise, but even that cannot be expected to significantly impact the butterfly fauna. In summation, it can be declared that as this area does not have valuable butterfly fauna anyway, therefore, indirect impacts are not expected to further deteriorate the status of the area.

With respect to butterflies the immediate impact of the cold and warm water channel extension is felt or may be felt in the arrangement of the channel banks. No impact however in its vegetation - which is regularly managed anyway - that would significantly affect the butterfly fauna can be expected. Considering the size of the area, no strong negative impact can be expected as it is a small area. From the faunistic point of view, no species worthy to be mentioned can be identified here. Items of one protected species those of the large copper butterfly *(Lycaena dispar)* occurred on this area. Its larvae feed on different *Rumex* species. In Hungary, they occur on all wet habitats including regularly managed channels. We were able to detect them in the broader environment of the power plant but it was not present in abundance anywhere. It is important to note however that their item number is showing significant fluctuations from year to year. As they can find much more favourable sites in the adjacent areas (where they do occur) and also considering the fact that we have three generations of this species in Hungary and the second and partial third generation are characterised by very strong dispersion behaviour (items wander over large areas), therefore, from one year to another there is high probability of the fact that they settle on new sites. For that reason works will certainly not affect the population of this species.

Related to the establishment of the new warm water channel from the aspect of butterflies, significant direct intervention planned on the area of the Island may come from the removal of the willow poplar flood plain forest vegetation. On this area, a number of protected species occur, or there may be species that we could not detect but their occurrence may be presumed/expected. These protected species are the following: pallas' sailor *(Neptis sappho),* European peacock *(Nymphalis io)*, *N. c-album*, red admiral *(Vanessa atalanta)*, blue underwing *(Catocala fraxini),* and the highly protected Freyer's purple emperor *(Apatura metis)*. With the exception of the blue underwing, all these species are large body nymphalinae and with no exception they have very strong dispersion ability. The red admiral is explicitly a wandering species. Freyer's purple emperor feeds on willow, the blue underwing feeds on poplar and willow, pallas' sailor feeds on lednek species *(Lathyrus),* the nutrition plant of the other species is nettle *(Urtica dioica).* The disturbance will not affect or will hardly affect the plants they feed on and for example the nettle stock can even increase following disturbance. With attention to the above, and also to the fact that south of the cooling water channel directly there is a flood plain gallery forest of large extension where each species was observed regularly, therefore, these populations are not endangered and following disturbance they may fast get resettled to the part remaining. They require no special nature conservation measure/intervention.

The *Euphydryas maturna* protected butterfly species included in the Red Book was not found in the narrower environment of the power plant, some items could be observed in the Tolnai-Duna, Imsósi forest together with *Lycaena dispar* also protected species included in the Red Book [18-85], [18-86], [18-87]. Construction of the power plant will not affect these populations. Construction of the new power plant unit will not affect the habitats on the ground squirrel field at Paks and the Dunaszentgyörgyi swamp forest and the butterfly species living there either.

From among the new establishments, the establishment of the high voltage lines will probably have the most significant impact on butterflies both in respect of its area and its length. Most of the current vegetation will be changed. When installing the poles for the long distance lines, vegetation will be removed on a large area because of the foundation earthworks and access to the given points by large machines. Removal of the fertile soil layer and its transportation off will also have significant impact on the plantation. Prior to, or simultaneously with the establishment, the woody vegetation will be cleared and transported of along the entire route of the lines.

The environmental nature conservation impact of these interventions, however, is not as harmful as that and the explanation is in the current vegetation cover. Most of the route of the transmission lines will run along acacia plantations, scots and pine forests, arable land to a small degree, and weedy, mostly strongly degraded dry and sand steppes. This means that from the point of view of butterflies, the route will hardly affect valuable habitats - mostly sand steppe - as the vast majority of the area is very poor in species and consist of highly degraded non-natural symbioses.

Protected butterfly species found on the broader area: southern festoon butterfly *(Zerynthia polyxena)*, European peacock *(Nymphalis io), N. c-album,* red admiral *(Vanessa atalanta)*, cardinal butterfly *(Argynnis pandora)*, jersey tiger *(Euplagia quadripunctaria), Cucullia balsamitae,* green silver-spangled shark *(Cucullia argentea)*, and it can be considered as a sampling mistake that on this area we did not catch any malachite moth *(Staurophora celsia)*. At the same time, items of the protected pallas' sailor *(Neptis sappho)* and the highly protected Freyer's purple emperor *(Apatura metis)* presumably not breeding here were found.

Most of the protected species breeding here were found in the better status sand steppes (mainly the ground-squirrel field at Paks) and in their fringes. Intervention along the route of the lines will allow the extension of grassland areas to the expense of the non-native plantations. It can be expected that on the grasslands resettling in place of the acacia and pine plantations very poor in species and intended to be cleared, the abovementioned protected species will resettle again and their existing communities will be further strengthened. The temporarily increased noise, dust and air pollution accompanying the intervention is fully negligible from the aspect of butterflies.

Excavation of fertile soil layer and its disposal will affect the soil fauna. None of the protected species occurring in the Island (granulated ground beetle *(Carabus granulatus))*, and on the temporary construction area *Geolycosa vultuosa* can be considered a rare species, they occur in Hungary on any habitats suitable for them, even on humans settlements. Due to temporary area occupation, soil fauna will disappear, its impact will be similar to the excavation of the fertile soil. Following the termination of area occupation the fauna of the area affected will most probably resettle from the adjacent similar habitats.

Due to increase traffic and trampling, the number of soil surface animals destroyed will increase and following the simultaneous change of the vegetation, sensitive species may disappear. It can be predicted that in the vicinity of roads of high traffic, item number of predatory anthropoda will decrease, while those of mixed nutrition will increase. Interestingly, this will be accompanied by diversity increase on species level as the environment will become more favourable for species of mixed (meet and plant) nutrition [18-18].

Survival of the amphibian and reptile populations on the Paks II site will primarily be determined by the magnitude of the termination of habitats. It must be noted, however, that a number of amphibian and reptile species can occur on the site of the Paks Nuclear Power Plant because relatively little intervention has been carried out on a certain part of the area since the time of its establishment (e.g., temporary construction area, Island). Therefore, the stocks of species occurring here show the result of long time resettlement process.

Construction of the Paks II new facilities on the planned area means almost the total termination of the current habitats. Most of the trees and bushes will be cleared, the fertile soil will be excavated and disposed. Exceptions are at most the north-east fringe areas of the temporary construction area. During earthworks species will be affected on the entire area of the extension site and on most of the temporary construction area. This is more intensively true if works are performed during their resting period (from November to March). If landscaping of a smaller scale is started during their active period, some of the items may flee from the area and hide in the fringes of the area where they may find an area to live on.

Transportation, traffic by construction machines on the area may have significant indirect impact and run over. For amphibians and reptiles with varied body temperature, the concrete or even more, the asphalt covered road surfaces function as ecological traps. During daytime, road surface warms up, after getting dark the wandering amphibians leave the green surface behind and have rest on the road surface while they try to take up some heat from the media. And in the meantime they do not move or move only at very slow speed, therefore, the threat of run over is even higher.

The planned new warm water channel branching off on the area of the Island will also lead to final habitats loss. This alternative, however, seems to be significantly more favourable for amphibians and reptiles than the one planned to flow into the Danube through the Uszódi Island. The environment of the Uszódi Island is a much more valuable habitats for amphibian and reptile species. Establishment of the new unit line poles and the extension of the cold water channel section causes a smaller - medium level habitats loss and temporary disturbance. In summation, it seems to be unavoidable that during these works, the amphibian and reptile species of slow movement not able for flee become victim of the movement of construction machines (trampling) and earthworks. The majority of the items currently occurring on the construction site will presumably be affected.

Based on the ornithological examinations conducted on the area directly or indirectly affected it can be established that due to the relatively long-term lack of disturbance on the inner area of the power plant, the planned development area and the temporary construction area as well as the Island are currently good feeding sites for a number of bird species of community importance, e.g., the black stork (*Ciconia nigra)*, tawny pipit (*Anthus campestris)*, the European night jar (*Caprimulgus europaeus)*, black wood packer (*Dryocopus martius)*, red backed shrike (*Lanius collurio)*, the two latter species are presumed to breed on the area).

Based on assessments performed in years 2012-2013 [18-85], [18-86], [18-87] and the Government Decree No. 275/2004. (X.8.) we compiled the Table 18.4.3-1. That includes the species included in the list of 'Bird species of community importance' and 'Other migrating bird species occurring on the territory of the European Community' which may be affected directly and/or indirectly by the construction works. Detailed modern review of the Natura 2000 species and site is given by the work of Haraszthy [18-50].

Kárókatona	Kis lile	Füsti fecske	Kis poszáta
Szürke gém	Szürke cankó	Molnárfecske	Fitiszfüzike
Nagy kócsag	Billegető cankó	Parti fecske	Csilp-csalp füzike
Bakcsó	Sárgalábú sirály	Sárgarigó	Sisegő füzike
Kis kócsag	Dankasirály	Vetési varjú	Sárgafejű királyka
Fehér gólya	Fattyúszerkő	Kék cinege	Szürke légykapó
Fekete gólya	Kormos szerkő	Őszapó	Örvös légykapó
Bütykös hattyú	Örvös galamb	Fakúsz	Erdei pityer
Tőkés réce	Vadgerle	Ökörszem	Parlagi pityer
Barátréce	Küszvágó csér	Léprigó	Barázdabillegető
Vörös kánya	Balkáni gerle	Énekes rigó	Sárga billegető
Barna kánya	Kakukk	Szőlőrigó	Nagy őrgébics
Héja	Erdei fülesbagoly	Fekete rigó	Tövisszúró gébics
Karvaly	Jégmadár	Hantmadár	Lappantyú
Egerészölyv	Gyurgyalag	Cigánycsuk	Seregély
Réti sas	Búbosbanka	Rozsdás csuk	Meggyvágó
Gatyás ölyv	Nyaktekercs	Házi rozsdafarkú	Zöldike
Darázsölyv	Fekete harkály	Fülemüle	Tengelic
Barna rétihéja	Balkáni fakopáncs	Vörösbegy	Kenderike
Vörös vércse	Közép fakopáncs	Nádi tücsökmadár	Erdei pinty
Haris	Búbos pacsirta	Nádirigó	Fenyőpinty
Bíbic	Erdei pacsirta	Barátposzáta	Citromsármány
Szárcsa	Mezei pacsirta	Mezei poszáta	Sordély

Note:
in green: bird species of community importance,
not coloured: other migrating bird species occurring on the territory of the European Community

Kárókatona - Cormorant,Kis lile -Little Ringed Plower,Füsti fecske - Swallow,Kis poszáta - Lesser Whitethroat
Szürke gém - Grey Heron,Szürke cankó - Greenshank,Molnár fecske - House Martin,Fitiszfüzike - Greenish Warbler
Nagy kócsag - Great White Egret,Billegető cankó - Common Sandpiper,Parti fecske - Sand Martin,Csilp-csalp füzike - Chiffchaff
Bakcsó - Night Heron,Sárgalábú sirály - Yellow-legged Gull,Sárgarigó - Golden oriole,Sisegő füzike - Wood Warbler
Kis kócsag - Little Egret,Dankasirály - Black-headed Gull,Vetesi varjú - Rook,Sárgafejű királyka - Goldcrest
Fehér gólya - White Stork,Fattyúszerkő - Whiskered Tern,Kék cinege - Blue Tit,Szürke legykapó - Spotted flycatcher
Fekete gólya - Black Stork,Kormos szerkő - Black Tern,Őszapó - Long-tailed Tit,Örvös legykapó - Collared Flycatcher
Bütykös hattyú - Mute Swan,Orvös galamb - Woodpigeon,Fakúsz - Tree creeper,Erdei pityer - Tree Pipit
Tőkes réce - Mallard,Vadgerle - Turtle dove,Ökörszem - Wren,Parlagi pityer - Tawny Pipit
Barátréce - Pochard,Küszvágó csér - Common Tern,Léprigó - Mistle Thrush,Barázdabillegető - Pied Wagtail
Vörös kánya - Red Kite,Balkáni gerle - Collared Dove,Énekes rigó - Song Thrush,Sárga billegető - Yellow wagtail
Barna kánya - Black Kite,Kakukk - Cuckoo,Szőlőrigó - Redwing,Nagy őrgébics - Great Grey Shrike
Héja - Goshawk,Erdei fülesbagoly - Long-eared Owl,Fekete rigó - Blackbird,Tövisszúró gébics - Red-backed Shrike
Karvaly - Sparrow hawk,Jegmadár - Kingfisher,Hantmadár - Wheatear,Lappantyú - Nightjar
Egerészölyv - Buzzard,Gyurgyalag - Bee-eater,Cigánycsuk - Stonechat,Seregély - Starling
Réti sas - White-tail Eagle,Búbosbanka - Hoopoe,Rozsdás csuk - Whinchat,Meggyvágó - Hawfinch
Gatyás ölyv - Rough- Rough-legged Buzzard,Nyaktekercs - Wryneck,Házi rozsdafarkú - Black Redstar,Zöldike - Greenfinch
Darázsölyv - Honey Buzzard,Fekete harkály - Black Stork,Fülemüle - Nightingale,Tengelic - Goldfinch
Barna rétihéja - Marsh Harrier,Balkáni fakopáncs - Syrian woodpecker,Vörösbegy - Robin,Kenderike - Linnet
Vörös vércse - Kestrel,Közép fakopáncs - Middle Spottted Woodpecker,Nádi tücsökmadár - Savi's Warbler,Erdei pinty - Common Chaffinch
Haris - Cornkrake,Búbos pacsirta - Crested Lark,Nádirigó - Great Reed Warbler,Fenyő pinty - Brambling
Bíbic - Lapwing,Erdei pacsirta - Woodlark,Barátposzáta - Blackcap,Citromsármány - Yellowhammer
Szárcsa - Coot,Mezei pacsirta - Skylark,Mezei poszáta - Whitethroat,Sordély - Corn Bunting

Table 18.4.3-1.: List of bird species occurring in areas directly affected

Among direct impacts, the termination of habitats is of outstanding importance. When foundation works are performed, the entire top layer of the soil is removed in place of which an artificial establishment will be built, which will lead to the disappearance of the habitats. The temporary construction area is currently an undisturbed grass association, that the black stork *(Ciconia nigra)*, the tawny pipit *(Anthus campestris)* and a number of protected bird species feed on. Due to construction works, they will not find these feeding places here anymore and will have to look for other habitats. On the temporary construction area and development and on the Island, a number of older trees decaying inside can be found, which provide a breeding site for bird species hatching in hollows of trees (wood packers) and for bird species hatching on trees and in bushes (Eurasian golden oriole, fringillidae, paridae, etc.) which is currently a breeding and feeding site for them. The belt of bushes, shrubs and trees is currently functioning as an ecological corridor for the birds of the area. Some of these ecological corridors will also disappear and fragmentation of the area can be expected which will directly impact the birds.

Outside the area of the new units, the size and in part the route as well of the cold and warm water channels will change. This intervention will directly affect the bird species breeding and feeding on the area and tied to water. When performing foundation works, vegetation is removed, some of the soft wood forest currently stretching along the channel will be cleared, the size of the breeding and/or feeding area will decrease and it will directly impact the birds living there. Habitats loss caused by the construction of the new 400 and 120 kV electricity lines will also result in the termination of habitats. Along the route of the block lines, the vegetation will be removed and the base of the poles holding the lines will be covered by concrete.

The birds of the area concerned will be most affected by the termination of the habitats. A consequence of the termination of the habitats is that birds will no longer find the necessary ecological conditions for reproduction and feeding. Termination of habitats will directly affect the protected and highly protected bird species enlisted in Table 18.4.3-2.

Faj	Latin név	tv. érték (Ft)	Faj	Latin név	tv. érték (Ft)
Szürke gém	Ardea cinerea	50000	**Széncinege**	Parus major	10000
Nagy kócsag	Egretta alba	100000	**Kék cinege**	Cyanistes caeruleus	10000
Kis kócsag	Egretta garzetta	250000	**Barátcinege**	Poecile palustris	10000
Fehér gólya	Ciconia ciconia	100000	**Őszapó**	Aegithalus caudatus	10000
Fekete gólya	Ciconia nigra	500000	**Csuszka**	Sitta europaea	10000
Barátréce	Milvus milvus	50000	**Fakúsz fajok**	Certhia sp.	10000
Vörös kánya	Aythya ferina	500000	**Ökörszem**	Troglodytes troglodytes	10000
Barna kánya	Milvus migrans	500000	**Léprigó**	Turdus viscivorus	50000
Héja	Accipiter gentilis	50000	**Énekes rigó**	Turdus philomelos	10000
Karvaly	Accipiter nisus	50000	**Szőlőrigó**	Turdus iliacus	10000
Egerészölyv	Buteo buteo	10000	**Fekete rigó**	Turdus merula	10000
Rétisas	Haliaeetus albicilla	1000000	**Hantmadár**	Oenanthe oenanthe	50000
Barna rétihéja	Circus aeruginosus	50000	**Cigánycsuk**	Saxicola torquata	10000
Vörös vércse	Falco tinnunculus	50000	**Rozsdás csuk**	Saxicola rubetra	10000
Haris	Crex crex	500000	**Házi rozsdafarkú**	Phoenicurus ochruros	10000
Bíbic	Vanellus vanellus	50000	**Fülemüle**	Luscinia megarhynchos	10000
Kis lile	Charadrius dubius	50000	**Vörösbegy**	Eritacus rubecula	10000
Szürke cankó	Tringa nebularia	10000	**Nádirigó**	Acrocephalus arundinaceus	10000
Billegető cankó	Actitis hypoleucos	50000	**Barátposzáta**	Sylvia atricapilla	10000
Dankasirály	Larus ridibundus	50000	**Mezei poszáta**	Sylvia communis	10000
Fattyúszerkő	Chlidonias hybridus	100000	**Kis poszáta**	Sylvia curruca	10000
Kormos szerkő	Chlidonias niger	250000	**Fitiszfüzike**	Phylloscopus trochilus	10000
Vadgerle	Streptopelia turtur	50000	**Csilp-csalp füzike**	Phylloscopus collybita	10000
Küszvágó csér	Sterna hirundo	100000	**Siseg ő füzike**	Phylloscopus sibilatrix	10000
Kakukk	Cuculus canorus	10000	**Sárgafejű királyka**	Regulus regulus	10000
Erdei fülesbagoly	Asio otus	50000	**Szürke légykapó**	Muscicapa striata	50000
Jégmadár	Alcedo atthis	50000	**Örvös légykapó**	Ficedula albicollis	10000
Gyurgyalag	Merops apiaster	100000	**Erdei pityer**	Anthus trivialis	10000
Búbosbanka	Upupa epops	50000	**Parlagi pityer**	Anthus campestris	50000
Nyaktekercs	Jynx torquilla	50000	**Barázdabillegető**	Motacilla alba	10000
Zöld küllő	Picus viridis	50000	**Sárga billegető**	Motacilla flava	10000
Fekete harkály	Dryocopus martius	50000	**Tövisszúró gébics**	Lanius collurio	10000
Nagy fakopáncs	Dendrocopos major	10000	**Lappantyú**	Caprimulgus europaeus	50000
Balkáni fakopáncs	Dendrocopos syriacus	10000	**Házi veréb**	Passer domesticus	10000
Közép fakopáncs	Dendrocopos medius	50000	**Mezei veréb**	Passer montanus	10000
Kis fakopáncs	Dryobates minor	50000	**Meggyvágó**	Coccothraustes coccothraustes	10000
Búbos pacsirta	Galerida cristata	50000	**Zöldike**	Carduelis chloris	10000
Erdei pacsirta	Lullula arborea	50000	**Tengelic**	Carduelis carduelis	10000
Mezei pacsirta	Alauda arvensis	10000	**Kenderike**	Carduelis cannabina	10000
Füsti fecske	Hirundo rustica	50000	**Erdei pinty**	Fringilla coelebs	10000
Molnárfecske	Delichon urbica	50000	**Fenyőpinty**	Fringilla montifringilla	10000
Parti fecske	Riparia riparia	50000	**Citromsármány**	Emberiza citrinella	10000
Sárgarigó	Oriolus oriolus	10000	**Sordély**	Miliaria calandra	10000
Vetési varjú	Corvus frugilegus	50000			

Legend:
tv. value: nature conservation value;
highlighted in grey: highly protected bird species
The nature conservation value of protected and highly protected bird species has been compiled based on the data in the search engine of protected species http://www.termeszetvedelem.hu/?pg=vf.

Szürke gém - Grey Heron
Nagy kócsag - Great White Egret
Kis kócsag - Little Egret
Fehér gólya - White Stork
Fekete gólya - Black Stork
Barátréce - Pochard
Vörös kánya - Red Kite
Barna kánya - Black Kite
Héja - Goshawk
Karvaly - Sparrow hawk
Egerészölyv - Buzzard
Réti sas - White-tail Eagle
Barna rétihéja - Marsh Harrier
Vörös vércse - Kestrel
Haris - Corncrake
Bíbic - Lapwing
Kis lile - Little Ringed Plower
Szürke cankó - Greenshank
Billegető cankó - Common Sandpiper
Dankasirály - Black-headed Gull
Fattyúszerkő - Whiskered Tern

Széncinege - Great Tit
Kék cinege - Blue Tit
Barátcinege - Marsh Tit
Őszapó - Long-tailed Tit
Csuszka - Eurasian Nuthatch
Fakúsz fajok - Treecreeper species
Ökörszem - Wren
Léprigó - Mistle Thrush
Énekes rigó - Song Thrush
Szőlőrigó - Redwing
Feketerigó - Blackbird
Hantmadár - Wheatear
Cigánycsuk - Stonechat
Rozsdás csuk - Winchat
Házi rozsdafarkú - Black Redstar
Fülemüle - Nightigale
Vörösbegy - Robin
Nádirigó - Great Reed Warbler
Barátposzáta - Blackcap
Mezei poszáta - Whitethroat
Kis poszáta - Lesser Whitethroat

Kormos szerkő - Black Tern	Fitiszfüzike - Greenish Warbler
Vadgerle - Turtle dove	Csilp-csalp füzike - Chiffchafff
Küszvágó csér - Common Tern	Sisegő füzike - Wood Warbler
Kakukk - Cuckoo	Sárgafejű királyka - Goldcrest
Erdei fülesbagoly - Long-eared Owl	Szürke legykapó - Spotted flycatcher
Jegmadár - Kingfisher	Örvös légykapó - Collared Flycatcher
Gyurgyalag - Bee-eater	Erdei pityer - Tree Pipit
Búbosbanka - Hoopoe	Parlagi pityer - Tawny Pipit
Nyaktekercs - Wryneck	Barázdabillegető - Pied Wagtail
Zöld küllő - Green Woodpecker	Sárga billegető - Yellow wagtail
Fekete harkály - Black Stork	Tövisszúró gébics - Red-backed Shrike
Nagy fakopács - Great Spotted Woodpecker	Lappantyú - Nightjar
Balkáni fakopáncs - Syrian woodpecker	Házi veréb - House Sparrow
Közép fakopáncs - Middle Spottted Woodpecker	Mezei veréb - Tree Sparrow
Kis fakopács - Lesser Spotted Woodpecker	Meggyvágó - Hawfinch
Búbos pacsirta - Crested Lark	Zöldike - Greenfinch
Erdei pacsirta - Woodlark	Tengelic - Goldfinch
Mezei pacsirta - Skylark	Kenderike - Linnet
Füsti fecske - Swallow	Erdei pinty - Common Chaffinch
Molnár fecske - House Martin	Fenyő pinty - Brambling
Parti fecske - Sand Martin	Citromsármány - Yellowhammer
Sárgarigó - Golden Oriole	Sordély - Corn Bunting
Vetesi varjú - Rook	

Table 18.4.3-2.: List of protected and highly protected bird species directly affected by the elimination of habitats.

The termination of their current breeding or feeding site will affect the following bird species of community importance: black stork *(Ciconia nigra)*, black wood packer *(Dryocopus martius),* tawny pipit *(Anthus campestris)*, European night jar *(Caprimulgus europaeus),* red backed shrike *(Lanius collurio).*

The basis of the poles of transmission lines and the route of the lines to be established during the construction of block lines will impact the breeding and feeding bird species of their immediate and broader environment. Technical literature data on high voltage electricity poles and lines show [18-4], [18-113] that they have the largest impact on the *Falconiformes*, *Passeriformes*, *Galliformes* and *Strigiformes*, as bird species frequently suffering an electricity shock belong to these orders. Birds suffer an electric shock most frequently because of the improper insulation of the lines and poles, collision with the pole and/or line and as a result of simultaneous touching of the cables. Most of the time electric shocks are fatal, or the birds suffer such an intensive physical damage which will lead to the loss of limbs and also their death [18-74], [18-103].

The ground squirrel field at Paks and the Dunaszentgyörgy swamp forest, both of them being Natura 2000 sites, are situated in the broader environment of the planned new lines north and south of the power plant. Predatory birds often feed on both areas, where the increase of the currently existing long distance lines and other lines may be a source of potential danger. Predatory birds may do larger distances for the purpose of finding food. Areas close to Birító are under intensive agricultural cultivation often serving as a feeding site for predatory birds. Construction of the lines will directly affect the following bird species of community importance: red kite *(Milvus milvus)*, black kite *(Milvus migrans)*, western marsh harrier *(Circus aeruginosus).* Construction of the electricity system will directly affect the protected and highly protected bird species enlisted in Table 18.4.3-3.

Faj	Latin név	tv. érték (Ft)	Faj	Latin név	tv. érték (Ft)
Szürke gém	Ardea cinerea	50000	**Énekes rigó**	Turdus philomelos	10000
Nagy kócsag	Egretta alba	100000	**Fekete rigó**	Turdus merula	10000
Fehér gólya	Ciconia ciconia	100000	**Hantmadár**	Oenanthe oenanthe	50000
Fekete gólya	Ciconia nigra	500000	**Cigánycsuk**	Saxicola torquata	10000
Barna kánya	Milvus migrans	500000	**Rozsdás csuk**	Saxicola rubetra	10000
Héja	Accipiter gentilis	50000	**Házi rozsdafarkú**	Phoenicurus ochruros	10000
Egerészölyv	Buteo buteo	10000	**Fülemüle**	Luscinia megarhynchos	10000
Rétisas	Haliaeetus albicilla	1000000	**Vörösbegy**	Eritacus rubecula	10000
Barna rétihéja	Circus aeruginosus	50000	**Nádirigó**	Acrocephalus arundinaceus	10000
Vörös vércse	Falco tinnunculus	50000	**Barátposzáta**	Sylvia atricapilla	10000
Vadgerle	Streptopelia turtur	50000	**Kis poszáta**	Sylvia curruca	10000
Kakukk	Cuculus canorus	10000	**Fitiszfüzike**	Phylloscopus trochilus	10000
Gyurgyalag	Merops apiaster	100000	**Csilp-csalp füzike**	Phylloscopus collybita	10000
Búbosbanka	Upupa epops	50000	**Sisegő füzike**	Phylloscopus sibilatrix	10000
Zöld küllő	Picus viridis	50000	**Sárgafejű királyka**	Regulus regulus	10000
Fekete harkály	Dryocopus martius	50000	**Szürke légykapó**	Muscicapa striata	50000
Nagy fakopáncs	Dendrocopos major	10000	**Örvös légykapó**	Ficedula albicollis	10000
Kis fakopáncs	Dryobates minor	50000	**Erdei pityer**	Anthus trivialis	10000
Búbos pacsirta	Galerida cristata	50000	**Parlagi pityer**	Anthus campestris	50000
Erdei pacsirta	Lullula arborea	50000	**Barázdabillegető**	Motacilla alba	10000
Mezei pacsirta	Alauda arvensis	10000	**Sárga billegető**	Motacilla flava	10000
Füsti fecske	Hirundo rustica	50000	**Nagy őrgébics**	Lanius excubitor	50000
Molnárfecske	Delichon urbica	50000	**Tövisszúró gébics**	Lanius collurio	10000
Parti fecske	Riparia riparia	50000	**Házi veréb**	Passer domesticus	10000
Sárgarigó	Oriolus oriolus	10000	**Mezei veréb**	Passer montanus	10000
Széncinege	Parus major	10000	**Meggyvágó**	Coccothraustes coccothraustes	10000
Kék cinege	Cyanistes caeruleus	10000	**Zöldike**	Carduelis chloris	10000
Barátcinege	Poecile palustris	10000	**Tengelic**	Carduelis carduelis	10000
Őszapó	Aegithalus caudatus	10000	**Kenderike**	Carduelis cannabina	10000
Csuszka	Sitta europaea	10000	**Erdei pinty**	Fringilla coelebs	10000
Fakúsz fajok	Certhia sp.	10000	**Fenyőpinty**	Fringilla montifringilla	10000
Ökörszem	Troglodytes troglodytes	10000	**Citromsármány**	Emberiza citrinella	10000
Léprigó	Turdus viscivorus	50000	**Sordély**	Miliaria calandra	10000

Note:
tv. value: nature conservation value; highlighted in grey: highly protected bird species

Szürke gém - Grey Heron
Nagy kócsag - Great White Egret
Fehér gólya - White Stork
Fekete gólya - Black Stork
Barna kánya - Black Kite
Héja - Goshawk
Egerészölyv - Buzzard
Réti sas - White-tail Eagle
Barna rétihéja - Marsh Harrier
Vörös vércse - Kestrel
Vadgerle - Turtle dove
Kakukk - Cuckoo
Gyurgyalag - Bee-eater
Búbosbanka - Hoopoe
Zöld küllő - Green Woodpecker
Fekete harkály - Black Stork
Nagy fakopáncs Great Woodpecker
Kis fakopáncs - Lesser Woodpecker
Búbos pacsirta - Crested Lark
Erdei pacsirta - Woodlark
Mezei pacsirta - Skylark
Füsti fecske - Swallow
Molnár fecske - House Martin
Parti fecske - Sand Martin
Sárgarigó - Golden Oriole
Széncinege - Great Tit
Kék cinege - Blue Tit
Barátcinege - Marsh Tit
Őszapó - Long-tailed Tit
Csuszka - Eurasian Nuthatch
Fakúsz fajok - Treecreeper species
Ökörszem - Wren
Léprigó - Mistle Thrush

Énekes rigó - Song Thrush
Fekete rigó - Blackbird
Hantmadár - Wheatear
Cigánycsuk - Stonechat
Rozsdás csuk - Winchat
Házi rozsdafarkú - Black Redstar
Fülemüle - Nightigale
Vörösbegy - Robin
Nádirigó - Great Reed Warbler
Barátposzáta - Blackcap
Kis poszáta - Lesser Whitethroat
Fitiszfüzike - Greenish Warbler
Csilp-csalp füzike - Chiffchafff
Sisegő füzike - Wood Warbler
Sárgafejű királyka - Goldcrest
Szürke legykapó - Spotted flycatcher
Örvös legykapó - Collared Flycatcher
Erdei pityer - Tree Pipit
Parlagi pityer - Tawny Pipit
Barázdabillegető - Pied Wagtail
Sárga billegető - Yellow wagtail
Nagy őrgébics - Great Grey Shrike
Tövisszúró gébics - Red-backed Shrike
Házi veréb - House Sparrow
Mezei veréb - Tree Sparrow
Meggyvágó - Hawfinch
Zöldike - Greenfinch
Tengelic - Goldfinch
Kenderike - Linnet
Erdei pinty - Common Chaffinch
Fenyő pinty - Brambling
Citromsármány - Yellowhammer
Sordély - Corn Bunting

Table 18.4.3-3.: List of protected and highly protected bird species directly affected by the construction of the electricity systems

Due to the construction works, in the 3 km radius of the power plant noise load will increase. Noise load will mostly affect the temporary construction area, the development area and some parts of the Island and the Tolnai-Duna Natura 2000 site (200-500 m zone of the warm water channel), as foundation and construction works will be accompanied by increased noise load. Bird species less tolerant to disturbance will most probably look for feeding and/or breeding in other areas nearby. Increased noise load will affect the following bird species of community importance and breeding on the area affected: western marsh harrier *(Circus aeruginosus)*, black wood packer *(Dryocopus martius)*, white backed wood packer *(Dendrocopos medius)*, woodlark *(Lullula arborea)*, collared fly catcher *(Ficedula albicollis)*, European night jar *(Caprimulgus europaeus)*, red backed shrike *(Lanius collurio)*. Increased noise load will affect the following bird species of community importance and feeding on the area affected: black stork *(Ciconia nigra)*, tawny pipit *(Anthus campestris)*, white tailed eagle *(Haliaeetus albicilla).*

All generated waste, generated during construction works may be a source of danger for bird species breeding or feeding there, highlighting from among them birds tied to water or large body birds which may easily get entangled in packaging materials that may even lead to their death. Smaller bits of waste can easily get into the digestion system of birds while feeding. Evidence shows that seagulls may give wastes to their youngs as food, which may lead to the death of the young birds. Liquid waste may get leached into the ground water and/or standing water which may directly or indirectly cause harm to the birds breeding and/or feeding there. Beyond physical injuries, polluting substances leached out by precipitation water may get into the ground water and standing waters whose negative impact will affect the entire community there. This source of danger, however, can be decreased to a minimum by proper storage of large quantities of waste generated during construction.

According to the preliminary surveys of 2012-2013, bats living in buildings can be found on the territory of the Paks Nuclear Power Plant and bats living in hollows of trees can be found in the 3 km radius of the power plant. Occurrence of mound-building mouse outstanding for the biodiversity monitoring system and of the ground squirrel, a Natura 2000 priority species, can be found primarily in the 10 km radius of the power plant. We found no sign of the presence of the highly protected tundra vole. As these species are tied to their place by living in hollows of trees and by pursuing a hiding way of life, they will be affected by the power plant extension primarily during the preparation, implementation and construction period. Impact will be the strongest in the immediate environment of the power plant.

With respect to the mammals, the most severe impact will be the loss of habitats. This will primarily affect the bats living in hollows because of the planned new warm water channel on the area of the Island. It must be noted however, that compared to sites in former plans this location of the facility entails much less damage than it would have been if the warm water channel were connected into the Danube through the Uszódi Island.

When establishing the high voltage lines, attention must be paid to the mound-building mouse living there. If construction will take place in the October to April period, mound-building mouse colonies of a 120 cm diameter and 50 cm tall mounds will be recognisable. If soil works are deeper than 40 cm, animals can be trapped live and can be removed. During summertime, the animals are dispersed and only few items will be exposed to danger along the route of the lines.

18.4.3.2 Indirect impacts

18.4.3.2.1 Botany

Deposition of dust, air polluting substances on the vegetation

This impact is felt to a smaller degree along the route of the lines, but most endangers the temporary construction area and also must be taken into account in the area around the power plant. Vegetation will be removed on the construction area, therefore, it will not be affected. The dust deposited on vegetation will inhibit certain physiological processes - plant breeding, photosynthesis, growth. To a lesser degree than the previous, the air emission polluting substances, the nitrogen compounds in particular, of the construction equipment will have an unfavourable impact during the time of construction. (Plants of open sand steppes have preference for nitrogen deficient soils). The air pollution increase coming from traffic during construction which will be felt in a circle of maximum 100 m along M6 and road 6 of heavy traffic, will not significantly influence the current status of road side associations.

Potential proliferation of invasive species

The vegetation will be removed from the area of the planned Paks II, in the future, first pioneer and broad tolerance species, then weeds, invasive species and generalists will be characteristic. By putting bare areas under grass and by regular management (grass cutting, mowing, watering) spread of invasive species can be and is necessary to be

prevented. Damage to habitats on the temporary construction area and the long distance electricity lines section during construction will also contribute to the proliferation of the above aggressive species and the supressing of indigenous species.

Impact of ground water level decrease causing drought stress

This impact may occur temporarily and locally on the temporary construction area adjacent with the construction area.

Impact on the fringes and habitats fragmentation

Potential affectedness of the poplar habitats adjacent with the grasslands of the temporary construction area may yield both positive and negative impacts for the grasslands. This patch of habitats, which is threatening natural grasses by invasive and non-indigenous plant species classified into the category of soft wood uncharacteristic pioneer forests of native tree species, at the same time may promote regeneration of the grasslands and decrease vulnerability of the neighbouring grasslands with its microclimatic impact and leaf litter nutrients .

Partial clearing of the willow-poplar flood plain forest between the cold and warm water channels - the area of the Island is not protected, its narrow Danube riparian zone is a Natura 2000 site - locally affects the temperature conditions - air and soil - the humidity of the air, moisture of the soil, wind strength and light conditions. Closing of the crown of trees, density of woody vegetation and liane level and shrub level coverage are changing on the fringes emerging. Volume of damage to foliage may potentially increase but it is habitats specific and difficult to estimate.

Along long distance transmission lines, especially at junctions covered by forests, impacts of fringes and habitats fragmentation can dominate again.

Waste enriching nutrients, attracting animals

This impact must be considered on the entire area of the planned investment. By the degradation of waste, soil becomes richer in nitrogen which will entail the proliferation of nitrophil plants. By digging, trampling, chewing the plants, excrement, spread of invasive and other plants, the animals cause damage to habitats, influence their structure and composition.

18.4.3.2.2 Zoology

With respect to the aquatic macroscopic invertebrates, in the situation to evolve following the extension of the cold and warm water channel section, the macroscopic invertebrates living at the bottom of the channel bed may be affected primarily by the larger put through quantity of water, the changed water flow and temperature conditions, but these impacts can only be followed up in a credible manner by monitoring the current and future conditions.

Dragon flies will be affected by the movement of the machines, thus noise and air pollution if construction is carried out during the swarming of the imagoes of species living in the area (in May-August). Due to their good flying capacity, imagoes can avoid this negative impact by change of their location. By the termination of certain habitats, the feeding and reproduction area of some species will decrease (Island between the cold and warm water channels), but the flying capacity of the species will avoid this problem.

Regarding fish, no indirect impact can be expected.

Unfortunately on soil surfaces disturbed by construction works different invasive plant species have a high chance to get into the former steppe habitats, where, by supressing the original vegetation and transforming the vegetation structure can significantly modify the life conditions of orthoptera (e.g., on wet patches golden rod - *Solidago sp*., on dry, sand habitats, milkweed - *Asclepias syriaca*). This is often accompanied by the impoverishment of the communities and may easily result in the disappearance of protected valuable species even if the grassland is not destroyed. In case of regenerating grasslands, the problem may be even more serious, immediately a structure totally different from the original evolves which prevents the resettlement of the original insect communities. This indirect impact is true for all the affected impact areas, especially where currently more valuable communities/species occur.

As on the areas affected by construction works, direct impacts are significant (removal of vegetation and fertile soil layer), terminating total communities, therefore, appearance of invasive species on these areas can rather be considered as a re-colonisation delaying factor. In the immediate environment of areas suffering significant direct impacts, however, due to disturbance having its origin there, further habitats not affected by the direct impact can also be damaged to even a greater extent due to invasive species having a good chance to break into those areas. The different grasslands of the area are currently unfortunately infected, although to a different degree by the above mentioned invasive species but the

strengthening of the propagulum sources eventually evolving on the degraded working area will by all means have a negative impact on these.

No detectable impact of exhaust gas and dust pollution and increased noise accompanying construction can be expected on the burrerfly fauna.

Polluting substances in the air may get enriched in less mobile ground surface anthropoda or soil animal species along the main public roads [18-81], [18-55]. In case of point sources, the different polluting substances may get accumulated in certain species in function of their physiological characteristics, while the size of the given species and its role in the food chain does not seem to have an impact on the accumulation [18-122], [18-90]. Technical literature data show that adaptation of the anthropoda to heavy metal contamination is well-known [18-100], [18-32], their immune system cannot get adapted to these [18-111]. Although negative impact of different pollutions on insect is broadly accepted, according to a more recent study [18-143] it can be questioned as they affect different taxons differently. In spite of that, ground surface anthropoda seem to be good potential bioindicators [18-54].

Damage to the vegetation and the soil and change in its characteristics will implicitly entail the transformation, termination of the habitats, change, termination in the nutrient sources, hiding places, etc. As a consequence of increased traffic and regular disturbance, certain invasive and synantrophic animal species may occur on the area and their proliferation may get accelerated.

Fragmentation of larger habitats areas may cause reduction of the size of the population of ground surface animal species, if distance between the patches is larger than what the different species are able to bridge. Most species tied to the soil, living in the soil have a bad dispersion capacity, for them a couple of metres wide unfavourable belt may be an obstacle. Decrease of the isolated population may lead to their local disappearance or even genetic transformation.

For amphibians and reptiles, the establishment of Paks II on the current territory of the Paks Nuclear Power Plant means not only physical impact and loss of habitats but entails further unfavourable indirect impacts. Among these, the significant decrease of the extension of habitats, damage (degradation), and intensive fragmentation may be mentioned. The extension of the Paks Nuclear Power Plant exercises its strongest impact primarily on its current area.

During the works, the vegetation disappears, is transformed (invasive species become dominant, microclimate provided by vegetation until then will be changed). Due to the fragmentation, habitats will be separated from each other, extension of optimal habitats will significantly decrease due to the edge effect. Edge effect may extend as far as 100 m, that is the reduction of the extension of undisturbed original habitats is of negligible rate only seemingly. The transformed vegetation will change the fauna, including the composition of insect communities most important for amphibians and reptiles relying on it as a source of nutrition, which will bring about a reduction of their food base.

The deep infrastructure earthworks and landscaping expected on the territory of the Paks Nuclear Power Plant may change the ground water level and contribute to further aridification of the area. This will primarily lead to the termination of the temporary reproduction sites of amphibians and in the longer-term it may result in the loss of feeding and dwelling sites. For amphibians occurring in this area however, these are not significant breeding sites, therefore, their termination will not fundamentally affect the breeding site of amphibian communities here. The standing water reproduction sites of larger extension are situated outside the area of the Paks Nuclear Power Plant.

During earthworks, there will be significant noise, dust and air pollution which on the territory of the Paks Nuclear Power Plant and along the transportation route will exercise strong disturbance for a long time, for that reason the majority of the amphibian and reptile species will most certainly look for refuge on further areas.

Increase of the traffic noise level will primarily be a problem for frogs having sophisticated acoustic signalling and sensing ability. Although a number of data supports the idea that they have good communication plasticity, but they cannot get adapted to the extremely fast changing conditions [18-132]. Noises cause interference, causing disturbance in females finding their way to males in the direction of their calling voice and all this can influence reproduction success [18-6]. Increased background noise is a major challenge for males singing in choirs, as above a certain level of noise they can no further increase their volume to transmit the appropriate information content [18-75], [18-117]. In case of frogs pursuing night lifestyle, traffic noise increase proved to be smaller as traffic decreased [18-52].

A number of studies have been published on the unfavourable impacts of block lines. Human health aspects of electromagnetic pollution have been well-documented, but their impact on the animals came into the forefront of research only in the last two decades [18-21], [18-107], [18-25]. Amphibians as indicator species have appeared in this field as well [18-1], [18-2]. In an electromagnetic field, embryonic development of amphibians is disturbed [18-77], [18-

31], [18-45]. Electromagnetic radiation of block lines can be detected on the territory of the Paks Nuclear Power Plant and along the outbound lines routes [18-113].

Impact of light pollution on amphibians is known. It has been demonstrated that artificial lights applied during night affects frogs, newt, salamander in finding their way, in their strategy for finding food, reproduction and growth as well as development [18-104].

As a consequence of the development of temporary road network for construction, consistent areas become fragmented. Although for birds it is easier to get from one area to another than for other animal species but the lack of the ecological corridor leading there may have an impact on them (habitats loss - direct impact). Due to fragmentation, the disappearing ecological corridor, the small body birds easily become prey which is favourable for the predators but unfavourable for the prey.

As another impact of excessive fragmentation species breeding there may not find the conditions necessary for them for successful hatching (decreased size of the area, decreased availability of food source, etc.). Direct loss of ecosystems should also be taken into account in addition to all that. For example bird species maintaining a territory may be supressed to a smaller area whose size is not optimal for them.

A third direct impact of fragmentation is the degradation of existing ecosystems, as along roads built, noise load, air pollution will increase, dust will be continuously deposited on vegetation, which will have an unfavourable impact on birds food (both on food of plant as well as of animal origin).

The fragmentation of habitats will directly affect mostly the following bird species of community importance and breeding on the area affected: black wood packer *(Dryocopus martius)*, wood lark *(Lullula arborea)*, collared fly catcher *(Ficedula albicollis)*, tawny pipit *(Anthus campestris)*, red backed shrike *(Lanius collurio)* European night jar*(Caprimulgus europaeus)*, corn crake *(Crex crex)*..

Dust pollution generated by construction will also indirectly affect the bird species living there. The rising dust will get deposited on the vegetation in the narrower and wider environment of construction, which in a direct manner will affect its development and in an indirect manner, the animals including birds living and feeding there. Rising and deposited dust affects not only the ground but also the food chain of standing waters. In addition to soil particles, rising dust can also contain organic matter which, when getting into waters, may change by biological status. Eutrophication may affect the reproduction and life of fish and consequently that of the water birds feeding on them. Dust pollution will affect in an indirect manner all bird species enlisted in Table 18.4.3-1. but the rate of impact may be different for the different species and this impact may be decreased by proper protective measures.

Increased noise load generated by construction works may indirectly affect the bird species breeding and feeding on the area which impact may be the result of changes coming about in the ecosystem. More valuable birds avoiding disturbance and higher noise may leave their current habitats and they may be replaced by less valuable bird species whose increased number may have a negative impact on the bird species currently living there. Increased noise load will affect the following bird species of community importance and feeding on the areas affected: black stork *(Ciconia nigra)*, tawny pipit *(Anthus campestris)*, white tailed eagle *(Haliaeetus albicilla).*

The area more affected by noise load and having larger richness of species is the area of the Tolnai-Duna Natura 2000 site being closer to the Island. On this area, we observed the black wood packer (Dryocopus martius) and the European night jar *(Caprimulgus europaeus)*, of which noise load will be more unfavourable on the latter.

The largest consequence of direct and indirect impact of the construction of Paks II will be the disappearance of birds formerly living and/or feeding there. Disappearance of the birds from the area may affect vegetation and other animal species living there. Insects are food for certain bird species, disappearance of the latter may bring about proliferation of certain harmful insect species. Plants are not only food for bird species feeding on their fruit but they also help in the reproduction of plants as birds may take the seeds of plants for larger distances for areas being further away. Harmful insect species will have a negative impact on plants through their excessive reproduction. Earlier these insect species were decreased by birds.

The construction will also affect a number of wet areas, where fish used to be food for bird species tied to water (breeding and/or feeding there). If these bird species disappear from these areas, excessive reproduction of invasive fish species can take place whose number used to be decreased by birds.

In summation, the direct and indirect impacts mentioned will affect the protected and highly protected bird species enlisted in Table 18.4.3-4.

Faj	Latin név	tv. érték (Ft)	Faj	Latin név	tv. érték (Ft)
Szürke gém	Ardea cinerea	50000	**Vetési varjú**	Corvus frugilegus	50000
Nagy kócsag	Egretta alba	100000	**Széncinege**	Parus major	10000
Bakcsó	Nycticorax nycticorax	100000	**Kék cinege**	Cyanistes caeruleus	10000
Kis kócsag	Egretta garzetta	250000	**Barátcinege**	Poecile palustris	10000
Fehér gólya	Ciconia ciconia	100000	**Őszapó**	Aegithalus caudatus	10000
Fekete gólya	Ciconia nigra	500000	**Csuszka**	Sitta europaea	10000
Barátréce	Milvus milvus	50000	**Fakúsz fajok**	Certhia sp.	10000
Vörös kánya	Aythya ferina	500000	**Ökörszem**	Troglodytes troglodytes	10000
Barna kánya	Milvus migrans	500000	**Léprigó**	Turdus viscivorus	50000
Héja	Accipiter gentilis	50000	**Énekes rigó**	Turdus philomelos	10000
Karvaly	Accipiter nisus	50000	**Szőlőrigó**	Turdus iliacus	10000
Egerészölyv	Buteo buteo	10000	**Fekete rigó**	Turdus merula	10000
Rétisas	Haliaeetus albicilla	1000000	**Hantmadár**	Oenanthe oenanthe	50000
Gatyás ölyv	Buteo lagopus	50000	**Cigánycsuk**	Saxicola torquata	10000
Darázsölyv	Pernis apivorus	100000	**Rozsdás csuk**	Saxicola rubetra	10000
Barna rétihéja	Circus aeruginosus	50000	**Házi rozsdafarkú**	Phoenicurus ochruros	10000
Vörös vércse	Falco tinnunculus	50000	**Fülemüle**	Luscinia megarhynchos	10000
Haris	Crex crex	500000	**Vörösbegy**	Eritacus rubecula	10000
Bíbic	Vanellus vanellus	50000	**Nádi tücsökmadár**	Locustella luscinioides	50000
Kis lile	Charadrius dubius	50000	**Nádirigó**	Acrocephalus arundinaceus	10000
Szürke cankó	Tringa nebularia	10000	**Barátposzáta**	Sylvia atricapilla	10000
Billegető cankó	Actitis hypoleucos	50000	**Mezei poszáta**	Sylvia communis	10000
Dankasirály	Larus ridibundus	50000	**Kis poszáta**	Sylvia curruca	10000
Fattyúszerkő	Chlidonias hybridus	100000	**Fitiszfüzike**	Phylloscopus trochilus	10000
Kormos szerkő	Chlidonias niger	250000	**Csilp-csalp füzike**	Phylloscopus collybita	10000
Vadgerle	Streptopelia turtur	50000	**Sisegő füzike**	Phylloscopus sibilatrix	10000
Küszvágó csér	Sterna hirundo	100000	**Sárgafejű királyka**	Regulus regulus	10000
Kakukk	Cuculus canorus	10000	**Szürke légykapó**	Muscicapa striata	50000
Erdei fülesbagoly	Asio otus	50000	**Örvös légykapó**	Ficedula albicollis	10000
Jégmadár	Alcedo atthis	50000	**Erdei pityer**	Anthus trivialis	10000
Gyurgyalag	Merops apiaster	100000	**Parlagi pityer**	Anthus campestris	50000
Búbosbanka	Upupa epops	50000	**Barázdabillegető**	Motacilla alba	10000
Nyaktekercs	Jynx torquilla	50000	**Sárga billegető**	Motacilla flava	10000
Zöld küllő	Picus viridis	50000	**Nagy őrgébics**	Lanius excubitor	50000
Fekete harkály	Dryocopus martius	50000	**Tövisszúró gébics**	Lanius collurio	10000
Nagy fakopáncs	Dendrocopos major	10000	**Lappantyú**	Caprimulgus europaeus	50000
Balkáni fakopáncs	Dendrocopos syriacus	10000	**Házi veréb**	Passer domesticus	10000
Közép fakopáncs	Dendrocopos medius	50000	**Mezei veréb**	Passer montanus	10000
Kis fakopáncs	Dryobates minor	50000	**Meggyvágó**	Coccothraustes coccothraustes	10000
Búbos pacsirta	Galerida cristata	50000	**Zöldike**	Carduelis chloris	10000
Erdei pacsirta	Lullula arborea	50000	**Tengelic**	Carduelis carduelis	10000
Mezei pacsirta	Alauda arvensis	10000	**Kenderike**	Carduelis cannabina	10000
Füsti fecske	Hirundo rustica	50000	**Erdei pinty**	Fringilla coelebs	10000
Molnárfecske	Delichon urbica	50000	**Fenyőpinty**	Fringilla montifringilla	10000
Parti fecske	Riparia riparia	50000	**Citromsármány**	Emberiza citrinella	10000
Sárgarigó	Oriolus oriolus	10000	**Sordély**	Miliaria calandra	10000

Note:
tv. value: nature conservation value; highlighted in grey: highly protected bird species

Szürke gém - Grey Heron
Nagy kócsag - Great White Egret
Bakcsó - Night Heron
Kis kócsag - Little Egret
Fehér gólya - White Stork
Fekete gólya - Black Stork
Barátréce - Pochard
Vörös kánya - Red Kite
Barna kánya - Black Kite
Héja - Goshawk
Karvaly - Sparrow hawk
Egerészölyv - Buzzard
Réti sas - White-tail Eagle
Gatyás ölyv - Rough-legged Buzzard
Darázsölyv - Honey Buzzard
Barna rétihéja - Marsh Harrier
Vörös vércse - Kestrel
Haris - Corncrake
Bíbic - Lapwing
Kis lile - Little Ringed Plower
Szürke cankó - Greenshank
Billegető cankó - Common Sandpiper
Dankasirály - Black-headed Gull
Fattyúszerkő - Whiskered Tern
Kormos szerkő - Black Tern
Vadgerle - Turtle dove
Küszvágó csér - Common Tern

Vetesi varjú - Rook
Széncinege - Great Tit
Kék cinege - Blue Tit
Barátcinege - Marsh Tit
Őszapó - Long-tailed Tit
Csuszka - Eurasian Nuthatch
Fakúsz fajok - Treecreeper species
Ökörszem - Wren
Léprigó - Mistle Thrush
Énekes rigó - Song Thrush
Szőlőrigó - Redwing
Feketerigó - Blackbird
Hantmadár - Wheatear
Cigánycsuk - Stonechat
Rozsdás csuk - Winchat
Házi rozsdafarkú - Black Redstar
Fülemüle - Nightigale
Vörösbegy - Robin
Nádi tücsökmadár - Savi's Warbler
Nádirigó - Great Reed Warbler
Barátposzáta - Blackcap
Mezei poszáta - Whitethroat
Kis poszáta - Lesser Whitethroat
Fitiszfüzike - Greenish Warbler
Csilp-csalp füzike - Chiffchafff
Sisegő füzike - Wood Warbler
Sárgafejű királyka - Goldcrest

Kakukk - Cuckoo	Szürke legykapó - Spotted flycatcher
Erdei fülesbagoly - Long-eared Owl	Örvös legykapó - Collared Flycatcher
Jegmadár - Kingfisher	Erdei pityer - Tree Pipit
Gyurgyalag - Bee-eater	Parlagi pityer - Tawny Pipit
Búbosbanka - Hoopoe	Barázdabillegető - Pied Wagtail
Nyaktekercs - Wryneck	Sárga billegető - Yellow wagtail
Zöld küllő - Green Woodpecker	Nagy őrgébics - Great Grey Shrike
Fekete harkály - Black Stork	Tövisszúró gébics - Red-backed Shrike
Nagy fakopács - Great Woodpecker	Lappantyú - Nightjar
Balkáni fakopáncs - Syrian woodpecker	Házi veréb - House Sparrow
Közép fakopáncs - Middle Spottted Woodpecker	Mezei veréb - Tree Sparrow
Kis fakopács - Lesser woodpecker	Meggyvágó - Hawfinch
Búbos pacsirta - Crested Lark	Zöldike - Greenfinch
Erdei pacsirta - Woodlark	Tengelic - Goldfinch
Mezei pacsirta - Skylark	Kenderike - Linnet
Füsti fecske - Swallow	Erdei pinty - Common Chaffinch
Molnár fecske - House Martin	Fenyő pinty - Brambling
Parti fecske - Sand Martin	Citromsármány - Yellowhammer
Sárgarigó - Golden Oriole	Sordély - Corn Bunting

Table 18.4.3-4.: List of protected and highly protected bird species affected by direct and indirect impacts

During construction works, the temporary removal of the current vegetation will significantly influence the quantity and composition of insect food for bats. Edge effect may extend as far as 100 m, that is, the reduction of the extension of undisturbed original habitats is of negligible rate only seemingly. The transformed vegetation (of decreased coverage) will change the fauna tied to it as a source of food, and also the composition of insect communities which will be accompanied by the decrease of food base for bats.

On the territory of the Paks Nuclear Power Plant affected by the investment, extensive landscaping is expected which will entail the removal of the vegetation and promote aridity. This will intensify water shortage due to global processes and will have an indirect impact on the agricultural activity outside the territory of the power plant. It is expected that small parcel farming will be further suppressed which will decrease the habitats of the mound-building mouse. A similar process is taking place in respect of grazing animal husbandry, based on which a decrease of ground squirrel habitats patches is expected. The ground squirrel field at Paks is characterised by low intensity grazing, where based on our survey in 2013, the ground squirrel stock is limited to the western part of the earth road cutting across the area. Because of the distance, this process is not in a cause-effect relationship with power plant development, but they coincide because of the common economic social background processes.

Continued aridification poses a threat to the Dunaszentgyörgy swamp forest which may lead to the total annihilation of the potential tundra vole habitats patches, preventing an eventual settlement. But as the presence of the tundra vole here is not supported by evidence, furthermore, the protected area is at a distance of some 5 km from the power plant and aridification would come about as a result of global processes irrespective of the construction, the extension works of the power plant will not affect this unfortunate process.

Due to light pollution, the lighting of the construction site will, on of the one, hand disturb the bats in finding food, on the other hand, insects gathering for the light may become food available in masses in certain periods [18-115], therefore, its impact on bats is not straigth forward and difficult to predict.

18.4.4 AREAS EXPECTED TO BE AFFECTED BY THE CONSTRUCTION

18.4.4.1 Direct impacts

Botany

From the aspect of plant associations and plant species to be protected, the scope of the direct impact area of the construction studied covers the temporary construction area, all the related construction areas (including the Island and the Danube bank), as well as the construction zone of the long distance transmission lines (Figure 18.4.4-1).

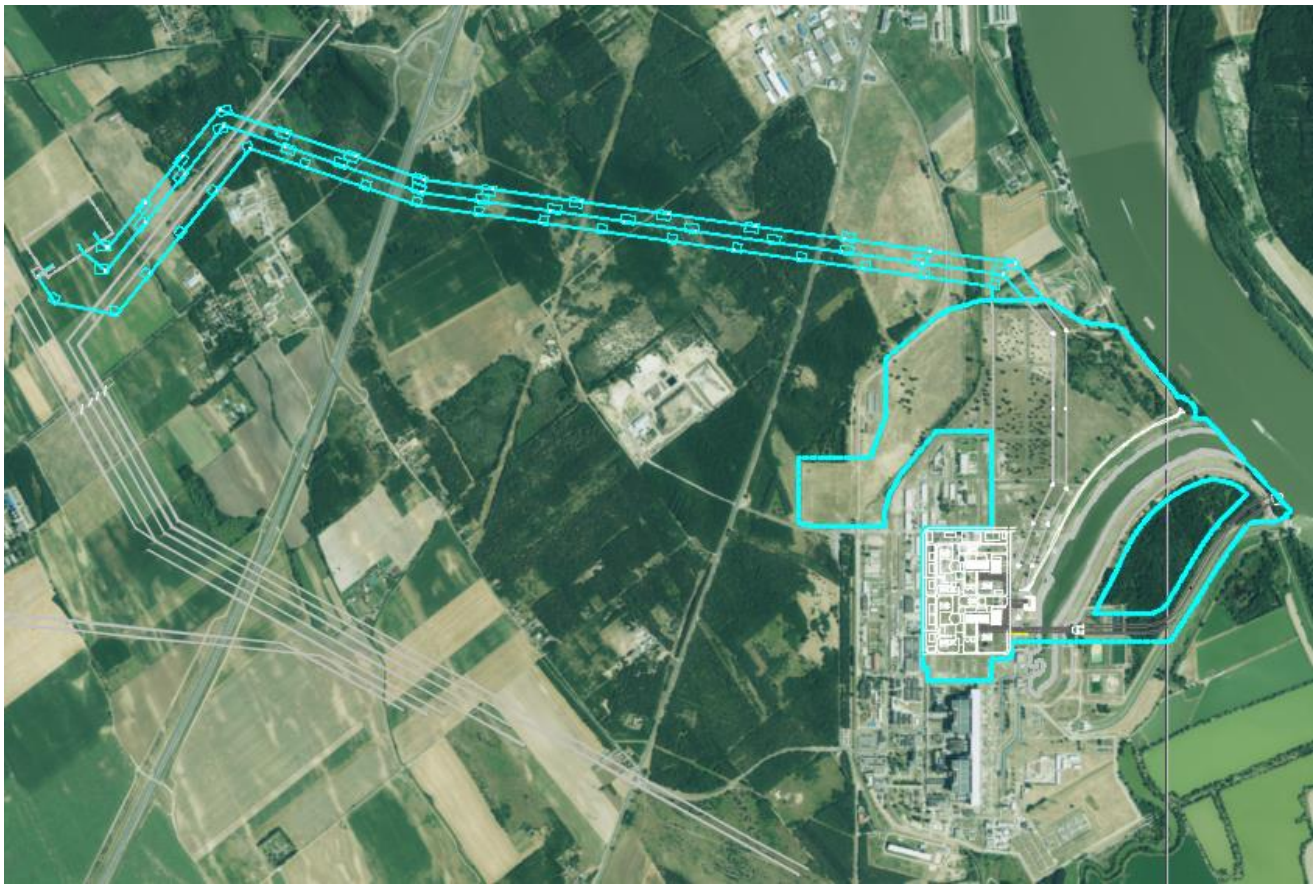


Figure 18.4.4-1.: Direct impact area of the establishment of Paks II - botany

Zoology

From the aspect of aquatic macroscopic invertebrates, the inflow and outflow of the cold and warm water channels, the two channels themselves, and the Danube section under the outflow of the warm water channel are affected.

Based on former assessments [18-85], [18-86], [18-87] it can be established that from the aspect of dragon flies, the ground squirrel field at Paks (HUDD20069) and the Dunaszentgyörgy swamp forest (HUDD20072) water areas being the competency of the Duna-Dráva National Park Directorate are not affected by the construction, while the Tolnai-Duna section (HUDD20023), the connection of the cold and warm water channel to the Danube are affected. Works performed here (branching off of the new warm water channel on the Island; extension of the cold and warm water channel section) will cause the destruction of the items of the yellow-legged dragon fly *(Gomphus flavipes)* and part of its habitats will also disappear.

The most significant construction works affecting the fish stock is the widening of the cold water channel bed and the construction of a new warm water channel section having its inflow into the Danube 200 m above the existing warm water outflow. The works performed along the banks, the artificial facilities and the recuperation structure planned to be established in the inflow section of the warm water discharge by 2025 will change the hydrological and river bed morphological conditions of the right-side bank of the Danube River.

During the construction of Paks II, the scope of direct impacts affecting the orthoptera and butterflies will cover the entire planned construction area (although their termination of communities not containing valuable components, presumably of very poor species is expected) significant impacts can be expected on the entire temporary construction area (here valuable communities will be affected during this period), on the territory of the Island closed by the cold and warm water channels (where again we do not have to reckon with significant loss of valuable populations), along the route of the long distance transmission lines to be constructed (on the sites of the poles of long distance transmission lines, and on the territory of tree plantations).

From the aspect of soil surface arthropoda, the direct impact area of the construction includes all areas affected by the investment.

For the amphibians and reptiles, with attention to direct impacts, the impact area of construction primarily includes the construction area and temporary construction area as well as the Island between the cold and warm water channels. The largest rate of habitats loss will take place here which may lead to the local disappearance of the stocks of these species. During the construction of the new water abstraction works on the Danube bank, the earthworks, equipment will be a serious danger for the amphibian and reptile species there. During the total length of construction, impact will be primarily expressed in trampling and running over. In the immediate vicinity of the pump station, on the northern site of the branching off of the current cold water channel, an item of the nationally widespread brisk lizard *(Lacerta agilis)* was found. Some old poplar trees along the route of the new fresh water cooling system are to be found on the site of occurrence of the green lizard *(Lacerta viridis)*. No further amphibian or reptile species were found along the route of the lines but some were found in the neighbourhood. For example, tadpoles of the fire-bellied toad of community importance *(Bombina)*, the green toad *(Bufo viridis),* the agile frog *(Rana dalmatina),* transformed young items of the common toad *(Bufo bufo)* and the marsh frog *(Pelophylax ridibundus)* were found in the pool of the pump station. Of these species the fire-bellied toad and the marsh frog stay in the water not only for a purpose of laying down the eggs but it spends more time there, it is feeding in the water or in the edge zone of the water. The other species mostly go to the water for laying their eggs, then they leave it and feed at places further away. The water pool of the pumping station on the territory of the Paks Nuclear Power Plant has so far attracted amphibians for reproduction purposes. In springtime amphibians and reptiles cover large distances between the winter resting site and the potential reproduction site. At times like that they take the shortest way to the water, they have to cross their migration routes where increased vehicle traffic due to construction is a potential danger for them. Lizard species more sensitive to noise disturbance and more adapted to changing their site will leave the construction site and get further away when works are started.

When the new warm water channel is constructed on the Island, the area will be affected by a number of impacts during the construction period. With consideration to edge effect as well it seems that the entire areas studied will be affected. A significant number of the amphibian and reptile species now occurring on the area may die during the construction as in practice they will have no way out from the area bordered by the cold and warm water channel. The bird observation site next to the warm water channel and the adjacent little lake also have an uncertain fate. In the last two years we saw some items of *Bombina bombina* and the national frequent *Pelophylax ridibundus*. The fire bellied toad is a species of community importance, therefore, its presence deserves attention but on the given area presumably it occurs only occasionally with a smaller stock. Eventual disappearance of the little lake and the shallow water body next to the bird watch site will not exercise perceivable impact on the stock of the given species in the area. From among the reptiles, a species of community importance, the European pond terrapin *(Emys orbicularis)* was found. Although it was only one young item of the species. Its presence may be due to the fact that the nearby fishpond at a distance of a couple of hundreds of meters is a home and reproduction site to a stable European pond terrapin community and most certainly the young item left the lakes and went up to the dike. In the edge zone of the gallery forest, items of the brisk and green lizard could be found in both years, for them the trunk of the fallen trees and branches are excellent hiding, feeding and sunbathing sites. These habitats will probably come to an absolute end when the new warm water channel is constructed. The new warm water channel will have high flow velocity similarly to the current one which will not be suitable for the settlement of amphibians and reptiles in its water.

The construction of Paks II will affect bird species occurring, breeding and feeding on the area. Most of the direct impacts will affect the preparation for construction and development areas, the Island surrounded by the current cold and warm water channels, the soft wood gallery forest stretching south of the warm water channel as well as grassland and forest areas along which the new 120 and 400 kV transmission lines will be built.

From the aspect of birds, the areas affected by the investment are the temporary construction and development area, the Island, as well as areas on the construction zone of the long distance lines route that will be directly affected by the termination of habitats. These habitats will be terminated, but when works are completed, some of the bird species may return. Mainly those bird species can be expected to return which better tolerate disturbance, better adapt to urbanised areas and which require relatively small area for breeding. For some of the birds breeding on the area, in addition to the negative impact, construction of the poles for the long distance transmission lines may have a positive effect, for example they can be used by them as sites for the observation of predatory birds.

Increased noise load during the works of the investment will affect to the largest extent the temporary construction area and development area, the road network leading up there, and its environment, the 'Island'.

Waste generated by the investment will be a source of danger to the greatest extent on the base area of the new units in the environment of the more recent and sometimes changing cold and warm water channels and along the access road network.

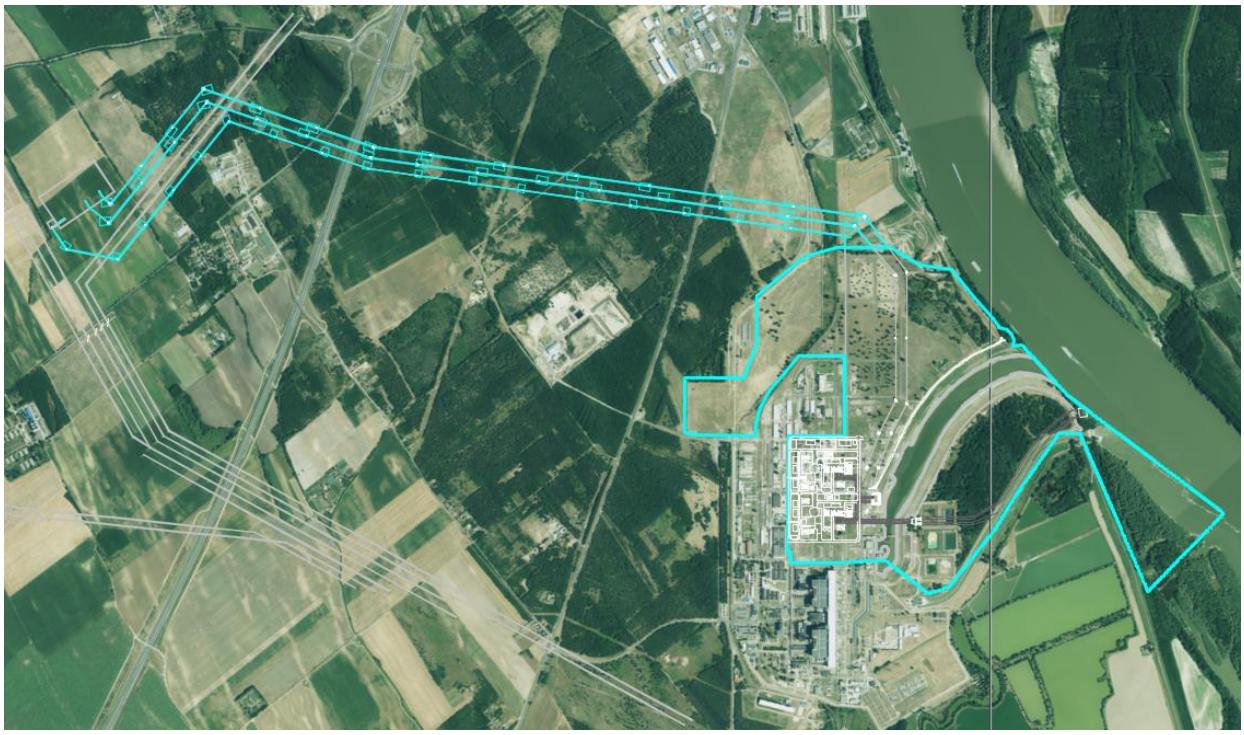


Figure 18.4.4-2.: Direct impact area of the implementation of Paks II - zoology

With regard to mammals, the impact area of construction is the construction and temporary construction area and the Island between the cold and warm water channels. During construction habitats loss will occur on the area, which may be followed by partial improvement following landscaping if putting under grass is done by natural grassland components, e.g., mixture of false, striated fescue. When the warm water channel extension is implemented on the Island, the high performance machine work in such a depth and at such a speed that the soil dwelling small mammals will not be able to flee, therefore, they can be expected to be destroyed. Removal of the old poplars presents a similar danger, where the hollow living bats may get into danger. As bats are sleeping during winter, works must be scheduled for their active period or prior to clearing the trees they should be removed and re-settled into trees with hollows suitable for the purpose. Construction of the warm water channel on the Island results in a closed area whose extension is not sufficient for permanent settlement, therefore, subsequent to construction it may function as an ecological trap for the soil living small mammals.

18.4.4.2 Indirect impacts

Botany

The scope of the immediate impact area of the processes affecting vegetation covers the temporary construction area for the investment, all the related construction area and its direct environment (including the Island and Danube bank), a couple of hundreds of metres environment of the Paks Nuclear Power Plant (maximum 500 m in the west, and in the direction of south, about 300 m), the construction zone of the route of the long distance transmission lines and its further environment of maximum 100 m. (Figure 18.4.4-3)

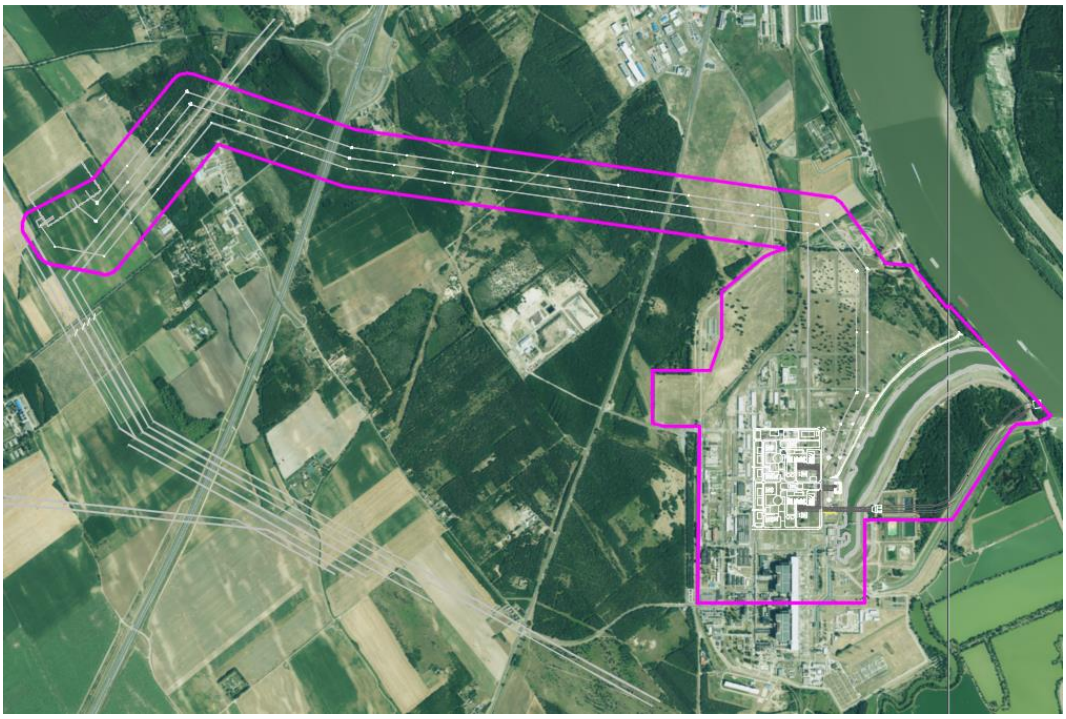


Figure 18.4.4-3.: Direct impact area of the implementation of Paks II - botany

Zoology

Presentation of the direct impact areas on a map is not relevant as due to the site changing ability of the animals, borders of the direct impact areas cannot be defined in an exact manner.

The indirect impact for dragon flies, such as the movement of machines, noise and air pollution, may affect dragon flies only during the swarming of the imagoes of species living in the area (in May-August). Imagoes with a good flying capacity can compensate negative impacts and may look for new habitats.

The construction presumably will not have a perceivable direct impact on fish.

During the construction of Paks II, indirect impact on the orthoptera (appearance of invasive species) can be expected on the temporary construction area and along the long distance transmission lines to be constructed in a disturbed zone, but the problem may occur in their vicinity in a circus of ten or even hundred metres circus, if infection by invasive species becomes large scale on the disturbed areas.

No indirect impact areas can be presumed for butterflies.

From the aspect of soil surface arthropoda, the indirect impact area of the implementation will include all the areas affected by the investment and their further maximum 100 metres environment.

With attention to indirect impacts including noise, dust and air pollution, the impact area of implementation for amphibians and reptiles will primarily be most intensive on the construction and temporary construction area, on the Island between the cold and warm water channels and along the transportation routes.

The noise, dust and air pollution loads of the works performed on the Island will have their impact as far as the Uszódi Island and the Paks Nuclear Power Plant Anglers' Association lakes. On the area of the fishing lakes and the Kondor Lake three Natura 2000 amphibian and reptile species occur *(Triturus dobrogicus, Bombina bombina, Emys orbicularis*), which are currently exposed to strong human presence, varied water level on the marsh areas at the end of the Kondor Lake, and noise impact due to the road running alongside with it. In spite of that their presence can be considered stable. Although extension works generate extra noise load, but it is known about the species occurring in abundance *(Pelophylax ridibundus, Lacerta viridis)* that they relatively well tolerate noise increase and can get adapted. Response of *Emys orbicularis* is a question, however, which is a much more sensitive species to noise impact.

During the time of construction only minimum noise and eventual air pollution can be expected in the area of the Uszódi Island from among the Natura 200 sites being closest to the Paks Nuclear Power Plant and in the most northern parts of

the Dunaszentgyörgy swamp forest, and this will not essentially affect the ordinary way of life of amphibians and reptiles living there.

With respect to birds, the scope of indirect impact of habitats fragmentation will cover the entire investment area and the areas affected by the temporary or final road network built for construction, the route of the electricity transmission system and the areas within its 50-100 metres zone as well as the Island. Further indirect non-significant impacts are expected on the northern part of the Dunaszentgyörgy swamp forest.

Areas affected by the increased noise load, dust pollution are the temporary construction area for the investment, all the related construction areas, including the Island and the broader environment of the Danube bank and the construction zone of the long distance transmission route and its 50-100 metres environment. Construction may have an indirect impact on the 50-100 metres buffer zone of the block lines route, and, to a non-significant extent, the northern part of the Dunaszentgyörgy swamp forest and the edge areas of the ground squirrel field at Paks Natura 2000 site.

The development area has been grassland relatively undisturbed for a longer time whose termination will have a negative impact also because there is no area in the neighbourhood with similar parameters. Some of the bird species hatching and/or feeding here will find other breeding site in the neighbourhood, some of them however will have to do a larger distance to find the habitats parameters which are currently available on the development area.

South of the warm water channel of the Tolnai-Duna Natura 2000 site is directly affected to a smaller degree and indirectly affected to a larger degree, which will have a negative impact on the priority bird species of the area as the number of the breeding pairs of the black wood packer and the European night jar will decrease on the area.

The southern route of the block lines will cut across agricultural areas for the most part, but on areas lying north and west of the power plant it is stretching across forest and grassland areas as well. Although areas with similar conditions like the areas affected can be found in their vicinity, but the full size of the current area will decrease due to the construction.

The Dunaszentgyörgy swamp forest has very good conditions for the breeding and/or feeding of birds, there is no similar area in the vicinity, therefore, it has an outstanding role. Although gallery forest similar to the Tolnai-Duna Natura 2000 site can be found in the riparian zone of the Danube, but fragmentation of this riparian zone should by all means be avoided. Construction will have indirect, not significant impact on the ground squirrel field at Paks Natura 2000 site. Due to the nature of the area a number predatory bird species live and feed on the area. Area with similar conditions is not available in the direct environment.

With regard to indirect impacts, the impact area of the power plant construction will primarily be the noise, dust and air pollution consequences [18-3]. These impacts will be significant on the construction and temporary construction area, on the Island between the cold and warm water channels and along the transportation roads. Impacts on bats will extent to the Uszódi Island and the Paks Nuclear Power Plant Anglers' Association lakes by the transformation of the food bases and disturbance of finding a prey. The noise generated by the construction may disturb the echo location of bats living in buildings and as such it may disturb their finding their way and finding a prey [18-102]. To mitigate this, it is recommended to have spatial grouping of the work process schedule so that bats may feed undisturbed on other parts of the Paks Nuclear Power Plant.

During construction physical disturbance and trampling changes vegetation which entails the transformation of the insect community and that may cause temporary disturbance in the food choice of the bat stock staying on site (Schaub et al 2008).

Although some small mammals may be run over in principal along the transportation routes [18-39], its nature conservation impact is insignificant as neither the 2012 nor the 2013 survey detected the presence of ground squirrel, mound-building mouse and the tundra vole on the construction site, and the chance of public road collision with bats living in buildings is negligible.

During the time of construction, dust pollution may occur depending on wind direction in the vicinity on the Uszódi Island. On areas of the Dunaszentgyörgy swamp forest being at a distance of some 5 km, no noise and pollution of such an extent is probable which would affect the life conditions of mammals living in the soil and bats living in tree hollows. Habitats decrease and species disappearance primarily occurs because changes are of larger magnitude and happen faster than what the organisms affected are prepared for from the point of view of evolution.

It is known that anthopogenic light pollution affects ecological processes in a number of groups of species. As bats feeding on insect are active primarily during the night, their behaviour and food base is fundamentally influenced by

strong artificial lighting. It has been supported by evidence that mercury lamps disturb the flying of certain bats species (e.g., *Rhinolophus hipposideros*), as a result, they are much less active, and although the strong light attracts insects, predation will not be successful [18-115].

18.4.4.3 Trans-boundary environmental impacts

18.4.4.3.1 Botany

From botany aspect the implementation of the investment does not have transboundary environmental impacts.

18.4.4.3.2 Zoology

The construction of Paks II will not have transboundary impact with regard to the aquatic macroscopic invertebrates and dragon flies. Works during construction will presumably have only local impact on the fish stock of the Danube River, therefore, no transboundary environmental impact can be expected in case of this group. With regard to the orthoptera insects, butterflies and soil surface arthropoda, no transboundary environmental impacts can be expected. With respect to the number of items of amphibians and reptiles affected by the construction of Paks II they are in line with the national average (e.g., occurrence of *Lacerta viridis* on the temporary construction area of the Paks Nuclear Power Plant), others show values well below this (*Pelophylax ridibundus, Lacerta agilis*), or their occurrence may be considered explicitly rare (*Bombina bombina, Bufo bufo, Bufo viridis, Rana dalmatina, Emys orbicularis, Natrix natix, Natrix tessellata*), limited rather to wandering items. Areas occupied for construction will impose detectable impact neither on the situation of the national stock, nor will there be certainly any transboundary impacts. The same can be told about birds. In case of mammal species construction of Paks II will not influence national stock dynamic processes. No stock of national importance can be found in a 3 km radius of the power plant, therefore, on the areas used for power plant construction there will be no detectable impact on the situation of the national stock, and transboundary impact will certainly not occur.

18.4.5 ENVIRONMENT PROTECTION MEASURES

18.4.5.1.1 Botany

Damage to protected plant species on the temporary construction area must be taken into account, therefore, when implementing the investment, the measures described below should be taken.

The transplantation of the populations of purple viper's grass covering significant size of area on the temporary construction area and the success of re-settlement is dubious, therefore, other solution must be found for saving this sward species. During the years preceding the investment, continuously, once a year, seeds must be collected. Collection of seeds can be done by having a permit to do so. Seeds should be submitted preferably to the Pannon Corebank (related institution: Plant Diversity Centre - Tápiószele, Hungarian Academy of Sciences Ecological and Botanical Institute of the Ecological Research Centre - Vácrátót, Aggtelek National Park Directorate), or if they refuse to accept, it should be coordinated with the Duna-Dráva National Park Directorate what should be done with the seeds.

For seed collection, mowing of the temporary construction area should be scheduled by allowing for the preliminary collection of ripe seeds. The purple viper's grass should be collected together with its external arista, depending on the weather in May-June, during dry weather from the dry items, when it can be easily removed from the plant. The objective is the random collection of minimum 5,000 seeds from minimum 200 items in order to ensure representivity and preserve allele frequency. Seed quantity can only be decreased if it exceeds 10% of the annual seed production (on the temporary construction area). As it is a protected plant, a larger percentage collection of its seed would endanger the population and we also have to take into account in respect of the investment that most of the entire population will be destroyed, therefore, survival of the community should also be ensured. Where impact of an area is apparent, as large-scale seed collection of the annual seed production of items to be found there should be carried out as possible. Collection can be done by an expert. In addition to recent documentation (data on the habitats, population and plant) photo documentation containing photos properly exposed of at least 2 megapixel size is also required (on stamps, phenophase, flowering environment).

Tick seed and dianthus sherotinus protected items along the route of the long distance lines affected by the investment should be preserved on their original site and should be designated and fenced for the duration of the construction. Of the purple viper's grass, seeds must be collected in a documented manner in the year preceding the construction of the long distance transmission lines (minimum 10% of the seed stock) and scatter the seeds without their external arista on the area adjacent to the long distance transmission lines not affected by the investment anymore in order to provide a propagulum source richer than the existing one for the re-settlement.

When making the plans of the investment, potential methods must be elaborated for the prevention of the spread of invasive plant species.

The re-settlement of protected plants and the collection of seeds of protected plants should be coordinated with the Duna-Dráva National Park Directorate. For interventions to be carried out along the route of the long distance transmission lines, a nature conservation permit must be requested from the Central Transdanubian Regional Inspectorate for Environment and Nature.

18.4.5.1.2 Zoology

The macrozoobenthos community living along the Tolnai-Duna Paks section represents the general and typical fauna picture of the downstream section of the Danube River in Hungary (under Budapest), with a number of rare, protected species. On the right side of the river bank, along the section above the warm water channel of the power plant, less invasive species and more rare protected species can be found. Former assessments did not examine the Island as operational area surrounded by the cold and warm water channel, where by the construction of the branching off of the new warm water channel to be constructed, when the inflow structure is developed - on the Danube section affected classified as Natura 2000 nature conservation site - the habitats of the river bottom dwelling macroscopic invertebrates will disappear in the riparian region. Presumably similarly valuable macroscopic aquatic invertebrate communities can be found on that section of the river bank as well, therefore, it is recommended to take stock of it before construction is started. Specific environment protection proposals can be made in light of these assessments.

Over one-third of the 64 domestic dragon fly species are under protection. The construction of Paks II will have a direct impact on two river dragon flies living on the Danube at the extension of the cold and warm water channel section on an area affecting the Danube; these are the yellow-legged dragon fly (Gomphus flavipes) and the common club-tail (Gomphus vulgatissimus) [18-85], [18-86], [18-87]. Gomphus flavipes is included in Annex IV of the Natura 2000 Habitat Directive [18-23], in the Red Book [18-125] as well as in the National Biodiversity Monitoring System. The nature conservation value of this species expressed in currency is 10,000 HUF. The nature conservation value of the protected Gomphus vulgatissimus species is 5,000 HUF. When performing works affecting the river bed of the Danube, disturbance, termination of the natural environment and activities affecting the river bed should possibly be limited to the smallest area.

Concerning fish, no special environment protection measures need to be done in respect of the construction of Paks II, as most of the fish would wander away from dredging, etc. intervention affecting the banks. As the macroscopic invertebrate organisations and the two protected dragon flies show a more sensitive response to interventions affecting the river bank (branching off of the warm water channel, inflow structure), therefore, statements made on macro invertebrate groups and dragon flies can also be used for fish. When performing works affecting the river bed of the Danube, disturbance, termination of the natural environment and activities affecting the river bed should possibly be limited to the smallest area.

During the construction of Paks II, as a consequence of the direct and indirect impacting factors, with respect to the orthoptera, negative consequences may be expected mostly on the temporary construction area. As there is no species affected here which has a community only in this environment, therefore, their re-settlement is not justified (and would not be easy to implement). Therefore, in order to maintain these valuable species here, it is necessary to maintain favourable conditions and/or improve these conditions for the populations of the habitats patches remaining in the vicinity. This primarily means improving the conditions of the sand steppe habitats in the vicinity of the Paks Nuclear Power Plant. The main problem affecting grassland structure is the invasion by milk weed. Its manual suppression by using herbicides on the existing smaller patches of grasslands would bring about a positive change for the insect communities here (and not in the least for the protected plants occurring here). Besides milk weed, the spontaneous occurrence of acacia is a similar problem, which leads to gradual disappearance of the habitats patches on the remaining grasslands around the power plant. Suppression of acacia (also manually, and by using herbicide) on the still existing and locally valuable patches of grasslands would contribute a lot to the maintenance of the original valuable

flora and fauna. These measures would promote the strengthening of the remaining population later to be used as a source on the habitats of the two protected local species in the vicinity and of the two locust species protected [18-79] and the small size field grasshopper [18-95].

The zone to be created under the long distance transmission lines, in place of the tree plantations, may bring back some form of the original sand vegetation on a major area. This can be considered as habitats reconstruction and requires complex nature conservation management. The most efficient solution would be the promotion of spontaneous regeneration following clearing by invasive species control, seed or hay application from the sand steppe patches in the vicinity. When a semi-natural grassland structure emerges, characteristic insect colonies may be inspected to re-colonise the new habitats. This would bring about significant positive nature conservation effect as evidence of that has been provided by Bazelet and Samways [18-5] with respect to the orthoptera.

Along the route of the block lines, when clearing of woody vegetation, stubbing and dispatching is done, the least possible trampling should be made in order to promote the regeneration of dry and sand steppes. Following intervention, special attention should be paid to the prevention of weeding and spread of invasive species which may accelerate the re-settlement and strengthening of indigenous sand steppes. It would be advisable to sow the safety zone of the electricity lines by seeds collected from the neighbourhood, promoting thereby landscape rehabilitation. These interventions will accelerate the re-settlement of protected insect species. Proper treatment of the route has proved to be successful in the nature conservation management of one of the protected butterfly species (Lycaeides melissa samuelis) of the United States [18-40]. Proper treatment of the vegetation of the route helped to increase the number of items and abundance of the butterfly fauna in a study in Finland although values found on natural habitats could not be reached [18-76].

On areas with natural or semi-natural vegetation cover, impacts should possibly be minimised so that they may serve as propagulum sources for soil surface animal species on the areas affected by the investment. On the areas affected, development as soon as possible of a plant association characteristic of the area should be promoted (e.g., by spreading sand steppe grassland seeds) where macro invertebrates typical to the area may get settled as soon as possible (e.g., ants, beetles).

With respect to amphibians and reptiles, prior to construction, as many as items as possible should be trapped from the area and transferred to undisturbed habitats in the vicinity. Trapping, transportation and re-settlement should be carried out under the control of an expert.

With respect to amphibians and reptiles, the following should be paid attention to during construction:

- Scheduling in time: earthworks should not be performed during the winter hibernation period, but should be done from spring to autumn when actively moving items can flee from the area.
- Scheduling in space: earthworks should not proceed from the edge of the area affected towards the inner part, but the opposite, enabling items to flee into several directions.
- Continuous maintenance of the work area: in order to avoid the generation of standing waters for longer time, because they may be attractive and function as ecological traps for amphibians.
- As mush as it is possible, noise towards the Uszódi Island should be moderated during the spring time reproduction period of the amphibians.

In order to mitigate light pollution, lamps/luminaires used for lighting at night should have an orientation towards the inner part of the area and not the outer part because in the latter case, it would have an attracting effect.

During landscaping, green areas as much as possible should be preserved or arranged which could be feeding or hiding places for a number of species. Chain of green surfaces may decrease fragmentation effect and by the method of ‘stepping stones’ it may create an opportunity for the spread of species.

One of the best and at the same time desirable method of mitigating the direct and indirect negative impacts with regard to birds is to perform the works which lead to the termination of the habitats (foundation, construction of road network and establishing temporary waste storage areas) during the autumn and winter period. If works are started in a period when hatching of birds has not been started yet, nests have not been built yet, eggs have not been laid yet, negative impacts can be mitigated as birds have a higher chance to look for another area and start breeding there.

Negative effects of block line construction can be decreased by the right construction and by the proper insulation of the poles as this would decrease the number of electric shocks. These negative impacts can be further mitigated if re-cultivation is carried out along the route and in the buffer zone of the block lines. The number and the extension of

potential breeding and feeding sites can be increased that way decreasing at the same time the negative impacts. Both during construction as well as subsequent re-cultivation attention should be paid to the currently existing ecological corridors and excessive fragmentation of consistent habitats should be avoided. With attention to these aspects negative impacts can be mitigated.

Maintenance of new ecological corridors established subsequently to construction and during re-cultivation, and maintenance of the re-settled vegetation is absolutely necessary. When re-cultivation is done, the most optimal strategy must be selected which pays attention to all the negatively affected planted animal species.

Negative effects of waste generated during construction can be decreased by their proper storage. Waste storage facilities should be avoided from wind and rain in order to avoid waste being transferred for a long distance by the wind or being brought together in a pile, or contaminated rainwater getting into the ground water or into standing water. These problems can be mitigated by the transportation of the waste from the site as soon as possible and by proper storage. Attention should be made that waste should not get into neither the cold nor the warm water channels nor in the Danube or its dead branches. Dead branches require special attention as they are a breeding and feeding site for a number of bird species.

We have less options to mitigate the increased noise load of the construction of Paks II, but negative impacts can be mitigated also by starting works not during the hatching period. By the restoration of ecological corridors between the fragmented areas, re-settlement of birds to areas affected by the investment can be promoted. Restored ecological networks have favourable indirect impact as well. Establishing ecological corridors is also advisable in the interest of avoiding isolation.

On the directly and indirectly affected areas special attention should be paid to the change in the number of communities of the following species from among the bird species currently breeding and/or feeding on the area: black crowned night heron (Nycticorax nycticorax), white stork (Ciconia ciconia), black stork (Ciconia nigra), red kite (Milvus milvus), black kite (Milvus migrans), white-tailed eagle (Haliaeetus albicilla), corn crake (Crex crex), cerean wood packer (Dendrocopos syriacus), tawny pipit (Anthus campestris), collared fly catcher (Ficedula albicollis) and the European night jar (Caprimulgus europaeus). The species mentioned above deserve high attention by all means in respect of their sensitivity, number of items within an area and frequency in Hungary.

Right before construction bats living in holes of trees should be caught by systematic examination of trees decaying in side and animals should be re-settled on a similar habitats patch. Trapping, transportation and re-settling of the soil living small mammals and the bats living in holes of trees should be carried out by an expert in this area. Damage should be minimised by using technology which entails the smallest possible threat.

During earthworks, significant dust, noise and air pollution can be expected which is unfavourable for bats using the current area for feeding. As the feeding site of bats living in buildings is adjusted to the presence of prey species bats may be expected to leave the area during the time of construction.

Similar procedure should be carried out for the small mammal rodent stock of the area. Although the small mammal species detected by the trapping in autumn 2013 are not highly protected (in order of frequency Apodemus agrarius, Myodes (Clethrionomys) glareolus, A. flavicollis, Microtus arvalis), but in themselves, and also as members of the food chain, they represent major nature conservation and ecological values, therefore, they should be caugth by live trapping and should be transported away.

In the interest of the protection of mammals, during construction attention should be paid to the following:

- earthworks should not be performed during the winter hibernation period, they should instead be done during the April-October period when animals living on the soil can flee from the area.
- Disposal of soil removed during earthworks will affect a large area, which should be cautiously selected in order to decrease further damage to nature.
- Wood clearing should not be done during reproduction period but should be done when young bats of that year are able to independently look for a new hiding place.
- Spatial planning result in mosaic, semi-natural vegetation patches, which may be feeding and hiding places for a number of species.

As a result of additional vehicle traffic generated by the construction activity, collision of the vehicles and the mammals is potential, but this is an event which may come about several times a year in case of larger body species, such as a roe for example and with high probability it will not affect protected small mammals. The dead bodies of non-protected

animals run over may attract other non-protected scavenger species [18-93], the fox and the badger in the first place. The construction of new buildings and roads and channels will cause the fragmentation of the currently consistent habitat which will result in the re-arrangement of the area for movement of larger body animals. As a result, roe, fox and badge can be expected to occur on areas where they could not be observed before. This impact may be significant in the vicinity of the cooling water channel on the flood plain of the Danube, where mammal species available for hunting live in high number. Along fix line structures, occurrence of species currently not living there can be expected and control of rats and other invasive species or species posing health risk may become necessary.

Before starting the necessary zoological measures, they must be coordinated with all the competent authority concerned with the area.

18.5 IMPACT OF THE OPERATION OF PAKS II ON THE BIOSPHERE

18.5.1 IMPACT FACTORS OF NORMAL OPERATION

Operational site of the power plant

Wastes generated by operation
Noise emission of operated machines and equipment
Air polluting substance and noise emission of operation fo diesel generators

New warm water channel with the Recuperation power plant at the end of it

Discharge of warmed up cooling water into the Danube
Transfer of treated technological waste waters
Noise emission of operated machines and equipment
Re-settlement (succession)

Route of the 400 kV block lines and 120 kV long distance lines up to the new sub-station

Mowing of the safety zone of the route
Occurrence of invasive species
Electromagnetic spaces
Re-settlement (succession)

18.5.2 IMPACT PROCESSES, IMPACTS OF NORMAL OPERATION

18.5.2.1 Direct impacts

18.5.2.1.1 Botany

Maintenance of artificial environment

On surface with facilities or with coverage, development of vegetation is inhibited. Soil coverage occurs, which at the same time also contributes to soil compactness and to the permanent maintenance of the drainage conditions of the soil due to being covered - which is for example inhibiting infiltration. The former natural vegetation cover cannot evolve anywhere on the densely built-up area of the power plant with facilities, and it is replaced by grass plantations in park like environment and secondary degraded grasslands will probably evolve.

Nature conservation value - preservation

On surfaces regenerated subsequent to the implementation of the investment on the temporary construction area, on areas surrounded by fences and maintained by proper landscape preserving management, natural vegetation - especially open and closed sand grasses - may develop without any disturbance and may be a rescue site for plants under protection.

Influencing cultivation and natural successive processes in agricultural environment

Limitations will be prescribed for the cultivation mode in the safety zone of the transmission lines during the operation of the long distance transmission lines. Development of the woody vegetation is inhibited which, in a natural environment, inhibits the development of successive processes pointing towards closing associations.

Impact of water temperature on plant associations

The warmed up cooling water discharged by Paks II will exercise an impact on the aquatic vegetation and the vegetation in contact with water, but no significant changes have been detected so far in case of this rate of heat effect.

18.5.2.1.2 Zoology

From among the impact factors of ordinary operation, impacts of the warmed up cooling water inflow are of primary importance for aquatic macroscopic invertebrates in the Danube riparian region.

In accordance with the prescriptions by the authorities on the current operation of the Paks Nuclear Power Plant on any point of the section in 500 m below the entry point, the temperature of the water of the Danube River cannot exceed 30 °C. This temperature limit value is valid and justified for the biosphere in the Danube and is in compliance with the international norms. Temperature difference between the recirculated cooling water and the recipient Danube cannot exceed 11 °C and when Danube water temperature is below 4 °C it cannot be higher than 14 °C.

From findings on former examinations of the full-scale mixture of the heat trail, the following should be highlighted:

According to ÖKO Rt. [18-94] findings:

> *'The heat trail is always travelling by being close to the right-side bank and penetrates into the water areas in between the shelves. Most of the heat trail is mixed, at a level of about 95%, within a distance of about 4-5 km measured from the point of entry. Based on the surveys in summer 2002 and winter in 2003, the heat trail can be followed up roughly to the Gerjen-Bátya line, which is exactly at a distance of 10 river km measured from the entry point. Based on the analysis of macrozoobenthos findings, it has been established that due to the warm water introduction, a spectrum of species becomes permanent which is dominated by species preferring warm water. The Danube fauna components to be found in the vicinity of the Paks Nuclear Power Plant again populate the sediment and surface of the solid basement of the river bed in the vicinity of the great brakewater to be found at a distance of 500 m from the entry point of warm water. The temperature increase of the water on a short section of the river by a few °C does not have significant detrimental impact in the composition of species of the macroscopic invertebrate fauna. Local studies have provided evidence to prove that under the current mode of operation, the cooling water discharged changes the composition of aquatic macroscopic invertebrates associations only on a limited section. From among macroscopic invertebrates, decrease of species was observed only in water of 27 °C or higher temperature on the Danube section. Under the current conditions, at the great breakwater, which is at a distance of 500 m measured from the entry of warm water, the composition of species and stock is regenerated. The quantity of cooling water to be increased by 10 % is not expected to influence this process in space and in time.'*

According to the findings of the Kék Csermely Kft. [18-65]:

> *'The warmed up cooling water travelling in the river in the form of a trail has only local impact in the members of the macroscopic aquatic invertebrate community and does not cover a distance larger than 1.5-2 river km. Furthermore, it must be stated that the natural and/or artificial bottom on the given sampling site may have a significant impact on these indices.'*

The own bio-monitoring studies of model value conducted in 2012-2013 are an addition to the former statements [18-85], [18-86], [18-87].

Based on data measured in the four sampling periods, it can be established that in the direct environment of the warm water outflow, in the embayment situated beneath, water temperature was 5.9 °C higher on an average than at the reference point situated upstream at a distance of 4.2 km: in spring time it was 5.5, in summer 5.1-7.1, and in autumn it was 6.0 °C higher. On the downstream section, on a distance of 9.8 km, this higher water temperature decreased on an average by 4.6 °C: in spring by 4.1, in summer by 4.0-5.7, in autumn by 4.7 °C, which was higher by 1.3 °C on an average than in the upstream section of the warm water inflow point. Compared to the values measured at Dunaszentbenedek, the reference site on the opposite bank of the Paks Nuclear Power Plant, higher water temperature of 6.1 °C was registered on an average: in spring higher by 4.7, in summer by 5.2-6.9, in autumn by 7.7 °C but water

temperature was higher on an average by 1.0 °C in the right bank side downstream reference district being at a distance of 9.8 km downstream: in spring by 0.6, in summer by 1.1-1.5, and in autumn by 0.9 °C. The 'one time' water temperature data registered at the time of the studies, and even more so, the differences of averages calculated from them are only of informative nature, but they call the attention to the direct impact and impact in further distance of the discharged warm water.

According to the dendrogram made on the basis of taxon composition of the sampling sites the embayment (P5 district) under the warm water discharge point of the power plant is not different from the other sites. Due to the impact of warm water, which at the time of our measurements was on an average 5.9 °C higher than the upstream reference, besides almost identical taxon composition and slightly decreased taxon number had a decreased total number of items. The river bank is characterised by detritus of shells of large body snails and mussels. At the downstream reference point, at a distance of 9.8 km, as a sign of regeneration a plant association of similar taxon composition but much higher item number occurs. The Sørensen index demonstrates this process: from 50.8% between P3 and P5, it increases to 61.3% between P5 and P7. A characteristic of the downstream section of the warm water discharge point - the embayment (P5) and the lower reference point (P7) 56 % of the cumulative taxon number is given by invasive species, the rate of protected species is 15 %, in contrast with 36 and 24% respectively of the upstream reference section. The impact of warm water is supported by the fact that the Asian clam (Corbicula fluminalis) invasive species preferring higher water temperature occurs only on the P5-P7 section. One item of the also invasively spreading eastern cray fish (Orconectes limosus) was also found only here.

The several decades of experience of the Paks Nuclear Power Plant shows that the conditions described above could be maintained at times of coincidence of the highest temperature and the lowest water level periods. As part of the technology, extra cooling water could be mixed in in order to comply with the authority requirements.

Following the extension of the power plant, an increase of the cooling water demand and the accompanying volume and temperature increase which is to be discharged into the recipient must be considered.

KHT's chapter titled 'Modelling the Danube river bed morphology and thermal load on the Danube' gives a detailed description of the statistic analysis of Danube temperature and water flow, analysis of extreme events, forecast of Danube water temperature increased based on climate change forecasts, and three dimension (3D) model analysis of the impact of the discharge of warmed up cooling water (heat trail) into the Danube. Analysis of the Danube's physical-chemical parameters, detailed analysis of the Danube's biosphere is given in the chapter titled 'Water quality analysis of the Danube and other surface waters in accordance with the Water Framework Directive' with attention to the result of the modelling.

The current operation of the Paks Nuclear Power Plant has not verified impact on the fish stock of the Danube. On a maximum 2 km section under the discharge point of warm water into the river, in the right bank belt of the Danube River, an increase of the fish stock has been found, but due to the large-scale spread of the data (high variability of the fish stock in space and time) this cannot be verified in every case; moreover, it is an impact of strongly local importance. Fish have a preference for this area which can be characterised by varied hydrological and river bed morphological conditions. On this section, the strong stirred water mass established deposition spots, where the organic debris and the accumulated nutrition organisms (macroscopic invertebrates) as well as branches of trees and detritus of shells are ideal feeding and hiding site for fish. At the inflow of the discharged warm water, the rushing water stirring up nutrition and fast drift of the water are an attraction for schools of fish instinctly swimming upstream. Results of monitoring so far [18-85], [18-86], [18-87] seem to confirm the data of international technical literature. Studies examining the composition of fish stock in a similar spatial arrangement, that is, above and under the warm water inflow point in the Rhone River (France) also confirmed the increase of the density of fish stock. But temporal variability of the fish stock was rather large on both sections (Daufrasne et al., 2003).

In relation with the operation of Paks II, the impact factor that can be considered most important for fish is the discharge of warmed up cooling water into the Danube. In contrast with the 100 m^3/s warm water current discharge, according to the plans, the 2 new units will have a total of 132 m^3/s warm water discharge into the Danube (66 m^3/s per unit) which means that the current and the new units taken together will have a maximum of 232 m^3/s warm water discharge which is the double of the current water discharge. Together with that, total heat load will also increase in spite of the fact that the water temperature discharged is maximised and cannot exceed 33 ^oC. It must be considered however that all the units will operate simultaneously only during a limited duration between 2030 and 2032, before and after not all the units will operate. Thus, during the planned operation of the Paks Nuclear Power Plant there will be a load of varied rate on

the aquatic biosphere whose maximum impact will be limited for a duration of two years. At the inflow of the warmed up cooling water, impact of two factors should be considered in particular, which may directly affect fish species composition and biological processes of certain species. One is the increase of the water discharge, which may change the hydrological and river bed morphological conditions of the area and thereby the use of the habitats by fish. The other one is the change, increase of the water temperature, which may affect the population dynamics and metabolic processes of the fish. According to the models, the increased water discharge quantities will bring about a smaller re-arrangement of the river bed conditions, especially on the two km section measured from the entry point. These hydrological and river bed morphological changes cannot be considered detrimental for fish. Presence of another inflow point creates varied habitats conditions, which, similarly to the currently operating inflow point, may even result in the increase of the local quantity of fish, at the inflow points and under the inflow and on the section between the breakwater structures on the right bank. Therefore, it can locally influence the distribution of fish in space, but presumably it will not have significant impact on the dynamics of Danube populations.

Impact of the extra heat calculated compared to the current state which certainly will be difficult to be separated from water temperature increase due to climate change will be less predictable. But while the former occurs only locally on sections under the inflow points, the latter will change the structure and community organisation processes of the Danube biosphere fundamentally and in a manner not known yet.

Most of the fish occurring in the Carpathian Basin are warm water fishes with a heat tolerance upper value above 25 ^{o}C in contrast with the trout occurring in the northern countries and/or in mountainous brooks and rivers, which are so-called cold water preferring species (with a heat tolerance of upper lethal value around 25 ^{o}C). Species frequent in the Danube are the so-called mezostenotherm fish species with an optimal temperature domain being between 14-28 ^{o}C, and their upper lethal temperature domain being between 28-34 ^{o}C [18-47]. Species like that are pike, ide fish, roach, bream, circle male, occurring on the Paks section as well. Other classifications are available as well which given a more detailed classification (on a more sophisticated scale) of fish species in the Danube according to their temperature demands. In accordance with that bream, circle male, doctor fish, rudd, catfish and for example the invasive, non-native black bullhead [18-27] can be classified specifically as fish species favouring warmer waters. The optimal growth temperature for fish (that is when the fish species grows most intensively at appropriate food supply) is between 20-28 ^{o}C, while lethal temperature for them is above 34 ^{o}C. Bleak, common barbel, roach and amour bitterling, which can be considered as species of medium tolerance of higher temperatures, have their optimal growth temperature between 14-23 ^{o}C, while their lethal temperature is 28-34 ^{o}C. Finally, pike, perch, gudgeon, common nase and dace can be classified as species less tolerant to high water temperature. The temperature demands of these species are in fact identical with that of the previous group, but in some respects (primarily with respect to the temperature for the development of larvae and reproduction) they tolerate an expressly narrow temperature domain. For example the spawning is between 5-10 ^{o}C, development of its larvae is optimal between 8-15 ^{o}C. For the larvae of common nase and dace, water temperature above 19 ^{O}C can be considered lethal, and both species spawn in relatively low temperature water (maximum 16 ^{O}C). It is not surprising therefore if the change in the water temperature of the Danube in the next decades influences the reproduction success and survival of fish species living therein, that is, the population dynamics of certain species. The change in the population dynamics of species will be accompanied by change in the structure of fish composition which is difficult to forecast.

Rivers are ecosystems especially sensitive to climate change [18-92]. According to studies analysing the impact of climate change on fish, gradual transformation of the structure of the composition of fish species will have to be taken into account in the next decades. These changes can already be verified. According to studies assessing the changes in the composition of fish species through long-term data series 'slight' increase of water temperature (1 ^{o}C in 10 years) may bring about fundamental changes in the composition of fish species, changing their quantity and diversity conditions [18-27]. According to studies conducted so far, temperature increase (which is still in harmony with the optimal growth and spawning domain of most species, *see* above) may be favourable for the fish stock. Increase close to the optimum provides higher survival primarily to larvae and young fish strongly exposed to size dependant mortality [18-82], [18-80]. These circumstances may result in fish yield growth if, in addition to temperature increase, sufficient nutrient supply is also available in the river. These processes and primarily the long-term increase of the quantity of certain carp species can be expected in the next decades in the Danube, unless other conditions influence it (e.g., poaching, pollution, spread of invasive species, transformation of further habitats). It is important to emphasise that the fish stock of the Danube, on a scale of decades, shows high variability in function of the water flow and the success of fish spawning. A good example for these difficult to predict changes is the spread of the invasive Neogobius sp. Starting in the middle of the 1990s, invasion of the ponto-caspic Neogobius sp species can be observed in the river including species that used to be unknown in the central Danube section. This process is of such a scale that a small body fish species coming up

from the Black Sea, now have become dominant components of the fish stock and they fundamentally influence the organisation of the food chain. For the reason of their spread a number of assumptions have been made (climate change, transformation of habitats including stone spreading along the banks, increase of the number of stone piles, increased ship traffic, etc.) It is difficult to give an estimation on what processes will be triggered in the fish stock of the river in the long-term by climate change, eventual further habitats transformations (e.g., construction of reservoirs, or revitalisation works) spread of invasive species compared to the warm water inflow of local impact. According to studies conducted so far the load arising from the warm water discharge of the Paks Nuclear Power Plant is dwarfed compared to the impacts tied to the current climate change (cannot be clearly verified) [18-28].

Dragon fly species in Hungary are tied to water during the larvae development phase, but live on land in adult age. They have good ability of flying. Presence of water spaces is indispensable for maintaining their population. Physical changes in wet habitats affect their life conditions, their presence or their lack of presence.

In relation with the operation of Paks II, the cooling water discharged into the Danube along the warm water channel will probably have a significant impact on the dragon fly communities, therefore, their larvae will occur on a section further away from the entry point. Former studies [18-94]; [18-65], and the most recent findings [18-85], [18-86], [18-87] show that increased temperature affects the biosphere of this section of the Tolnai-Duna (HUDD20023) and the different macroscopic aquatic invertebrate taxon to a different degree. During studies of the dragon fly in 2013, 450 metres downstream from the entry point of the warm water, at the sampling site on the right bank, larvae of yellow-legged dragon fly *(Gomphus flavipes)* were found in a number appropriate for a natural section in spite of the fact that the date of the sampling was a critical date of heat load in August (low water level, high temperature).

On the large temporary construction area to be used during the time of construction, on the site of the power plant gradually dry steppe habitats will evolve, similar to the one today after the completion of the construction works, their former insect assemblages from the adjacent remaining habitats patches will be able to get resettled again. Again valuable **orthoptera** communities may settle and survive during the term of operation. The same is true for the open steppe areas to evolve along the route of the long distance lines to be constructed. For all this, however, undisturbed environment of long time, several decades is needed.

In the environment of the power plant units, on the non-covered parts, ordinary operation will not have significant impact on the **butterfly** fauna. Subsequent to construction, maintenance of the area will result in a secondary steppe urbanised/park like environment. Protected butterfly species have not occurred here, their breeding here is not expected in the future either.

The extended cooling water system carrying larger quantity of water may increase, although only to a small rate, the temperature of the micro environment, but it will not bring about fundamental change for butterflies, may eventually create minor changes in the phenology of certain species but it cannot be precisely predicted and probably it will be an impact of negligible rate. Following the regeneration of the area (the Island) surrounded by the cooling water conduit system, no major change can be expected in the nature conservation status of the butterfly fauna there during the term of ordinary operation, breeding of one or two protected species there, or use of the area as a temporary 'stop' can be further expected. Maintenance of the status requires no special intervention. On this area, it is important, especially in the first years, to pay attention to controlling invasive species, as they are present in large communities everywhere in the environment of the power plant and during and after the construction period the area will be exposed to more intensive invasive pressure.

As *Euphydryas maturna* and *Lycaena dispar* were not found in the narrower environment of the power plant, ordinary operation will not affect these populations. Ordinary operation will not affect the habitats of the ground squirrel fields at Paks and the Dunaszentgyörgyi swamp forest, and the butterfly species living there either.

Maintenance of the artificial environment inhibits successive processes and the development of a natural vegetation cover, and, as a result, the appearance of the related natural fauna. In general, it can be stated that by the increase of the intensity of cultivation, the number of species occurring on the area is decreasing. Not only the application of insecticide and herbicide but the cultivation method of the soil (e.g., ploughing) can also affects animals living in and on the soil [18-119].

Due to permanent area occupation, soil surface habitats will disappear together with the fauna thereon. Electromagnetic fields affect the spatial orientation and movement of **anthrodpoda** [18-88], [18-62]. At the same time electric equipment may be attractive for certain taxons [18-112]. As disturbance is often limited on the area of the power plant, on certain

areas favourable conditions may be created for rare, more valuable and protected soil surface animal species, items and those may occur in relatively large number.

The operation of Paks II is not expected to cause direct damaging impacts to **amphibians and reptiles**.

The implementation of Paks II, the green surfaces to be established between the buildings and the area of the Island are not expected for a long time to become suitable habitats for re-settlement. But landscaping between the buildings, planting bushes and trees may in a long-term create new opportunities for the settlement of certain species (e.g., *Bufo bufo, Bufo viridis, Lacerta viridis, Lacerta agilis*). The number of species settling on the area depends on whether there is an opportunity for migration (traffic increase on the roads, larger scale human presence, decrease of green surfaces).

During the operation period, the water abstraction works on the Danube bank will probably not have unfavourable impact on the amphibians and reptiles occurring in its environment. Based on the assessments conducted in years 2012-2013, amphibians, reptiles were not found on this area, only *Lacerta agilis* items were found on the site of the dike nearby. If they survive the works they may continue to stay there. Along the route of the fresh water to be established anew the grassland will certainly be restored, the channel recessed into the soil will not affect the surface biosphere in the future. The most frequent lizard species the community of *Lacerta viridis* may get resettled potentially again on the area.

The new warm water channel will provide space for living for example for *Lacerta viridis* at most on the side of the dike in the long-term. The fast flow warm water channel will continue to be not suitable for the settlement of aquatic amphibians and reptiles.

During ordinary operation, factors most affecting birds can be best modelled by the current condition. During the operation of the currently operating units and the two new units to be constructed negative impacts of certain impact factors will increase whose expected impacts presently can only be partially predicted.

Currently the status of both the operation area of the power plant and the 3 km environment of it are appropriate, due to the long-term relative lack of disturbance of the operation area, a number of protected and highly protected birds species found their habitats here (mostly as a feeding site). During the years following construction works and re-cultivation, partial or full re-settlement of the currently feeding and /or breeding species can be expected. To realise this, it is necessary to restore the current or similar status of the areas concerned.

The increased number of long distance lines and poles holding those can be considered as continuous source of danger during operation, to the largest extent for the *Falconiformes*, *Passeriformes*, *Galliformes* and *Strigiformes*. To mitigate death due to collision, electric shock, safe implementation, continuous control and maintenance are indispensable. Poles, however, will be also be positive for predatory birds as pole tops can also be used by birds for sitting there. Expected positive and negative effects can be modelled based on our assessments conducted on the arable land in the neighbourhood of the power plant. During the construction period the birds living on the area affected will leave the area but if construction is followed by proper re-cultivation, some of them can be expected to return.

Due to the construction works the size of the area occupied by artificial facilities will increase and the size of living environment will decrease. Green areas in the vicinity of the new facilities may be occupied by certain bird species (primarily by the urbanised ones).

With respect to **mammals**, the operation period of Paks II will be less disturbing than construction.

The Paks II facilities may be suitable for the settlement of bats living in buildings, and it can be expected when the vegetation between the buildings is populated with flying insects. The cold and warm water channels along the Danube bank may have unfavourable impact during operation as fast water flow may inhibit small soil living mammals in getting out of the Island. During the operation period, the bats living in holes of trees able to get settled on the Island may enjoy relative lack of disturbance.

Green surfaces established by landscaping may become suitable for the settlement of species less valuable for nature conservation. On the regularly cut green surfaces ground squirrels *(Spermophilus citellus)* could also get settled if grass mixture of natural composition rich in dicotyledonous were used [18-68], [18-121]. Most of the ground squirrel colonies currently known can be found on artificially maintained lawns, airports with ground squirrels-friendly grasslands. The option on establishing a ground squirrel-friendly airport is currently studied as part of an EU application. The closest place where ground squirrel can be found is the ground squirrel field at Paks, but in the absence of an ecological corridor the two areas are isolated from each other. In coordination with the nature conservation authority on the territory of Paks II, a ground squirrel colony could probably be created. By artificial settlement with attention to genetic diversity a ground squirrel colony of national importance due to extension of the lawn area could be self-sustaining.

Habitats loss of species of low tolerance and settlement of species easily adapted to human disturbance following landscaping and the creation of green surfaces can be expected. Settlement of the vole *(Microtus arvalis)* can be expected on the area of still loose structure but already covered by vegetation. In the interest of the protection of the buildings preparation must be made for the occurrence of the brown rat *(Rattus norvegicus)* and house mouse *(Mus musculus)* frequent in the environment of the power plant based on all of the pellets. As a consequence of this process and because of the vicinity of the town, wandering cats and foxes can also settle here as these predators well tolerate human presence and they can feed on voles, rats and mice.

The route of the block lines outside the area of the Paks Nuclear Power Plant mostly travels across arable land, where, along its route, mound-building mouse colonies can be found. We are not aware of any disturbing effect of the high-voltage lines electromagnetic field on the mound-building mouse, but as it has high dispersion capacity, it is able to get further away from the route. On the Dunakömlőd area and earlier in other part of the country we found such colonies on the long distance lines.

18.5.2.2 Indirect impacts

18.5.2.2.1 Botany

Potential proliferation of invasive species

Permanent antropogenic presence and disturbance, degradation of the soil and vegetation or existing degradation, its secondary nature due to former impacts are favourable for the spread of invasive species, on surrounding areas directly not affected by the investment.

Impact on the fringes and habitats fragmentation

The power plant facilities along the river bank – recuperation plant, energy dissipation structure – represent an artificial environment, which interrupt the continuity of the willow poplar flood plain forest on the two banks of the Danube on a narrow riparian section of a couple of hundreds of metres. But during the operation period this will not affect the vegetation and the flood plain forests classified as Natura 2000 as the facilities are bordered by the cold and warm water channel – the existing energy dissipation structure.

Edge effects may prevail on the areas getting regenerated in the direct environment of the area closed by the warm and cold water channel, non-protected and on the areas of the willow poplar flood plain forest classified as Natura 2000. The closure of the foliage of the surrounding forest, the shrub level coverage and the thickness of lianes show the vicinity of the artificial environment.

Deposition of air polluting substances

Paks II discharges air polluting substances into the air, which will have an indirect impact on vegetation at deposition, but this impact will probably not cause sensible, detectable change in plant associations.

Impact of electric field of long distance lines

Some studies have demonstrated that the electric field of long distance lines affects the fertility of the pollens of plants and at cell division which reduces chromosome by half (meiosis), and the number of chromosome irregularities will increase. The higher the voltage in the transmission lines, the more explicit the phenomenon is. [18-140], [18-141], [18-142]

18.5.2.2.2 Zoology

In order to point out the potential impact of global climate change affecting in a complex manner the hydro-climate of the entire water system of the Danube, we would like to highlight - in light of the most recent research works - those major aspects that may affect the river and primarily its aquatic macroscopic invertebrate fauna and which will have to be considered by all means.

In relation with the increased heat load on the Danube due to the extension of the Paks Nuclear Power Plant beyond the impact of the warmed up cooling water discharged by the power plant, climate changes caused by global warming must also be considered, their joint impact must be modelled and they need to be monitored in the future.

According to the report by the Intergovernmental Panel on Climate Change, global warming up has become a real threat of the 20th century, as since 1850 average temperature increased by 0.76 °C [18-60]. Considering also increased emissions due to social economic development, the report forecast minimum 2°C increase by the end of 21st century, which according to less conservative forecast may amount to 5°C. Due to the CO_2 quantity doubled in the atmosphere by 2050, the temperature of certain water courses of the United States and the United Kingdom may increase by 1-9 °C [18-134], [18-136].

There is global interest in the research of river waters' temperature as temperature is a major and sensitive factor - affecting the physical, chemical and biological processes of river courses - and climate change will significantly alter the future temperature of rivers. Our increasing knowledge on the temperature conditions of rivers - with special attention to regulators fundamentally affecting temperature behaviour, temperature heterogeneity on different space scales, anthropogenic impacts, current and future national trends and the temperature models - is summarised by a number of authors ([18-110], [18-130], [18-19], [18-137]. All this shows that temperature is a major physical parameter of our river courses due to its tremendous importance exercised on all aquatic fauna as well as other aspects of water quality (for example dissolved oxygen) [18-84], [18-51], [18-123], [18-127].

Change in water temperature may be caused both by natural processes as well as human activities. From among natural processes (atmosphere, terrain, water discharge, river bed) affecting water course temperature, ambient conditions are of primary importance because of their role in heat exchange through the water surface and change of conditions. Water discharge (volume of water flow) primarily affects heat capacity through the change of water volume and mixture of different water sources causing cooling (e.g., through heat exchange of the river bed) [18-19]. In the last century, the temperature trends in the large rivers were the results of complex functions of interactions of the climatic and hydrological changes, the major climatic patterns and the increasing anthropogenic impacts (river regulation, water reserves, urbanisation, cooling water discharge in the rivers). These latter human impacts significantly modify temperature conditions of rivers, whereby they influence the ecology of water courses.

In the 20th century, the water temperature of rivers is Austria increased by 1 °C on an average, increase was even higher at water reservoirs of large lakes on upstream sections and on sections affected by hydro power stations on the Danube River [18-133]. Compared to ordinary conditions, temperature changes significantly mainly during winter, moreover, winter icy conditions were fully left out [18-135]. Seasonal and daily temperature important for the spread of aquatic habitats can also change, which has been emphasised by Vannote et. al [18-124] in River Continuum Concept. Other European data show that an average 1 °C temperature increase of river courses came about in the last century but this tendency is not continuous [18-136]. In the past 50 years, the average temperature of the Danube River at Budapest increased by 1.3 ^{o}C [18-51].

Biological factors and conditions such as the productivity of the river water are closely interrelated with water temperature. Aquatic organisations have special temperature demand which clearly determines their spread in the rivers [18-19]. Velocity of biological processes in the river water are closely interrelated with water temperature, this interrelations follows the rule of Van't Hoff according to which the speed of chemical reactions (and so it is in case of biological activity) is doubled and increased even more than that with every 10 °C temperature increase. Biological process speed increase related to oxygen consumption causes a problem where due to higher temperature, dissolved oxygen is decreased or is running out. Water temperature increase increases the productivity of the ecosystem especially that of the aquatic invertebrates (e.g., aquatic insects).

Absolute value of water temperature plays a major role in the embryo and larvae development of aquatic insects. There is a clear correlation between the success of hatching and water temperature. Depending on the species, maximum hatching success occurs at optimal temperature, at sub-optimal temperature, hatching success is decreased. Dependence of growth and development on temperature is one of the most decisive factor in the longitudinal zonation distribution of aquatic insects in water courses. Increased water temperature may significantly increase the area of spreading of certain species [18-131].

Global warming up fundamentally affects the trophic conditions and primary production of continental waters [18-78]. Bacterial metabolism, speed of nutrient cycle and algae production all increase with increased temperature [18-70]. Climate change and human contaminations usually jointly increase eutrophication. As fresh water food chains have characteristic seasonal dynamics, the impact of climate is also a function of the season [18-116].

Depending on its extent, climate change may cause the extinction of certain aquatic species or may significantly change their spread in water systems. As the different climatic models all predict the frequency of occurrence of hot summers like in 2003, over half of the molluscs species currently populating the large rivers are threatened by extinction [18-84].

On the Danube section in Austria, a clear correlation can be identified between the approximately 1.5 °C increase and the increasing number of neozoa (invasive species) in the last 25-30 years [18-83].

In one of the large rivers of Europe, in Rhone, a major water quality improvement came about during 1986 and 1991. Parallel with this water temperature increased due to climate change. It seems that water quality improvement delays the impact of global warming on community structures. Trends observed in community structures are related to high temperature and decreasing oxygen levels. Gradual and fast changes occur in the conditions of communities. These shifts are related to extreme hydro-climatic events like flood waves or the heat wave in 2003 which increase the spread of euritolerant and invasive species without being able to tolerate the gradually warming up environment. In spite of site specific 'press' factors (hydro power and nuclear power plant), similar changes came about in a community structure on the total length of the river. This level of permanency of spatial processes on the large space scales underlines the priority of hydro-climatic effects affecting community structures in vis-á-vis specific local disturbances. Finally, community structures do not show signs of restoration and their relative sensitivity against extreme hydro-climatic events will increase in time. Findings suggest that global changes may decrease the adaptability of the current community structures [18-26].

Studying the temperature tendency of the Danube water, significant 0.8 °C increase could be detected of the monthly average water temperature at Linz (Austria) during the period 1901-1990. Strongest increase was felt during autumn and the early winter months [18-133]. Multiple regression formulae combined with scenarios of future changes of air temperature and water discharge caused by global warming forecast moderate increase in the monthly average water temperature of the Danube by the end of the 20th century, but by 2030 they forecast higher than 1 °C increase for each month and higher than 2 °C for the small water periods in autumn. Such a temperature increase will, by all probability, have a significant impact on the ecological conditions of the Danube as a European large river. The fact that the average water temperature increase measured at Linz in the Danube is more than the double of that of air temperature in the same period it gives the hint that water temperature that has been increasing since 1990 is not purely the consequence of climatic changes. Water temperature of the river also increases due to the increasing impact of human activities; such as increasing quantities of cooling water discharges, intervention for the regulation of the Danube River.

Pekarova et. al. [18-96] studied in detail the dependence of water temperature on air temperature using the monthly data series measured in the Danube at Bratislava between 1926 and 2005. Monthly water temperature values follow monthly air temperature values with a delay and the reason for the delay is the high specific heat capacity of water. In line with the histeresis curve, when air temperature increases in the first half of the year, water temperature is about 1.6 °C lower than what is found at decreasing air temperature in the second half of the year. Correlation between water and air temperature is not linear. Dependence of water temperature on air temperature changes in function of water discharge. Findings show that temperature of the Danube water increased by 0.6 °C in the past 25 years, while the average heat load of the Danube did not change in the 80 years period examined, but there was a change in the distribution of the average monthly water discharge during the year. During winter, warmer climate causes melting of the snow resulting in more cold water getting into the river. At the same time, less summertime precipitation in the upper basic of the Danube causes lower summertime water discharges.

Since the 1.6 °C increase as a starting point that came about in the upper Danube basin since 1960, and examining the climate and social changes to come about during the period 2011-2060, the GLOWA-Danube scenario forecasts an average annual temperature increase between 3.3 and 5.2 °C. In summer, a 14-69 % decrease, in winter, 8-47 % increase in precipitation can be expected. The two combined will cause an annual 4-16 % decrease. Due to the decreasing stored snow quantity and the increasing summer evapotranspiration, the summer flow maximums will be shifted to the spring time between 1961 and 2060. *The 3-35% decrease in water use to come about in the upper Danube valley may decrease hydro power plant capacities and cooling water abstraction opportunities of thermal power stations mainly during the periods of low water levels combined with increasing temperature* [18-101].

Glaciers are excellent indicators of the climate change. Significant decrease was found in the extension of the glaciers of the European Alps during the last century. In 2003, the year of extreme temperature, melting of the glaciers was for example three times larger than the average of a long period. Climate simulations forecast significant, 2.1 and 7.8 °C warming up for the European Alps. Studies emphasise that even the Lower Danube water courses will be influenced by the glaciers smaller compared to the size and distance of the full basin. Melted glacier water is a significant contribution to the summer discharges of the medium and lower sections of the Danube. Alternately, their decrease may cause water shortage economic problems (agricultural irrigation, navigation, ground water level decrease) on the entire length of the Danube River and entails even ecological effects. Future shrinking of the glaciers will have a more significant impact on the hydrogeology of the large rivers than we ever thought earlier [18-58].

At linear temperature increase, higher temperature resulted at higher phytoplankton abundance in the Danube River, but only at higher nutrient supply in the period of 1979-1990. Low nutrient supply is not favourable for algae even at a 2 °C higher temperature. According to the model applied, global warming up brings about drastic changes in the nutrient rich environment but will not have significant impact on the phytoplankton of water poor in nutrients [18-108].

The seasonal dynamics of the *Cyclops vicinus* species of *(Copepoda)* zooplankton was modelled based on the 10-year data series of the species from the Danube section at Göd, and by applying climate change scenario scaled to the neighbourhood of Budapest, changes in the number of items were forecast for the period 2070-2100. Due to climate change, date of occurrence of maximum abundance may come 1-1.5 half months earlier during the year and larger fluctuations may be expected in the number of populations in between the years [18-109].

All measurements and long-term data series show that global warming is a fact irrespective of whether it is the consequence of natural or human impact. Increasing melting of glaciers, significant global changes in precipitation distribution, extreme weather events (more frequent and violent storms, floods and draughts) [18-10] are clear signs of that.

Presently researches are aiming at studying how the temperature of brooks and rivers change in the past and how it will change in the future. As responses to global temperature increase may be very much different on the broader geographical scale of spaces, and as the prediction of the future water temperature increase greatly depends on the climate scenarios applied, prediction of river temperature changes are surrounded by a lot of uncertainties. Further researches are necessary especially more detailed seasonal and spatial analysis of river course temperature. It is urgent to map places and periods where and when river temperature is most sensitive to the large scale effects of future climate change. But it is already evident that climate change impact on the biosphere will be much more powerful than we ever thought before.

Macroscopic invertebrates are undoubtedly underrepresented in climate change research [18-73]. We only have sporadic knowledge about the impact of climate change on macro invertebrate species [18-48]. Based on the knowledge that we have so far, in general, we can state, that water temperature increase will have its highest - or even drastic - impact on species tied to a place (sessile) during their whole life or in certain development phases with preference for cold water and low tolerance ability. Similar significant impact can be expected in case of slowly moving, less mobile species (e.g. molluscs, see above). Mobile species of broader tolerance will be the least affected. As a consequence of the forecast joint impact of climate change and warm water discharge,occurrence of invasive species with preference for warmer waters that have already appeared from the south spreading upstream on the Danube will probably increase both with respect to their number of items and number of species. As these organisations play a major role in the nutrient cycle of the river, it is highly needed to study their relationship with the temperature and climate change [18-92]. The structure of macroscopic assemblages, the population dynamics of certain species are expected to change to a great extent due to climate change forecast for the next decades. In summation, temperature may not only directly affect species where they are but the production of the entire system may increase (bacteria, algae, etc.), and through the nutrient network and mass turnover it may affect the operation of the entire system.

The construction of Paks II will probably not have indirect impact on the fish stock of areas affected.

During the operation time of the power plant, invasive weeds may cause the same problems as at the time of construction. Therefore, on the areas to be re-cultivated, invasive species should be controlled or suppressed which is at the same time a general nature conservation interest as well. Continuous management (extensive mowing or grazing) has positive impact by all means, promotes to a great extent the suppression of invasive weeds and maintains conditions similar to sand steppes in a stable manner, which is favourable for a number of protected species valuable for nature conservation. During arid warm years, at times of permanent low water level, which will be coupled by heat pollution from the power plant, space occupation by invasive species in line identical with the river flow (gallery forest of Uszód Island) will probably increase. Their increasing dominance together with the suppression of feed and nectar plant communities may cause a lot of damage in the conditions of the insects. To prevent this is a major task.

Impact of the deposition of air polluting substances emitted by the ordinary operation of the power plant and of the slightly increased noise level will not be detectable with respect to the butterfly fauna. Base studies in this direction are missing globally.

Human presence, disturbance and increased traffic is more favourable for the occurrence and spread of soil surface animals under anthropogenic impact on areas directly not affected by the investment.

Polluting substances emitted into the air may get enriched in certain less mobile species along the main transport roads [18-81]. In case of point sources, the different polluting substances may get accumulated in certain species in function of their physiological characteristics, while the size of the given species and its role in the food chain does not seem to have an impact on the accumulation [18-122], [18-90]. Technical literature data show that adaptation of the arthropoda to heavy metal contamination is well-known [18-100], their immune system cannot get adapted to these [18-111]. Although the negative impact of different pollutions on the insects is broadly accepted, according to a more recent study [18-143], this statement can be questioned as toxic substances have different impact on the different taxons. In spite of that, it seems that soil surface arthropoda can be applied as potential bioindicators.

Reduction of the size of habitats patches is a threat for the maintenance of soil surface fauna populations (minimum population size; depending on taxon). By the loss of certain populations functional relations (e.g., a food chain) within the community may be damaged, ultimately may have a cascade like negative impact. The location of the willow poplar flood plain forests along the banks is changing. The plant and soil surface invertebrate animal populations living here have adapted to the irregular changes of water conditions, follow it up by wandering or protect themselves against it by other strategy (e.g., inactive status).

Although keeping the opening clear, due to disturbance, it may unfavourably affect the fauna occurring there, Dutch researchers have pointed out that the openings of the forest may serve as habitats and a corridor for ground beetle species occurring on the open area separated by forest [18-89]. Probably similar impacts can be identified for invertebrates of similar strategy and ability.

During the operating time of Paks II, personal and cargo traffic and together with this, noise, dust and air pollution will increase. This will be experienced primarily on the access roads of the Paks Nuclear Power Plant and the territory of the plant. Settlement of amphibians and reptiles here will be made difficult by the disturbance caused by human presence. Although a number of species are able to get adapted to that as well, most the species, however, avoid such habitats [18-49]. The site of the Paks Nuclear Power Plant and Paks II will show all the disturbing effects of a large extension human settlement (road network, traffic, noise, dust, polluting substances).

Along the route of the new block lines leaving the territory of Paks II, strong electromagnetic effect will occur and its area occupation will result in a fragmentation impact. The edge zone of steppe grass associations to evolve along the route to be maintained on a regular basis (e.g., by mowing) may promote the re-settlement of lizard species in time. No significant size of the population can be expected which is also indicated by the edge zone of the arable land studied for two years (where the block lines more certainly had unfavourable impacts).

The warm water channel to be constructed will be unsuitable for maintaining species tied to water (due to fast water flow and water temperature). In time, sides of the dike covered by grasses can also be suitable for the re-settlement of lizard species (primarily *Lacerta viridis*). The area can be re-populated from the adjacent areas but the warm water channel cuts off the route of spreading running parallel with the Danube.

It is primarily the second warm water channel discharging into the Danube which may have a measurable water temperature increasing effect. Water temperature increase may eventually affect micro-climate. The impact of warming up was not clear in respect of whether certain amphibians start reproduction earlier or it influences the length of reproduction [18-8]. Although a local micro-climate change does not clearly follow the impacts of global climate change, some factors still may have consequences [18-9], [18-20]. Water temperature increase of a couple of degrees may accelerate the embryonic development of the eggs laid by amphibians and the development of larvae. Amphibian larvae are able to tolerate temperature change on a relatively broad scale. Amphibian larvae developing in water are able to adjust their comfort zone by their behaviour, they actively search for actually warmer or colder parts of the water [18-41]. Similar adaptation and the impact of extreme high temperature were studied by Gvoždík et al. [18-46] in case of species *Triturus dobrogicus*, establishing that higher temperature is not necessarily more favourable for physiological processes. In waters warm during winter as well, some amphibian species (*Rana dalmatina, Pelophylax ridibundus*) do not go into hibernation but stay active [18-24], [18-11]. As the warm water trail of the Danube in the area close to the bank does not have a thermal water nature, this impact cannot be expected here, but continuous activity of some items cannot be excluded either. It has been demonstrated in case of a number of amphibian and reptile species that temperature had a decisive role in the differentiation on the genitals. Wallace et al. [18-129] and Wallace and Wallace [18-128] have shown under experimental conditions and by applying extreme temperature, that the proportion of genders has changed in the offsprings of certain newt species (e.g., members of the *Triturus cristatus* group of species). Above ordinary 18-24 °C, the number of females, under this temperature the number of males increased, and what is more, it has even occurred that following early gender determination, permanently high temperature brought about a change of the gender.

Following the discharge from the warm water channel into the Danube, water temperature can even amount to the value applied in the experiment, but during the studies of the last two years, we established that the Danube crested newt (*Triturus dobrogicus*) does not occur and does not breed in the area of the Uszódi Island. If it eventually occurred on the area, it would exclusively live and breed in the hardly flowing almost standing water type close to the shore shallow waters of dead channels where no such extreme water temperature can be expected. Pieau [18-97] and Pieau et al. [18-98] pointed out in case of the European pond terrapin/terrapin that when incubation temperature was 30 °C, all of its offsprings were female, while at 25 °C, all of them were males. This temperature of course must be realised at a distance of 20-100 m from the water in the soil of area with exposition to the south and in a depth of about 10 cm. The temperature increase of the water of the Danube does not exercise this impact at such a distance and on another media. Concerning the impact of the warm water discharge of the nuclear power plant called 'Savannah River' in South Carolina it was stated that it had both disadvantageous and uncertain consequences. It was identified as an advantageous inmpact that primary and secondary production increased, it had a positive impact on the growth and reproduction of certain plants, fish and turtles, angling period was extended to the winter season, certain species continued to be active during winter as well. Among unfavourable impacts they mentioned for example that the abudance, population density of certain plant and animal species decreased. They considered it as an uncertain impact that the genetic stock of certain species changed, the community of the water was transformed and animals of varied body temperature became concentrated in the warm water during the winter season [18-43]. The yellow bellied terrapin *(Pseudemys scripta)* grew large in the warm water, growth rate of the young animals exceeded that of their fellows of the same species in the neighbourhood. The impact of warm water can be put down to increased food base and increased metabolism intensity [18-44].

Concerning birds, it is essential that in the edge zones of temporary or final road networks established during construction, succession processes got started. There will be positive impacts as well of the relative lack of disturbance of the temporary construction area and the operation area following the termination of former long-term disturbance (years of construction works). Excessive fragmentation will have an indirect effect on birds through their food.

During the operation period, the higher temperature water discharged through the warm water channel into the Danube will exercise its impact south of the warm water channel on the Tolnai-Duna Natura 2000 site areas and the dead channels to be found there, which may have an indirect effect on birds breeding and/or feeding there.

Eventual changes caused by increased water temperature of the dead channels will have an indirect effect on the bird species living there. Due to the negative factors eventually occurring prey animals of birds may disappear from the area. That will affect in the first place the aquatic birds. Based on the preliminary plans, however, no water temperature increase of such an extent can be expected that would have an excessively negative impact on the area. When construction works are finished, excessive noise load comes to an end and re-settlement of bird species that abandoned the area before will get started.

Air polluting substance emission may have an indirect impact on bird species living on the area through vegetation. Polluted substances emitted into the air will have a negative impact on plants and animals feeding on them and these may have direct and indirect impacts on certain bird species.

During the operation period of Paks II, noise, dust and air pollution will be decreased compared to the period of construction, therefore, they are not expected to be influencing factors during the period of operation [18-3]. Mammals are not expected to get settled on areas of high traffic. Buildings to be constructed, however, may be habitats/hiding place for species that cannot be found currently on the given locality, and as such, bats living in houses may get settled there [18-114]. The nutrition of bats may be promoted by the artificial lighting of buildings and roads attracting insects there. On the other hand, due to the poor habitats, this insect community is expected to have less species, therefore, choise of nutrition is expected to be less but will consist of species in abudance.

Rate of light pollution will certainly decrease compared to the construction period on the entire territory of Paks II.

18.5.3 IMPACT AREAS OF THE OPERATION OF PAKS II

18.5.3.1 Direct impact areas

Botany

The scope of the direct impact area of operation, studied from the aspect of plant associations and plant species to be protected covers the entire area of Paks II (including temporary construction area), the safety zone of the transmission lines, the energy dissipation structure and the environment of the recuperation plant. (Figure 18.5.3-1.)

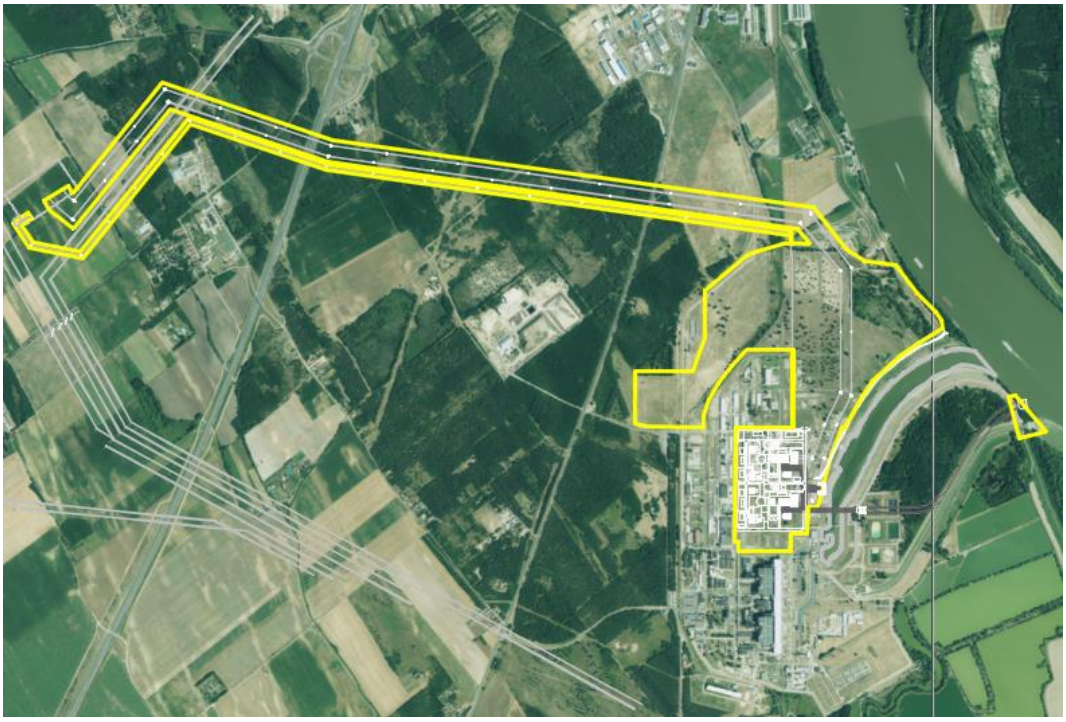


Figure 18.5.3-1.: Direct impact area of the implementation of Paks II - botany

Zoology

The impact of the operation of Paks II is expected on aquatic macroscopic invertebrates to a small extent at the inflow of the cold water channel and at the outflow of the warm water channel as well as on the Danube section below this.

Based on former assessments [18-85], [18-86], [18-87] it can be established that the water covered areas of the ground squirrel field at Paks (HUDD20069) and the Dunaszentgyörgy swamp forest (HUDD20072) under the competence of the Duna-Dráva National Park Directorate are not affected while the Tolnai-Duna section (HUDD20023) in the vicinity of the Uszódi Island is affected in respect of warm water load as impact area of the operation of Paks II from the aspect of dragon flies. The narrower environment of the inflow is a direct impact area, where the conditions of living for dragon fly larvae are not provided.

Introduction of the warmed up cooling water can presumably influence fish stock structure only locally (downstream of the discharge point on the Danube at a distance of 1,000 m up to the medium line of the Danube).

From the aspect of the orthoptera, the direct impact area of ordinary operation will cover the entire area of the power plant (including the temporary construction area) and the safety zone of the transmission lines.

From the aspect of soil surface arthropoda, the direct impact area of operation will include areas of the Island closed by the cold and warm water channels, the operation site of the power plant, and the route of the block lines up to the new Sub-station.

For amphibians and retiles, the impact area of operation will primarily be the transformed, artificial environment of Paks II. No direct transformations, changes, further threatening habitats (and together with this, occurrence of species) can be expected here, landscaped surfaces can be potential sites for more frequent amphibian and reptile species. The dike

side of the cold and warm water channels will presumably be put under grass, which may be potential habitats for *Lacerta viridis* and *Lacerta agilis* species. On the Island, between the cold and warm water channels, following the significant habitats loss and degradation, during the operation period, no new impacts can be expected. During construction, the two more frequent lizard species may re-settle on the sites of the dike from the non-affected areas. The route of the block line outside the area of the Paks Nuclear Power Plant mostly cuts across arable land, which is not decisive for amphibians and reptiles as they occur there in a rather small number.

Concerning birds, habitats fragmentation and edge effect emerging as a result will affect the temporary construction area and development area, the Island, the route of the long-distance lines and the route of the cold water/warm water channels.

With regard to mammals, the direct impact area covers the entire operation area of Paks II.

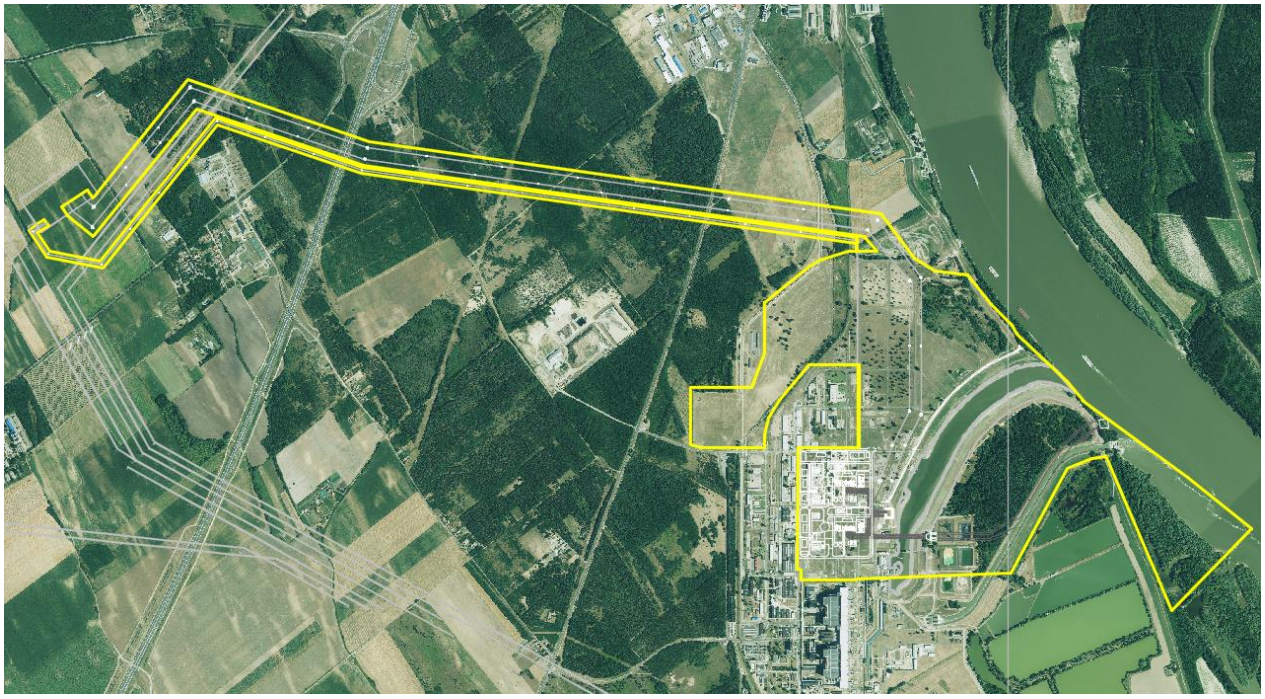


Figure 18.5.3-2.: Direct impact area of the establishment of Paks II - zoology

18.5.3.2 Indirect impact areas

Botany

The indirect impact area of operation, studied from the aspect of plant associations and plant species to be protected covers the entire area of Paks II (including temporary construction area), the safety zone of the transmission lines, the energy dissipation structure and the environment of the recuperation plant. The area overlapped by the impact area of air pollution may also be potentially affected.

At ordinary operation, pollution emission from non-radioactive emission will presumably not have detectable negative impact on plants and habitats - including priority species and habitats - on the ground squirrels field at Paks, the Dunaszentgyörgy swamp forest and the Tolna-Duna Natura 2000 site.

Zoology

On aquatic macroscopic invertebrates, the direct impact of the operation of Paks II can be expected to a small extent on the Danube section under the warm water channel outflow into the Danube.

From the aspect of dragon flies, on the impact area of the operation of Paks II, getting away from the narrow environment of the inflow, by the dilution of the cooling water, settlement options of the dragon fly larvae are improved. At a distance of 450 m from the inflow, downstream the quantity of larvae is in line with natural sections.

From the aspect of the orthoptera, the total area of the power plant (including the temporary construction area) and the safety zone of the transmission lines are areas of direct impacts.

In case of the soil surface arthropoda, the indirect impact areas of the operation include the areas adjacent with the direct impact areas on the one hand and the impact area of air pollution on the other.

For amphibians and reptiles, the termination of the habitats covering most of the site of Paks II will at the same time inhibit migration options of species living in the vicinity. This fragmentation effect can be decreased by the potential new habitats established by landscaping the area and by the regeneration of the temporary construction area.

Water temperature increase of the Danube will have its impact on the Uszódi Island of the Tolnai-Duna Natura 2000 site. Water temperature increase can be primarily expected in the main stream, its impact between the Island and in the dead channels can be significantly lower. As amphibians and reptiles occur on water sections of the smallest movement or of standing water nature, detrimental consequences of water temperature may not be necessary to be considered.

18.5.3.3 Trans-boundary environmental impacts

Operation will have trans-boundary effect neither from the point of view of botany nor from the aspect of zoology.

18.5.3.4 Impact of the joint operation of Paks II and Paks Nuclear Power Plant

Botanic and zoological impacts of joint operation in their nature are identical with those described in detail in Chapter 0.

No other direct impact can be expected by the joint operation of Paks II and the Paks Nuclear Power Plant on the aquatic macroscopic invertebrates and dragon flies than what has been described as an impact of the operation of Paks II.

With respect to the impact of the joint operation of Paks II and the Paks Nuclear Power Plant on fish, the most critical period will be the period between 2030 and 2032, when both units will be operational. Impact will presumably be of local significance.

Under ordinary joint operation of the two power plant units, the two direct impact factors, the noise and the heat load on the Danube will not exceed the value which would have actual impact on orthoptera, butterflies and soil surface arthropoda.

During the joint operation of the Paks Nuclear Power Plant and Paks II, for the amphibians and reptiles one environmental impact, the warm water discharge will occur more intensively. During joint operation, water temperature increase will be primarily felt in the main stream of the Danube River, where neither amphibian nor reptile species occur, therefore, this impact will not be direct. In the internal bays of the Uszódi Island and the dead channels, the water temperature increase may accelerate the embryonic and larvae development of amphibians as a result of which, their metamorphosis may take place at an earlier time. From the aspect of physiology and survival, it is probably not a disadvantage. It is probably not necessary to consider the increase of other indirect environmental factors as they will not impact amphibians and reptiles.

Regarding birds and mammals, the joint operation of the Paks Nuclear Power Plant and Paks II will not be an extra load during operation.

18.5.3.5 Impact areas of the joint operation of Paks II and the Paks Nuclear Power Plant

18.5.3.5.1 Direct impacts

Botany

The scope of the direct impact area of operation, studied from the aspect of plant associations and plant species to be protected covers the entire area of the power plants, site and safety zone of related facilities, the energy dissipation structure and the environment of the recuperation plant.

Zoology

The impact of the operation of Paks II and the Paks Nuclear Power Plant on aquatic macroscopic invertebrates and dragon flies can be expected to a small extent at the inflow of the cold water channel and at the outflow of the warm water channel as well as on the Danube section below the latter.

Outflow of the warmed up cooling water may influence the structure of fish community locally (on a length of maximum 11 km).

From the aspect of the orthoptera, the direct impact area of ordinary operation will cover the entire area of the power plant (including the temporary construction area) and the safety zone of the transmission lines.

From the aspect of soil surface arthropoda, the direct impact area of operation will include the areas of the Island closed by the cold and warm water channels, the operation site of the power plant, the route of the block lines up to the new Sub-station and the supply delivery routes.

For the amphibians and reptiles, Paks Nuclear Power Plant and Paks II are artificial environment. No direct transformations, changes, further threatening habitats (and together with this, occurrence of species) can be expected here, landscaped surfaces can be potential sites for more frequent amphibian and reptile species. The dike side of the cold and warm water channels, the surface route of fresh water will presumably be put under grass, which may be potential habitats for *Lacerta viridis* and *Lacerta agilis* species. On the Island, between the cold and warm water channels, following the significant habitats loss and degradation, during the joint operation period, no new impacts can be expected. During construction, the two more frequent lizard species may re-settle on the sites of the dike from the non-affected areas.

Concerning birds, the joint operation will affect the temporary construction area and development area, the Island, the route of the transmission lines and the route of the cold water/warm water channels. The higher temperature waters discharged from the power plants, pumped up then discharged through the warm water channel will affect the southern section of the Danube River on a length of maximum 11 km and the dead branches to be found there. Polluted substances emission into the air will indirectly affect the broader environment of Paks II and the Paks Nuclear Power Plant. The size of the area affected largely depends on the quantity of emitted air polluting substances and the actual weather conditions.

With regard to mammals, the direct impact area will cover the entire operation area of Paks II and the Paks Nuclear Power Plant.

18.5.3.5.2 Indirect impacts

Botany

The scope of the indirect impact area of operation, studied from the aspect of plant associations and plant species to be protected covers the entire area of the power plants, site and safety zone of related facilities, the energy dissipation structure and the environment of the recuperation plant. The area overlapping with the joint air pollution impact area of the plants may potentially be affected.

Zoology

During the joint operation of the Paks Nuclear Power Plant and Paks II, no indirect factor can be expected to occur which would have an actual impact on the macroscopic invertebrates, dragon flies, orthoptera, butterflies and soil surface anthropoda, amphibians, reptiles, birds and mammals living on the site of the power plant and in its environment.

Indirect impact of the inflow of warmed up cooling water into the river are not known and cannot be predicted in light of the climate change of much stronger impact than warm water inflow and affecting the whole biosphere of the Danube River.

18.5.3.5.3 Trans-boundary environmental impacts

Joint operation is not expected to have trans-boundary impact from the aspect of botany and zoology.

18.5.4 IMPACT FACTORS, IMPACT PROCESSES, IMPACTS OF MALFUNCTIONS, ACCIDENTS, EMERGENCIES

18.5.4.1 Direct impacts

18.5.4.1.1 Botany

Malfunctions, accidents locally occurring on the site will not affect areas covered by vegetation valuable for nature conservation. With the protective measures in place, malfunctions, accidents may not cause damage to the protected plants and plant associations of the broader environment.

Among non-radioactive emission emergencies, fire cases will result in the damage to or destruction of the vegetation in proportion to the extension of the area affected. Emergencies related to waters, water system in connection with the Danube may cause damage to plant and plant associations breeding in the riparian zone of the Danube.

18.5.4.1.2 Zoology

As most of the environment is characterised by dry habitat, they are highly exposed to the risk of extensive fires. This is especially true for the pine plantations along the route of the transmission lines. The bulk of the insects are able to survive a less intensive fire of smaller extension, but in case of large extension and intensity, these habitats may be severely damaged. With regard to transmission lines, electric discharge may pose fire danger. Most of the gaseous compounds released by fire are toxic (e.g., material of insulations) but the deposited remaining materials (substances in ashes) may also be toxic. According to our information, their impact on butterflies living in the open air has not been studied, with the exception of the toxicological test of some compounds performed on standard laboratory animals. Higher concentration of smoke will certainly kill insects.

Petroleum products spilled on soil surface will on the one hand cause the suffocation of animals living in the soil [18-42]; [18-34], and on the other hand, in the long-term, depending on the composition, they will unfavourably influence the physiological processes of animals occurring there [18-63]. Hydrazine, boron, nitric acid, sulphuric acid, hydro-chloric acid, sodium-hydroxide, and, depending on its composition, waste water with chemicals may cause mortality or decreased viability.

The impact of municipal waste water getting into the environment in case of malfunction depends on its composition. In case of higher organic matter content, composition and structure of the soil may change. Occurrence of weed association well-tolerating disturbance may be expected together with a soil fauna characteristic to it. Polluting substances emitted into the air may get enriched in certain soil surface animal species [18-81], [18-122], [18-90].

18.5.4.2 Indirect impacts

18.5.4.2.1 Botany

Among non-radioactive emission emergencies, air pollution events may affect plant associations of the adjacent areas but this impact compared to an emergency involving radioactive emission is smaller by the order of magnitude, and cannot trigger major changes destruction physiological modification, necrosis, mutation if environment protection measures are complied with.

18.5.4.2.2 Zoology

If malfunction in the operation of the power plant of such a scale that as an impact of the emergency, the surrounding environment is affected by significant dust pollution, then it will negatively affect the insects and also the orthoptera living there, and in severe cases, it may even involve the termination of certain populations on the impact area, whose magnitude depends on the size and nature of the emergency.

Toxic gaseous compounds released by fire (e.g., substance of insulation) may get deposited, but their impact on butterflies living in the open air is unknown. Higher concentration of smoke will certainly kill insects.

18.5.4.2.3 Trans-boundary environmental impacts

Botany

Emission emergency events of non-radiology aspect have no trans-boundary impact from the aspect of botany.

Zoology

In the event of malfunctions, no trans-boundary impacts can be expected.

18.5.5 ENVIRONMENT PROTECTION MEASURES

On all areas affected by the investment, their secondary grasslands are established or degradation of the grassland must be taken into account, suppression of invasive species (primarily acacia and milk weed) and mowing of the grasses must be ensured. Mowing and its frequency must be determined and implemented in a way that it should inhibit the spread of invasive species and prevent the spreading of seed of the invasive species settling there.

The most important task in relation with the maintenance of the route of the transmission lines and the openings from nature conservation aspect is to suppress the spreading of weeds and invasive species. This is a prerequisite for the preservation and strengthening of native sand steppes and their fauna. These interventions must be carried out in the most environmentally-friendly manner (carried out on foot, or by light machines or equipment with special wheels) to avoid trampling and soil compaction. Invasive species should be suppressed possibly without using insecticides, or by minimising it.

It is advisable to accelerate and stabilise landscape rehabilitation by sowing the seed of natural steppe species collected from the neighbourhood following preliminary targeted examinations and by carrying out monitoring.

Successful rehabilitation of the vegetation will accelerate the return of the natural butterfly assemblages and protected species. It would be advisable to launch artificial propagation programmes for certain selected emblematic species. One of the most interesting protected butterfly species is the blood word burnet *(Zygaena laeta)*, which has become very scarce nationally and disappeared from most of its habitats (mostly due to the afforestation of sand areas by pine plantations). Its larvae lives on field iryingo *(Eryngium campestre)*. In the recent years, a few items were found on the area (on the ground squirrel field at Paks). Following the clarification of its ecological conditions, it would be worth carrying out artificial propagation and re-settlement of it.

18.5.6 PROPOSAL FOR THE INSTALLATION OF BIO-MONITORING SYSTEMS

The bio-monitoring studies [18-85], [18-87] have created the basis for launching modern bio-monitoring in the environment of the Paks Nuclear Power Plant and Paks II to be constructed. The botanic and faunistic base line [18-138] necessary for bio-monitoring have been included. Studies have been performed in accordance with the relevant protocols of the National Bio-monitoring System with a few necessary and advisory amendments. As the methods (sampling site, date, collection and evaluation methods) can be found in document on the basis of that the studies can be repeated, findings are comparable with each other and this way they will be suitable for bio-monitoring. With the help of monitoring, problems may be perceived in time and corrected.

In the following, we give a short description of the most important aspects.

The bio-monitoring system can be integrated into the monitoring systems existing and operating in the environment of the Paks Nuclear Power Plant. It is to be noted that such a broad bio-monitoring system [18-139] that is included in this proposal can be found in a few places in the environment of operating power plants. That is, in case our proposal is accepted, a bio-monitoring system of world standard would be implemented.

The following groups have been selected for bio-monitoring studies. (It has been stated that the tundra vole does not live on the area therefore it cannot be monitored. If later it is found and it gets settled on the area then of course its monitoring is recommended.)

- Flora and vegetation
- Aquatic macroscopic invertebrates
- Orthoptera (species, communities)
- Dragon flies (flying adders, communities)
- Butterflies (day butterflies, night butterflies)
- Soil surface anthropoda
- Fish
- Amphibians, reptiles
- Birds
- Mammals (mound-building mouse, bats, ground squirrel, small mammals on the basis of owl pellet)

18.5.6.1 Botany

The purpose of the survey of the flora and vegetation:

- *Assessment and mapping according to the NBmR protocol of the quantity and quality data of the protected and Natura 2000 pile the plant species in the 3 km radius of the power plant every 3 years.*
- *In relation with the Tolnai-Duna Natura 2000 site, assessment of the entire flora every 3 years on both banks of the Danube on the area of priority habitats types south of the warm water inflow for a distance of 2 km.*
- *Documentation of all the vascular plant species and all habitats in the 3 km radius of the power plant by mapping every 12 years in accordance with the National Biodiversity Monitoring System.*

General description of the sampling procedures

Sampling type 'A' (to be applied primarily for rare species)

The task is to carry out a detailed examination of all known localities by determining the size of the population (number of stems) and by detailed mapping every 3 years. Site of occurrence of the population should be given on a map on a scale of 1:25,000:

Determining population size:

by counting (*in case of separate stems that can be counted)*: counting of items, stems (within 5 % margin of error), extension of the community (m^2), preparation of a sketch map on the area.

by estimation based on sampling (in case of stems that can be separated but cannot be counted*)*: Sampling after becoming acquainted with the full extension of the assemblage, counting of stems in squares of known size, total stem number can be calculated on the basis of the data of homogeneous sub-units (the area of the sampling units should cover if possible at least 1% of the total assemblage, the sampling unit should be placed in assemblage parts of varied density.

Sampling type 'B' (for population that can be separated but are not rare)

For each National Park Directorate minimum 5 endangered habitats should be assessed according to method 'A' given above, therefore, for the 5 selected assemblages (and documented in the protocol) it is necessary to determine the size of the community and to prepare micro-area maps.

Sampling site 'C' (for species of diffuse spread, not rare but endangered on a large area)

Mapping in a square of 1x1 km on the selected area. The sampling site should possibly be in a 5x5 km square or on the site of other studies. The index number next to the letter of the method stands for the number of square. In case of species included in the annexes of the Habitats Directive examination of a number of sampling squares may be necessary, distributed in a weighted manner according to the size of the community.

Mapping population patches in 1x1 km sampling site: population patches must be mapped on a scale of 1:10,000. On the different patches population size (number of stems or coverage) must be identified (*see* methods, sampling type 'A').

Raster mapping on a sampling site of 1x1 km: if there are no separable patches, raster survey should be conducted on the 1x1 km sampling site on a grid of 50x50 m by *coverage estimation* of the study species in the individual cells.

Variables studied

In case of sampling type 'A', and in the 5 populations selected in method 'B':

- number of stems/number of items (number calculated, number estimated)
- extension of the assemblage (m^2)
- map patches on different scales
- endangering factors
- area map M=1:25,000 (as in case of method 'A' all communities are assessed, here the task is only to display all the communities in one map)

Method 'C':

- population map in 1x1 km square
- detailed information on the given map patches, *see* according to method 'A'
- endangering factors

The most recent protocol following **NBmR** [18-38] is the following:

Sampling type 'A':

With respect to species classified into sampling type 'A', **all known habitats** must be assessed **within one vegetation period** by determining the **size of the community** (count value).

Determining the size of the community:

Items of a given species occurring on a given site must be precisely counted on the 100 count unit (*item, shoot, flowering shoot, flowering item or coverage*). In case of a larger count unit, assessment can also be made but it must be based on sampling (e.g., average of precise counting performed on a x number of 1x1 m sampling site should be multiplied by the area of occurrence of the items).

For each species the impact of potential environmental changes must be evaluated.

Study areas

As with the exception of the Tolnai-Duna NATURA 2000 site, the botanic surveys are not designated sampling site but are part of the entire 3 km radius sampling area, it has been divided after the following area parts based on vegetation types determining the landscape and covering the entire area:

- Flood plain of the Danube
- Flood protection dike
- Páskom
- Csámpa side
- Stand steppes in the vicinity of the Paks Nuclear Power Plant
- Dunaszentgyörgy marsh forests, marshes, swamp meadows
- Agricultural areas
- Site of the Paks Nuclear Power Plant
- Channels and their banks
- Vicinity of fish ponds

Schedule of botanic studies

Flora will be surveyed by touring the site during spring (early March – end of May), early summer (middle of June – early July) and end of summer (end of August – early September). Routes of the tours will be recorded by GPS.

List of species

Detailed data table will be made about the plant species detected on the area studied, where information essential for nature conservation will be displayed (protected, highly protected, brought in invasive species).

Protected species will be displayed in separate table giving their stem number, and where it is difficult, the number of their polikormons, or an estimation of the patch size of the population in square meter. In addition to these, the GPS coordinates recorded on-site and the exact date of the recording will also be included in the document. In case of species which occur in abundance in a given year, during the tour of the areas stem number will be averaged on a few square meters, and further on, as many locality points will be recorded as possible. Subsequently, the locality points will be used to calculate the area with the help of geographical information programme and the result we arrive at will be multiplied with the averages recorded on-site. This is how an estimation will be given of the number of stems of a given species. Occurrence of protected species will also be displayed on appointment.

In accordance with the Nature Protection Value Categories Social Behaviour Types and Value Numbers of Level of Natural Status groups share diagrams will be made of the flora lists and they will be compared. Ecological indexes were taken from the FLÓRA database 1.2. The narrative description describes the flora of the area with species attention to the protected an invasive species, and discusses the impacts of environmental factors potentially threatening the area.

Mapping habitats

For the preparation of habitats maps the basis is provided by the NBmR protocol.

Based on the digital aerial photos available, the borders of the habitats units will be indicated, visible habitats patches will be limited, and with this the first patch map in .shp format of the entire 3 km radius circus will be created. By on-site assessment, detailed tour of the different patches and identification of habitats covering the patches will be done on the basis of the prepared polygon coverage. If on a patch delimited before a number of habitats can be differentiated, their borders will be drawn with the help of manual GPS. Based on the detailed tour, name of the habitats on the different patches, description list of species creating the association and characterisation of their dominance relations, furthermore, list of other major plant species eventually occurring in the patch determination of the natural status of the patch and further additional information considered important in the description of the habitats patch will be recorded on-site. In addition to narrative documentation photo documentation will also be made during the on-site survey. When processing is done, routes and points will be downloaded from the GPS equipment directly as .gpx or .shp format. Then, on the basis of the notes made on-site and the recorded routes and points computerised documentation of narrative data and detailed editing of the maps made before will be carried out by digitalising the newly recorded borders of patches.

Description of priority habitats

With respect to the NATURA 200 sites, documentation of the abundance and quality characteristics of the priority habitats types and habitats plant species will be done by assigning the Á-NÉR 2011 categories, by the description and evaluation of the impacts of potential environmental changes and factors arising from that threaten natural status.

18.5.6.2 Zoology

Bases of sampling

Sampling sites of different animal groups may not necessarily coincide. When selecting the specific sampling sites, the characteristics of the given taxon were considered.

Two general comments can be made in relation with the studies:

1. Each group is research by a specialist with significant experience and scientific work.

2. Study methods are given by the appropriate protocols of NBmR, with the necessary and advisory modifications.

Aquatic macroscopic invertebrates

Among the large European rivers the Danube is not only a major economic factor as a transcontinental water way, but, even in its current regulated condition, it is a major ecological corridor for the biosphere. In that respect, the free flow section of the Danube in Hungary has tremendous importance, it is a sampling site and, in a number of aspects, reference of the Central Danube. As the Danube River and its flood plain is a protected area of the aquatic Natura 2000 species, one of the most suitable tour for the exploration of the status of the section to be studied is the aquatic macroscopic invertebrates monitoring programme of the National Biodiversity Monitoring System (NBmR). The primary objective of monitoring is a description of the composition (biodiversity) of the macroscopic invertebrate community and the determination of the changes in their quality and quantity relations.

General description of the methodology applied

During sampling, the sampling protocol of the aquatic macroscopic invertebrates elaborated for the monitoring of NBmR aquatic habitats biological diversity trend [Monitoring wet habitats and their communities (ÁNÉR classification U8, U9). Protocol for sampling of aquatic macroscopic invertebrates (208.02.18) [18-156]].

As this protocol has been elaborated in general for small and medium water courses, in respect of the studies on the Danube, modifications to be applied in case of large rivers/streams.

General characteristics of sampling

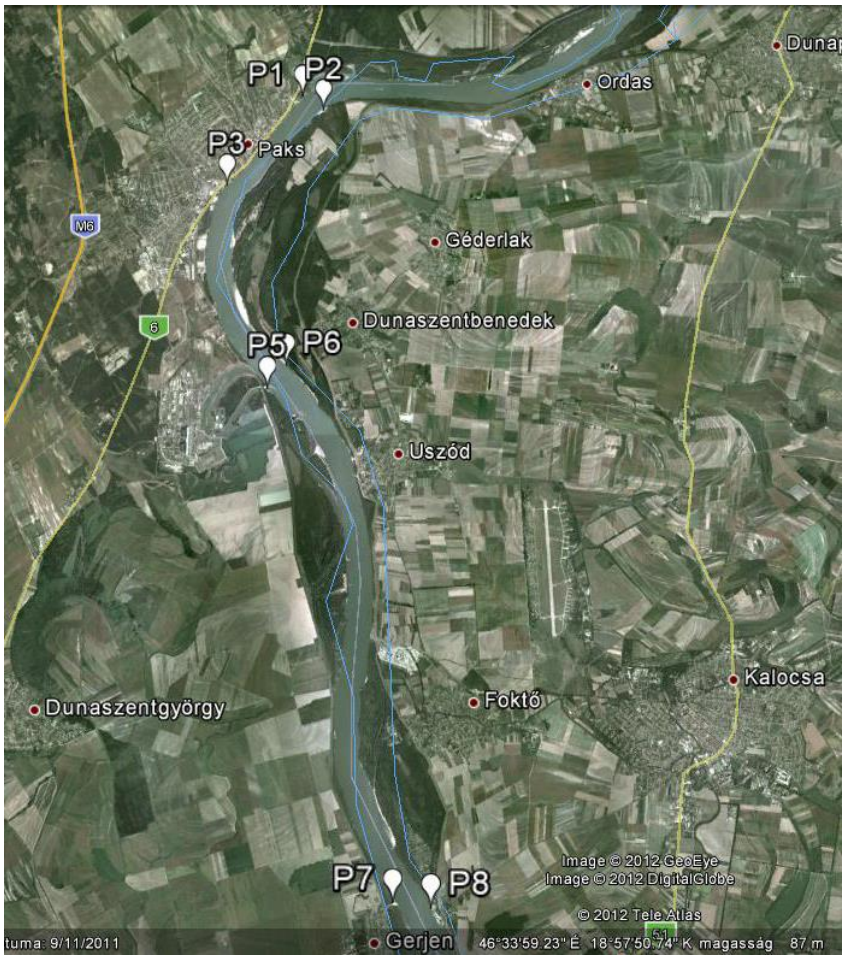
Sampling sites

Sampling will affect an approximately 17 km long section upstream and downstream of the power plant in accordance with the data in the Table 18.5.6-1..

Mintavétel helyszíne:	Duna (1533 fkm)	Jele: P1
	Paks (jobb part)	
LAT (EOV):	46°38'07.49" (637075)	18°52'43.25" (143464)
Mintavétel helyszíne:	Duna (1533 fkm)	Jele: P2
	Géderlak (bal part)	
LAT (EOV):	46°37'58.19" (637488)	18°53'02.69" (143176)
Mintavétel helyszíne:	Duna (1530,4 fkm)	Jele: P3
	Paks (jobb part)	
LAT (EOV):	46°37'08.75" (635668)	18°51'37.31" (141653)
Mintavétel helyszíne:	Duna (1526,2 fkm)	Jele: P5
	Paks (jobb part)	
LAT (EOV):	46°34'57.95" (636596)	18°52'21.35" (137612)
Mintavétel helyszíne:	Duna (1526,2 fkm)	Jele: P6
	Dunaszentbenedek (bal part)	
LAT (EOV):	46°35'14.99" (636917)	18°52'36.35" (138138)
Mintavétel helyszíne:	Duna (1516 fkm)	Jele: P7
	Gerjen (jobb part)	
LAT (EOV):	46°29'57.18" (639173)	18°54'23.15" (128220)
Mintavétel helyszíne:	Duna (1516 fkm)	Jele: P8
	Foktő/Kalocsa (bal part)	
LAT (EOV):	46°29'55.49" (639858)	18°54'55.31" (128267)

Mintavétel helyszíne - Sampling site
Duna - Danube
fkm - river km
Jele - mark
jobb part - right bank
bal part - left bank

Table 18.5.6-1.: Sampling sites of aquatic macroscopic invertebrates



P1-P8 – Sampling sites

Figure 18.5.6-1.: Sampling sites of macroscopic aquatic invertebrates (at 1533.0 and 1516.0 river km of the Tolnai-Duna) [18-168]

Sampling times

Sampling frequency of the aquatic macro invertebrates depends on the nature of the given habitats and the development course of the taxon to be studied. In the interest of collecting larvae of species flying out at an early stage, it is most important to have an early spring sampling (depending on water level, during March-April), in case of a flood during the small water status in May at the latest. The second assessment should be conducted during the summer period (middle of July - middle of August). Sampling times of water courses must be adjusted to opportunities determined by water level. Based on our former field experiences along the section of the Danube River in Hungary, in the lithoral zone, logistically the most suitable periods are when water level measured at the Budapest gauge is between 150-200 cm.

Sampling methods

When collecting macroscopic invertebrates a number of different collection techniques and combination of them are applied - with attention to the varied demands of the different groups and development forms, and requirements of the river bank section designated for collection and of the underlay type - in order to achieve our objective, the most efficient qualitative and semi-qualitative sampling.

With attention to the requirements of AQEM protocol but also with attention to the characteristics of the section described above (underlay of more coarse texture) we apply the 'kick and sweep' technique with the water net recorded in EU ISO-7828-1985 standard (edge length = 0.4 m), the traditional semi-circle hand net (0.25 m), and forceps, and triangular shape dredge (0.25 m). The number in brackets stands for edge length. Each tool has nets of uniform whole size, 720 µm. With the help of the dredger depth that can be extended towards the deep region, enabling us to have access to more information for the description of the cross section. Application of a net with 720 µm mesh is necessary

in order to preserve at sampling the juvenile larvae forms of macroscopic aquatic invertebrates, which is necessarily a source of further information when biodiversity monitoring is done.

On fine texture underlay, the dredger gives similar or a bit less efficient result. Semi-quantitative samples attributed to the same time or area unit and hand collected with identical 'effort' (at least 1 m^2 for each replicatum in case of Danube conditions) for the assessment of communities suitable for quality comparison and for the detection of changes in time and space. In addition, we also apply all possible variants of qualitative collection by forceps by lifting larger stones, using forceps scratching cover layers. By methods applied in the littoral zone – depending on the tools and the river bed profile – we are able to carry out collection up to a distance of 10-15 or 15-20 m from the edge of the bank and down to a depth of 1.0-1.5 or 1.5-3 m. At times of low water level, with certain limitations, this collection strategy also characterises the profundal region.

Analyses and evaluations

When monitoring biodiversity, in addition to the species level identification of taxon prescribed in the protocol (*Gastropoda* - snails, *Bivalvia* - molluscs, *Hirudinea* - blood sucker, *Malacostraca* - higher crayfish, *Ephemeroptera* - mayflies, *Odonata* - dragon flies, *Heteroptera* - aquatic and semi-aquatic bugs, *Plecoptera* - stone flies, *Coleoptera* - water bugs, *Trichoptera* - sedge-flies) we also record other taxon that are expected to occur (e.g., *Polychaeta* - ammelid worms, *Oligochaeta* - earthworms, *Diptera* - flies and midges, *Megaloptera* - dobsonflies and alderflies).

For the purpose of the analysis we use the taxon and species number of the aquatic macroscopic invertebrates; their number of item (ind/m^2); and the species composition of the assemblages. In order to demonstrate the similarity or difference of sampling site quantity figures are analysed by multiple, variable methods. Similarities of macro invertebrate assemblages are assessed on the basis of presence-absence of taxon.

Assessment of sampling sites is done in a similar manner in line with the abiotic parameters (flow, morphology of the river bank, underlay quality, organic detritus, vegetation, light) important for a macroscopic invertebrates of the habitats. Assessment of the studied Danube section and the different sampling sites is done on the basis of percentage proportion of taxon groups' faunistic and nature conservation aspect with special attention to the presence of the priority species of the Tolnai-Duna NATURA 2000 site (*Unio crassus* - thick shelled river mussel).

Orthoptera

General characteristics of sampling

Sampling sites

In the 3 km radius of the power plant sampling of the total orthoptera insect population will be done. Site of the study will be the following six sampling sites (Table 18.5.6-2.):

Name of sampling site	Number of site	N.L	E.L	Which point of the quadrate
Arable land (alfalfa)	1	46.56437°	18.8567°	middle of the quadrate
Gallery forest (power plant, Island)	2a	46.58238°	18.86292°	middle of the quadrate
Gallery forest on the flood plain of the Danube	2b	46.5603°	18.88113°	middle of the quadrate
Development area of the power plant	3	46.58521	18.85943	N-E corner of the quadrate
Forest plantation (Scots)	4	46.58463°	18.82555°	N-W corner of the quadrate
Dry steppe (sand steppe)	5	46.57158°	18.84288	middle of the quadrate
Natural forest	6	46.55653°	18.8251°	S-W corner of the quadrate

Table 18.5.6-2.: Sampling sites of the orthoptera

Sampling times

On the different sampling sites, filed collection is done three times during the year suitable for the assessment of the entire orthoptera community. Weather conditions determined the actual timing of field work on a large scale, as on days of bad weather they cannot be carried out efficiently. Based on the general principle, the first sampling is done in the second half of May - first half of June, the second sampling is done during July (or perhaps in early August) and the third sampling is possibly done during September. As the actual weather significantly influences the efficiency (success) of collection, sampling of the community must be scheduled in accordance with the following criteria. In general it is done between 9 a.m. and 6 p.m., in case of high temperature/hot weather it is not recommended between midday and 14 hours, and collection is to be avoided on days of strong winds, very cold weather (colder than 15-20 °C) and in case of rainy weather.

Sampling methods

On each site designated for sampling of the orthoptera communities, field sampling is done in accordance with the up-to-date protocol of NBmR. On each sampling site, 50 m edge length quadrat is designated. Corner points of the quadrats are to be designated by GPS equipment because of multiple sampling. Within one quadrat, by using the same size sweep net in each sampling, a sample of 300 sweeps are taken by intensive sweep netting. The sample can be collected in one or in a number of parts depending on the abundance of the assemblages and the structure of the habitats. Items collected are preferably identified alive on-site, in case of problems, they are identified in laboratory after obfuscation of the items. Standardised sweep netting can be performed on a random meandering route within the quadrat. In addition to sweep netting, additional sampling is done also in each quadrat. Some of the special of small abundance and more difficult to collect by using a net can be better detected visually, while other species are easier to detect acoustically and finally all or almost all actually present species of the local orthoptera assemblages can be detected. In addition to the description of the full community, this methodology is also suitable for the monitoring of species important for nature conservation and eventually present. To detect potentially occurring protected species, sampling in July-August is appropriate.

In addition to sampling, some other community or habitats characteristics are also assessed and documented:

- o full coverage by vegetation,
- o coverage by monocotyledons and dycotyledons,
- o average vegetation height and
- o average estimated abundance of the full orthoptera assemblage.

Along a transect, by using ultrasound detector, acoustic sampling is carried out in line with the activity of the males in the late afternoon, early evening hours. At these points of times, the males are searching for females ready for mating by a species specific calling voice of around 15-20 KHz frequency maximum, relatively difficult for human ears to hear. In addition to determining presence by this method, based on the number of signing males, an estimation of the magnitude is also made for the population.

Analyses and assessments

The orthoptera assemblages of the different sampling sites can be well-compared on the basis of their simple characteristics. The most important of these are the full species number, which is the simplest measure of the biodiversity of that insect group on the habitats. By one year study, it cannot be fully explored but the different localities can be well-compared and most of the occurring species have a good chance of occurrence during the three events of sample taking. In addition to identification on species level, genus level perception was added as a new species to the total sum if from that genus, no species was found. In other words, the values we arrive that are a minimum number of species, as in case of genuses, we calculated with a minimum number of 1 species. A further option is to give the number of protected and valuable species, or their proportion compared to the total number of species.

On the basis of the sample, the structure of the full assemblage can be described (estimate of dominances of certain species and their actual abundance for each species can also be given for the sampling area). Based on the community structure, by applying multiple variable sample analysis methods, full communities of the different areas are compared, and the nature conservation aspect ranking of sampling sites are carried out based on the rarity of species.

Estimated abundance of local populations of species important for nature conservation and found there can be calculated on the basis of their dominance perceived in the full sample, which enables us to make an approximate population estimation.

Dragon flies (Odonata)

General description of the methodology applied

As imagoes of dragon flies have a good flying capacity, their presence on a given site is less informative. Consequently, in our research we focus only on the data of larvae and exuviums belonging to the habitats studied, in an integrated manner. The study of the *Odonata* larvae is also supported by the idea that the domestic species, during their state of larvae development, all live in waters, and because of their air exchange and predatory nature in water, they are rather suitable for the assessment of the natural status of aquatic associations.

Sampling sites

Designation of sampling sites is done by site tours. Most natural water areas must be selected for the purpose. Efforts must be made also to appoint sampling sites that are the most diverse in the micro-habitats of the given water area, and the sampling point must have a good accessibility. Permanent sampling sites are the Danube River (Dunaszentbenedek) and the Kondor Lake (Paks). Parameters of these and further proposed sampling sites:

Name of sampling site	Mark	NL	EL	EOV Y, X
Paks, Csámpa, channel	P-2	N46°33'43.3"	E18°49'48.4"	633333, 135315
Paks, Kondor Lake	P-9	N46°34'15.4"	E18°51'53.7"	636004, 136300
Paks, Lake IV	P-10	N46°34'19.6"	E18°51'55.5"	636043, 136429
Paks, Lake VI	P-11	N46°34'17.8"	E18°51'57.5"	636085, 136373
Paks, Lake V	P-12	N46°34'19.8"	E18°52'05.3"	636252, 136435
Dunaszentbenedek, Danube	P-15	N46°35'15.5"	E18°52'36.2"	636913, 138153
Paks, Csámpa, ditch used for producing clay bricks	P-17	N46°33'57.1"	E18°50'11.3"	633822, 135740

Table 18.5.6-3.: Proposed sampling sites of dragon flies

Sampling times

Sampling is done on two occasions annually. The two occasions are sufficient to detect the larvae of all species living on the area. Knowing the phenology of larvae, the most suitable times are April and June, but it may be influenced to a smaller or larger degree by the weather conditions of the year and the water level of the Danube.

Sampling methods

The entire dragon fly fauna of the area is assessed on a presence/absence basis. The method elaborated for the study of the macroscopic aquatic invertebrates in NBmR is applied. This is the 'kick and sweep' sampling (FBA Pond Net) used as a standard procedure in the EU Countries. In addition to this, 'targeted' pinching by netting [18-72] is also carried out covering all micro-habitats (stone spreading; gravel, sand, clay underlay; sediment piles; aquatic vegetation routes, etc., riparian vegetation hanging into the water) as well as pinching by forceps from stones, tree trunks, branches and other water objects lifted out from the water. Pinching type of collection of exuviums in different parts of the water bodies from the emersed and littoral vegetation and from soil surface and other objects (e.g., bridge pillars). The length of the section examined by sampling sites is about: 30-50 m. Efforts should be made to carry out the work with the least possible sacrifice from nature conservation aspect, this way, species that can be identified on the area will not be collected.

Analyses and assessments

Evaluation of faunistic data will be done similarly to works publishing dragon fly monitoring results. Sampling sites and species found are described, indicator species of habitats types are designated. Assessment of the habitats must be given based on the list of species and the lists reflecting the referent status of the given water types. Quantitative conditions must be given on a scale of four degrees (not available, little/few, medium, a lot).

Butterflies (Lepidoptera)

General description of the methodology applied

Biodiversity-monitoring methods can fundamentally be classified into 3 major groups:

- qualitative methods to detect presence-absence;
- semi-quantitative methods;
- quantitative methods elaborated for the estimation of abundance.

Qualitative methods to detect presence-absence

Hand collection

Hand collection is a summary name of qualitative, non-automatic collection methods, which can be applied for almost all animal groups. During the investigations, we intend to use the following hand collection methods: observation (without an aid or with a telescope), netting, baiting and using a lamp on bed sheet for collection. Baiting is used for insects not with an expressed photophilic behaviour but with a strong preference for the fermenting alcoholic fruity juices. A limitation and at the same time advantage of the method is that the items do not or hardly leave their narrower habitats. It is advisable to apply this method mainly in early spring and in autumn. Using a collection sheet with a lamp is one of the most important collection method for photophil insects active during the night (the vast majority). The great advantage of this method is that the specific collection events are characterised by high species and item number. An advantage and at the same time disadvantage of the method is that it attracts items from a larger area.

Semi-quantitative, quantitative methods

Installed light trap

A method, which with regard to its technical parameters can be standardised, an automatic mass collection method. In Hungary, the Jermy type light trap is used most often. If requires a permanent control and lined energy supply as its most important characteristic is that it functions every 2-3 days during the entire vegetation period (in general, from early March to end of October). Due to this, it is the most intensive sampling type from among the faunistic examinations. The catch structure of the trap consists of a circular roof of 1 m diameter, and a funnel of 60 cm diameter. The roof is hanging at a height of 2 m or is attached to a pole and underneath there is a 100 W bulb. Between the funnel and the roof structure, there is a distance of 25 cm. The funnel is used to collect the insect flying in for the light and falling down. To the bottom of the funnel, the kill bottle is attached. At the bottom of the kill bottle, cotton weds can be found to prevent injury to insects, to make them state suitable for identification. In the kill bottle, the vial containing the kill agent can be found (chloroform – heavier than air but not flammable). The pre-dehydrated substance of the different sampling times are placed in a paper box among cotton to protect the substance from damages and provide exact data. Collection of samples stored this way is done every 3 weeks, personally, at the sampling events.

Portable light trap

With respect to its principle, it is identical with the above method, but due to its much smaller performance light source (6–8 W UV fluorescent lamp), it has a smaller domain of attraction, and better reflects of smaller habitats patches. It is a method applied for one night and operated by a generator or battery. It is usually used simultaneously with a method of sheet with a lamp and baiting but at some other location. Traps are placed on-site before getting dark and are collected at sunrise.

In case of both methods, processing of the sample is done in a laboratory. The collection is separated into groups of animal species, and data are recorded in protocols.

Quantitative methods elaborated for the estimation of abundance

The purpose of this type of investigation is to determine the size of the population of selected species and the trend of changes in the population, and based on these information, to establish rational habitats and species protection programmes. In bio-monitoring context, two main methods are used, survey along the transect and the triple catch estimation of item number. Both methods have a high labour input, especially the latter one (one sample is the result of work of minimum two persons on several days) and careful planning. Sampling should possibly be done at the culmination of the swarming period of target species.

Estimation of the number of items by surveying zones

Survey is done by observation (absence of the target species also constitutes data!). Butterflies are counted along the previously designated route on the investigated habitats in the following manner. The maximum 1000 m long route of the same habitats type is divided up into 50 m sections. Butterflies are counted along the route on the right and left, in a 2.5 m zone on a section of 5 m in front of the surveyor and up to a height of 2 m. If the habitats intended to be surveyed is of linear nature (e.g., gallery forest along a water course, tall herb sites, etc.) then counting should be done along one single long route. If the habitats is patch like (e.g., marsh meadow, swamp meadow), the route should be designated by providing a full coverage of the representative area of the habitats, but the zones surveyed should not touch each other and there should be no overlaps. The number of sections surveys should be minimum three. To identify the proper sampling time, preliminary tour of the site should be made during the expected period of flying. Surveys should be conducted in good weather conditions (sunshine, warm, not windy).

Triple catch

For further investigation of populations designated for long-term monitoring, the mark-recapture method should be applied to determine specific population size and population structure. This method family provides the most precise estimations but at the same time it has, this is the one which has the highest labour and time input demand. A simplified version of this method, through the applied in biodiversity monitoring practice in Hungary is the so-called triple-catch. This method in essence means that on the previously designated habitats possibly on 3 consecutive days at the culmination of swarming, the mark-recapture sampling is applied by applying identical sampling effort. When planning sampling, lifestyle, vagility, detectability, extension of the species and the extension of the habitats must be considered. It is important to record the environmental parameters of sampling (cloud cover, wind strength, temperature and humidity). The sample will be processed in a laboratory. The collection is separated into groups of animal species, and data are recorded in protocols.

General characteristics of sampling events

Sampling sites

Sampling sites have been designated in such a manner that they include all characteristic habitats types of the area studied. Accordingly, the three most important sampling sites contain sand steppes, riparian soft wood gallery forest along the Danube, and marsh and swamp meadows south of the power plant with better water supply.

Sampling times

Sampling is done every 3-4 weeks from the middle of March to middle of October in accordance with the actual weather conditions not disturbing sampling. Under the prevailing conditions in Hungary, this frequency allow us to cover all aspects of the full vegetation period, that is, the fullest possible fauna is sampled in time.

Analyses and assessments

In case of all methods, recording exact locality (geographical coordinates) and time (in the given case of the habitats as well) are important for the evaluation. Maximum effort should be made that sampling is done for all aspects every 3-4 weeks and that it should be done on all habitats types. In line with the international practice, it is advisable to store at least one item as an evidence even from the more ordinary species. And collection and two light trapping methods (installed and portable) cannot be standardised in the strict sense (although certain parameters can be fixed in a given series of investigation), yet in fauna research and base line assessment of nature conservation status t is the most important, broadly applied group of methods for establishing presence - absence. The faunistic animal geographical and

nature conservation evaluation of the material of installed light trap is not any different from that of the collection sheet with the lamp or the portable trap. The primary result of the surveys is a list which contains the names, the name of the person describing them and the year of description of all species that were found during sampling, as well as the precise geographic location, habitats type and time of the collection or observation. This list can be compared with the list of other areas or with the list of certain habitats. In the list, specific indication is given to species included in national or international protection lists. With respect to the Macrolepidopteras, domestic authors [18-126] elaborated a qualification method which contains all the animal geographical and ecological qualification of all species of the domestic large butterfly fauna. Beyond the compilation of species list, this allows us to describe the composition of fauna and distribution of the different categories of a given area from animal geography and ecological aspect.

Soil surface arthropoda

General description of the methodology applied

Arthropods moving on the soil surface spend the whole of their life on certain sections of their development on the soil or tied to the soil surface. They are tied to a given habitats more than other groups (e.g., insects with good flying capacity) have lower mobility and they are more loyal to their site. Therefore, based on the monitoring of their composition of species and quantities, they are suitable for the description and follow-up of changes of different habitats. Their settlement on a new habitats is a relatively limited, slow process, therefore, when certain impacts come about, they tend to reflect original conditions for a longer time, and they are more exposed to the threat of local extinction as they have less rescue options.

The most important background factors of establishing soil surface *Arthropoda* assemblages are the following: type, structure of the soil, soil moisture and temperature, pH, organic matter content, changes in disturbance and mosaic nature of habitats, and vegetation structure and changes in relation with all that.

General characteristics of sampling events

According to NBmR recommendation, the level of reference soil surface anthropoda taxon and their identification is the following:

Taxon	Level of identification
Formicidae	up to the level of species
Araneae	up to the level of species (juvenile items up to the level of genus)
Carabidae	up to the level of species
Other Coleoptera	certain priority species
Diplopoda, Chilopoda, Isopoda	determination of number of items

Table 18.5.6-4.: Soil surface anthropoda taxon as reference and their level of identification according to NBmR recommendations

The standard method applied for collecting them is soil trapping, which provides excellent base data suitable for the description of the habitats and for comparison of different areas. The material collected by soil traps reflects the surface activity of species and their dynamics, a selective method from certain aspects, but this mistake is eliminated in the comparison of habitats / periods, and we arrive at the absolute difference of areas / periods. With this method, the standardisation, repeatability of sampling can be easily performed.

Sampling sites

1. Arable land (dry, wet), 2. Soft wood forest, 3. Site of the power plant, 4. Forest plantation (poplar), 5. Dry steppe, 6. Natural forest

GPS and EOV coordinates of the sampling sites with the data of the left first trap of the trap grid:

I. Temporary construction area:
N 46°35.125' EO 18°51.562' EOV: Y: 635583 X: 137909 (46° 35' 07.49", 18° 51' 33.73")
II. Soft wood gallery forest:
N 46°34.867' EO 18°51.728' EOV: Y: 635794 X: 137431 (46° 34' 52.02", 18° 51' 43.69")
III. Arable land (alfalfa):
group 1: N 46°33.973' EO 18°51.694' EOV: Y: 635746 X: 135775 (46° 33' 58.39", 18° 51' 41.62")
group 2: N 46°33.984' EO 18°51.651' EOV: Y: 635691 X: 135795 (46° 33' 59.03", 18° 51' 39.04")
IV. Dry sand steppe:
N 46°34.296' EO 18°50.572' EOV: Y: 634314 X: 136377 (46° 34' 17.77", 18° 50' 34.31")
V. Pine forest plantation:
N 46°35.136' EO 18°49.650' EOV: Y: 633141 X: 137936 (46° 35' 08.15", 18° 49' 39.02")
VI. Natural forest (Dunaszentgyörgy swamp forest):
N 46°33.384' EO 18°49.588' EOV: Y: 633052 X: 134690 (46° 33' 23.02", 18° 49' 35.27")

Sampling events

During the period of 2 times 6 weeks, traps were collecting for 2 times 4 weeks, operating in the first 2 and last 2 weeks of the period, with emptying of the trap after each 2 weeks period. 'Activity' period of the traps: spring time (period between end of April and early June) and end of summer - autumn (middle of August to end of September), when activity of certain targeted reference taxon can be expected.

Presence - absence data are recorded during the soil trapping periods, minimum 2 times a year, when the designated areas are toured.

Sampling methods

One sampling site (habitats) 10 traps are positioned. Within the network of traps, the soil traps should be placed in the micro-habitats characteristic of the habitats investigated, at a distance of minimum 5 m from each other.

Soil traps used in monitoring consist of two plastic glasses put into each other, of 10 cm diameter, with a volume of half a litre. The lower glass ('external' glass) is dug into the soil up to its brim, and the bottom of the glass is punched to enable drainage of rainwater getting collected. The upper brim of the second glass is cut around down to a depth of 2 cm. This 'internal' glass which is easy to take out is placed into the external glass and this contains the killing and preservation liquid which is a 3:1 mixture of ethylene-glycol and water. To decrease surface tension, a few drops of washing liquid is added. Above the traps a 15 x 15 cm roof (e.g., plywood) placed on peg legs is positioned to prevent damage of the content of the traps, the evaporation and dilution of the killing and preservation liquid. About 2 cm gap is left between the roof of the trap and the soil surface to allow vertebrates moving on the soil surface to get in.

During the time in between the active trapping periods, internal glasses are removed, traps are no longer collecting, but the external glasses covered stay out there (allowing for the locally precise repeatability of trapping and the least possible habitats disturbance).

When emptying the traps, the internal glass is slipped out from the internal glass dug into the soil together with the liquid and samples in it, and then its full content is filtered. The filtered content of soil traps is provided with a label containing the parameters of the trap and collection, written in (graphite, black ink or perhaps a copied label) resistant to the chemicals applied (also indicating the identification of the collection site and the trap, the date, year, month and day of emptying of the trap) put into a packaging of filter paper, tying it in rubber bent and store in 70 % alcohol. The filtered liquid can be used several times and filled into the trap again, it is reasonable to change it when the kill liquid becomes excessively diluted or get contaminated, e.g., large quantity of soil, leaf-litter get into the trap.

Selection of the material collected is done in a laboratory by separating the different reference taxon. Separated material is stored in alcohol.

Based on the selection, primary databases prepared, that is, it is recorded in a table how many ground beetle (*Carabidae*), other beetle (non-*Carabidae Coleoptera*), ants (*Formicidae*), spiders (*Araneae*), diplopods (*Diplopoda*),

centipedes (*Chilopoda*) and *Oniscidea* items were collected at the specific sampling events on the specific sampling sites in the given trap. The tables will used to prepare primary database, which, without identification, will allow for the follow-up of the changes of the higher taxon level composition of selected groups and abundance of certain reference taxon, and provides information about the size of materials to be identified, etc.

Analyses and assessments

Selection and identification must be done up to the level given in NBmR. In case of *Carabidae*, *Formicidae and Araneae* adult items, number of items are assigned to species, in *Araneae* sub-class juvenile items are assigned to genus, while in case of diplopods, isopods, chilopoda, item numbers are recorded on the level of taxon. Number of item data are recorded per trap and collection events.

Derived data: Species and item number of reference taxon per trap and collection site (locality) for one year. Habitats diversity indicators for one year.

Fish (Pisces)

General description of the methodology applied

The representative sampling units are designated on the Paks Danube section (at 1,535-1,516 river km), diversity of the fish stock is assessed, and size of the fish stock of the NATURA 2000 species is evaluated in accordance with the methodology appropriate for the protocol of NBmR.

Impact of the Paks Nuclear Power Plant on the fish stock of the Danube can primarily be felt through the changes of the physical and chemical characteristics caused by the warm water discharge of the power plant. As the habitats characteristics of the Danube section upstream and downstream of the warm water outflow (river bank line, river bed materials, flow conditions, water depth, etc.) can be considered identical, the Danube section upstream of the warm water outflow can be considered as a control area for establishing the potential impact of the outflow. With attention to the NBmR protocol sampling input and comparability of data, it is advisable to designate identical (aggregate) sampling section length (2,500 m) on the upstream and downstream Danube section.

Based on monitoring experiences of the Danube, survey of the section of 2,500 m total length does not give a representative picture on the number of species occurring on the area and in particular the detectability of truly rare species (even NATURA 2000 species) is quite dubious at this sample size. Fishing on a section of 5,000 m significantly increases the number of detectable species, but even then the species number curve is in the ascending and not in the descending phase. It is advisable therefore either to include another sampling event or if survey is conducted on one occasion, by increasing the length of the sampling section in order to increase the efficiency, representativity of sampling. As in spring and early summer, high water level makes representative and efficient sampling unpredictable, we recommend to select a summer (possibly after the green flood) and a late summer - early autumn date to be selected for the survey.

General characteristics of sampling events

Sampling sites

Precise designation of the sampling sites (here sampling units) is carried out prior to the assessment, which is accessible in function of water level, possibly in sections not deeper than 1.5 m. In accordance with the general methodology, we designate 10 sampling units of 500 m length along the 1,535-1,516 river km section, 5 units downstream of the warm water outflow and 5 units upstream of this section. In proportion of the habitats, we also considered a natural and artificial (covered by stones) river bank sections. The fish stock of habitats types have varied quantity composition, but it is important to survey both types in the interest of detectability of the species and getting more precise information about their quantities.

Sampling times

Survey is carried out on two occasions, at the low water level in the month of June (if there is no low water level, survey can be shifted to July), and in the late summer, early autumn period (August-October).

Sampling methods

Surveys are conducted during the night by using high performance electric fishing machines in accordance with the provisions of NBmR protocol. Survey is done in the riparian zone of the main stream (down to the water depth maximum 1-1.5 m) by electric fishing machine operated by an aggregator. With respect to the survey conducted during the night, we designate 10 sampling units of 500 m length each, with attention to the diversity of the habitats differentiating the natural and artificial (stone covered) riparian sections.

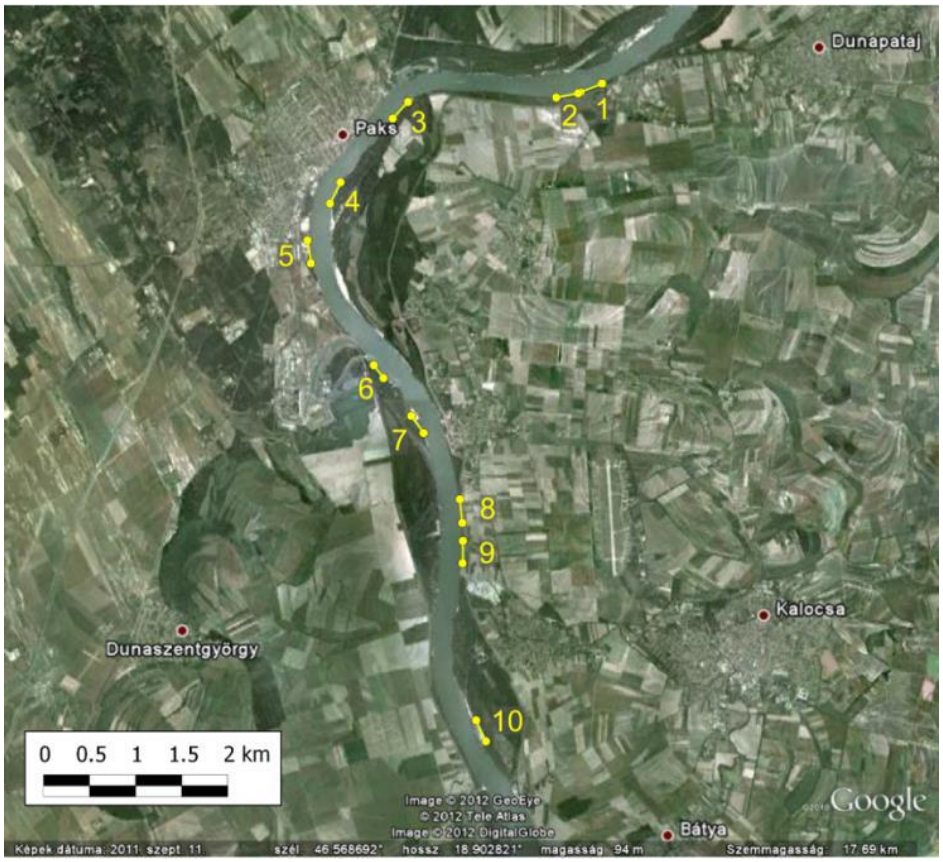


Figure 18.5.6-2.: Proposed location of the designated sampling units for fish survey on the studied area [18-168]

Survey of the sampling section of a total length of 5,000 m is one by using a boat, slowly drifting as drifted by the flow. Fish collected by the land held electing landing net (anode) must be returned into the water at the collection point following identification on species level and counting the number of items.

Analyses and assessments

As a result of the survey, the diversity of the fish stock (diversity indicators), value of natural status, frequency of species under nature conservation protection (highly protected and protected species), NATURA 2000 priority species, invasive species and certain ecological groups are evaluated separately for downstream (under warm water inflow) and upstream section and for the entire area.

Amphibians (Amphibia) and reptiles (Reptilia)

General description of the methodology applied

In monitoring amphibian and reptile species, we applied methods recommended by the protocol of NBmR and suitable for community level assessment (that is elaborated not for the targeted investigation of one species), which may be suitable for the assessment of the presence of a number of species simultaneously and for the assessment of their relative abundance [18-69]. If items are caught, then other parameters characteristic to the population can also be surveyed (e.g., gender, age, occurrence of irregularities).

General characteristics of sampling events

The primary objective of the survey of amphibians and reptiles is to determine what species occur and what type of habitats are suitable for their breeding, feeding and wintering.

Sampling sites

Sampling sites are the following (temporary water covered areas and built-up areas of course do not need to be considered):

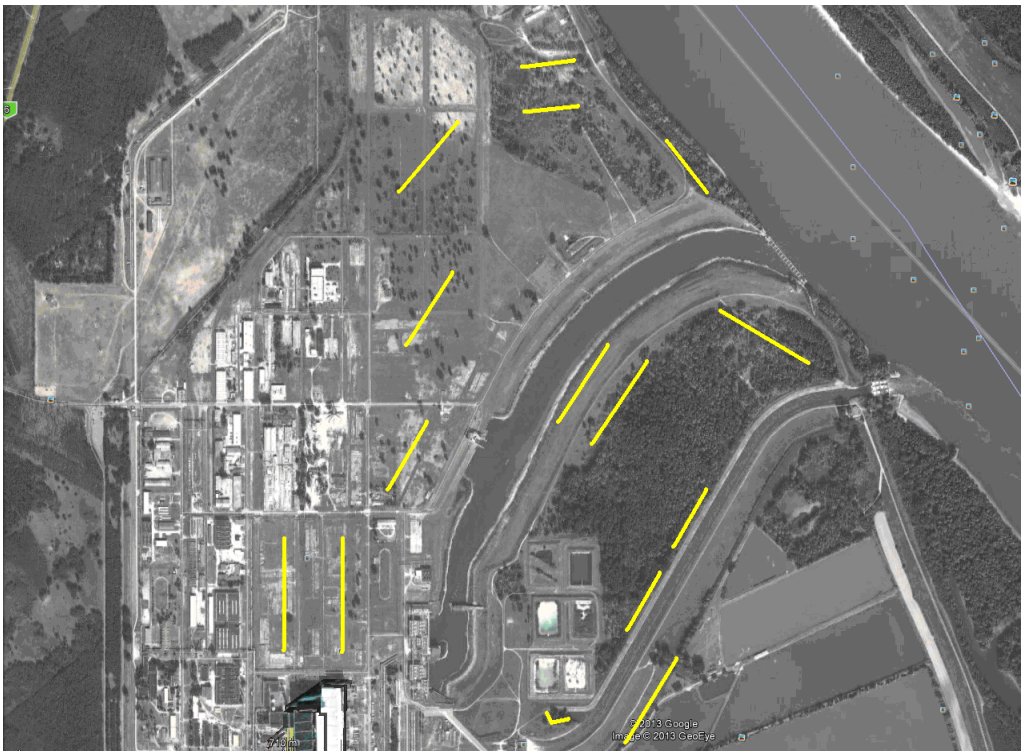


Figure 18.5.6-3.: Sampling sites on the Paks Nuclear Power Plant site [18-168]

Figure 18.5.6-4.: Sampling sites in the alfalfa field and along its edge in the vicinity of the Paks Nuclear Power Plant [18-168]

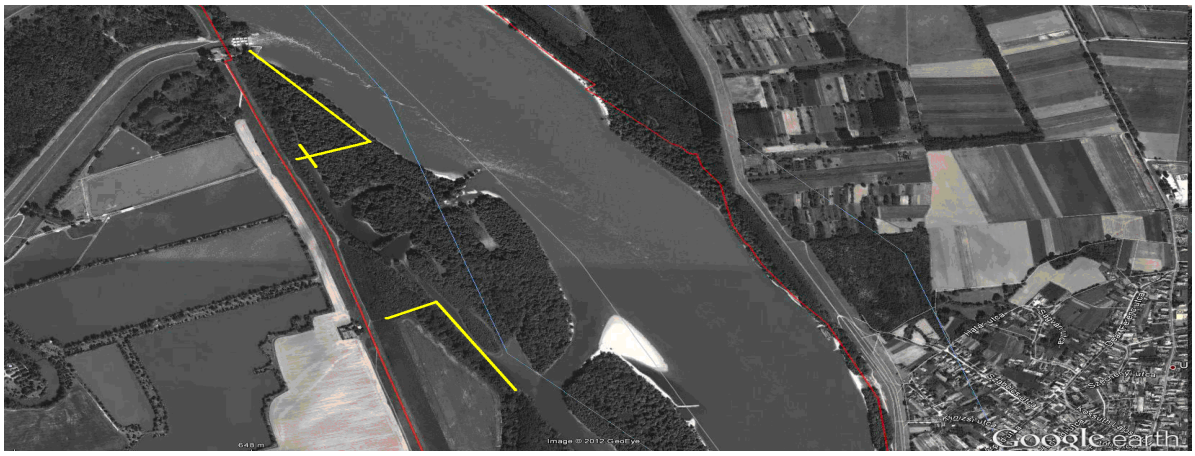


Figure 18.5.6-5.: Sampling sites in the Uszódi Forest [18-168]

Figure 18.5.6-6.: Sampling sites in the edge zone of the pine forest plantation and in the Waterworks channel [18-168]

Figure 18.5.6-7.: Sampling sites in the sandy steppe grassland and in the channel at the south gate to the Paks Nuclear Power Plant [18-168]

Figure 18.5.6-8.: Sampling sites in the New-Brinyó area [18-168]

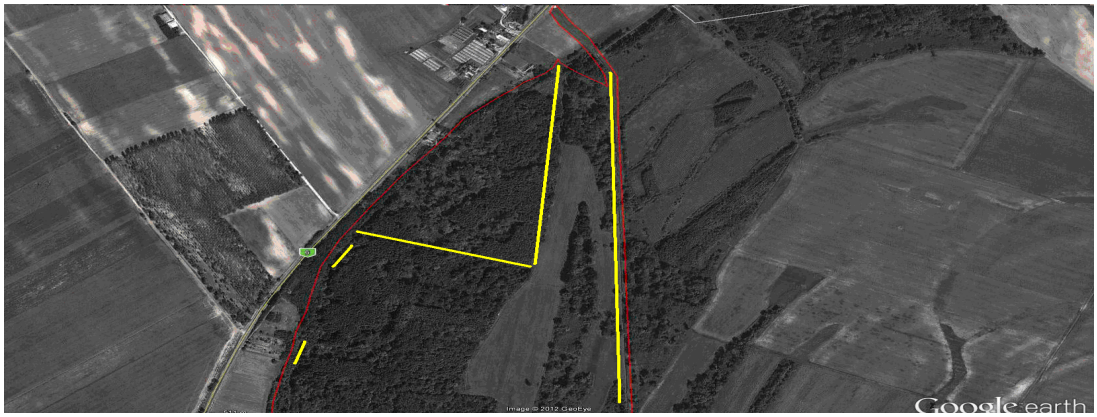


Figure 18.5.6-9.: Sampling sites in the north of the Dunaszentgyörgy Forest [18-168]

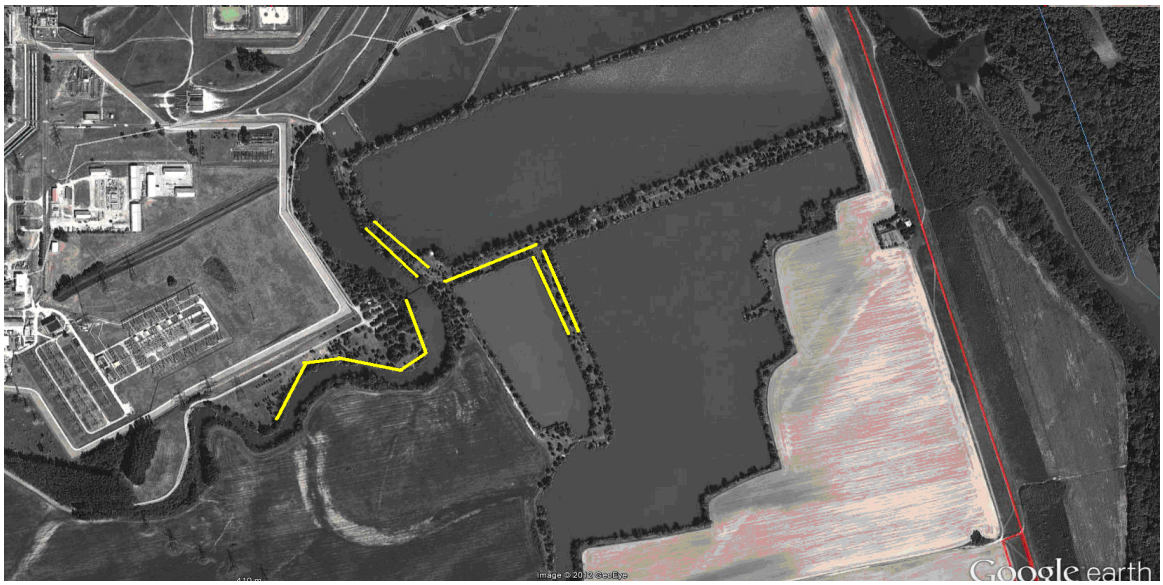


Figure 18.5.6-10.: Sampling sites on the Angler's Association area of the Paks Nuclear Power Plant [18-168]

Sampling times

For surveying amphibians the most suitable period is the period of reproduction in spring because this is the time when they stay for shorter or longer time in the water covered areas. Our sampling dates are primarily determined by the weather conditions and activity of the animals. For surveying species of early reproduction (agile frog, common toad) the month of March is a suitable period, while in April newts, the spade food toad and the European tree frog can be well observed. In May-June, the presence of the fire-bellied toad and the bull frog can be well surveyed. According to the

NBmR protocol on amphibians during the springtime reproduction period 5 samples should be taken, while in August and September sample should be taken another two times to measure up the increase.

Survey of reptiles tied to water coincides in part with the sampling of amphibians (April-May), but the investigation of the terrestrial species can be continued in the summer period as well (in June). Activity of reptiles again increases in the warmer end of summer, autumn period, they can be well observed at these times, therefore in late August and September repeated surveys are conducted.

Sampling methods

When moving about on the area, exact location of items observed anywhere on the area will be measured by the GPS equipment. Central coordinates of sampling points, sections and units surveyed in the selected habitats are also recorded.

Central units are of identical length (area), speed of touring the area and the duration of sampling is systematically identical for the sampling units.

Suitability of the different methods are determined by a number factors (species, age, gender, period, part of the day, weather, habitats, etc.). Application of a number of methods together may be necessary on one sampling site. Therefore, each of the methods enlisted here may be part of the monitoring examinations, but their application is determined by the local factors.

When sampling is done the habitats and the communities species living there should be disturbed as little as possible. For that reason, we apply primarily the different forms of visual observation and acoustic perception. Newt species can reliably be examined only by trapping. After the identification of gender development stage external characteristics the trapped items should be immediately released.

Determining presence and number of items of amphibians

1. Visual search for developed animals at the reproduction sites during the day and at twilight by using lamps:

Developed items of amphibians are counted during the breeding period on a determined length of section and on area unit. Survey is conducted on 5 sampling units per habitats type. The shape of the zones is adjusted to the bank line of the water covered area. Deviation from the 50 m long 5 m wide zone designated per unit is possible only if the vegetation of the bank does not allow for visibility of the 5 m broad belt.

Observation from the designated points is applied on habitats with good visibility.

Daytime visual observation of certain habitats types and at certain points of time must be supplemented with night time survey performed with the help of lamps. Surveying with a lamp is used to assess the occurrence of Caudata and frogs staying in waters during the reproduction period (and following this period as well). Survey by lamps should be performed of the twilight, along road sections crossing the migration route of amphibians, on water bank/shore or in its vicinity.

2. Search for adult animals on the basis of their sound at reproduction sites after getting dark

Monitoring on the basis of sound is preferential on sites where vegetation makes access and visual observation difficult or prevents it. But it is suitable for the dissemination of the number of items only in a limited manner. Counting on the basis of sound is done by standing at one point along the wet habitats. In the interest of the best results the following method is to be applied:

a) during the period between half an hour after sunset and before midnight,

b) at less than 20 km/hour wind speed and minimum background noise,

c) after high humidity or rain.

3. Catching adult animals by trapping, netting

Both methods are primarily suitable for the collection of Caudata staying in water and for the collection of.

Trapping is definitely recommended for the detection of newts. It can be well applied in case of waters of 0.3 m depth or deeper than that and of slow flow. It has high labour demand compared to other methods. Bottle traps are placed during

spring, in the evening hours for one night. In the morning traps are collected and the species of newts, their number of items and gender are determined.

Netting can be an efficient method in all water areas but may severely damage the habitats and cause injures to eggs and larvae. If alternative method is available, application of netting should be avoided for sampling purposes. Recommended net is of 30 cm diameter with mesh size of 2-4 mm. Holding the net in the water we pull it towards the bank.

4. Visual search for adult and young animals outside the reproduction period.

Survey of adult animals outside the reproduction period is an efficient method only for aquatic amphibian species. Determination of the presence of juvenile age groups is recommended twice a year: in end of summer - early autumn period. Counting of adults and young items of amphibians is to be performed on 5 designated sites of 250 m^2 (in case of aquatic species along the banks/shores, in case of terrestrial species on the selected habitats) (in square or in a zone).

5. Determination of the occurrence if species and the number of items suitable for reproduction based on the number of eggs laid.

It is applied on the site of reproduction for the purpose of the detection of the presence of species and for the estimation of the number of items of certain species suitable for reproduction. Egg masses count can only be performed where the water spaces not disturbed or destroyed as a consequence. In sampling units, egg masses are counted at the time of egg laying at two or three points of time for each species. When determining item number, the higher value is considered.

6. Establishing occurrence of the species by examining tadpoles, larvae.

It is apply to determine the presence of a species when occurrence of a species is known from former years, but no other methods are available to observe it and larvae can be well identified on the site as well. Examples may be the detection of spade foot on the basis of its tadpole and the Caudata on the basis of its larvae.

Determining of presence and number of items of reptiles

1. To survey species occurring in water, tied to water:

Survey in spring time is combined with that of the reptiles. It is also applied independently outside this period. Animals found are given for area unit (250 m^2) applied in the monitoring of amphibians. In case of explicitly aquatic species or species tied to water, survey is conducted on a designated zone along the bank/shore, whose area can be calculated for the unified extrapolation basis.

The survey of the presence of a number of species of aquatic life (e.g., European pond terrapin, grass snake) by immobile observation performed at definite points. This method can be mainly used for exploring and checking the sunbathing sides of the European pond terrapin. Of the half an hours noise free observation, it can be continued by using a telescope.

2. Survey of terrestrial species:

Sampling methods of terrestrial reptiles can be done by active search and visual sampling depending on the conditions of the habitats along a zone or in a square or on a patch. The area unit selected for investigation should contain the optimal habitats spots for reptiles. When sampling is done along a zone if the site of the area selected allows to do so, the survey should be conducted in a zone of 2-5 m width and 500-1,000 m length. The zone can be further divided into a number of parallel zones depending on the conditions of the given terrain. The size of the zone should be identical with the area units used for comparison (250 m^2) or should be multiples of that. Sampling should be extended also to the end of summer, early autumn period.

Analyses and assessments

When survey are done the following base data must be documented:

- exact identification of the sampling area and the sampling units
- point of time and duration of sampling
- identification of persons performing surveying
- identification of the applied sampling methods
- data of species observed and their number of items (development stage, age group and/or according to gender). Numbers of items data are always relevant for one sampling unit. In case of species where items are not quote (fire-bellied toad, European pond terrapin) surveyed data are limited.
- registration of sampling circumstances, changes that have occurred subsequent to previous sampling at the sampling site (naming potential hazard sources, eventual changes in the size, extension of the water covered area).
- occurrence of development irregularities (their number, nature),

On the basis of base line data, the following data will be calculated.

- calculation of maximum number of items. The highest number of items observed of a given species during a survey period can be best used for the estimation of the abundance of the population. This gives a minimum abundance, the population can be larger than that but not smaller in any case.
- determination of the number of items with reproduction ability on the basis of egg masses number: egg masses laid down by frogs are usually proof of the presence of a female (and minimum one male).
- calculation of relative abundance values for each species and each habitats type applied to area unit or number of traps
- provision of nature conservation value numbers.

Birds (Aves)

General description of the methodology applied

The sampling methods of monitoring bird communities is fundamentally classified into 5 groups by NBmR. The proposed monitoring procedure can fundamentally be considered as a combined procedure which combines the method of 'territory mapping' with the 'Danish-type points counting' method.

Combination is in essence means that around the reference areas designated in advance, reference points are designated every 200 meters, where, at every point, we stop for 5 minutes and take note of the species and number of items of birds heard and seen. This is a specific feature of the Danish-type point counting method. This is supplemented with counting birds along the line transect, which is used in mapping the territory. In essence, this means that bird counting is done also during the time when the route is done in between the designated reference points around the areas.

Species and their item number recorded during counting must be aggregated on a single report sheet for each area and point of time. Presence or potential absence of NATURA 2000 priority bird species must also be examined.

General characteristics of sampling events

Sampling sites

Sampling routes are the following (Legend: 'blue colour': Borders of Natura 2000 sites; 'green and lilac colour': registered routes):

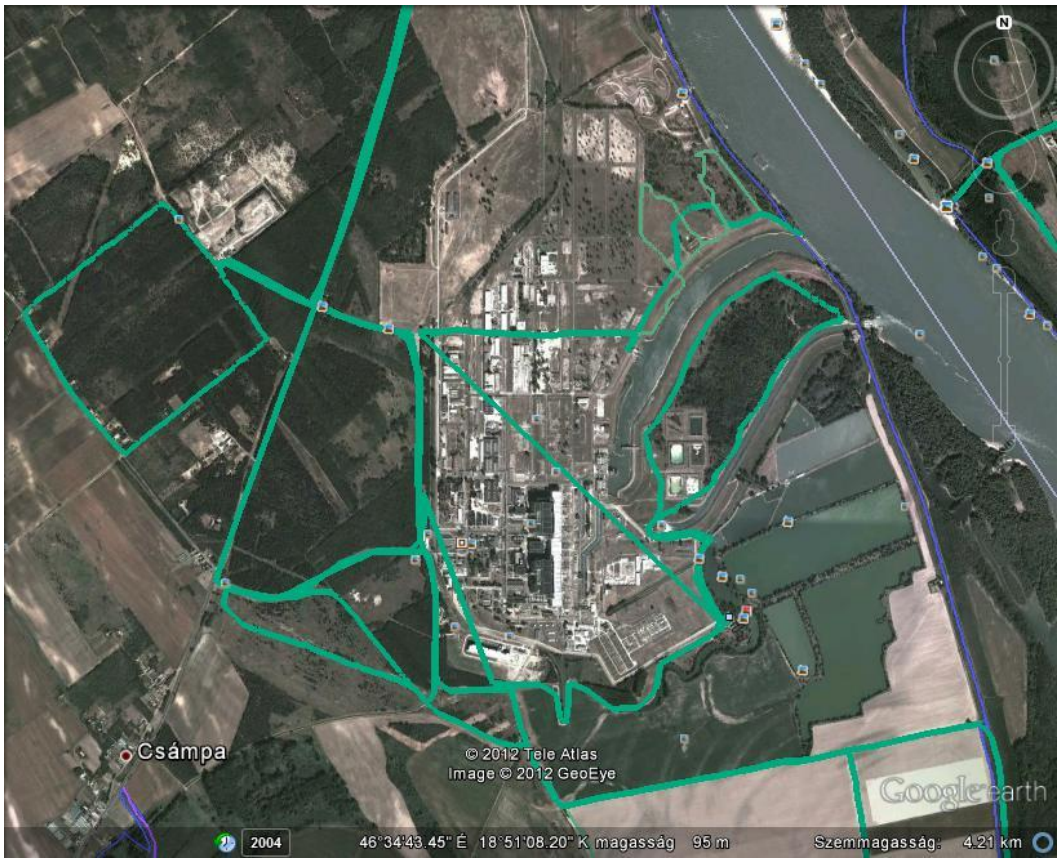


Figure 18.5.6-11.: Routes identified (1) in the 3 km radius of the Paks Nuclear Power Plant [18-168]

Figure 18.5.6-12.: Routes identified (2) in the 3 km radius of the Paks Nuclear Power Plant [18-168]

Figure 18.5.6-13.: Routes identified in the Dunaszentgyörgy swamp woodlands [18-168]

Sampling times

Surveys are performed at 6 different points of time, which include the breeding, dispersion and migration periods. Surveying during the migration and dispersion period had largest importance in respect of the wet areas from the aspect of mapping and monitoring resting sites used during migration.

Times:

- during hatching time, 4 occasions, in April-July once every month
- during dispersion time (which is at the same time also the beginning of migration) 1 occasion: August
- end of migration time: early October.

Sampling methods

At the designated stopping points, point counting must be performed for 5 minutes. The species of birds heard and seen and their number of items must be recorded. The route between the stopping points is done on foot during which again the species of birds heard and seen and the number of their items are again recorded (line transect method).

The species of birds heard and seen and their number of items are aggregated for each area. Sampling sites are toured at the different times of sampling in different orders, and this enables us to eliminate the deviations caused by the time of the day. During sampling, manual telescope and spotting scope are used.

Analyses and assessments

One data communication sheet is filled in for each sampling site and sampling time.

Mammals (Mammalia)

Mound-building mouse

General description of the methodology applied

The mound-building mouse is quite widespread in Hungary, it can be found in most places with the exception of a few regions. The presence of the mound-building mouse can be verified in the easiest way by the mounds that they build in early October. The mounds can be found on their habitats from autumn to spring and by counting the mounds and efficient estimation can be made of their relative population density.

Sampling

Occurrence of the mound-building mouse can be tied to the wastelands/barren lands. When assessing the 3 km radius of the power plant, every wasteland area of at least 5 hectares must be visited and toured along a transect line to check the occurrence of mounds built by mound-building mouse. Based on the density of mounds, assessment of the stop is carried out if signs of the presence of the mound-building mouse can be found. According to the methodology of NBmR, the sampling site must be assessed on one occasion at the same time. In knowledge of the annual activity pattern of the mound-building mouse, the sampling frequency is determined as one sampling per year taken up in late autumn. Simultaneous survey of the area is recommended in order to eliminate the distorting effect of agricultural works (autumn time deep ploughing).

Sampling methods

Due to their size, mound-building mouse's mounds are easy to recognise, their presence can be easily perceived by looking around from the roads of the area studied. Based on that, the occurrence of the mound-building mouse can be mapped in a satisfactory manner. Parcels with mounds are checked by traversing the parcels. When surveying the area, first we localise the occurrence of mounds then within the island like occurrences, we make an estimation of mound density. GPS coordinates of the occurrence are recorded and are linked to the 5x5 km UTM square.

On each of the areas with the mounds, we carry out the counting of the mounds by looking around at one point, and carry out the counting by transect method on the 5 parcels.

Mound counting

From the edge of the agricultural parcel, by looking around, we count the total visible mounds on the area. If the size of the parcel makes it necessary, we use a telescope or in order to avoid disturbance by objects covering the site (buildings, vegetation, etc.) counting is done in a number of details from a number of points.

Transect mound counting method

Density estimation is carried out by touring five 20 m wide belt on a 1 hectare (100x100 m) sampling sites and by counting the total number of mounds to be found there, once sampling site is characterised by the average of 5-5 data and spread. Vegetation height along the transect does not influence perception from immediate vicinity (0-10 m) which means that with careful tour of the area the total number of mounds built there can be identified.

Analyses and assessments

The central point of the area with the mounds (GPS coordinates) and the date of the survey are recorded on a data sheet. The base data in our case are the number of parcels to be found in the UTM squares, the area proportion of the mound-building mouse parcels compared to the squares and the number of mounds identified on the different parcels.

According to reference studies [18-118] in one mound on an average 7 mouse can be found. By using this figure mound-building mouse density in the different squares can be calculated:

$d = (l * c) / (25 * T)$,

where d stands for mound-building mouse density (individual item/hectare), c stands for the item number of the mouse / proportionate number of mounds (item/piece), l stands for the average number of mouse found on parcels (mounds/hectare), T stands for the area proportion of mound-building mouse parcels compared to the square (%).

In the evaluation we follow the prescriptions on national level mound-building mouse monitoring. When evaluation is being done it is advisable to consider the analysis of owl pellets and as such, the occurrence frequency data can be compared with small mammals' occurrence determined on the basis of owl pellets.

Bats

General description of the methodology applied

As on the area to be surveyed at Paks, no caves and other underground dwelling places can be found, the three sub-programmes of NBmR (hymen netting in case, survey of common bent wing bat and survey of bat stock wintering underground) is not possible only sub-point four of the NBmR protocol on bats, that is survey of bats dwelling in buildings can be carried out.

Survey of building dwelling bats needs to be supplemented with a method of detecting the orientation sound of bat (ultrasound). The advantage offered by bat detection surveys is that on a relatively large area large quantity of occurrence data can be produced, but its disadvantage is that not all sounds recorded can be determined on the level of species.

Sampling methods

As the buildings to be found on the area have an arrangement where bats may occur primarily in the facade gaps, the building dwelling survey is performed by the combined application of three methods. During the daytime, we tour the potential buildings to assess to survey bat excrement on the ground. In the late afternoon hours, we pay attention to social sounds bats issue primarily before flying off. On the basis of the excrement found, and location of the bats within the building as well as the colony sounds perceived, species can also be determined.

The bat detection surveys are performed by line-transect and point survey methods. Sounds heard during the survey are digitally recorded and the digital files are copied to the computer. Sequences recorded are analysed with the help of sound analysing software and parameters of the different impulses are measured as well as the time elapsing between impulses. When determining the sounds, we also consider the form and other features of the impulses. In the 3 km circus of the power plant the ultrasound of bats are collected by line-transect route touring and point sampling.

Sampling

The line-transect routes with detector application are the following:

Figure 18.5.6-14.: Line-transect route on the temporary construction area [18-168]

Figure 18.5.6-15.: Line-transect route on the Island [18-168]

Designation of the point sampling sites is done in a way enabling us to examine the two characteristic micro habitats of the area of the power plant (one natural and one artificial).

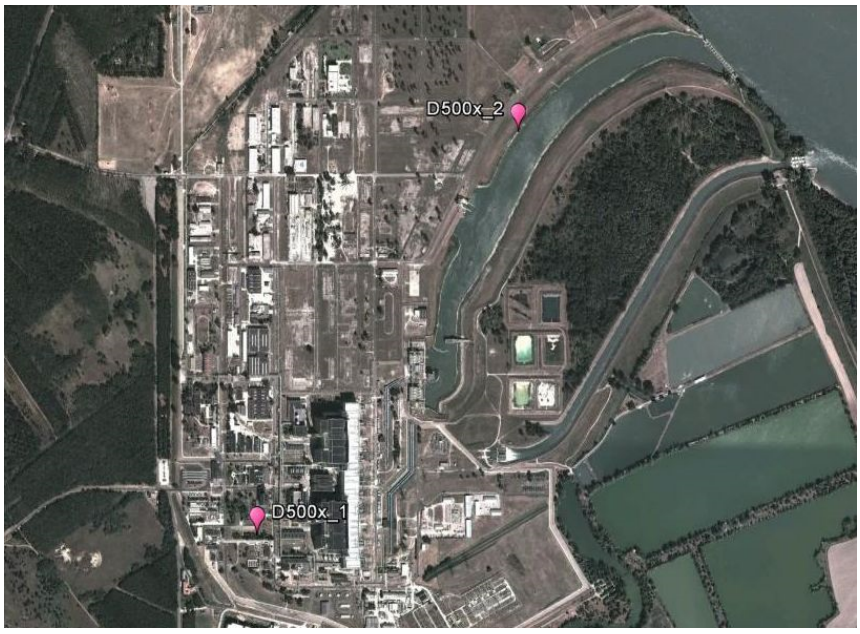


Figure 18.5.6-16.: Sampling sites of the detectors [18-168]

Sampling methods

When building dwelling bats are surveyed it is important to consider that the item number of colonies is changing during the year. From September to April, bats in the attics can only be found in rare cases. In May, the site of the colony becomes stable and remains unchanged until the end of June, middle of July - during the period of bringing up the young ones. According to NBmR monitoring protocol the building selected must be inspected once between 15 May and 30 June.

Analyses and assessments

When surveying building dwelling species, the coordinates of the buildings giving a home to explored colonies and the item number of the different bat species (adult and juvenile item numbers separately defined in certain cases) are the variables received.

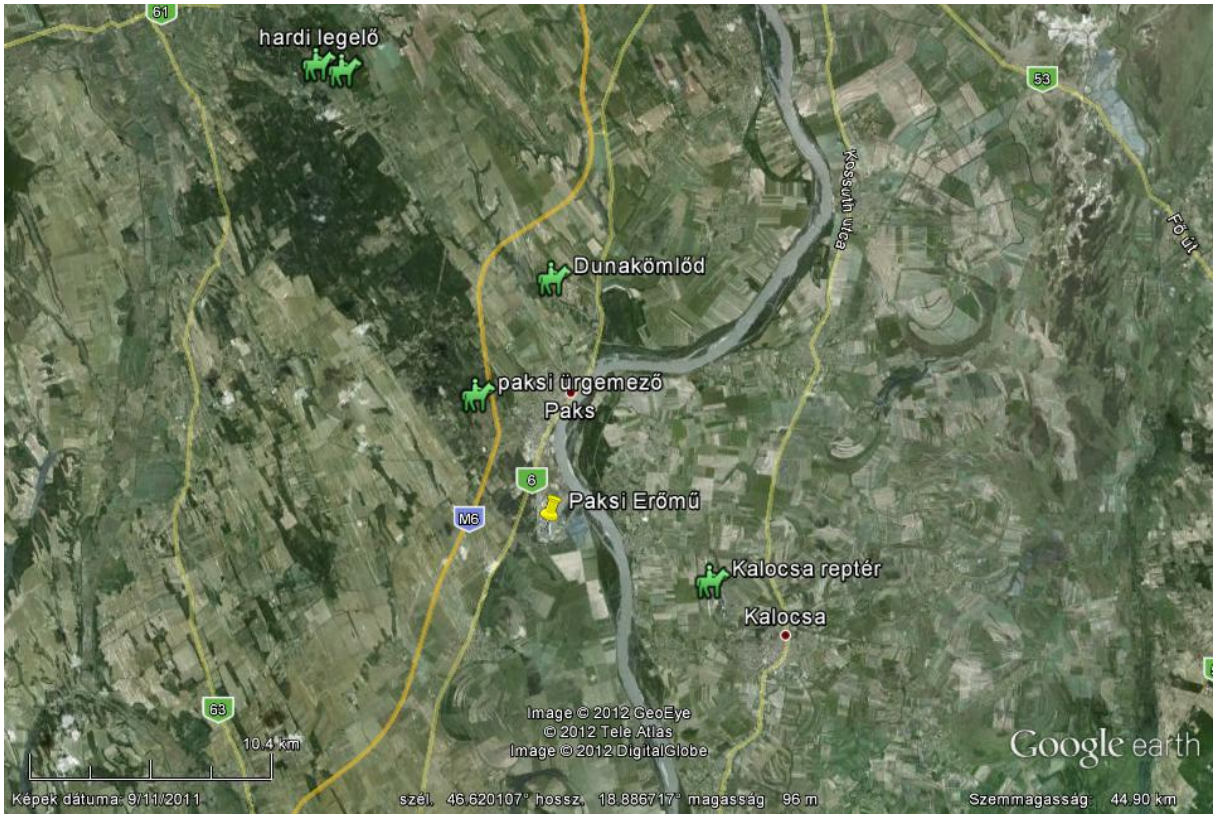
Ground squirrel

General description of the methodology applied

Although ground squirrel is a daytime animal, it is disturbed by observation and its surface activity strongly depends on the part of the day. In line with that, NBmR requires that in order to make an estimation of the number of the animals, not the ground squirrels but the ground squirrel holes should be counted. The ground squirrel hole has a diameter of 4 cm (of about two inches) is a hole vertically built into the ground, not branching off directly under the surface of the ground.

Sampling

Ground squirrels occur mainly on short grass steppes. When assessing the 3 km radius of the power plant, every steppe surface of at least 5 hectares is visited and inspected by transect tour to identify occurrence of ground squirrel holes.



Legend:
Paksi ürgemező - Ground-squirrels field at Paks
Paksi Erőmű - Paks Nuclear Power Plant
Kalocsa reptér - Airport of Kalocsa

Figure 18.5.6-17.: Known ground squirrel habitats in the vicinity of Paks [18-168]

If presence of the ground squirrel is detected, stock assessment is carried out based on the density of holes. To determine the density of the holes, strip estimation (census) is a suitable method, which can be repeated, the number of piles noticed does not depend from the observer, therefore, by this method reliable estimation can be given of the whole density of the area. Having information about the reproduction rhythm of the ground squirrel (one single litter a year), sampling frequency has been identified as one survey per year. According to NBmR, sampling is to be done on the Day of the Earth, that is, around 22 of April.

Sampling methods

Counting of the holes is done on a length of 5x200 m, of a total length of 1,000 m, on both sides of the route in a strip of 1-1 m. Following calibration (!), it is sufficient to measure the length of the route by counting the number of steps.

Counting is done along 5 200 m long parallel straight lines located around the central point of the area studied and being at a distance of 50 m from each other.

Strip estimate gives reliable data concerning the number of ground squirrel holes, but the application is made difficult by the fact that we do not know how many holes a ground squirrel has and on different types of soil the chance of maintenance of holes is different. Based on his investigation in Bugacpuszta, Katona [18-64] came to the conclusion that the number of ground squirrels is one-fifth of the number of holes. On compact soils, this proportion may change, on the airport at Szentkirályszabadja, there was one animal for 10 holes.

Analyses and assessments

The place and time of data collection (GPS coordinates) are recorded. The survey gives an estimate of the ground squirrel stock based on the density of ground squirrel holes. The data received are the number of ground squirrels / hectare and the size of the colony.

Small mammals based on owl pellet

General description of the methodology applied

An indirect method applied quite widespread in the ecological research of small mammals, based on the analysis of owl pellets. From nature conservation aspect, this methodology cannot be objected, as it is suitable for the fast collection of large quantity of occurrence data. Data obtained from the analysis of barn owl pellet gave a lot of information to enable mapping of the changes in the spread of mammals species in Hungary. In addition to rodent species, the Soriciade species under protection can also be detected from its pellets. As barn owl (*Tyto Alba*) has the broadest nutrition spectrum, the NBmR sub-programme uses the monitoring of the breeding site of this owl species and the collection of its pellets in the investigation of the presence of small mammals.

Sampling

Pellet collection is based on the survey of barn owls and it is performed on all the local sites of occurrence of the barn owl known from previous years. During the survey of the building dwelling on the area under study in the 3 km radius of the Paks Nuclear Power Plant, we made a tour of all the attics and towers of buildings suitable for the hatching of the barn owl. The new protocol of the NBmR sampling requires a minimum 250-500 pellet sample to be collected each year. It is recommended to take samples twice a year (in spring and in autumn) by collecting the minimum number of samples.

Sampling methods

The samples should contain 250-500 items each sampling time. The collected pellet should contain whole pellets, as certain indexes can only be calculated on the basis of whole pellets. Breaking of pellets can be prevented by collection several times, single pellets should be stored covered by foil until it is processed.

Identification can be performed on the basis of skull stamps and teeth. In accordance with the recommendation of NBmR, Neomys species like Neomys fodiens and Neomys anomalus Cabrera are identified by a number of guides by measuring the height of the lower jaw coronoid process 1907. But their definite separation is possible by the skull morphometric method. Therefore, in relation with sampling and determination, the, the protocol finds it necessary to distinguish Neomys and to transfer it to the MTTM Animal Archive to allow for further morphometric processing. The summary name of the species in the genus Apodemus is forest mice (*Apodemus spp*.).

Identification of two species of Mus genus in Hungary, the house mouse, *Mus musculus Linnaeus*, 1758 and the mound building mouse, *Mus spicilegus* separated from owl pellet by Petényi, 1882 is justified because of comparison with the sub-project on the assessment of the spread of mound building mouse. Morphometric identification can be carried out on the basis of the work of Demeter [18-29] and Demeter et al. [18-30]. Two species can be separated on the basis of the proportion of the upper and lower zygomatic curve, if it is not possible, then we only give the name of the genus (*Mus spp*.).

Analyses and assessments

Data of the pellet (GPS coordinates of the site, when it was found, settlement, farm, other geographical names, date of collection, name of person collecting it) are precisely recorded. As sampling points are available in accordance with the separate treatment of the pellet, based on the analysis of the owl pellets collected close to the priority habitats monitored in the project quality and quantity data of small mammals is investigated [18-57]. In addition, Soricidae / Rodentia proportion can also be determined in line with the habitats assemblages.

18.6 IMPACT OF THE ABANDONMENT OF PAKS II ON THE BIOSPHERE

With respect to the abandonment of Paks II expected to take place between 2085 and 2090, it is a fundamental fact that conditions to evolve after such a long time (up to 80 years) without anthropogenic impacts in complicated systems such as the ecosystems cannot be forecast in a responsible manner. The following, therefore, can only be considered very rough estimations. Information available on abandonment events are rather poor [18-12], and those primarily refer to the impacts of radiation, based on the otherwise disputable principle that its radiation is not detrimental to humans it is not detrimental to the biosphere either [18-53]. Currently 149 nuclear power stations are under decommissioning all over the world [18-59]. Experiences of decommissioning are continuously collected and by the time of the abandonment of Paks II, the information relevant for the commissioning may be available.

The abandonment of Paks II will presumably have a negative impact on the animals living there during the decommissioning works. The impact of the abandonment of Paks II will greatly depend on the abandonment technology. Largest impact will be exercised by the full demolition of the power plant and the related facilities (transmission lines, etc.). In that case, in terms of the magnitude and nature, specifically similar impacts will have to be taken into account like at the time of the construction of the power plant. The abandonment technology will presumably require a larger temporary construction area. As an impact of the demolition works, vegetation and habitats regenerated during the operation period will be affected. Following demolition, the original or similar status of habitats will be restored by rehabilitation. The rate of re-cultivation will determine to what extent biosphere can take possession of the area again. The site of the power plant, however, is quite small in total to cause a significant change in the environment by the abandonment.

In our opinion, maintaining the route of transmission lines is important also for nature conservation aspects. This area is strongly exposed to weeding and infiltration of invasive species, which are the largest danger for the native sand steppe habitats.

The impact area will less affect wet habitats. Following the abandonment of the power plant, the negative impact detailed above will come to an end, following the environmental changes, the fauna and the flora can populate the area become again suitable habitats for them (e.g., the dragon flies will populate the Danube section influenced by warm water until then).

18.7 NATURA 2000 IMPACT ASSESSMENT OF THE TOLNAI-DUNA AFFECTED (HUDD20023)

Rules applicable to Natura 2000 sites are contained in Government Decree No. 275/2004. (X.8.) on the nature conservation areas of European Community importance. The Decree regulates the designation and purpose of maintenance of Natura 2000 sites, determines the so-called priority species of community importance (Annexes 1, 2 and 3), the habitats type of community importance (Annex 4), enlists the special bird protection sites in Hungary (Annex 5), the areas designated for special nature conservation (Annex 6), the areas of priority importance, designated for nature conservation (Annex 7), the criteria applicable to the designation of special bird protection and special and priority importance nature conservation areas (Annex 9), as well as the approved special (Annex 11) and the approved priority (Annex 12) nature conservation areas.

Pursuant to Section 10 of the Government Decree, if the planned development, investment or any activity affect a Natura 2000 site, the impact expected to be exercised by the investment on the species and habitats of community importance and their nature conservation status being the basis of the designation of the area as Natura 2000 site must be examined with attention to the extension of the area affected by the investment the location of the area affected compared to the Natura 2000 site, and the data on the biosphere occurring on the Natura 2000 site.

If, according to the study, the planned activity may have a significant impact on the Natura 2000 area, the Natura 2000 impact assessment documentation must be prepared. The Government Decree prescribes its content related

requirements (Annex 14) and also determines the aspects of establishing the impacts affecting the Natura 2000 site (Annex 15).

Impact assessment is performed by the inspectorate on the basis of the Natura 2000 impact assessment documentation.

18.7.1 IDENTIFICATION DATA

18.7.1.1 Name, address, contact of the designer and the investor

18.7.1.1.1 Name, address, contact of the investor

Name of the Licence Requester: MVM Paks II. Atomerőmű Fejlesztő Zártkörűen Működő Részvénytársaság
Headquarters of the Licence Requester: H-7030 Paks, Gagarin u. 1-3. 302/B

18.7.1.1.2 Name, address, contact of the designer and the designer

Name of the designer: MVM ERBE ENERGETIKA Mérnökiroda Zártkörűen Működő Részvénytársaság
Headquarters of the designer: H-1117 Budapest Budafoki út 95.

Name of the designer: Tölgy Természetvédelmi Egyesület
Headquarters of the designer: H-2103 Gödöllő Páter Károly u. 1.

18.7.1.2 Experts involved in filling in the data sheet

Subject	Name		SzTV biosphere protection expert licence number issued by OKTVF
	dr. Gábor Bakonyi		Sz-018/2013
Zoology			
Aquatic macroscopic invertebrates	dr. Nándor Oertel		Sz-023/2013
Orthoptera	dr. Zsolt Gergely Szövényi		Sz-015/2013
Dragon flies	Tibor Kovács		Sz-014/2013
Butterflies	László Peregovits		Sz-024/2013
Soil surface arthropoda	dr. Erzsébet Hornung		Sz-011/2013
	Dávid Fülöp		Sz-068/2013
Fish	dr. Tibor Erős		Sz-022/2013
	Péter Sály		-
Amphibians, reptiles	Dr. István Kiss		Sz-006/2013
Birds	Norbert Mátrai		Sz-017/2013
Mammals	dr. Vilmos Altbäcker		
	dr. János Farkas		
	Tamás Cserkész		
	Tamás Görföl		
	Péter Szenczi		
	Olivér Váczi		
Botany			
	Balázs Pintér		Sz-020/2013
	Zoltán Barina		Sz-019/2013
	Zsófia Fehér		Sz-010/2010

Table 18.7.1-1.: Participating experts

18.7.1.3 Description of the technical references of the experts involved in filling in the data sheet

In the following, the list of reference works of experts performing impact assessment are described.

DR. GÁBOR BAKONYI

Somogyi Z, Kádár I, Kiss I, Juríková T, Szekeres L, Balla S, Nagy P, Bakonyi G Comparative toxicity of the selenate and selenite to the potworm Enchytraeus albidus (Annelida: Enchytraeidae) under laboratory conditions EUROPEAN JOURNAL OF SOIL BIOLOGY 50: pp. 159-164. (2012)

Mátrai N, Bakonyi G, Gyurácz J, Hoffmann Gy, Raijmakers K, Neto J M, Mátics R Do the European Great Reed Warblers (Acrocephalus arundinaceus) reach South Africa during wintering? JOURNAL OF ORNITHOLOGY 153:(2) pp. 579-583. (2012)

Bakonyi Gábor, Dolezsai Anna, Mátrai Norbert, Székács András Effects of Consumption of Bt-maize (MON 810) on the Collembolan Folsomia candida, Over Multiple Generations: A Laboratory Study INSECTS 2:(2) pp. 243-252. (2011)

Posta K, Bakonyi G Consideration of AMF-plant-collembola interactions in plant production In: Feldmann F, Kapulnik Y, Baar J (szerk.) Mycorrhiza Works Braunschweig: Deutsche Phytomedizinische Gesellschaft, 2008. pp. 344-352. (ISBN:978-3-941261-01-3)

Somogyi Z, Kiss I, Kádár I, Bakonyi G Toxicity of selenate and selenite to the potworm Enchytraeus albidus (Annelida: Enchytraeidae): a laboratory test ECOTOXICOLOGY 16: pp. 379-384. (2007)

Bakonyi G, Nagy P, Kovacs-Lang E, Kovacs E, Barabas S, Repasi V, Seres A Soil nematode community structure as affected by temperature and moisture in a temperate semiarid shrubland APPLIED SOIL ECOLOGY 37:(1-2) pp. 31-40. (2007)

Seres A, Bakonyi G, Posta K Zn uptake by maize under the influence of AM-fungi and Collembola Folsomia candida ECOLOGICAL RESEARCH 21:(5) pp. 692-697. (2006)

Kertesz V, Bakonyi G, Farkas B Water pollution by Cu and Pb can adversely affect mallard embryonic development ECOTOXICOLOGY AND ENVIRONMENTAL SAFETY 65:(1) pp. 67-73. (2006)

Bakonyi G Toxicitás talajlakó szervezeteken In: Darvas B, Székács A (szerk.) Mezőgazdasági ökotoxikológia Budapest: L'Harmattan Kiadó, 2006. pp. 135-139. (ISBN:963-7343-39-3)

Bakonyi G, Szira F, Kiss I, Villányi I, Seres A, Székács A Preference tests with collembolas on isogenic and Bt-maize. EUROPEAN JOURNAL OF SOIL BIOLOGY 42: pp. 132-135. (2006)

NÁNDOR OERTEL

Hufnagel Levente, Gimesi László, Dede Lilla, Sipkay Csaba, Vadadi-Fülöp Csaba, Verasztó Csaba, Gergócs Veronika, Kiss Keve Tihamér, Oertel Nándor, Nosek János Megfigyelt cönológiai mintázatok monitoring és térbeli adatbázisok alapján In: Hufnagel L, Sipkay Cs (szerk.) A klímaváltozás hatása ökológiai folyamatokra és közösségekre Budapest: Budapesti Corvinus Egyetem, 2012. pp. 334-447. (ISBN:978-963-503-511-3)

Bódis E, Nosek J, Oertel N, Tóth B, Hornung E, Sousa R Spatial distribution of bivalves in relation to environmental conditions (Middle Danube catchment, Hungary) COMMUNITY ECOLOGY 12:(2) pp. 210-219. (2011)

Bódis E, Nosek J, Oertel N, Tóth B, Fehér Z A Comparative Study of Two Corbicula Morphs (Bivalvia, Corbiculidae) Inhabiting River Danube INTERNATIONAL REVIEW OF HYDROBIOLOGY 96:(3) pp. 257-273. (2011)

Tóth B, Nosek J, Oertel N Composition and dynamics of benthic organic matter in the middle Danube Section. ARCHIV FÜR HYDROBIOLOGIE SUPPLEMENTBAND LARGE RIVERS 18/1-2:(Arch.H.Suppl.166) pp. 257-270. (2008)

Sipkay Cs, Horváth L, Nosek J, Oertel N, Vadadi-Fülöp Cs, Farkas E, Drégelyi-Kiss Á, Hufnagel L Analysis of climate change scenarios based on modelling of the seasonal dynamics of a Danubi an copepod species APPLIED ECOLOGY AND ENVIRONMENTAL RESEARCH 6:(4) pp. 101-108. (2008)

Nosek J, Oertel N Similarity patterns of macroinvertebrate communities in the Hungarian Danube and adjecent wetlands (Szigetköz and Gemenc). ARCHIV FÜR HYDROBIOLOGIE SUPPLEMENTBAND LARGE RIVERS 18/1-2:(Arch.H.Suppl.166) pp. 243-256. (2008)

Bódis E, Nosek J, Oertel N Spatio-temporal pattern of mussels (Corbiculidae, Dreissenidae, Sphaeriidae) in the waters of the Hungarian Danube. ARCHIV FÜR HYDROBIOLOGIE SUPPLEMENTBAND LARGE RIVERS 18/1-2:(Arch.H.Suppl.166.) pp. 293-308. (2008)

Sipkay CS, Nosek J, Oertel N, Vadadi-Fülöp CS, Hufnagel L Klímaváltozási szcenáriók elemzése egy dunai Copepoda faj szezonális dinamikájának modellezése alapján KLÍMA 21 FÜZETEK 49: pp. 80-90. (2007)

Oertel N, Nosek JN Sampling of macroinvertebrates by artificial substrates in the River Danube (Hungary) VERHANDLUNGEN DER INTERNATIONALE VEREINIGUNG FÜR THEORETISCHE UND ANGEWANDTE LIMNOLOGIE 29:(4) pp. 1762-1766. (2006)

Oertel N, Nosek J Makroszkopikus vízi gerinctelen állatok vizsgálata a Dunában In: Török Katalin, Kovácsné Láng Edit (szerk.) Válogatás az MTA Ökológiai és Botanikai Kutatóintézete kutatási eredményeiből, 2005 Vácrátót: MTA Ökológiai és Botanikai Kutatóintézet, 2005. pp. 23-26. (ISBN:963-8391-31-6)

Oertel N, Nosek J, Andrikovics S A magyar Duna-szakasz litorális zónájának makroszkopikus gerinctelen faunája (1998-2000) ACTA BIOLOGICA DEBRECINA-SUPPLEMENTUM OECOLOGICA HUNGARICA 13: pp. 159-185. (2005)

Oertel N Nehézfémek biomonitorozása a Szigetközben 1987-1996 között. In: Láng I, Banczerowski Jné, Berczik Á (szerk.) A Szigetköz környezeti állapotáról Budapest: MTA Szigetközi Munkacsoport, 1999. pp. 55-65. (ISBN:963-03-9932-6)

GERGELY SZÖVÉNYI

2006: „A tervezett M8 autópálya Dunavecse és Lajosmizse közötti szakaszának botanikai és zoológiai felmérése, természetvédelmi szempontú értékelése" (Ambrus A., Csorba G., Halpern B., Lóránt M., Merkl O., Németh Á., Németh A., Puskás G., Sárospataki M., Szövényi G., V., Zsebők S.)

2010: Az M8-as gyorsforgalmi út Kecskemét (M5)-Szolnok közötti szakasz A nyomvonalú változatának kritikus részei a kétéltűek és a hüllők szempontjából (Szövényi G.)

TIBOR KOVÁCS

Subject: Editing of the journal Folia Historico-naturalia Musei Matraensis. Function: expert. Period: 2009 – until now

Subject: Management of the master data bank of the Nature Protection Information System – Ephemeroptera, Plecoptera, Cerambycidae. Function: expert. Period: 2004 - until now.

Subject: Participation in determining the material of the "Ecological Survey of Surface Waters of Hungary" – Ephemeroptera, Plecoptera, Megaloptera. Function: expert, definition of the material collected. Period: 2005.

Subject: Expert activity in the elaboration of the Water Framework Directive in Hungary. Function: expert. Period: 2004.

Subject: Participation in the research work of the National Biodiversity Monitoring System – Ephemeroptera, Odonata, Plecoptera, Coleoptera. Function: expert, collection, processing, evaluation. Period: 2002 – until now.

Subject: Participation as expert in the programme of extending the Habitat Regulation and Natura 2000 lists with Hungarian species and areas – Ephemeroptera, Odonata, Cerambycidae. Function: expert. Period: 2000-2008.

Subject: Editing of the journal Odonata - stadium larvale. Function: editor. Period: 1997 – until now.

Subject: Participation in the development of the Hungarian of the National Biodiversity Monitoring System – V. Crebs, dragonflies, orthoptera; VI. Beetles. Function: expert. Period: 1997.

Subject: Kis-Balaton – Odonata, Ephemeroptera – bio-monitoring. Function: expert, gyűjtés, feldolgozás, értékelés. Period: 1993-2005.

Subject: Szigetköz – Odonata – bio-monitoring. Function: expert, collection, processing, evaluation. Period: 1992-2011.

Subject-Function: Writing the script for the standing exhibition of Mátra Museum, organisation of the insect material of the exhibition, "Natura 2000 sarok" idea and its implementation (presentation of all invertebrate Natura 2000 speicies). Period: 2011.

LÁSZLÓ PEREGOVITS

Book, book chapter, part of the book

Demeter, A., Vámosi, J., Peregovits, L. and Topál, Gy. (1994): An image-capture and data-collection system for morphometric analysis. In: Marcus, L. F., Corti, M., Loy, A. Naylor, G. J. P. & Slice, D. E. (eds) Advances in Morphometrics. NATO ASI Series A: Life Sciences Vol. 284. – Plenum Press, New York–London, pp. 359–369.

Horváth F., Rapcsák T., Fölsz, F. Hoffer, J., Lőkös, L., Peregovits, L., Rajczy, M., Samu, F., Szép, T. és Szilágyi G. (1997): Biodiverzitás-monitorozó Program metaadatbázisának terve (TERMET). [Metadatabase for the National Biodiversity Monitoring Program.] Pp. 88–95. In: Horváth F., Rapcsák T. és Szilágyi G. (szerk.): Nemzeti Biodiverzitás-monitorozó Rendszer I. Informatikai alapozás. [National Biodiversity Monitoring Program I. Informatics] – Magyar Természettudományi Múzeum, Budapest. [in Hungarian]

VARGA, Z., RONKAY, L., BÁLINT, ZS., LÁSZLÓ, GY. M. & PEREGOVITS, L. (2004): *A magyar állatvilág fajjegyzéke. 3. kötet. Nagylepkék*. [*Checklist of the Fauna of Hungary. Volume 3. Macrolepidoptera*.] – Magyar Természettudományi Múzeum, Budapest, 111 pp.

VARGA, Z., RONKAY, L., BÁLINT, ZS., LÁSZLÓ, GY. M. & PEREGOVITS, L. (2005): *Checklist of the Fauna of Hungary. Volume 3. Macrolepidoptera*. – Hungarian Natural History Museum, Budapest, 114 pp.

BERECZKI, J., PECSENYE, K., PEREGOVITS, L. & VARGA, Z. (2005): Pattern of genetic differentiation in the Maculinea alcon species group (Lepidoptera, Lycaenidae) in Central Europe. – In: SETTELE, J., KÜHN, E. & THOMAS, J. A. (eds): *Studies on the ecology and conservation of butterflies in Europe. Vol. 2. Species ecology along a European gradient: Maculinea butterflies as a model.* Pensoft, Sofia–Moscow, pp. 167–170.

EVERETT, S., WORGAN, A. D. P., SIELEZNIEW, M., STANKIEWICZ, A., NASH, D. N., WYNNE, I., NOWICKI, P., TARTALLY, A., PEREGOVITS, L., TESAR, D., MAES, D., WYNHOF, I., ANTON, C., MUSCHE, M., BONELLI, S., WARDLAW, J. C., CSŐSZ, S., SIMCOX, D. J., ELMES, G. W., WOYCIECHOWSKI, M., VARGA, Z., SETTELE, J., THOMAS, J. A. & SCHÖNROGGE, K. (2005): Variation in chemical profiles of Maculinea and their Myrmica hosts across Europe. – In: SETTELE, J., KÜHN, E. & THOMAS, J. A. (eds): *Studies on the ecology and conservation of butterflies in Europe. Vol. 2. Species ecology along a European gradient: Maculinea butterflies as a model.* Pensoft, Sofia–Moscow, pp. 174–177.

E. & THOMAS, J. A. (eds): *Studies on the ecology and conservation of butterflies in Europe. Vol. 2. Species ecology along a European gradient: Maculinea butterflies as a model.* Pensoft, Sofia–Moscow, p. 130.

BÉRCES, S., SZÉL, GY., KÖDÖBÖCZ, V., KUTASI, CS., SZABÓ, K., FÜLÖP, D., PÉNZES, ZS. & PEREGOVITS, L. (2007): A magyar futrinka. – In: FORRÓ, L. (szerk.): A Kárpát-medence állatvilágának kialakulása. Magyar Természettudományi Múzeum, Budapest.

KŐRÖSI, Á., PEREGOVITS, L., KIS, J., SZABÓ, A., ÖRVÖSSY, N. & BATÁRY, P. (2007): Viselkedésökológiai vizsgálatok nappali lepke fajokon a természetvédelem tükrében. – In: FORRÓ, L. (szerk.): A Kárpát-medence állatvilágának kialakulása. Magyar Természettudományi Múzeum, Budapest.

MERKL, O., SZABÓ, K., FÜLÖP, D., BOZSÓ M., MÁTÉ A., PEREGOVITS, L., SOLTÉSZ, Z., SOMOGYI K. & PÉNZES, ZS. (2007): A pusztai gyalogcincér. – In: FORRÓ, L. (szerk.): A Kárpát-medence állatvilágának kialakulása. Magyar Természettudományi Múzeum, Budapest.

ÖRVÖSSY, N., KŐRÖSI, Á., BATÁRY, P., VOZÁR, Á., KÖVÉR, S., & PEREGOVITS, L. (2007): Védett lepkefajok élőhelyhasználata. – In: FORRÓ, L. (szerk.): A Kárpát-medence állatvilágának kialakulása. Magyar Természettudományi Múzeum, Budapest.

PECSENYE, K., BERECZKI, J., TÓTH, A., MEGLÉCZ, E., PEREGOVITS, L., JUHÁSZ, E. & VARGA, Z.: A populációstruktúra és a genetikai variabilitás kapcsolatavédett nappalilepke-fajainknál. – In: FORRÓ, L. (szerk.): A Kárpát-medence állatvilágának kialakulása. Magyar Természettudományi Múzeum, Budapest.

PEREGOVITS, L., KÖVÉR, SZ. & SOLTÉSZ, Z. (2007): A kiskunsági szikes puszták gyalogcincér-együttesei. – In: FORRÓ, L. (szerk.): A Kárpát-medence állatvilágának kialakulása. Magyar Természettudományi Múzeum, Budapest.

Scientific article

Hreblay, M., Peregovits, L. and Ronkay, L. (1999): New genera and species of Noctuidae from Vietnam, Thailand and Nepal (Lepidoptera). – Acta zool. hung. 45(1): 1–96.

Peregovits, L., Dobos, Zs., Kun, A. (2001): A Maculinea alcon xerophila populációökológiája és természetvédelme. In: Ökológia az ezredfordulón II. Esettanulmányok. Stratégiai kutatások a Magyar Tudományos Akadémián. Műhelytanulmányok. [Population ecology and nature conservation of the Maculinea alcon xerophila.] Hungarian Academy of Sciences. Pp. 27–56.

BERECZKI, J., PECSENYE, K., PEREGOVITS, L. & VARGA, Z. (2005): Pattern of genetic differentiation in the Maculinea alcon species group (Lepidoptera, Lycaenidae) in Central Europe. – *Journal of Zoological Systematics and Evolutionary Research* 43(2): 157–165.

Pecsenye, K., Bereczki, J., Tihanyi, B., Tóth, A., Peregovits, L. & Varga, Z. (2007): Genetic differentiation among the Maculinea species (Lepidoptera: Lycaenidae) in eastern Central Europe. – *Biological Journal of the Linnean Society* 91(1): pp11–21.

ÖRVÖSSY N, KŐRÖSI Á, BATÁRY P, VOZÁR Á, KÖVÉR SZ, PEREGOVITS L (2007) *Védett lepkefajok élőhelyhasználata*. In: A Kárpát-medence állatvilágának kialakulása. (szerk. FORRÓ L.) Magyar Természettudományi Múzeum, Budapest

BATÁRY P[1], ÖRVÖSSY N [1], KŐRÖSI Á, VÁLYI-NAGY M, PEREGOVITS L (2007) *Microhabitat preferences of Maculinea teleius (Lepidoptera: Lycaenidae) in a mosaic landscape.* European Journal of Entomology, 104. 731-736. ([1]Mindkét szerző azonos mértékben járult hozzá a publikációhoz) IF: 1.061

KŐRÖSI Á, ÖRVÖSSY N, BATÁRY P, KÖVÉR SZ, PEREGOVITS L (2007) *Restricted within-habitat movement and time-constrained egg-laying of female Maculinea rebeli butterflies.* Oecologica 156 (2): 455–464.IF: 3.412

BATÁRY P, KŐRÖSI Á, ÖRVÖSSY N, KÖVÉR SZ, PEREGOVITS L (2008) *Species-specific distribution of two sympatric Maculinea species across different meadow edges.* Journal of Insect Conservation 13, pp. 223–230.IF: 1.688

KŐRÖSI Á, ÖRVÖSSY N, BATÁRY P, HARNOS A, PEREGOVITS L (2011) *Different habitat selection by two sympatric Maculinea butterflies at small spatial scale.* Insect Conservation and Diversity 5:118–126. IF: 1.705

ÖRVÖSSY N, KŐRÖSI Á, BATÁRY P, VOZÁR Á, PEREGOVITS L(2012) Potential metapopulation structure and the effects of habitat quality on population size of the endangered False Ringlet butterfly. Journal of Insect Conservation DOI: 10.1007/s10841-012-9538-4 (IF: 1.688)

Other technical publication

Peregovits, L. (1988): Entomological Report. In: The SAREC supported Integrated Usambara Rain Forest Project, Tanzania. Report for the period 1983–1987. Uppsala, Sweden, pp. 31–33.

Edited books

Zombori, L. and L. Peregovits (eds) (1992): Proceedings of the Fourth European Congress of Entomology and the XIII. Internationale Symposium für die Entomofaunistik Mitteleuropas, (1991, Gödöllő. Vols 1–2, Hungarian Natural History Museum, Budapest.

Demeter, A., Kovács-Láng, E., Peregovits, L. and Szentesi, Á. (1995): Ecology in Hungary. A directory of organizations and personnel in ecological research and education. Hungarian Natural History Museum. 83 pp.

ERZSÉBET HORNUNG

Csonka D, Halasy K, Szabó P, Mrak P, Štrus J, Hornung E Eco-morphological studies on pleopodal lungs and cuticle in Armadillidium species (Crustacea, Isopoda, Oniscidea) ARTHROPOD STRUCTURE & DEVELOPMENT 42:(3) pp. 229-235. (2013)

Vilisics Ferenc, Szekeres Sándor, Hornung Erzsébet Size dependent differences in litter consumption of isopods: preliminary results ZOOKEYS 176: pp. 247-259. (2012)

Hornung E Evolutionary adaptation of oniscidean isopods to terrestrial life: Structural – physiological – behavioural aspects TERRESTRIAL ARTHROPOD REVIEWS 4:(2) pp. 95-130. (2011)

Bódis E, Nosek J, Oertel N, Tóth B, Hornung E, Sousa R Spatial distribution of bivalves in relation to environmental conditions (Middle Danube catchment, Hungary) COMMUNITY ECOLOGY 12:(2) pp. 210-219. (2011)

Vilisics F, Hornung E Urban areas as hot-spots for introduced and shelters for native isopod species URBAN ECOSYSTEMS 12: pp. 333-345. (2009)

Vilisics F, Hornung E City matrix as hot spot for introduction and shelter for native fauna elements: examples on Isopods (Crustacea, Oniscidea) from Hungary Urban Biodiversity & Design- Implementing the Convention on Biological Diversity in towns and cities, International Conference Erfurt, Germany, 21. – 24. May, 2008. (oral presentation) (2008)

Végh A, Berg M, Mariën J, Kreeftenberg W, Hornung E Testvér fajok (Trichoniscus provisorius és T. pusillus, Isopoda: Oniscidea) geográfiai elterjedése Hollandiában és annak ökológiai háttere In: Lengyel S; Mihók B; Lendvai Á Z; Sólymos PV (ed.): Magyar Természetvédelmi Biológiai Konferencia, Program és absztrakt-kötet, p.67 (2008)

Pouyat RV, Yesilonis ID, Szlávecz K, Csuzdi Cs, Hornung E, Korsós Z, Russell-Anelli J, Giorgio V Response of forest soil properties to urbanization gradients in three metropolitan areas LANDSCAPE ECOLOGY 23:(10) pp. 1187-1203. (2008)

Magura T, Hornung E, Tóthmérész B Abundance patterns of terrestrial isopods along an urbanization gradient COMMUNITY ECOLOGY 9:(1) pp. 115-120. (2008)

DÁVID FÜLÖP

Fülöp D., Mikó I., Seltmann K., Melika G., Pénzes Zs The description of Alloxysta chinensis, a new Charipinae species from China (Hymenoptera, Figitidae) ZOOTAXA 3637:(3) pp. 394-400. (2013

Pujade-Villar J, Fülöp D, Paretas-Martínez J, Melika G First record of Phaenoglyphis villosa (Hartig, 1841) from Korea (Hymenoptera: Cynipoidea: Figitidae: Charipinae) ORSIS 25: pp. 141-146. (2011)

Pénzes Zs., Melika G., Bozsóki Z., Bihari P., Mikó I., Tavakoli M., Pujade-Villar J., Fehér B., Fülöp D., Szabó D., Bozsó M., Sipos B., Somogyi K., Stone GN Systematic re-appraisal of the gall-usurping wasp genus Synophrus Hartig, 1843 (Hymenoptera: Cynipidae: Synergini) SYSTEMATIC ENTOMOLOGY 34:(4) pp. 688-711. (2009)

Tavakoli M, Melika G, Sadeghi SE, Penzes Z, Assareh MA, Atkinson R, Bechtold M, Miko I, Zargaran MR, Aligolizade D, Barimani H, Bihari P, Pirozi F, Fuloep D, Somogyi K, Challis R, Preuss S, Nicholls J, Stone GN New species of oak gallwaps from Iran (Hymenoptera : Cynipidae : Cynipini) ZOOTAXA 2008:(1699) pp. 1-64. (2008)

Melika G, Pénzes Zs, Mikó I, Bihari P, Ács Z, Somogyi K, Bozsóki Z, Szabó K, Bechtold M, Fári K, Fehér B, Fülöp D, Csóka Gy, Stone G N A Kárpát-medence tölgyön élő gubacsdarazsai In: Forró L (szerk.) A Kárpát-medence állatvilágának kialakulása: A Kárpát-medence állattani értékei és faunájának kialakulása Budapest: Magyar Természettudományi Múzeum, 2007. pp. 165-174. (ISBN:978-963-7093-99-9)

TIBOR ERŐS

Specziár András, György Ágnes Irma, Erős Tibor Within-lake distribution patterns of fish assemblages: the relative roles of spatial, temporal and random environmental factors in assessing fish assemblages using gillnets in a large and shallow temperate lake JOURNAL OF FISH BIOLOGY 82:(3) pp. 840-855. (2013)

Heino J, Schmera D, Erős T A macroecological perspective of trait patterns in stream communities FRESHWATER BIOLOGY 58:(8) pp. 1539-1555. (2013)

Erős T, Sály P, Takács P, Higgins CL, Bíró P, Schmera D Quantifying temporal variability in the metacommunity structure of stream fishes: the influence of non-native species and environmental drivers HYDROBIOLOGIA Online first: pp. 1-13. (2013)

Schmera D, Erős T Sample size influences the variation of invertebrate diversity among different levels of a stream habitat hierarchy INTERNATIONAL REVIEW OF HYDROBIOLOGY 97:(2) pp. 74-82. (2012)

Schmera D, Baur B, Erős T Does functional redundancy of communities provide insurance against human disturbances? An analysis using regional-scale stream invertebrate data HYDROBIOLOGIA 693: pp. 183-194. (2012)

Erős Tibor, Olden Julian, Schick Robert, Schmera Dénes, Fortin Marie-Josée Characterizing connectivity relationships in freshwaters using patch-based graphs LANDSCAPE ECOLOGY 27:(2) pp. 303-317. (2012)

ERŐS T, SÁLY P, TAKÁCS P, SPECZIÁR A, BÍRÓ P Temporal variability in the spatial and environmental determinants of functional metacommunity organization – stream fish in a human-modified landscape FRESHWATER BIOLOGY 57:(9) pp. 1914-1928. (2012)

Sály P, Takács P, Kiss I, Bíró P, Erős T The relative influence of spatial context and catchment- and site-scale environmental factors on stream fish assemblages in a human-modified landscape ECOLOGY OF FRESHWATER FISH 20:(2) pp. 251-262. (2011)

Erős T, Schmera D, Schick RS Network thinking in riverscape conservation - A graph-based approach BIOLOGICAL CONSERVATION 144:(1) pp. 184-192. (2011)

ISTVÁN KISS

SÁLY PÉTER, TAKÁCS PÉTER, KISS ISTVÁN, BÍRÓ PÉTER, ERŐS TIBOR Lokális és tájléptékű tényezők hatása a jövevény halfajok elterjedésére a Balaton vízgyűjtőjének kisvízfolyásaiban ÁLLATTANI KÖZLEMÉNYEK 97:(2) pp. 197-216. (2012)

Lovász Zsófia, Kovács Tibor, Sály Péter, Kiss István A mocsári teknős (Emys orbicularis) térbeli és időbeli aktivitásmintázata a Naplás-tavon ÁLLATTANI KÖZLEMÉNYEK 97:(2) pp. 217-228. (2012)

Deák Gábor, Sály Péter, Kiss István A Triturus dobrogicus és Lissotriton vulgaris gőtefajok állománydinamikája és élőhelyhasználata a szaporodóhelyen ÁLLATTANI KÖZLEMÉNYEK 97:(1) pp. 61-76. (2012)

Sály P, Takács P, Kiss I, Bíró P, Erős T The relative influence of spatial context and catchment- and site-scale environmental factors on stream fish assemblages in a human-modified landscape ECOLOGY OF FRESHWATER FISH 20:(2) pp. 251-262. (2011)

Sály P, Erős T, Takács P, Kiss I, Bíró P Tájléptékű, lokális és térbeli tényezők relatív jelentősége kisvízfolyások halegyütteseinek szerveződésében a Balaton vízgyűjtőjén HIDROLÓGIAI KÖZLÖNY 90:(6) pp. 123-124. (2010)

Kiss I, Babocsay G, Dankovics R, Gubányi A, Kovács T, Molnár P, Somlai T, Vörös J Kiválasztott Natura 2000 fajok (Triturus carnifex, T. dobrogicus és Bombina bombina) monitorozását előkészítő felmérések ÁLLATTANI KÖZLEMÉNYEK 95:(2) pp. 281-304.

Gubányi A, Vörös J, Kiss I, Dankovics R, Babocsay G, Kovács T, Molnár P, Somlai T Az alpesi tarajosgőte (Triturus carnifex), a dunai tarajosgőte (T. dobrogicus) és a vöröshasú unka (Bombina bombina) magyarországi elterjedésének elemzése ÁLLATTANI KÖZLEMÉNYEK 95:(2) pp. 253-279. (2010)

Sály P, Erős T, Takács P, Specziár A, Kiss I, Bíró P Assemblage level monitoring of stream fishes: The relative efficiency of single-pass vs. double-pass electrofishing FISHERIES RESEARCH 99:(3) pp. 226-233. (2009)

NORBERT MÁTRAI

Mátrai N, Gyurácz J, Lenczl M, Hoffmann Gy, Bakonyi G, Mátics R Philopatry analysis of the great reed warbler (Acrocephalus arundinaceus) based on ringing data in Europe BIOLOGIA-BRATISLAVA 67:(3) pp. 596-601. (2012)

Mátrai N, Bakonyi G, Gyurácz J, Hoffmann Gy, Raijmakers K, Neto J M, Mátics R Do the European Great Reed Warblers (Acrocephalus arundinaceus) reach South Africa during wintering? JOURNAL OF ORNITHOLOGY 153:(2) pp. 579-583. (2012)

Júlio M Neto, José L. Arroyo, Bruno Bargain, Juan S. Monrós, Norbert Mátrai, Petr Procházka, Pavel Zehtindjiev Phylogeography of a Habitat Specialist with High Dispersal Capability: The Savi's Warbler Locustella luscinioides PLOS ONE 7:(6) Paper e38497. 14 p. (2012)

Mátrai Norbert, Bakonyi Gábor, Gyurácz József, Lenczl Mihály, Hoffmann Gyula, Mátics Róbert A nádirigó (Acrocephalus arundinaceus) költő- és születési területhez való hűsége: gyűrűzési adatbázisok problémái, megoldási javaslatok ORNIS HUNGARICA 19:(1-2) pp. 109-117. (2011)

Bakonyi Gábor, Dolezsai Anna, Mátrai Norbert, Székács András Effects of Consumption of Bt-maize (MON 810) on the Collembolan Folsomia candida, Over Multiple Generations: A Laboratory Study INSECTS 2:(2) pp. 243-252. (2011)

Mátrai Norbert, Gyurácz József, Bank László A nádi tücsökmadár (Locustella luscinioides) vonulásának dinamikája, zsírraktározása és szárnymorfológiai jellemzői az őszi vonulási időszakban ORNIS HUNGARICA 15-16:(1) p. 109. (2008)

Mátrai Norbert, Gyurácz József, Mátics Róbert, Bakonyi Gábor A nádirigó (Acrocephalus arundinaceus) lehetséges telelőterületei az EURING adatbázisának megkerülési adatai alapján. ÁLLATTANI KÖZLEMÉNYEK 92: pp. 37-44. (2007)

BALÁZS PINTÉR

Base line study for the nature conservation management plan of West Cserhát - preparation of the part on botany (2003).

Participation in the preparation of the CD-Rom titled 'natural assets of the West Cserhát' for education, awareness raising and dissemination of knowledge purposes (preparation of the part on botany and characterisation of areas) (2004).

Impact of DDC Kft's mines in Naszály on Natura 2000 sites (Comment on habitats, plant and animal species of community importance occurring at Naszály) – editing, preparation of the part on botany (2005).

Preparation of the environmental protection programme for settlements called Borsodgeszt, Csobád, Dubicsány, Farkaslyuk, Györgytarló, Igrici, Nyomár and Vatta (2005).

Botanic assessment of 19 natural assets (nature conservation areas) of local importance of Budapest and two 'ex lege' protected areas to be found within the public administration border of Budapest (2006).

Assessment of *Crambe tataria* in the vicinity of localities called Rád and Vácduka (2006).

Preparation of nature conservation management plans for 22 natural assets of local importance of Budapest (2007).

Sites of Budapest proposed for protection – Proposal for further sites to be brought under protection in Budapest (2008).

Mapping the habitats of the HUBN20062 (Középső Ipoly-völgy) Natura 2000 site (2008).

Three seasons botanic and ornithology assessment as part of the environmental impact study prepared for the highway to avoid the city of Győr (2012).

ZOLTÁN BARINA

Monitoring studies

Monitoring *Chrysopogono–Caricetum humilis* associations in South Gerecse, National Biodiversity Monitoring System (DINP, 2004)

Csákvár (O5×5_010) quadrat habitats mapping, National Biodiversity Monitoring System (DINP, 2005)

Assessment of *Echium russicum* on a number of Natura 2000 sites of the Duna-Ipoly National Park Directorate (DINP, 2005)

Assessment of *Himantoglossum caprinum* assemblages on the DINP area (DINP, 2006, 2010)

Quadrat habitats mapping of Pisznice (O5x5_39), National Biodiversity Monitoring System (DINP, 2007)

Assessment of *Serratula lycopifolia* on the area of the Duna-Ipoly National Park Directorate (DINP, 2007)

Quadrat habitats mapping of Zsámbék (O5×5_49), National Biodiversity Monitoring System (DINP, 2007)

Quadrat habitats mapping of Csóványos (O5×5_50), National Biodiversity Monitoring System (DINP, 2010)

Monitoring the *Querco-Carpinetum* on the area of the Börzsöny Mountains (DINP, 2010)

Mapping

Habitats mapping of the Vértes Mountain (DINP, 2005, 2007, 2008, 2011)

'Description of the wet habitats of the Ipoly and the Danube, establishing the transboundary Natura 2000 monitoring system in relation with an application, the habitats mapping of Komárom County' (DINP, 2006–2008)

Preparation of habitats maps on 4295+1398 hectares area of Pilis (Danube-Ipoly National Park Directorate, 2007)

Impact assessment

Botanic expert opinion on the impact of the planned mine extension on the area with topographical lot number Oroszlány 0187/4 (2005, 2006)

Impact on the planned extension of the 'Bajna III. (Borostyánkő) lime mine' on vegetation (2006)

Analysis of the proposed route of the bicycle road to be implemented between Esztergom and Dömös from the aspect of plant species and plant types affected (2008)

Impacts of the implementation of the planned production site on the Natura 2000 priority plant species and habitats of the Csolnok area topographical lot number 061/2, 3, 4, 5, 6 (2009)

Impacts of the waste water collection system and the biological waste water treatment plant of Pilisszántó on the Natura 2000 site code HUDI20039 (Municipality of Pilisszántó, 2009).

Expected impacts of the extension of the gravel mine XVIII at Délegyháza on the flora of the area (2010)

Nature conservation impact study of the extension of the dolomite mine in the external areas of Hajmáskér (2010)

Introduction of the collected waste waters from Pilisszentkereszt into the Szentendre system, Natura 2000 impact assessment (Mécsvirág kft., 2011)

Natura 2000 impact assessment of the extension of the rubble mine registered under name Telki-I. (Páty) (Mécsvirág kft., 2011)

Nature conservation description of the area of topographical lot number Győr 5387/112 of the Nemak kft. (2011)

Sopron: Assessment of the Bécsi-domb protected area and related parts (2011)

Nature conservation appraisal of the proposed exchange of areas affecting the Bécsi-domb protected area in Sopron (2011)

Pápa: vegetation along the Tapolca Brook of former times (2012)

Surveys

Research report on the botanic assessment of the Natura 2000 site including the Búzás Mountain next to Nyergesújfalu and the Szarkás Mountain (Holcim Hungária Zrt., 2006)

Description of the vegetation of the area along the Danube banks situated between the north-east corner of the Nyáros Island (Esztergom) and the south-west corner of the Prímás Island (Esztergom) (2008)

Assessment of the vegetation of the impact area of the conveyor belt planned to be implemented between the Kecske-kő stone mine and Nyergesújfalu (Holcim Hungaria Zrt., 2008)

Report on the botanic assessment conducted on the site of the Peat Ponds at Dunakeszi (Öko-Design Nature Conservation Development and Consultancy Kft., 2010)

Expert opinion

Expert opinion prepared for the Budapest district VIII Police Station in relation with case, temporary case number 01080~2177/2007 (2007)

Expert opinion prepared for the Kiskőrös Police Station in relation with criminal case number 1092/2008 (2008)

Expert opinion prepared for the Kiskőrös Police Station in relation with criminal case number 612/2009 (2009)

Expert opinion for the Budapest district IV Police Station in relation with the criminal case number 144-318/2009 titled 'Buck thorne cut off at Újpest' (2010)

Other

Areas of Nagysáp of outstanding nature conservation importance and protected plant species of the town (Terület- és Vidékfejlesztési Bt., 2005)

Nature Conservation Information Board, Tát (2007)

Preparation of Gerecse Nature Park (Öko-Design Nature Protection Investment and Consultancy Kft., 2010)

ZSÓFIA FEHÉR

Environmental impact assessment of 400 kV transmission lines of Almásfüzitő – Dad - chapter on nature conservation (05.2012)

MIFŰ Kft. Construction permit documentation - Chapter on nature conservation (05.2011)

Feasibility study of a small size power plant working on pyrolysis technology processing plastic-based side products planned to be implemented at the Bodajk site - Chapter on environmental protection (12.2010)

Implementation of a waste gassification plant, ISD POWER Energy Production and Servicing Kft. - Chapter on environmental protection of the plan (11.2010)

Csepel Power plant III, environmental impact study and integrated environmental permit licencing documentation - Chapter on nature conservation (05.2010)

Implementation of a gas engine small power plant of 2 x ~450 kWe performance at the Babócsa site - feasibility study, Chapter on environmental protection (03.2010)

Almásfüzitő Solar Power Plant - preliminary assessment documentation (02.2010)

Paks Recuperation Plant of 6.8 MWe - preliminary assessment documentation (12.2009)

Bánhida Power Plant of biomass of 16.5 MWe - construction permit documentation, Chapter on environmental protection

Százhalombatta combined cycle gas turbine power plant of 850 MWe - environmental impact study and integrated environmental permit licensing documentation (12.2009)

Csepel Power Plant III - preliminary consultation documentation (10.2009)

Szőreg-1 Safety Natural Gas Storage SZBT-2,3,4 integrated environmental permit licensing documentation of the collection and distribution centres (08.2008)

Gomba, exploration of reserves - preliminary assessment documentation (09.2007)

Szőreg-1 environmental impact assessment of Safety Natural Gas Storage (07.2007)

Opening of natural gas field for production at Vízvár north - environmental impact assessment (02.2007)

Opening of natural gas field for production at Vízvár north - preliminary assessment documentation (10.2006)

Babócsa mechanised cooling and gas quality standardisation MTK plan (07.2006)

Ortaháza mechanical cooling and intensification of PB production Labour, fire and environmental protection plan (03.2006)

Field production project at Tóalmás and in its vicinity - preliminary environmental impact study (12.2005)

Opening the gas reserve at Soltvadkert and Soltvadkert-K for production - preliminary environmental impact assessment (10.2005)

Extension of the natural gas transmission compressor station at Hajdúszoboszló, MTK plan (06.2005)

Relocation of hydro-carbon facilities affecting the extension of the Tatabánya-Környe industrial park, MTK plan (04.2005)

Qualification of small water courses from ecological aspect by water chemistry and water biology tests (scientific student circle and university degree thesis subject) (1999-2000)

18.7.2 GENERAL DESCRIPTION OF THE TOLNAI-DUNA (HUDD20023) THE NATURA 2000 SITE AFFECTED

Name of Natura 2000 site: **Tolnai-Duna**

Code: HUDD20023

Extension: 7161.69 ha

Status of the area (to be marked):

□ special bird conservation area
□ area designated for special nature conservation area
□ area designated for special nature conservation area of priority importance
□ approved special nature conservation area
□ approved nature conservation area of priority importance
□ special nature conservation area
x *Nature conservation (SCI) Natura 2000 site of priority importance*

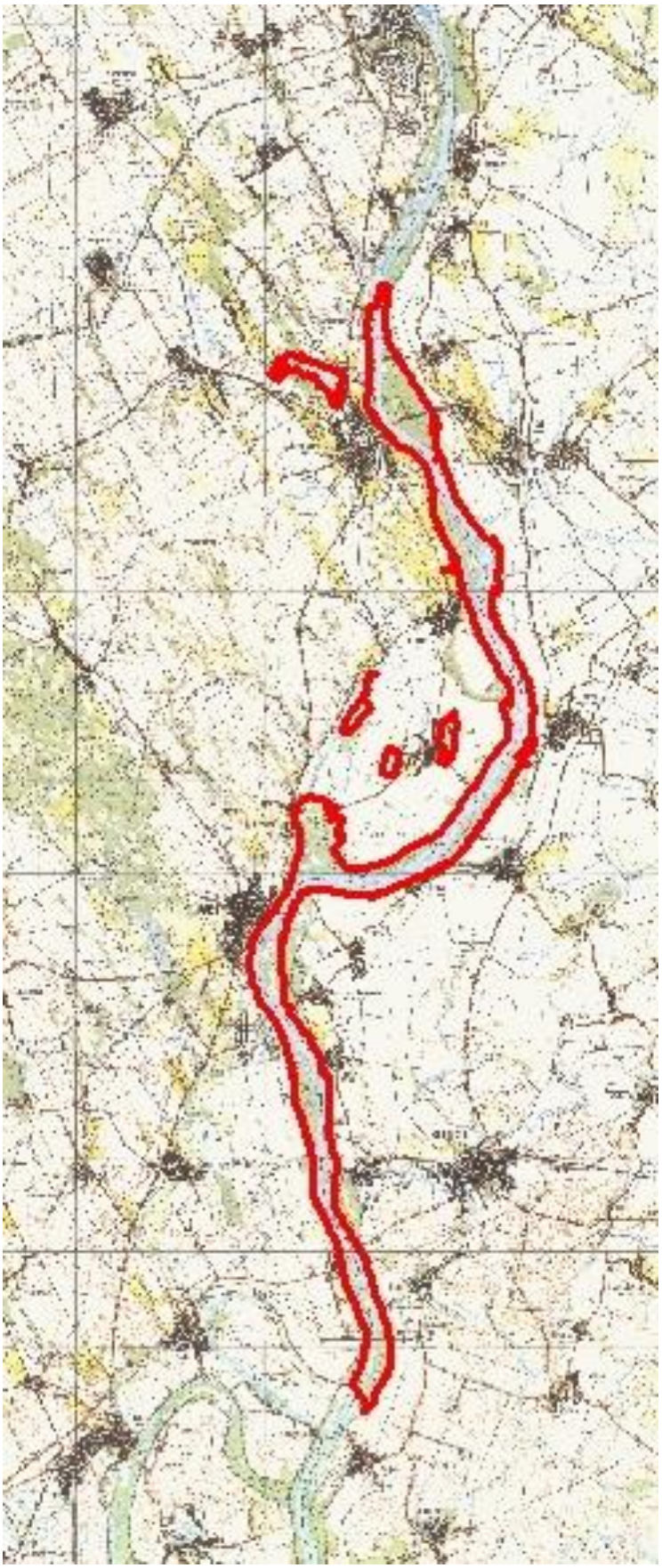


Figure 18.7.2-1.: The-general map of the Natura 2000 site along the Tolnai-Duna (HUDD20023)-[18-162]

Priority habitats types on the entire of ***HUDD20023*** Natura 2000 site

		% rate of habitats	Representativity	National importance
3130	Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or Isoeto-Nanojuncetea	0.01	C	C
3270	Rivers with muddy banks with Chenopodion rubri p.p. and Bidention p.p. vegetation	1	C	B
6430	Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels	1	D	
6440	Alluvial meadows of river valleys of the Cnidion dubii	10	C	C
91E0	Alluvial forests of (Alnus glutinosa) and (Fraxinus excelsior) (Alno-Padion, Alnion incanae, Salicion albae)	10	B	C
91F0	Riparian mixed forests of Quercus robur, Ulmus laevis and Ulmus minor, Fraxinus excelsior or Fraxinus angustifolia species (Ulmenion minoris)	10	C	C

Note:
B: good representativity, C: significant representativity, D: n-on significant presence,
National importance, B: 15 ≥ p > 2 % and C: 2 ≥ p > 0 %, where p: proportion of area covered by natural habitats types compared to the national extension of the natural habitats type.
18-157]

Table 18.7.2-1.: Priority habitats types of the Natura 2000 site

Priority species of the entire territory of the Tolnai Duna (HUDD20023) site

amphibians-reptiles			
Species name	**Scientific name**	**Size of community**	**Population**
great crested newt	Triturus cristatus	C	C
European pond terrapin	Emys orbicularis	C	C
fire bellied toad	Bombina bombina	R	C
fish			
Name of species	**Scientific name**	**Size of community**	**Population**
asp	Aspius aspius	C	C
common zingel	Zingel zingel	R	C
Danube streber	Zingel streber	P	C
Eudontomyzon spp.	Eudontomyzon spp.	R	C
European mudminnow	Umbra krameri	R	C
Danube roach	Rutilus pigus	C	C
pond loach	Misgurnus fossilis	C	C
striped ruffe	Gymnocephalus schraetzer	C	C
balon's ruffe	Gymnocephalus baloni	P	C
invertebrates			
Name of species	**Scientific name**	**Size of community**	**Population**
scarce fritillary	Euphydryas maturna	P	D
large copper butterfly	Lycaena dispar	P	D
scarlet beetle	Cucujus cinnaberinus	P	C
thick shelled river mussel	Unio crassus	P	C
mammals			
Name of species	**Scientific name**	**Size of community**	**Population**
mouse-eared bat	Myotis myotis	*P*	*C*
European ground squirrel	Spermophilus citellus	*P*	*D*
western barbastelle bat	Barbastella barbastellus	*P*	*C*
pond bat	Myotis dasycneme	*P*	*C*
otter	Lutra lutra	*R*	*C*
plant			***C***
Name of species	**Scientific name**	**Size of community**	**Population**
creeping marsh wort	Apium repens	*V*	*D*

Note:
Size of community: C: frequent, R: rare, V: very rare, P: present. Population: C: 2 ≥ p > 0 %, D: non-significant population (where p: proportion of area covered by natural habitats types compared to the national extension of the natural habitats type.
[18-157]

Table 18.7.2-2.: Priority species of the entire HUDD20023 Natura 2000 site

18.7.3 PRESENTATION OF THE DESIGN OR INVESTMENT EXPECTED TO HAVE IMPACT ON THE NATURA 2000 SITE

18.7.3.1 Objective of the investment expected to have impact on the Natura 2000 site

In addition to the electricity generation by the new nuclear power plant units of the planned Paks II, heat that cannot be used for electricity generation will be generated both in the primary and in the secondary circuit. The planned condenser cooling water system - similarly to the currently applied solution in the four units of the current nuclear power plant - removes the necessary heat by the circulation of the water abstracted from the Danube River through the condenser.

The current warm water channel was established at the time of the implementation of the Paks Nuclear Power Plant by making it suitable for carrying the warm water quantity of the Paks Nuclear Power Plant and the 2 x 1 000 MW extension planned at the time.

The joint operation of the 2 x 1 200 MW performance units and the existing four units of the Paks Nuclear Power Plant - with consideration to the expected Danube water levels and the limiting effect of the water level maintaining weir of the Paks Nuclear Power Plant on the highest water levels in the warm water channel - may require the extension of the warm water channel and the energy dissipation structure at the inflow into the Danube. (Figure 18.7.3-1.).

The area surrounded and closed by the existing cold water channel and the existing warm water channel entry point has been designated as the second entry point of the warm water channel, because in case of this location for this entry point, impact on the Natura 2000 site will be the smallest possible.

By establishing the recuperation plant in the structure established on this entry point, mixture of warm water discharged into the Danube can be improved and significant amount of electric energy can be recovered.

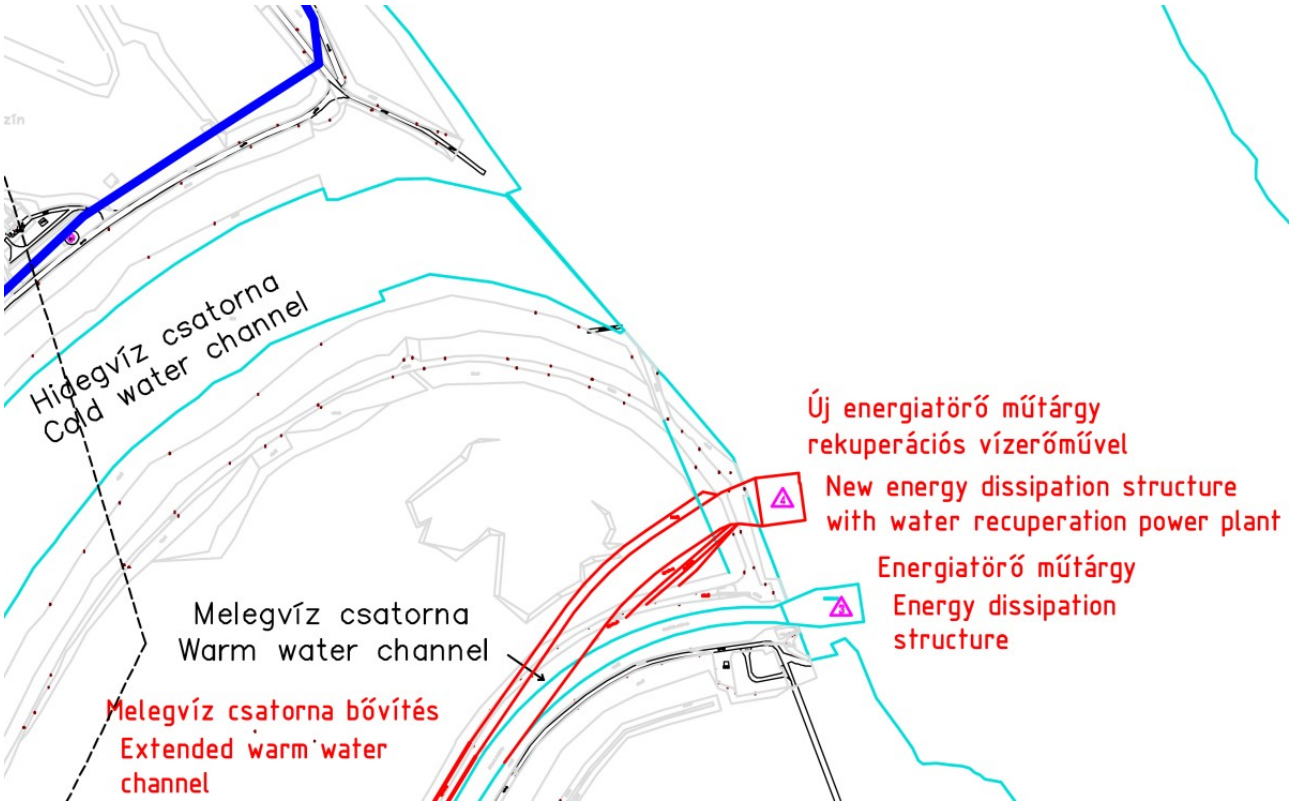


Figure 18.7.3-1.: Site plan of the existing energy dissipation structure and the second new inflow point

18.7.3.2 Description of the facilities necessary for implementation

Components of the planned fresh water cooling system affecting the Tolnai-Duna (HUDD20023) Natura 2000 areas:

- recuperation plant and its environment

- estuary of the warm water channel into the Danube, with the energy dissipation plant at the end and its environment

Recuperation plant

By damming of the warm water channel for the nuclear power plant, the gravitation of the warm water channel at its estuary into the Danube makes it suitable for the operation of water turbines of about 7-8 MW nominal built-in performance. With attention to the Danube water flow, and the operation of the nuclear power plant units, electric power than can be generated on annual level is close to 35 GWh.

The upstream site dammed up water level of the recuperation plant is generated by the closing dam built into the end of the warm water channel where the water turbines and its direct facilities have also been installed. Closing structures to determine water flow and its operation components, the transfer equipment necessary for service and maintenance and ancillary facilities are included here.

Electric and control technology equipment, switchboards and transformers are placed in an separate electric building next to the water plant. This is where the cables for the connection with the power plant and the transmission lines for the transmission of generated electricity come in. Equipment providing ancillary energy, the compressor and the oil station are also placed here.

The recuperation water plant has an over flow facility which, at times of failure or maintenance of the water turbines, can provide for the transfer of the current maximum cooling water quantity arriving from the nuclear power plant into the Danube in a safe manner.

The water plant is a fenced separate facility, which does not require continuous presence of a controller. Property security is ensured by the physical dam and signal system.

Building of the recuperation power plant

The closing dam with the water turbines and the downstream energy dissipation structure and the inflow water channel is a structure of about 35-45 m width of almost identical size of the warm water channel and of a total of 50-60 m length.

Dimensions:	*60 x 45 x 25 m*
Wall structure:	*reinforced concrete*
Roof structure:	*reinforced concrete*
Foundation:	*plated foundation/base plate supported by reinforced concrete poles*
Estimated foundation depth:	*between 20-25 m*

As the water quantity of the units starting operation in 2025 was significantly increase warm water channel water level and would make the performance of the warm water channel extension works difficult, it is recommended to implement the channel extension necessary for 2030 together with a transformation in 2025 when the first unit starts operation.

18.7.3.3 The Tolnai-Duna (HUDD20023) Natura 2000 site area expected to be affected by the size of the planned development

Facilities to be built on the bank of the Danube and the environment affected by their construction activity affect 0.8 hectares terrestrial area classified as Natura 2000 and a length of 200 m Danube bank section.

The total area of the Tolnai-Duna (HUDD20023) Natura 2000 site is 7,161.69 hectares.

*The extension of the terrestrial area affected by the planned fresh water cooling system represents **0.01%** of the total 7,161.69 hectares of the Tolnai-Duna (HUDD20023) Natura 2000 site.*

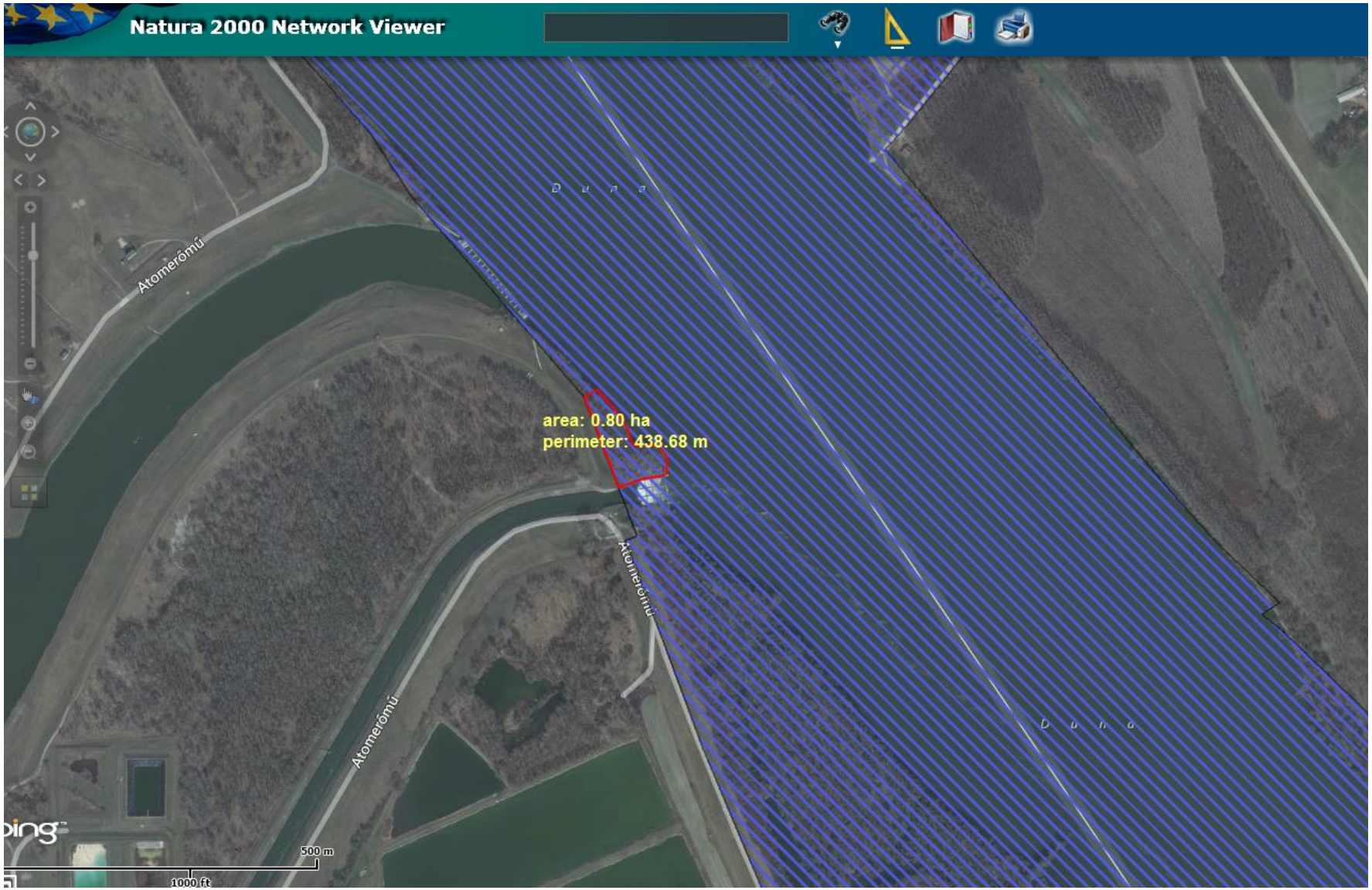


Figure 18.7.3-2.: Terrestrial areas of the Tolnai-Duna affected by the investment [18-159]

Figure 18.7.3-3.: Affected areas of the Tolnai-Duna (HUDD20023) - in real colour aerial photo [18-164]

Figure 18.7.3-4.: Affected areas of the Tolnai-Duna (HUDD20023) - in infra aerial photo [18-165]

18.7.3.4 Description of the natural conditions of the Tolnai-Duna (HUDD20023) site area expected to be affected by the planned development

Botany

Habitats

During the construction and extension of water facilities on the bank of the Danube River, the construction area can be considered impact area from the aspect of the habitats.

The area affected by the planned recuperation water power plant and energy dissipation structure is the flood plain gallery forest strongly affected by water flow and the secondary degraded grassland on the side of the dike. The Natura 2000 site area affected by the water facilities is 0.8 hectares of which 0.78 hectares is willow poplar flood plain forest.

Figure 18.7.3-5.: The Natura 2000 site affected

The gallery forest along the bank of the Danube can be characterised by the dominance of white willow *(Salix alba)* and black poplar *(Populus nigra)*. Among the large size old black poplar and old white willow stands hybrid grey poplar can be seen mixed with some smaller size green maple, red ash, white bullberry, and European white elm. Along the dike, close to the slope, nut tree and field maple also occur.

Priority habitat type identified on the Natura 2000 site is the following:

> 91E0* Alluvial forests with (*Alnus glutinosa*) and (*Fraxinus excelsior*) (*Alno-Padion*, *Alnion incanae, Salicion albae*)

The grasslands to be found on the affected Natura 2000 area is not a priority habitats type, OC – Classified into the category of uncharacteristic dry and semi-dry grasslands.

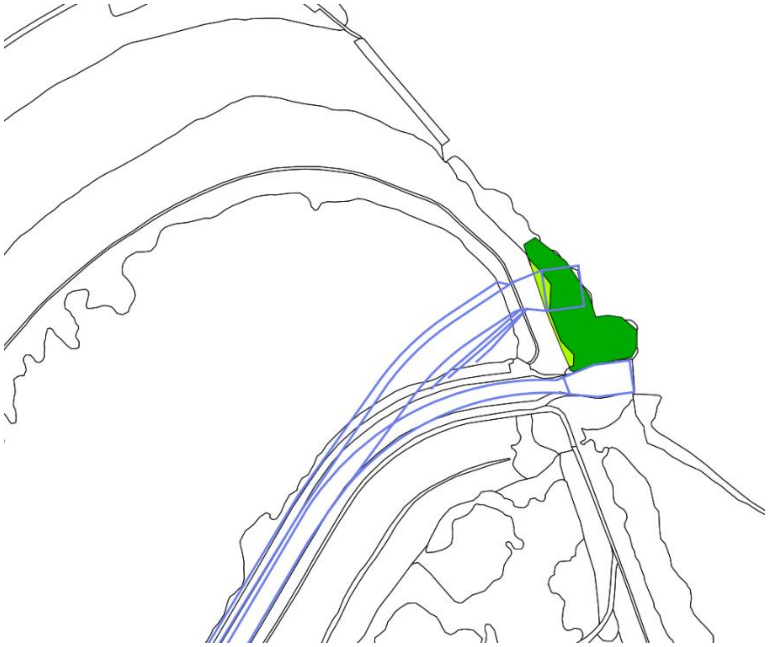
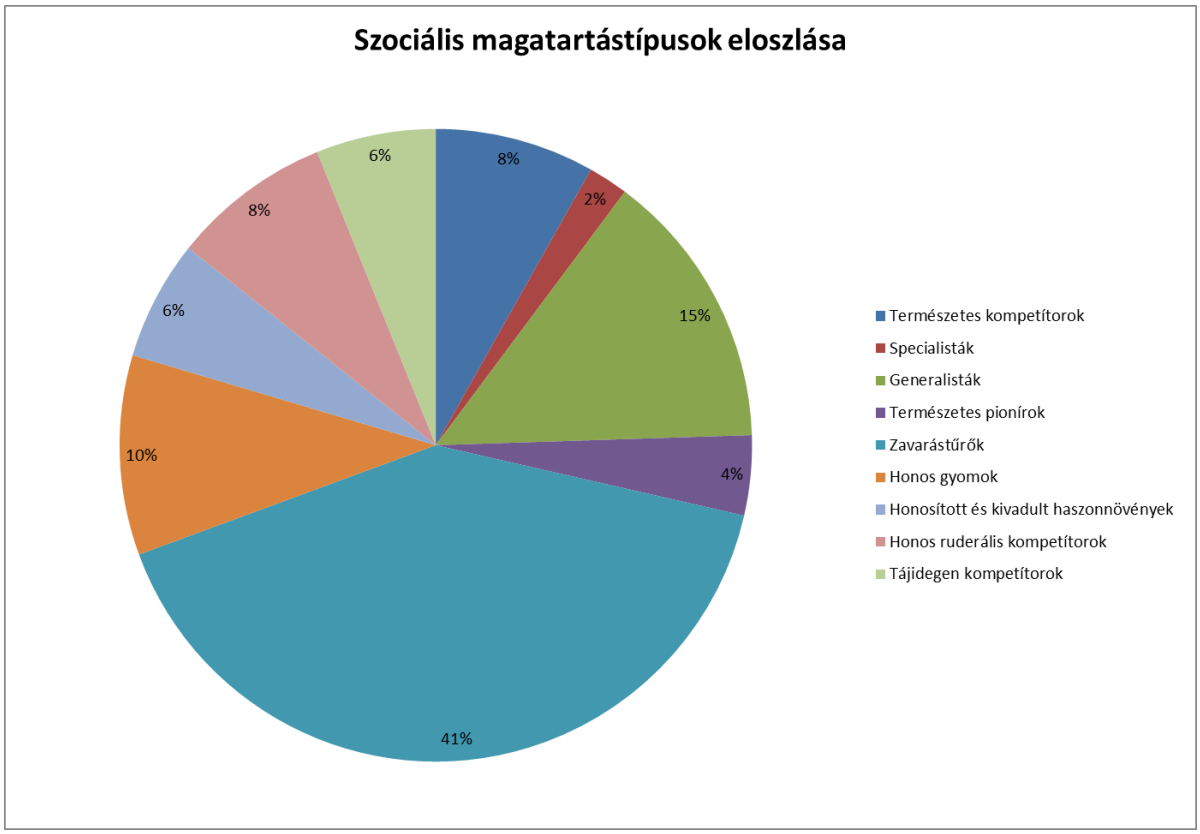


Figure 18.7.3-6.: Terrestrial habitats of the Natura 2000 site affected

Natural status of the flood plain forest is good (4), natural status of the flood protection dike is poor (2).

Of the entire species abundance, the ones taking the largest share and at the same time being the most frequent groups are the generalist species (G), the disturbance tolerant species (DT) and the native weed species (W), which together represent two-third of the entire species abundance. The other behaviour type groups individually represent less than 10 % of the entire species abudance. The studied areas are dominated by the ruderal groups (R), but the proportion represented by stress tolerant species is also significant. All this supports the idea that the area is under strong anthropogenic impact.



Természetes kompetítorok - Natural competitors
Specialisták - Specialists
Generalisták - Generalists
Természetes pionírok - Natural pioneers
Honos gyomok - Native weeds
Honosított és kivadult haszonnövények - Introduced and kivadult cash crops
Honos ruderális kompetítorok - Indigenous ruderal competitors
Tájidegen kompetítorok - Competitors non-native to the landscape

Figure 18.7.3-7.: Distribution of species occurring on the Natura 2000 site according to social behaviour types

Social behaviour types (SBT) and their base value figures according to A. Borhidi [18-14]

C = Natural competitors /+**5**/
ST = Stress tolerant
- **S** = Specialists /+**6**/
- **G** = Generalists /+**4**/

R = Ruderal
- **NP** = Natural pioneers /+**3**/
- **DT** = Disturbance tolerant (in natural production sites) /+**2**/
- **W** = Native weeds /+**1**/

Anthropogenic components, alien to the landscape
- **I** = Introduced and escaped cash crops /-**1**/
- **A** = Adventives /-**1**/

Competitors of secondary production sites
- **RC** = Indigenous ruderal competitors /-**2**/
- **AC** = Aggressive competitors non/native to the landscape /-**3**/

List of plant species

The list of plant species occurring on the Natura 2000 area affected is contained in the following table (The guide follows the work of Király 2009 and Király et al. 2012.)

Latin name	English name	Family
Acer campestre	Field maple	Aceraceae
Acer negundo	Green maple	Aceraceae
Alopecurus pratensis	Meadow fox tail	Poaceae
Amorpha fruticosa	Shrub level false indigo	Fabaceae
Anchusa officinalis	Common bugloss	Boraginaceae
Arrhenatherum elatius	False oat grass	Poaceae
Bromus hordeaceus	Soft brome	Poaceae
Bromus sterilis	Barren brome	Poaceae
Bromus tectorum	Downey brome	Poaceae
Buglossoides arvensis	Bustard alcanet	Boraginaceae
Cirsium arvense	Creeping Thistle	Asteraceae
Convolvulus arvensis	**Field bindweed**	Convolvulaceae
Cornus sanguinea	**common dogwood**	Cornaceae
Crataegus monogyna	**common hawthorn**	Rosaceae
Cruciata laevipes	**crosswort**	Rubiaceae
Dactylis glomerata	**cock's-foot**	Poaceae
Erodium cicutarium	**redstem filaree**	Geraniaceae
Eryngium campestre	Field eryngo	Apiaceae
Euphorbia cyparissias	**cypress spurge**	Euphorbiaceae
Festuca arundinacea	**tall fescue**	Poaceae
Fraxinus pennsylvanica	Red ash	Oleaceae
Galium aparine	**Cleavers**	Rubiaceae
Juglans regia	**Persian walnut**	Juglandaceae
Lamium purpureum	**red deadnettle**	Lamiaceae
Morus alba	While mullberry	Moraceae
Myosotis arvensis	**Field Forget-me-not**	Boraginaceae
Ornithogalum boucheanum	-	Hyacinthaceae
Ornithogalum umbellatum	**Star-of-Bethlehem**	Hyacinthaceae
Plantago lanceolata	Plantain	Plantaginaceae
Poa bulbosa	**bulbous bluegrass**	Poaceae
Poa pratensis	Common meadow grass	Poaceae
Populus nigra	Black poplar	Salicaceae
Pyrus pyraster	Wild pearl	Rosaceae
Ranunculus acris	**meadow buttercup**	Ranunculaceae
Ranunculus ficaria	**Lesser celandine**	Ranunculaceae
Rubus caesius	**European dewberry**	Rosaceae
Rumex acetosa	common sorrel	Polygonaceae
Salix alba	White willow	Salicaceae
Sambucus nigra	Black-berried elder	Caprifoliaceae
Solidago gigantea	Tall golden rod	Asteraceae
Stellaria media	**chickweed**	Caryophyllaceae
Taraxacum officinale	**common dandelion**	Asteraceae
Thalictrum flavum	**-**	Ranunculaceae
Thlaspi perfoliatum	Cotswold Penny-cress	Brassicaceae
Ulmus laevis	European white elm	Ulmaceae
Urtica dioica	**common nettle**	Urticaceae
Valerianella locusta	**corn salad**	Valerianaceae
Vicia angustifolia	-	Fabaceae
Viola arvensis	**field pansy**	Violaceae

Table 18.7.3-1.: List of plant species

Protected plant species

On the affected Natura 2000 site area, neither protected plant (Decree No. 13/2001. (V. 9.) KöM) nor Natura 2000 priority species (Council Directive No. 92/43/EEC) was found.

Zoology

The Danube river bank section affected is some 200 m length. As animals are able to change location, we cannot tell in advance how many items of how many species will be staying on the river bank section at the time of starting construction. It can only be established by sampling at that time. As the thick shelled river mussel (*Unio crassus*) sporadically occurs on this Danube section (two items were found under the warm water channel outflow embayment during the survey conducted in 2001-2003) and the yellow-legged dragon fly can also be found (its larvae was found under the outflow of the current warm water channel during the survey of 2012-2013 [18-85], [18-87], survey of these species is a specially recommended prior to commencing the investment. Our surveys on the river bank strip have provided evidence that NATURA 2000 priority fish species can occur on the intervention area. With attention, however, with the very short river bank section affected and the mobile nature of fish it would be irrational to name species here.

The fauna of the terrestrial area is in line with the fauna of an average soft wood gallery forest along the Danube. This is true for the orthoptera, beetle, ant, and spider and butterfly fauna. Items of protected species may cut across the area. A number of protected and highly protected bird species (little egret, while stork, black stork, red kite, black tern, European bee-eater) may feed and in principle some can be even breed on the area, but we could not observe such an event. A relatively large number of bat species occur on the area because they find food in abundance.

18.7.3.5 Habitats and species of community importance identified on the affected area

Based on the on-site studies, affected by the planned fresh water cooling system, the following habitats and species of community importance occur:

Priority habitats types

91E0* Alluvial forests with (Alnus glutinosa) and Fraxinus excelsior (*Alno-Padion*, *Alnion incanae, Salicion albae*)

From among habitats belonging to the above category, on the Danube section direct affected, willow poplar flood forest of 91E0 Natura 2000 code was identified.

Priority species

On the Natura 2000 area affected, no priority plant species was found.

With attention to the very small size of the area, and the mobility of the animals enlisting priority animal species is not relevant.

18.7.4 UNFAVOURABLE IMPACTS OF THE PLANNED DEVELOPMENT

18.7.4.1 Impacts of the construction of the planned development

Habitats - Priority habitats

On the Natura 2000 site affected, from among the priority habitats, the flood plain willow poplar gallery forest can be found (Natura 2000 code: 91E0). The willow poplar gallery forest of 0.78 hectares in the flood plain on the Natura 2000 area will be cleared during the construction. When the Natura 2000 classified narrow forest zone along the Danube bank will be cleared, that will change the coverage of the surface, edge effect will occur, and temperature conditions - air and soil -, humidity of the air, moisture of the soil, wind intensity and light conditions will locally change.

Estimation of the tree stand of the area of the Natura 2000 site affected by the planned riparian facilities

Because of the area occupation of the huge poplar and willow trees, a relatively small number (about 220-300) trees of varied size can be found on the area in the following division.

tree species	proportion %	trunk perimeter cm	Proportion of given trunk perimeter %
white willow	26	10-40	28
		80-100	53
		250-300	19
black poplar	38	40-60	49
		80-100	36
		200-300	15
grey poplar	2	40-50	14
		100-150	86
nut	1.8	40-60	50
		100-150	50
green maple	14.4	30-50	67
		70-80	33
red ash	12	10-40	100
European white elm	2	40-60	100
field maple	1.8	30-50	100
while mullberry	2	10-30	100

Table 18.7.4-1.: Distribution in percentage of wood species in the area, their trunk circumference and distribution broken down for wood species

When construction works are started, the items of most of the animal species will pass over to the adjacent areas. From among the groups studied by us, the aquatic macroscopic invertebrates strongly tied to the underlay, items of the dragon fly larvae and ants to be found on the area may be exposed to threat. With attention to the size of the area, the number of items that can be potentially threatened is small. The river bed of the Danube will probably be affected by the construction of the warm water channel to a negligible rate. Works may cause the destruction of items/populations living at the river bed bottom of the Danube River.

With regard to terrestrial animals, the habitats of small body soil surface arthropoda will be destroyed, therefore, their local populations will die. The affected parts of the reproduction hatching and feeding sites of larger body animals (amphibians, reptiles, birds and mammals) will disappear. But items of these species have a good chance to find new habitats in the vicinity.

18.7.4.2 Impacts of the operation of the planned development

Habitats - Priority habitats

During the period of operation, no further earthwork will be performed, thus, beyond soil coverage and soil compactness, no direct impact on the habitats can be expected. On the newly established area of the dike, secondary succession processes will be launched, as a result of which, together with the vegetation plantation, new vegetation units may evolve from the remnants of the former vegetation and a result of the competition of newly setting in or introduced species.

Botany

During the period of operation, partly controlled re-settlement of plant species will be launched to the areas that used to be disturbed.

As in the vegetation environment, a number of invasive plant species transforming their environment *(Amorpha fruticosa, Solidago gigantea, Solidago canadensis, Asclepias syriaca)* is present in large masses, special attention should be paid to their suppression during operation. To prevent the proliferation of the above species, at least until stable steppe assemblages emerge, mowing should be done twice a year (in early June and in August - by adaptation to the crop ripening period of species) in order to prevent the ripening of the crops and further spread of the items of these eventually occurring species. When earthworks are completed, and when growth of vegetation is influenced, attention should be paid to prevent the settlement of potentially invasive species.

Water level fluctuating impact of operation on the section between the cold water inflow and the warm water outflow is of negligible rate, impacts and impact area cannot be detected. The warmed up cooling water discharged by Paks II will exercise a minimum impact on the aquatic vegetation and the vegetation in contact with water, no significant changes have been shown so far at this rate of heat effect and the impact area is not defined.

Zoology

Environmental conditions emerging during operation are difficult to estimate. Probably the items of animal species tolerating or even favouring the cultural landscape will get re-settled but it cannot be stated in advance which one of them will have permanent, stable population on this small area. In case of large body animals, probability is very low while in the case of the small body animals, the chance is higher.

Evaluation

In the event of the implementation of the investment, there is no chance for the Natura 2000 priority habitats to re-emerge under the changed terrain conditions, therefore, the area loss occurring due to construction will have to be considered permanent. Different impacts can be accounted for in case of the priority species. There will be species whose local population will experience larger impact in relation with the implementation of the establishment and there will be some which will experience less.

18.7.5 UNFAVOURABLE IMPACTS OF THE INVESTMENT

The most unfavourable impact of the investment in itself is that the area will be totally changed due to the investment. This impact, however, can be mitigated by restoration and landscape rehabilitation works subsequent to the investment. Plant and animal populations to be found on the work area will be injured or will locally disappear depending on the rate of the intervention. Following the construction phase, rehabilitation steps will be needed.

18.7.6 ALTERNATIVE SOLUTIONS

Construction of the new warm water channel branching off to the south from the current warm water channel was mentioned as an alternative solution (Figure 18.7.6-1.). Size of the planned area is ~10.6 hectares significantly larger than the proposed solution. Biodiversity of the area is also appropriately more significant.

Detailed description of the project in accordance with Natura 2000 criteria can be found in MVM PAKS II Zrt report [18-86].

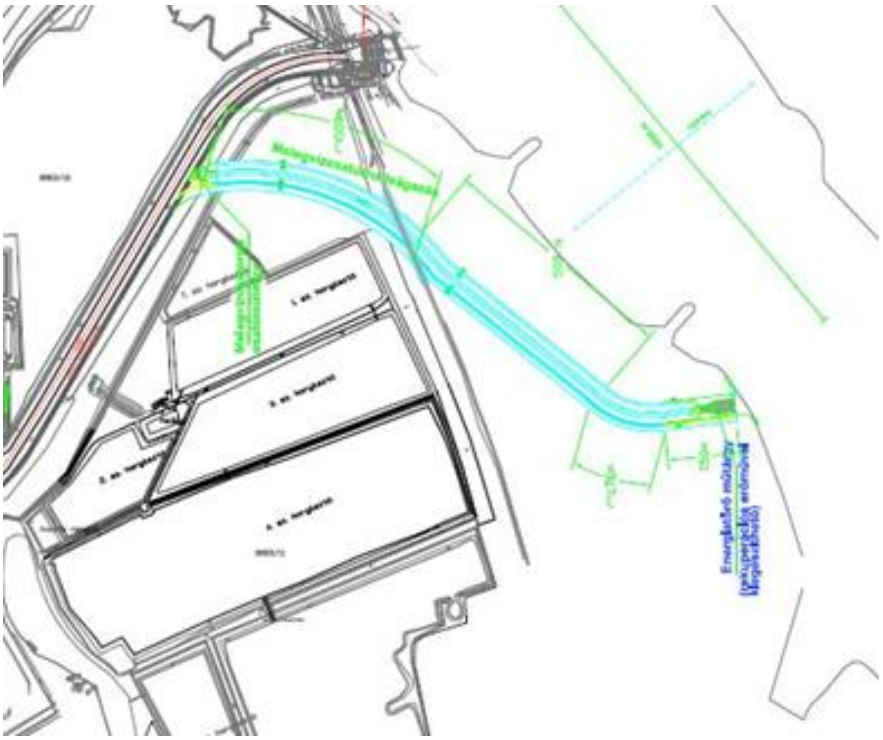


Figure 18.7.6-1.: Area affected in the course of the implementation of the hot water channel according to the former alternative [18-153]

Search for a new route of the warm water outflow

Detailed studies have been made on the option of warm water inflow by the current warm water channel and by a southern side channel branching off from it to conduct the warmed up cooling water of the new Paks Nuclear Power Plant units. The current warm water channel and the inflow point at a distance of a 1,000 m from the current estuary from the warm water channel downstream of the Danube would have allowed the current warmed up cooling water conducted into the Danube through the current warm water channel to get mixed in the Danube and get cooled down. The mixture analysis, however, has pointed out that inflow by a side channel further south at a distance of about 1,000 m creates more unfavourable mixing conditions for the warmed up cooling water and the main reason behind is that the main stream of the Danube is shifted from the right bank side towards the left bank side where the warmed up cooling water entry point is further away from the current warm water channel estuary downstream on the Danube. Proceeding from the existing warm water channel estuary towards the flow direction of the Danube, the Danube is gradually getting shallower and shallower along the right bank side.

Inflow into the river getting further away from the estuary of the warm water channel for the affected Natura 2000 areas in a gradually increasing manner.

Studies conducted joint with attention to environmental aspects have shown that entry into the river by a side channel cutting across a Natura 2000 area does not promote the compliance with environmental requirements. Based on that, as planning was progressing, the Natura 2000 areas, which were planned to be affected were taken out from the scope of the investment.

Warm water discharge through the existing warm water channel, with a new structure to improve mixture at the inflow point

By discharging the warmed up cooling water of Paks II through the existing warm water channel and by the application of a new structure improving mixture at the entry point, impact on the Natura 2000 areas can be minimised and by the construction an appropriate new structure, water mixture conditions can be improved.

Evaluation

By the discharge of the warmed up cooling water through the existing warm water channel, and by having the inflow into the river on the area closed by the cold water channel and the warm water channel impact on the Natura 2000 areas can be minimised by the application of a new structure, a recuperation power plant to improve mixture of the discharged

warm water with Danube water. The designer considered especially the Natura 2000 principles and aspects when it rejected the previously described implementation option.

18.7.7 REASONS FOR THE IMPLEMENTATION

Without the implementation of the planned investment, safe operation of Paks II cannot be ensured.

The necessity to implement the design or the investment is supported by one of the following reasons (the relevant part to be indicated)

x public interest of high importance of social or economic nature (if it does not endanger habitats type or species of priority importance)

□ protection of human health or life

□ maintenance, preservation of public safety or restoration

□ to attain a favourable impact of outstanding importance from the aspect of the environment

x other public interest of priority importance not classified into any of the above categories (if it threatens habitats type or species of priority importance)

18.7.8 MITIGATION OF UNFAVOURABLE IMPACTS

In the course of the investment, efforts should be made that interventions damage habitats of species living there on the smallest possible area and to the smallest possible rate. Investment will have a direct impact on the area and on the animal species feeding and/or breeding there. Unfavourable impacts can be mitigated if investment is followed by landscape rehabilitation works. The investment is recommended to be implemented during autumn and winter from the aspect of most of the animal species living on the area. Unfavourable impacts on fauna can be mitigated by this scheduling.

18.7.9 OFFSETTING (COMPENSATORY) MEASURES

In the course of the investment, use of the non-native nature or landscape components should be possibly minimised (river bed coverage, river bank coverage). River bed coverage should be as heterogeneous on the given area as possible (e.g. stone spreading). That may facilitate the re-settlement of invertebrate macro-fauna.

In place of the cleared tree stand, reforestation by trees in a proportionate manner is recommended.

To prevent, inhibit the spread of invasive species, regular mowing of the dike covered by grasses is necessary.

Use of herbicides should be avoided on the area to facilitate the re-settlement of as many invertebrate animal species as possible on the site of the planned investment.

Re-settlement of certain bird species could be facilitated by placing out bird nests.

18.8 BIBLIOGRAPHY

[18-1] Balmori, A. (2006): The incidence of electromagnetic pollution on the amphibian decline: Is this an important piece of the puzzle? Toxicological és Environmental Chemistry, 88(2): 287–299.

[18-2] Balmori, A. (2010): Mobile phone mast effect on common frog (Rana temporaria) tadpoles: The city turned into laboratory. Electromagnetic Biology és Medicine, 29: 31-35.

[18-3] Barber JR Crooks KR Fristrup KM (2010). The costs of chronic noise exposure for terrestrial organisms. Trends in Ecology and Evolution 25: 180-189

[18-4] Bavenger, K. (1998): Biological and conservation aspects of bird mortality caused by electricity power lines: a review. Biological Conservation 86, 67-76.

[18-5] Bazelet, C.S., Samways, M.J. (2011): Relative importance of management vs. design for implementation of large-scale ecological networks. - Landscape Ecology 26: 341-353.

[18-6] Bee, M.A. and Swanson, E.M. (2007): Auditory masking of anuran advertisement calls by road traffic noise. Animal Behaviour 74: 1765-1776.

[18-7] Bern Convention (1994): Convention on the Conservation of European Wildlife and Natural Habitats. Appendices to the Convention. – Council of Europe, Strasbourg, T-PVS (94) 2, 21 pp.

[18-8] Blaustein, A.R., Belden, L. K., Olson, D. H., Green, D. M., Root, T. L. és Kiesecker, J. M. (2001): Urban bioacoustics: it's not just noise. Amphibian breeding és climate change. Conservation Biology 15(6): 1804-1809.

[18-9] Blaustein, A.R., Walls, S.C., Bancroft, B.A., Lawler, J.J., Searle, C.L. és Gervasi, S.S. (2010): Direct és indirect effects of climate change on amphibian populations. Diversity 2: 281-313.

[18-10] Bloesch J. (2011): Climate change – Temperature and light: two drivibg forces for aquatic biology. Editorial. Danube News, May 2011, No. 23. Vol. 13. p. 1.

[18-11] Bogdan, H-V., Covaciu-Marcov, S-D., Antal C., Cicort-Lucaciu, A-Ş és Sas, I. (2011): New cases of winter-active amphibians in the thermal waters of Banat, Romania. Arch. Biol. Sci., Belgrade, 63 (4), 1219-1224, 2011

[18-12] Bond, A., Palerm, J., & Haigh, P. (2004): Public participation in EIA of nuclear power plant decommissioning projects: a case study analysis. Environmental Impact Assessment Review, 24(6), 617-641.

[18-13] Borhidi A. – Sánta A. (szerk.) (1999): Vörös könyv Magyarország növénytársulásairól 1-2. – TermészetBÚVÁR Alapítvány Kiadó, Budapest. 362 + 404 pp.

[18-14] Borhidi A. (1993): A magyar flóra szociális magatartás típusai, természetességi és relatív értékszámai – A KTM TVH és a JPTE kiadványa, Pécs. 93 pp.

[18-15] Borhidi A. (2003): Magyarország növénytársulásai.– Akadémiai Kiadó, Bp., 610 pp. http://www.tankonyvtar.hu/biologia/magyarorszag-080905-154

[18-16] Bölöni J. – Kun A. – Molnár ZS. (szerk.): Élőhelyismereti Útmutató 1.9 – Vácrátót, 2003

[18-17] Bölöni J. – Molnár ZS. – Kun A. (szerk): Magyarország élőhelyei. Vegetációtípusok leírása és határozója ÁNÉR2011 – MTA ÖBKI Vácrátót, 2011.

[18-18] Butovsky, R. O. (1994): Carabids in roadside ecosystems: perspectives of bioindication. pp 241-246. In: Desender, K. et al. (eds): Carabid Beetles: Ecology and Evolution. Kulwer Academic Pubilshers.

[18-19] Caissie D. (2006). The thermal regime of rivers: a review. Freshwater Biology 51: 1389–1406.

[18-20] Carey, C. és Alexéser, M.A. (2003): Climate change és amphibian declines: is there a link? Diversity és Distributions 9: 111–121.

[18-21] Carpenter D.O. and Ayrapetyan S. (eds) (1994): Biological effects of electric és magnetic fields. Vol. I. Sources és Mechanisms. Academic Press, Inc. London

[18-22] Christophe, N. & Baudoin, C. (1998): Olfactory preferences in two strains of wild mice, Mus musculus musculus and Mus musculus domesticus, and their hybrids. Anim. Behav., 56: 365-369.

[18-23] Council Directive (1992): Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora. – Official Journal L 206, 22 July 1992, pp: 7–50.

[18-24] Covaciu-Marcov, S-D., Sas, I., Cornel, A., Cicort-Lucaciu, A-S. és Buncan, M. (2010): We cannot hibernate again: new amphibian populations active during winter in the thermal habitats from Western Romania. Biharean Biologist 4(2): 153-159.

[18-25] Cucurachi, S., Tamis, W.L.M, Vijver, M.G., Peijnenburg, W.J.G.M., Bolte, J.F.B., de Snoo, G.R. (2013): A review of the ecological effects of radiofrequency electromagnetic fields (RF-EMF), Environment International 51: 116–140.

[18-26] Daufresne M., Bady P. & Fruget J.-F. (2007): Impacts of global and extreme hydroclimatic events on macroinveretbrate community structures in the French Rhone River. Oecologia 151: 544-559.

[18-27] Daufresne, M., Boet, P. (2007): Climate change impacts on structure and diversity of fish communities in rivers. Global Change Biology 13: 2467-2478.

[18-28] Daufresne, M., Roger, M.C., Capra, H., Lamouroux, N. (2003): Long-term changes within the invertebrate and fish communities of the Upper Rhone River: effects of climatic factors. Global Change Biology 10: 124-140.

[18-29] Demeter A. 1995: Morfometriai módszerek alkalmazása emlősök taxonómiai kutatásában. Kandidátusi értekezés, Magyar Természettudományi Múzeum, Budapest.

[18-30] Demeter A., Rácz G., Csorba G. 1995: Identification of house mice (Mus musculus) and mound-building mice (Mus spicilegus) using distance and landmark data. In: L. F. Marcus, M. Corti, A. Loy, G. Naylor and D. E. Slice (eds.): Advances in Morphometrics. Plenum Press, New York. pp. 359-369.

[18-31] Denegre, J. M., Valles, J. M., Lin, K., Jordan, W. B., Mowry, K. L. (1998): Cleavage planes in frog eggs are altered by strong magnetic fields. Proceedings of the National Academy of Science (PNAS) 95:14729–14732.

[18-32] Donker, M.H. Zonneveld, C.; van Straalen, N.M. (1993): Early reproduction and increased reproductive allocation in metal adapted populations of the terrestrial isopod Porcellio scaber. Oecologia 96:316–323.

[18-33] Dövényi Z. (szerk.2010). Magyarország kistájainak katasztere. 2., átdolgozott és bővített kiadás. Szerk.: Budapest, MTA FKI, 876 p.

[18-34] Evans, W.G. (1970): Thalassotrechus barbarae (Horn) and the Santa Barbara oil spill (Coleoptera: Carabidae). Pan-Pacific Entomologist 46:233-237.

[18-35] Farkas S. (1999): A Paksi Atomerőmű Rt. szűkebb körzetének növényvilága – A flóra és vegetáció természetességi állapotának felmérése – Paks. 46 pp.

[18-36] Farkas S. (szerk., 1999): Magyarország védett növényei – Mezőgazda Kiadó, Budapest. 416 pp.

[18-37] Fekete Gábor, Molnár Zsolt, Horváth Ferenc (szerk.) (1997): Nemzeti Biodiverzitás-monitorozó Rendszer II. A magyarországi élőhelyek leírása, határozója és a Nemzeti Élőhely-osztályozási Rendszer. Magyar Természettudományi Múzeum, Budapest.

[18-38] Fodor L. Török K. (szerk. 2010) Védett és veszélyeztetett edényes növényfajok monitorozása. Természetvédelmi Információs Rendszer, Központi protokoll. pp. 5.

[18-39] Forman RTT Alexander LE (1998). Roads and their major ecological effects. Annual Review of Ecology and Systematics 29: 207-231

[18-40] Forrester, J. A., Leopold, D. J. and Hafner, S. D. (2005): Maintaining Critical Habitat in a Heavily Managed Landscape: Effects of Power Line Corridor Management on Karner Blue Butterfly (Lycaeides melissa samuelis) Habitat. Restoration Ecology, 13:488–498.

[18-41] Freidenburg, L.K. és Skelly, D.K. (2004) Microgeographical variation in thermal preference by an amphibian. Ecology Letters,7: 369–373.

[18-42] Freitag, R. (1979): Carabid Beetles and Pollution. In: Erwin et al. (eds.): Carabid Beetles: Their Evolution, Natural History, and Classification

[18-43] Gibbons J. W. és Sharitz R. R. (1981): Thermal ecology: Environmental teachings of a nuclear reactor site. BioScience 31(4): 293- 298.

[18-44] Gibbons, J.W. (1970): Reproductive dynamics of a turtle (Pseudemys scripta) population in a reservoir receiving heated effluent from a nuclear reactor. Canadian Journal of Zoology, 48(4): 881-885.

[18-45] Grefner, N. M., Yakovleva, T. L., Boreysha, I. K. (1998): Effects of electromagnetic radiation on tadpole development in the common frog (Rana temporaria L.). Russian J. Ecol. 29:133–134.

[18-46] Gvoždík, L. Puky M. és Šugerková M. (2007): Acclimation is beneficial at extreme test temperatures in the Danube crested newt, Triturus dobrogicus (Caudata, Salamésridae). Biological Journal of the Linnean Society 90: 627–636.

[18-47] Györe, K. (1995): Magyarország természetesvizi halai. Környezetgazdálkodási Intézet, Budapest 339 pp..

[18-48] Haidakker A. (2004): The effect of water temperature regime on benthic macroinvertebrates. A contribution on the ecological assessment of rivers. Inaugural-Dissertation, Universitat Duisburg-Esen, 92. pp.

[18-49] Hamer, A.J. és McDonnell, M.J. (2008): Amphibian ecology és conservation int he urbanising world: A review. Biological Conservation 141: 2432-2449.

[18-50] Haraszthy, L. (szerk.) (2014): Natura 2000 fajok és élőhelyek Magyarországon. Pro Vértes Közalapítvány, Csákvár, ISBN 978-963-08-8853-0

[18-51] Harka Á. & Bíró P. (2007): New patterns in Danubian distribution of Ponto-Caspian gobies – a result of global climatic change and/or canalization? Electronic Journal of Ichthyology 1: 1-14.

[18-52] Herrera-Montes, M.I. and Aide, T.M. (2011): Impacts of traffic noise on anuran és bird communities. Urban Ecosyst (2011) 14:415–427.

[18-53] Higley, K. A., Alexakhin, R. M., & McDonald, J. C. (2004): Dose limits for man do not adequately protect the ecosystem. Radiation protection dosimetry, 109(3), 257-264.

[18-54] Hopkin , S. P., D. T. Jones and D. Dietrich (1993): The isopod Porcellio scaber as a monitor of the bioavailability of metals in terrestrial ecosystems: towards a global 'woodlouse watch' scheme. Science of the Total Environment 357-365.

[18-55] Hopkin, S.P. (1989): Ecophysiology of metals in terrestrial invertebrates. London: Elsevier Applied Science Publishers Ltd; 120–140.

[18-56] Horváth F., Dobolyi K. Z., Morschhauser T., Lőkös L., Karas L., Szerdahelyi T. (1995): Flóra Adatbázis 1.2. Taxon-lista és attribútum-állomány. Flóra Munkacsoport MTA Ökológiai és Botanikai Kutatóintézete és MTM Növénytár, Vácrátót - Budapest, 252 pp.

[18-57] Horváth Gy – Molnár Dániel – Nagy Tibor – Baksza Ildikó – Németh Tamás: 2004: A gyöngybagoly (Tyto alba) költési paramétereinek és táplálék-összetételének vizsgálata a költőhelyek tájmintázatának elemzése alapján. Természetvédelmi közlemények, 11. 491-499.Wijnandts, H. 1984: Ecological energetics of the long-eared owl (Asio otus). Ardea 72, 1-92.

[18-58] Huss M. (2011): Melting glaciers: Is there an impact on the Danube hydrology? Danube News, May 2011, No. 23. Vol. 13. p. 5-8.

[18-59] IAEA (2014): International Conventions and Agreements

[18-60] IPCC (2007): Climate Change 2007: Synthesis Report. Contribution of Working Group I, II and II to the Fourth Assessment Report of the Intergovernmental Panel of Climate Change. IPCC, Geneva, Switzerland.

[18-61] IUCN (1996): 1996 IUCN Red List of Threatened Animals. – IUCN, Gland, Switzerland, 368 pp.

[18-62] Jackson, C. W., Hunt, E., Sharkh, S., & Newland, P. L. (2011): Static electric fields modify the locomotory behaviour of cockroaches. The Journal of experimental biology, 214: 2020-2026.

[18-63] Kafel, A. Gospodarek, J. Zawisza-Raszka, A. Rozpędek, K. Szulińska, E. (2012): Effects of Petroleum Products Polluted Soil on Ground Beetle Harpalus rufipes. Ecological Chemistry and Engineering. A. 19:. 731--740.

[18-64] Katona K. (1997): Az ürge mikrohabitat használata Bugacpusztán. Szakdolgozat ELTE Etológiai Tsz. Pp. 47.

[18-65] Kék Csermely Kft. (2010): Vizsgálati jelentés a Paksi Atomerőmű üzemidő hosszabbításának környezetvédelmi engedélyében előírt, a Duna ökológiai állapotának jellemzésére alkalmas monitoring program végrehajtásáról. 2009.04. – 2010.04. időszak. Kék Csermely Kft., 2010.

[18-66] Király G. – Virók V. – Molár V. A. (ed.) (2011): Új magyar füvészkönyv. Magyarország hajtásos növényei. Rajzok. – ANP Igazgatóság, Jósvafő.

[18-67] Király G. (ed.) (2009): Új magyar füvészkönyv. Magyarország hajtásos növényei. Határozókulcsok. – ANP Igazgatóság, Jósvafő, 616 pp.

[18-68] Kis, J., Váczi, O., Katona, K. Altbacker, V. (1998): A növényzetmagasság hatása a cinegési ürgék élőhely választására. Természetvédelmi Közlemények 7: 117-123.

[18-69] Kiss I. (szerk.), Bakó B., Dankovics R., Kovács T., Szénási V. (2005): Nemzeti Biodiverzitás-monitorozó Rendszer Kétéltűek és hüllők monitorozásának protokollja. KvVM Természetvédelmi Hivatal, NBmR Mintavételi módszerek. pp. 17.

[18-70] Klapper H. (1991): Control of eutrophication in Inland waters. Ellis Horwood Ltd., West Sussex, UK.

[18-71] Kovács T. & Ambrus A. (2010): Szitakötők faunisztikai vizsgálata a Szigetközben. – In: Gubányi, A. & Mészáros, F. (szerk.): A Szigetköz állatttani értékei. Magyar Természettudományi Múzeum, Budapest, 39–48.

[18-72] Kovács, T., Ambrus, A., Bánkuti, K. & Juhász, P. (1998): New Hungarian mayfly (Ephemeroptera) species arising from collectings of larvae. – Miscellanea zoologica hungarica, 12: 55–60.

[18-73] Lawrence J.E., Lunde K.B., Mazor R.D., Bêche L.A., McElravy E.P., & Resh V.H. (2010): Long-term macroinvertebrate responses to climate change: implications for biological assessment in mediterranean-climate streams. Journal of the North American Benthological Society, 29(4): 1424-1440.

[18-74] Lehman, R.N., Kennedy, P.L., Savidge, J.A. (2007): The state of the art in raptor electrocaution research: A global review. Biological Conservation 136, 159-174.

[18-75] Lengagne, T. (2008): Traffic noise affects communication behaviour in a breeding anuran, Hyla arborea. Biological Conservation 141: 2023–2031.

[18-76] Lensu, T., Komonen, A., Hiltula, O., Päivinen, J., Saari, V., & Kotiaho, J. S. (2011): The role of power line rights-of-way as an alternative habitat for declined mire butterflies. Journal of environmental management, 92: 2539-2546.

[18-77] Lésesman, R. H., Douglas, W. S. (1990): Abnormal limb regeneration in adult newts exposed to a pulsed electromagnetic field. Teratology 42:137–145.

[18-78] Lofgren B.M. (2002): Global warming influences on water levels, ice, and chemical and biological cycles in lakes: some examples. In: McGinn N.A. (ed): Fisheries in a changing climate. American Fisheries Society, Bethesda, MD, pp. 15–22.

[18-79] Magyar Természettudományi Múzeum (2004): A paksi telephely jellemzését szolgáló, a környezetvédelmi-, telephely- és vízjogi engedélyezéssel összefüggő monitorozási program végrehajtása. Minta értékű zoológiai bio-monitoring vizsgálatok. - MTM Állattár, Budapest, 82 o.

[18-80] Mann, R.H.K. (1996): Environmental requirements of European non-salmonid fish in rivers. Hydrobiologia 323: 223-235.

[18-81] Maurer, R. (1974): Die Vielfalt der Käfer- und Spinnenfauna des Wiesenbodens im Einflußbereich von Verkehrsimmissionen. Oecologia 14:327-351.

[18-82] Mills, C.A:, Mann, R.H.K. (1995): Environmentally-induced fluctuations in year-class strength and their implications for management. Journal of Fish Biology 27: 209-226.

[18-83] Moog O., Graf W., Ofenböck T. & Wiesner C. (2009): Neozoen der Fisch- und Makrozoobenthosfauna in Österreich. 2. Österreichische Neobiota Tagung: "Neobiota und Klimawandel". Universität für Bodendkultur, Wien, 2009

[18-84] Mouthon J. & Daufresne M. (2006): Effects of the 2003 heatwave and climatic warming on mollusc communities of the Saône: a large lowland river and of its two main tributaries (France). Global Change Biology 12: 441-449.

[18-85] Lévai projekt, Környezeti hatástanulmány összeállítását megalapozó szakterületi vizsgálati és értékelési programok kidolgozása és végrehajtása, Minta értékű bio-monitoring vizsgálatok, 2012

[18-86] MVM Paks II. Zrt., A Tolnai-Duna (HUDD20023) érintett területének Natura 2000-es hatásbecslési dokumentációja., 2013

[18-87] MVM Paks II. Zrt., Minta értékű bio-monitoring vizsgálatok, 2013

[18-88] Newland, P. L., Hunt, E., Sharkh, S. M., Hama, N., Takahata, M., & Jackson, C. W. (2008): Static electric field detection and behavioural avoidance in cockroaches. Journal of Experimental Biology 211: 3682-3690.

[18-89] Noordijk, J., Schaffers, A.P., Heijerman, T., Sýkora, K.V. (2011): Using movement and habitat corridors to improve the connectivity for heathland carabid beetles. Journal for Nature Conservation 19:276-284.

[18-90] Nummelin, M., Lodenius, M., Tulisalo, E., Hirvonen, H., & Alanko, T. (2007): Predatory insects as bioindicators of heavy metal pollution. Environmental Pollution 145: 339-347.

[18-91] Oertel N., Nosek J. & Andrikovics S. (2005): A magyar Duna-szakasz litorális zónájának makroszkópikus gerinctelen faunája (1998-2000). – Acta Biologica Debrecina, Supplementum

[18-92] Ormerod, S. J. (2009): Climate change, river conservation and the adaptation challenge. Aquatic Conservation: Marine and Freshwater Ecosystems 19: 609-613.

[18-93] Oxley, DJ, MB Fenton, GR Carmody (1974). The effects of roads on populations of small mammals. Journal of Applied Ecology, 11: 51-59.

[18-94] ÖKO Rt. (2005). Paksi Atomerőmű üzemidő hosszabbítás RKTH kidolgozása. Hidrobiológia, vízminőségi és ökológiai állapotfelmérés a Paksi Atomerőmű térségében. ÖKO - környezeti, gazdasági, technológiai, kereskedelmi szolgáltató és fejlesztési Rt., 2005.

[18-95] Panrok, A., Szövényi, G. (2013): First record and current distribution of Omocestus minutus (Brullé, 1832) (Orthoptera: Acrididae) in Hungary. - Articulata 28: 91-102.

[18-96] Pekarova P., Halmova D., Miklanek P. & Onderka M. (2008): Is the Water Temperature of the Danube River at Bratislava, Slovakia, Rising? Journal of Hydrometeorology 9: 1115-1122.

[18-97] Pieau, C. (1982): Modalities of the action of temperature on sexual differentiation in field-developing embryos of the European pond turtle *Emys orbicularis* (Emydidae). Journal of Experimental Zoology. 220(3): 353–360.

[18-98] Pieau, C., Dorizzi, M., Richard-Mercier, N. és , Desvages, G. (1998): Sexual Differentiation of Gonads as a Function of Temperature in the Turtle Emys orbicularis: Endocrine Function, Intersexuality and Growth. The Journal of .Experimental Zoology 281:400–408.

[18-99] Pópez-López, P., Ferrer, M., Madero, A., Casado, E., McGrady, M. (2011): Solving man-induced large-scale conservation problems: The spanish Imperial Eagle and power lines. PlosOne, Volume 6, Issue 3, e17196.

[18-100] Posthuma, L., & Van Straalen, N. M. (1993): Heavy-metal adaptation in terrestrial invertebrates: a review of occurrence, genetics, physiology and ecological consequences. Comparative Biochemistry and Physiology Part C: Pharmacology, Toxicology and Endocrinology 106: 11-38.

[18-101] Prasch M. & Mauser W. (2011): GLOWA-Danube: Integrative techniques, scenarios and strategies for the future of water in the Upper Danube Basin. Danube News, May 2011, No. 23. Vol. 13. p. 2-5.

[18-102] Schaub A, Ostwald J and Siemers BM (2008). Foraging bats avoid noise. Journal of Experimental Biology, 211, 3174-3180.

[18-103] Sergio, F., Marches, L., Pedrini, P., Ferrer, M., Penteriani, V. (2004): Electrocaution alters the distribution and density of a top predator, the eagle owl Bubo bubo. Journal of Apllied Ecology 41, 836-845.

[18-104] Sharon, Wise, S. (2007): Studying the Ecological Impacts of Light Pollution on Wildlife: Amphibians as Models. Presentation at the International Conference in Defence of the Quality of the Night Sky és the Right to Observe the Stars

[18-105] Simon T. (1992): A magyarországi edényes flóra határozója. Harasztok – virágos növények. Nemzeti Tankönyvkiadó, Budapest. p. 892.

[18-106] Simon T. (2000): A magyarországi edényes flóra határozója. – Harasztok-virágos növények – Tankönyvkiadó, Budapest. 976 pp.

[18-107] Singh, A.P. és Kaur, R. (2014): Electromagnetic fields: biological implications on various life forms. International Journal of Bioassays 3(04): 2030-2040.

[18-108] Sipkay Cs., Kiss K.T., Vadadi-Fülöp Cs. & Hufnagel L. (2010): The possible effects of climate change on the phytoplankton communities in the Danube river, Hungary. 38th IAD Conference, June 2010, Dresden, Germany, Extended Abstracts, p. 1-5.

[18-109] Sipkay Cs., Nosek J., Oertel N., Vadadi-Fülöp Cs. & Hufnagel L. (2007): Klímaváltozási szcenáriók elemzése egy dunai Copepoda faj szezonális dinamikájának modellezése alapján. "KLÍMA-21" Füzetek, 49: 80-90.

[18-110] Smith K. (1972). River water temperatures – an environmental review. Scottish Geographical Magazine 88: 211–220.

[18-111] Sorvari, J., Rantala, L. M., Rantala, M. J., Hakkarainen, H., & Eeva, T. (2007): Heavy metal pollution disturbs immune response in wild ant populations. Environmental Pollution 145: 324-328.

[18-112] Sotavalta, O (1963): The Flight Sounds of Insects. Pages 374-390 in Busnel, R.G.(ed.).Acoustic Behavior of Animals. Elsevier Publishing Co .Amsterdam

[18-113] Söderman, T. (2006): Treatment of biodiversity issues in impact assessment of electricity power transmission lines: A Finnish case review. Environmental Impact Assessment Review 26, 319-338.

[18-114] Spellerberg IF (1998). Ecological effects of roads and traffic: A Literature Review. Global Ecology and Biogeography Letters, 7: 317-333.

[18-115] Stone EL, Jones, G. Harris S (2009). Street lighting disturbs commuting bats. Current Biology, 19 1123-1127.

[18-116] Straile D. (2005): Food webs in lakes – seasonal dynamics and the impacts of climate variability. In: Belgrano A, Scharler U.M, Dunne J & Ulanowicz R.E.

[18-117] Sun, J.W.C., Narins, P.M. (2005): Anthropogenic sounds differentially affect amphibian call rate. Biological Conservation 121: 419–427.

[18-118] Szenczi, P., O Bánszegi, A Dúcs, CsI. Gedeon, G Markó, I Németh, V Altbäcker (2011): Morphology and function of communal mounds of overwintering mound-building mice (Mus spicilegus). J. Mammal., 92: 852-860.

[18-119] Thiele, H. U. (1977): Carabid beetles in their environments. A study on habitat selection by adaptation in physiology and behaviour. Springer-Verlag.

[18-120] Török K. (szerk. 1997): A Nemzeti Biodiverzitás Monitorozó Rendszer IV. Növényfajok. – Magyar Természettudományi Múzeum, Budapest. 130 pp.

[18-121] Váczi O., Altbäcker V (1999) Füves repülőterek ürgeállományának felmérése. Természetvédelmi Közlemények 8, 205-214.

[18-122] van Straalen, N. M., & van Wensem, J. (1986): Heavy metal content of forest litter arthropods as related to body-size and trophic level. Environmental Pollution Series A, Ecological and Biological 42: 209-221.

[18-123] van Vliet M.H.T. & Zwolsman J.J.G. (2008): Impact of summer droughts on water quality of the Meuse river. Journal of Hydrology 353: 1-17.

[18-124] Vannote R.L., Minshall G.W., Cummins K.W., Sedell J.R. & Cushing C.E. 1980: The river continuum concept. Canadian Journal of Fisheries and Aquatic Sciences 37: 30–137.

[18-125] Varga Z., Kaszab Z. & Papp J. (1989): Rovarok - Insecta. – In: Rakonczay, Z. (szerk.): Vörös Könyv. A Magyarországon kipusztult és veszélyeztetett növény- és állatfajok. Akadémiai Kiadó, Budapest: 178–262.

[18-126] Varga, Z., Ronkay, L., Bálint, Zs., László, Gy. M. & Peregovits, L. (2005): Checklist of the Fauna of Hungary. Volume 3. Macrolepidoptera. - Hungarian Natural History Museum, Budapest, 114 pp.

[18-127] Verdonschot P.F.M. (2009): The significance of climate change in streams utilised by humans. Fundamental and Applied Limnology. Archive für Hydrobiologie 174/1: 101-116.

[18-128] Wallace, H. and Wallace B. M.N. (2000): Sex reversal of the newt Triturus cristatus reared at extreme temperatures. Int. J. Dev. Biol. 44: 807-810.

[18-129] Wallace, H., Badawy, G. M. I. and Wallace B. M. N (1999): Amphibian sex determination és sex reversal. CMLS, Cell. Mol. Life Sci. 55: 901–909.

[18-130] Ward J.V. (1985). Thermal characteristics of running waters. Hydrobiologia 125: 31–46.

[18-131] Waringer J. 2011: The influence of temperature and light on aquatic insects. Danube News, May 2011, No. 23. Vol. 13. p. 5-8.

[18-132] Warren, P.S., Katti, M., Ermann, M. és Brazel A. (2006): Urban bioacoustics: it's not just noise. Animal Behaviour 71: 491–502.

[18-133] Webb B.W. & Nobilis E. (1994): Water temperature behaviour in the River Danube during the twentieth century. Hydrobiologia 291: 105-113.

[18-134] Webb B.W. & Walling D.E. (1992): Long term water temperature behaviour and trends in a Devon UK, river system. Hydrological Sciences Journal 37: 567-580.

[18-135] Webb B.W. & Walling D.E. (1993): Temporal variability in the impact of river regulation on thermal regime and some biological implications. Freshwater Biology 29: 167-182.

[18-136] Webb B.W. (1996): Trends in stream and river temperature. Hydrological Processes 10: 205–226.

[18-137] Webb B.W., Hannah D.M.R., Moore D. Brown L.E. & Nobilis F. (2008): Recent advances in stream and river temperature research. Hydrological Processes 22: 903-918.

[18-138] Willis, K. J. Gillson, L., Brncic, T. M. and Figueroa-Rangel, B. L. (2005): Providing baselines for biodiversity measurement. Trends in Ecology and Evolution 20(3): 107–108.

[18-139] You-Shao Wang (2011). Effects of the Operating Nuclear Power Plant on Marine Ecology and Environment - A Case Study of Daya Bay in China, p. 255-290., Tsvetkov, P. (Ed.) Nuclear Power - Deployment, Operation and Sustainability.

[18-140] Zaidi, Sahar & Khatoon, Surayya: Effects of electromagnetic fields (created by high tension lines) on the indigenous floral biodiversity in the vicinity of Karachi-I: Studies on PMC meiosis, meiotic products and pollen fertility – Pak. J. Bot., 35 (5): 743-755.2003

[18-141] Zaidi, Sahar & Khatoon, Surayya: Effects of electromagnetic fields (created by high-tension lines) on some indigenous plant species in the vicinity of Karachi–II. Asteraceae – Pak. J. Bot.., 44(4): 1311-1318, 2012.

[18-142] Zaidi, Sahar, Khatoon, Surayya &Shaukat Shahid: Effects of electromagnetic fields on some indigenous plantspecies–III. Capparaceae and Chenopodiaceae

[18-143] Zvereva, E. L., & Kozlov, M. V. (2010): Responses of terrestrial arthropods to air pollution: a meta-analysis. Environmental Science and Pollution Research 17: 297-311.

Data sources made available by MVM Lévai Project:

[18-144] A Paksi Atomerőmű Üzemidő-hosszabbítása Környezeti Hatástanulmány, ETV-ERŐTERV Rt., 000000K00004ERE/A, 2006. február

[18-145] Zárójelentés a Paksi Atomerőmű telephely-jellemzési programjának keretében a minta értékű zoológiai bio-monitoring vizsgálatokról, ETV-ERŐTERV Rt., 0000K00ERA00041/A, 2004. március

[18-146] A Paksi Atomerőmű Rt. szűkebb körzetének növényvilága (Részjelentés), Farkas Sándor, Paks, 2001. szeptember-október

[18-147] A Paksi Atomerőmű Rt. szűkebb körzetének növényvilága III. (Összesítő jelentés), Farkas Sándor, Paks, 2002. december

[18-148] A Paksi Atomerőmű Rt. szűkebb körzetének növényvilága IV. (Év végi összesítő jelentés), Farkas Sándor, Paks, 2003. december

[18-149] A Paksi Atomerőmű Végleges Biztonsági Jelentése 2. fejezet, Paksi Atomerőmű Rt., 2009.

[18-150] Környezetvédelmi felülvizsgálatok jelentései, PA Zrt.

[18-151] A Paksi Atomerőmű üzemidő hosszabbításának környezetvédelmi engedélyében előírt, a Duna ökológiai állapotának jellemzésére alkalmas monitoring program végrehajtásáról, Kék-Csermely Kft. 2009-2010 I. félév

[18-152] Előzetes konzultációs dokumentáció, Pöyry Erőterv Zrt., 6F111121/0002/O, 2012. 01.31.

[18-153] Mélyépterv Komplex Zrt.: A PAKSI ATOMERŐMŰ Zrt. területén létesítendő új blokkok hűtési lehetőségeinek vizsgálata, Döntés előkészítő tanulmány, 2011.

Offiical data archives

[18-154] http://www.termeszetvedelem.hu

[18-155] http://www.termeszetvedelem.hu/termeszetvedelmi-celkituzesek-prioritasok-natura-2000-teruleteken

[18-156] http://www.termeszetvedelem.hu/_user/downloads/mintavetel/makrozoo_protokoll_uj_080218.pdf

[18-157] http://www.termeszetvedelem.hu/_user/browser/File/Natura2000/Natura%202000%20teruletek%20adatlapjai_2011_okt/HUDD20023.pdf

[18-158] http://www.novenyzetiterkep.hu/

[18-159] http://natura2000.eea.europa.eu/#

[18-160] http://www.natura.2000.hu/index.php?p=termegorze&nyelv=hun

[18-161] https://www.teir.hu/

[18-162] http://ddnp.nemzetipark.gov.hu/_user/browser/File/NATURA2000/tolnaiduna/tolnaiduna_atnez.jpg

[18-163] http://www.iaea.org/PRIS/WorldStatistics/ShutdownReactorsByCountry.aspx (2014.05.26-i megtekintés)

Aearial photos

[18-164] Eurosense Kft. által 2013. évben készített digitális ortofotó RGB kivágata

[18-165] Eurosense Kft által 2013. évben készített digitális ortofotó infra kivágata

Software

[18-166] Qantum GIS 1.8

[18-167] Microsoft Office 2010

[18-168] Google Earth