Hungarian Biodiversity Monitoring System

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State Secretariat for Nature and Environment Protection
Ministry of Environment and Water

Ministry of Environment and Water

TERMÉSZETVÉDELEM

THE HUNGARIAN BIODIVERSITY MONITORING SYSTEM

The Hungarian Biodiversity Monitoring System (HBMS) is a national programme governed by the State Secretariat for Nature and Environment Protection, Ministry of Environment and Water, and its mission is the long-term surveillance of the status and trends of biological diversity in Hungary.

Hungary ratified the Convention on Biological Diversity in 1994 and declared it in Act No. 81 of 1995, assuming legal responsibility for its implementation. Act No. 53 of 1996 on the nature conservation makes provision for surveying and sampling biological diversity for the purposes of nature conservation. The first step to develop HBMS was to elaborate the programme, after which data collection could begin. Today, the programme has more than ten years of experience on monitoring for conservation. Its international recognition is shown by the fact that experts from numerous European countries have expressed their interest for the experience gathered during the years of operation, and used it to develop their own national monitoring systems.

We hereby wish to inform experts and the general public about the goals, structure, and results of HBMS as well as its compliance with legal requirements of the European Union.

The diversity of living organisms is a fundamental biological feature without which life cannot exist on Earth. Biological diversity enables through natural selection the adaptation to a continuously changing environment, which results in the relative stability of living systems.

Biological diversity varies in time and space. In a geological timescale, species have always evolved and become extinct, just as today. The ever-growing human population of Earth and the more and more widespread and intensive human activities (agriculture, forestry, fisheries, industry, transport, tourism, energy production and mining) that satisfy the increasing demands threaten the survival of wildlife.

The rapid extinction of species has drawn attention to the vulnerability of the biosphere. The exploitation of natural resources has led primarily to fragmentation and loss of habitats, expansion of invasive species, decline of wildlife, pollution of water, soil and air, and furthermore, to global climate change. These all contribute to the modification, usually reduction of biological diversity. At the same time nature provides renewable resources and services that are used daily by humans (e.g. soil formation, medicines, etc.). Thus, the loss of nature also threatens our own survival.

Fifteen years ago, an international convention, known as the Convention on Biological Diversity (CBD), was signed in Rio de Janeiro, Brazil, which Hungary also signed and ratified. One of the basic commitments of the Parties is that a national strategy and supporting legislation have to be formed that enable the conservation of biological diversity and the sustainable use of its certain components.

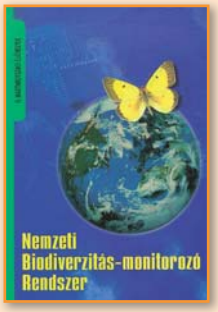
The implementation of the nature directives of the EU also poses significant tasks for the preservation of biodiversity. The Commission of the European Union issued a declaration in 2006 with the title "Halting the loss of biodiversity until 2010 and beyond". This summarises the scope of problems, and identifies key policy actions, objectives and the measures needed for implementation. To meet these obligations and undertakings, it is vital to know the status and trend of the biota, and that this knowledge should be based on long-term, continuous and repeated surveys. In parallel with this, Hungary also joined the "Countdown 2010" campaign of IUCN (International Union for the Conservation of Nature) in 2006, undertaking, among others, to divulge information on biodiversity in order to raise awareness. It is hoped that this publication will also contribute to achieving these goals.

Beyond the diversity of species, biological diversity also includes the infraspecific variability of species and the diversity of associations of living organisms. Biodiversity monitoring implies the long-term observation of certain characteristics of selected species and communities. Observation of the natural conditions provides the basis for recognition and evaluation of processes different from the natural ones. The aim of monitoring can also be to study the effects of certain known or predictable environmental changes on an ecosystem, such as sinkage of water-table level or climate change. Taking into account the extremely large number of species and habitats, it is simply not feasible and not sensible to monitor everything and everywhere. The following principles were taken into consideration when designing the Hungarian monitoring activities:

– monitoring of the status of protected and threatened natural values,
– observation of indicators of the general status of ecosystems in the country,
– study of direct or indirect effects of certain human activities or environmental factors.

DEVELOPMENT OF THE HUNGARIAN BIODIVERSITY MONITORING SYSTEM (HBMS)

In compliance with the National Nature Conservation Concept (1994), and in line with the forming National Biodiversity Strategy and Action Plan, the development of a national monitoring system was initiated by the Authority for Nature Conservation in 1996 with the support of the PHARE programme of the European Union, involving several research institutes. As a result of several years of work, the programme of HBMS was published in a ten-volume manual in 1997, to which an eleventh volume was added in 1999, and later the whole series was made available on the internet. Building on the expert advice of many ecologists, this programme provides the theoretical background of wildlife monitoring, the selection process and sampling methods of species, communities and habitats. As a major novelty in this field, the experts elaborated the habitat classification system of Hungary. It has been revised several times since, but still serves as the basis for habitat mapping.



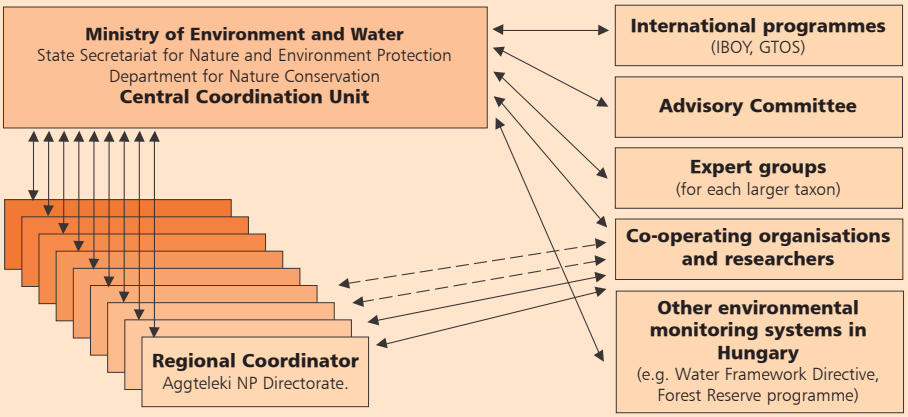
Based on this programme, development of the monitoring system started in 1997. Field surveys began in 1998. The number of components monitored increases each year.

During 2003-2005, a comprehensive review was carried out for HBMS. For some taxa, it resulted in refining and improving the sampling methods, while in other taxa the data sets from several years were evaluated. Efficiency of the system and use of data were also studied, and the results verified that biotic data provided by the programme are useful in the daily work of both professional researchers and nature conservationists.

In addition to giving technical guidance, the HBMS programme also made a proposal for the structure and development of a monitoring organisation within the state nature conservation organisations to govern and administratively manage HBMS, and to carry out co-ordination and implementation of sampling.

The first year in the operation of the system was 1997, when a Central Coordination Unit (CCU) was formed. Development and coordination of the national programmes are provided by the CCU, while local tasks are coordinated regionally. Since 1998, one regional co-ordinator works on implementation of local tasks in each national park directorate.

The CCU puts special emphasis on involving a wide range of experts. Decisions reached by consensus of all concerned provide a strong ground for close collaboration of experts within the frame of the monitoring system. Expert groups have been formed for each higher taxon to discuss the results of surveys and data analysis. These expert groups carry out the review and constant improvement of methodologies.

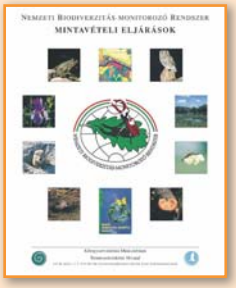


Technical supervision of the entire programme is provided by an independent Advisory Committee consisting of prominent experts. HBMS also rests on the contribution of external institutions, i.e. research institutes, universities and NGOs that carry out sampling and data analysis on a national or regional scale. Some tasks that do not require expert input are carried out by involving volunteers from nature conservation societies or schools. In addition to technical work, informing the general public is also an important task. Hungary's natural heritage is still outstanding at the European level, and its conservation needs a concerted response from society, including other sectors of public administration and local communities.

Monitoring and long-term observation of biodiversity is not only a requirement of the Convention on Biological Diversity, but it is also a priority task in the European Union. Upon Hungary's accession, implementation of the nature directives were also undertaken, including the Directive on the Conservation of Wild Birds (79/409/EEC), and the Directive on the Conservation of Natural Habitats and of Wild Flora and Fauna (92/43/EC), which aim to preserve the natural heritage and biological diversity of Europe through the conservation of species and habitats of Community importance.

During the selection of components to be studied by HBMS, both nationally protected natural values as well as vulnerable, rare, endangered or endemic species and localised and threatened habitats listed on the annexes of the two directives for community level protection were considered. Under Article 17 of the Habitats Directive, the conservation status of species and habitats of community importance has to be continuously monitored and reported every six years to the European Commission. Instead of a detailed guidance, the Commission only provides recommendations on the methodology of surveying and sampling, as well as the format of reporting. HBMS covers many of the species and habitats of community importance. In certain taxa, steps have already been made to test the methodology used for several years and improve it towards EU compliance. Therefore, data gathered in the frame of HBMS are suited to comply with EU reporting obligations, but the components to be studied and the number of sampling sites have to be extended.

The Water Framework Directive (2000/60/EC), aiming to protect surface and underground waters and enhance their quality, is also relevant for nature conservation, as it requires to use ecological water qualification based on macrophyton, phytoplankton, phytobenthos, macroscopic invertebrates and fishes to determine the status of waters. Despite the differring goals of individual monitoring projects, the surveys can be based on a common methodology. For wetland-related components studied in the frame of HBMS, sampling methods have been harmonised with the provisions of the directives in the past few years.



Monitoring activities have been grouped into projects that have been formulated, based on the series of monitoring manuals, by defining the objectives and setting out the exact tasks. In addition to the ten projects defined in the first stage, an eleventh project has also been elaborated in order to implement the monitoring tasks laid down by the nature directives of the European Union.

- **I.** Monitoring of protected and threatened species
- **II.** Monitoring of wetland habitats and their communities
- **III.** Surveying, mapping and monitoring of habitat types in Hungary
- **IV.** Monitoring of invasive species
- **V.** Monitoring of forest reserves and managed deciduous woodlands
- **VI.** Monitoring of plant and animal species in the Kis-Balaton
- **VII.** Monitoring of wildlife communities of the River Dráva
- **VIII.** Monitoring of saline habitats
- **IX.** Monitoring of dry grasslands
- **X.** Monitoring of montane meadows
- **XI.** Monitoring of species and habitats of community importance (Natura 2000)

Within each project, appropriate components (such as habitats, communities, populations of species) have been carefully selected to achieve the objectives set out. For the sake of standardisation of monitoring activities, detailed guidance (termed as protocols) has been prepared for each component with the help of specialist teams. The protocols contain detailed guidelines for the selection of sample plots, the studied parameters, sampling methods, frequency of sampling and the derived parameters that are able to show correlations and trends.

Components monitored by the HBMS are habitats, plant associations, protected and invasive plant species, mosses, fungi, mammals (small mammals, root vole, bats, souslik, steppe mouse, dormice), amphibians, reptiles, fishes, aquatic macroinvertebrates, dragonflies, butterflies, larger moths, terrestrial arthropods and orthopterans. Monitoring programmes focussing on particular regions also cover other taxa, depending on the specialities of the given site, such as birds, molluscs, spiders, caddisflies, algae and zooplankton.

The following part of the brochure describes those components whose monitoring has yielded the most robust, nationally important results, and whose surveying is carried out by a large number of contributors.

Within the framework of the HBMS there are several projects that also involve volunteers (students, undergraduates, teachers, NGO-s etc.). By activating large numbers of people, these projects make countrywide monitoring possible. Besides, they play an educational role by actively involving the public in the protection of natural values. Volunteers' monitoring activity requires careful preparations and management. It is helpful to describe the sampling method in detail in a professionally written handout. Prior to the survey it is also useful to organise trainings and field visits. Precise data collection and standardised data sets can only be ensured if tasks are unambiguously determined. The organisation of sustained monitoring is an extremely difficult task, and experience has shown that involving persistent participants requires a lot of time and effort, therefore training needs to be repeated many times.

European ground squirrel survey

The first programme based on the active participation of volunteers was launched in 2000 to assess the Hungarian population of ground squirrels. The programme was a great success as shown by the fact that each year numerous volunteers take part in the Ground Squirrel Monitoring Event arranged on Earth Day. The key to success is a simple method to count the burrow entrances of ground squirrels in a standardised way. An information leaflet has been published to help this monitoring project.

Monitoring amphibians

In the course of testing the monitoring methods for amphibians during 2001, volunteers played a significant role in collecting data from five regions of the country. Over 80% of their data were concordant with those of experts who worked at the same time and in the same localities. A conclusion of the pilot project was that an expert co-ordinator is necessary in each region, and handouts must be prepared. Also, prior to commencing independent field work, volunteers should participate in several surveys led by the co-ordinator.

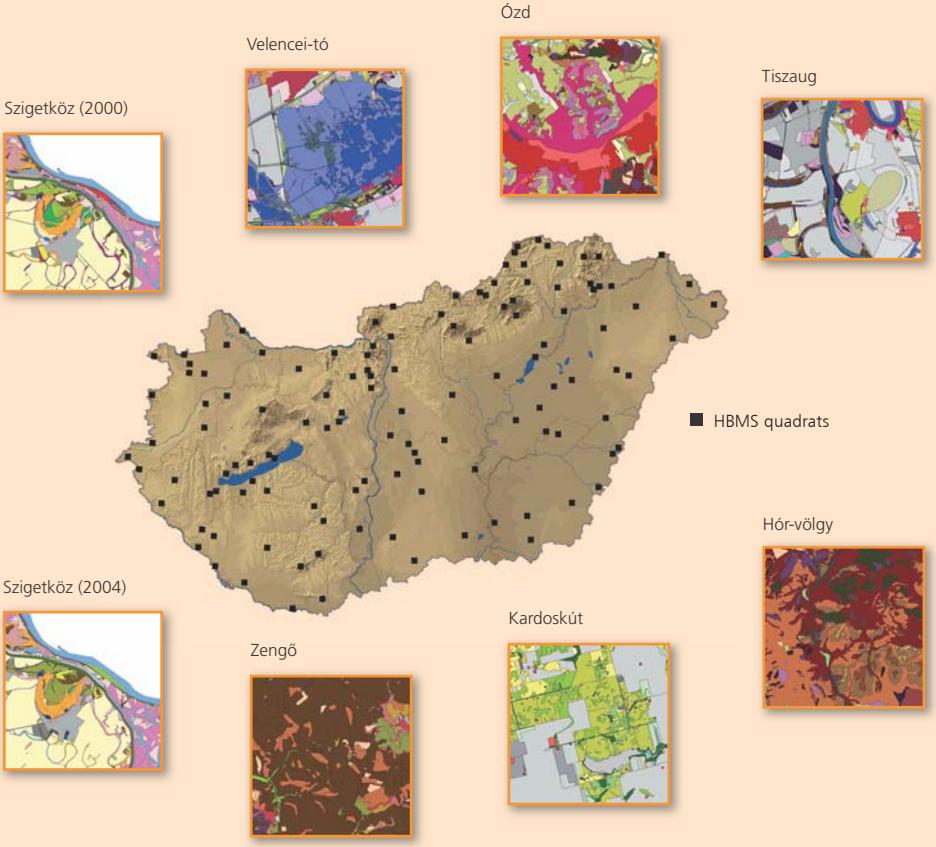
Butterfly monitoring

In several Western European countries butterfly monitoring networks are successfully operated by involving civil groups. After the appropriate training, volunteers can be involved in surveying certain species, and occasionally in estimating caterpillar or food plant numbers. A short, illustrated description of the method has also been published to support volunteers' participation.

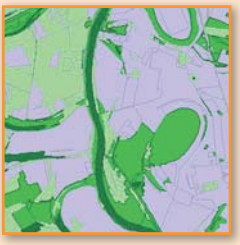
HBMS monitors ecosystem diversity and its changes at the landscape level by habitat mapping. The National Habitat Classification System (NHCS) makes it possible to determine, classify and map any habitat type in Hungary. Not only NHCS, but also the methodology of mapping has been newly developed. The programme has attracted great international interest.

During the initial phases of the programme, a total of 125 5x5 km quadrats were selected for mapping, taking into account nature conservation aspects, regional problems and considerations of general landscape representativity. Maps are produced at a scale of 1:25000. Habitat mapping must be repeated every ten years for each quadrat.

The first round of habitat mapping will be finalised in 2007. Prior to starting the next mapping round in 2008, the special requirements of re-mapping will be identified in the frame of a methodology development process.



Repeated mapping makes it feasible to describe the changes of types and boundaries of habitat patches. Changes at the landscape level can indicate directly the impacts of human activities, e.g. changes in landscape use. In many cases, these patterns help to understand finer changes detected at the association or population levels. Therefore, habitat mapping provides the background and framework for biodiversity monitoring.



Through GIS analysis of maps, different landscapes and their naturalness can be compared, and changes in time can be assessed. The degree and distribution of naturalness of habitats differs from landscape to landscape. Progress of this work and the methods of data analysis are summarised in a publication on the first results of HBMS.

MONITORING OF ROOT VOLE

In Hungary, a rare subspecies of the Root Vole *(Microtus oeconomus méhelyi)* occurs. The species, also known as Tundra Vole or Northern Vole, has been protected since 1974 and strictly protected since 2001. Its populations are scattered in the Carpathian Basin as postglacial relicts along the southern boundary of the species' Holarctic range. It is listed on Appendix III of the Bern Convention and on Annexes II and IV of the Habitats Directive of the European Union.

In Hungary, three isolated populations are known at present, in the Szigetköz, Fertő-Hanság-Tóköz and the Kis-Balaton areas.

Population level monitoring based on HBMS protocol began in 2000. Surveys are repeated annually. Periodic trapping bouts take several days each and provide data on population numbers and changes in time. The population size of the Root Vole fluctuates heavily from year to year. The most recent peak year was 2001 for the Hanság (Lake Barbacsi) population, and was well tracked by repeated sampling of the 50 x 50 m quadrat.

As a result of the data and experience gathered, the Root Vole is now known to be very sensitive to environmental changes in its habitat. One of the most important factors for the species is the proper water supply and water coverage of the habitat. Too high water levels are not suitable for the species. On the other hand, drying out causes the spreading of weeds, further fragmenting the habitats of the Root Vole and wiping out its subpopulations. All these processes are accelerated by human activities (e.g. improper water management, too frequent mowing, burning), so it is very important for the survival of the Root Vole to start the practical implementation of the approved species action plan and to elaborate and implement site management plans for its habitats.

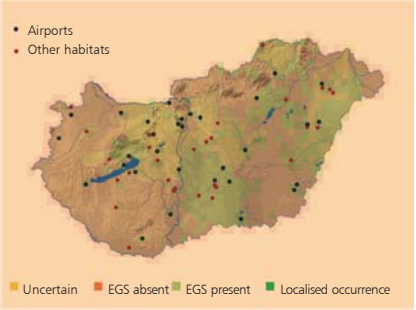
The national survey of European Ground Squirrel *(Spermophilus citellus)* populations has been organised with the active participation of volunteers since 2000, in the week of Earth Day in April.

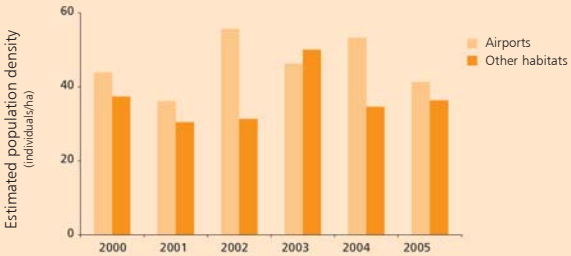
The western border of the range of the ground squirrel lies in Hungary. The Hungarian ground squirrel population has dramatically decreased as a consequence of the loss of suitable habitats, so the species was declared protected in 1982. In addition to national legal protection, the species is listed in Annexes II and IV of the Habitats Directive of the European Union, and appears on the list of strictly protected species of the Bern Convention.

Ground squirrels dig their burrows in open steppes. The burrow is often more than a metre long, and has several entrances. Several of the rare and extremely valuable birds of prey feed on these animals, such as the Saker *(Falco cherrug)* and the Imperial Eagle *(Aquila heliaca)*. Stabilising populations of these raptors can only be achieved if ground squirrel habitats are protected, and if necessary, restored.

Based on earlier experiences, the Department of Ethology of the Eötvös Loránd University, Budapest, elaborated a simple method to estimate population numbers. Having established the average number of burrows per individual, population size can now be assessed by simply counting the burrows used. This method is suitable for a rapid, standardised and synchronous estimation of the relative number of individuals of small-density ground squirrel populations at independent locations, without employing special expertise.

The success of the project is shown by the wide range of participants: school groups led by teachers, nature conservation activists and experts of the national park directorates all submitted reports.





The data clearly show that no drastic change has been observed in the Hungarian population, although ground squirrel have disappeared from certain localities in the past few years. An additional conclusion from the surveys is that it is grassy airports that can ensure the long-term survival of the species in Hungary.

MONITORING SMALL MAMMALS FROM OWL PELLETS

In ecological studies of small mammals, indirect sampling methods based on analyses of owl pellets are often used. Pellets of the Barn Owl *(Tyto alba)* are best for this purpose as this species has the widest prey spectrum among Hungarian owl species. Depending on the availability of different prey species, the preference of this top predator and thus the range of species on its diet may not reflect the full range of potential prey species. Nevertheless, because food preference is relatively constant, the results of annually repeated surveys help to draw conclusions on the quantitative changes of small mammals, both in space and in time.

In the frame of the national monitoring programme, 100 pellets are collected from each of the 96 sample sites, twice a year. After extracting the bones, prey items are identified mostly on the basis of skulls and teeth.

The community level analysis of data and the comparison of entire species lists are good methods to compare monitoring results with earlier data. So far it can be concluded that the small mammal species composition of Hungary has not changed radically, but the abundance of some species has changed. These shifts and changes in the distribution pattern of various species are presumably caused by structural changes in the landscape and in landscape use.

The study of owl pellets provides a general picture on which species or genera are more or less abundant in different parts of the country. New occurrences are also very important in rare and protected species. For example, the results contributed to the more precise range determination of the protected Field Vole *(Microtus agrestis)* and several records confirmed the occurrence of the Striped Field Mouse *(Apodemus agrarius)* in Western and Northern Transdanubia and the distribution of the protected water shrews along lowland rivers.

The study of owl pellets indirectly keeps track of changes in the population size of small mammals, so in addition to a faunistic evaluation, population trends can also be outlined. During the serious droughts in 2002-2003, the vole populations (especially those of the Common Vole) collapsed, which caused owls to take a higher proportion of mice.

In order to protect bat species, it is of key importance to track down any population changes of the most important colonies. A better understanding of their distribution and spatial habitat use also serves to increase the efficiency of protection. In Hungary, 20 protected and 8 strictly protected bat species occur.

Although bats are nocturnal animals, their behaviour, population density and species diversity can be observed and monitored with proper equipment and sufficient practise. Hungarian bats are exclusively insectivorous, so they are good indicators of environmental factors affecting insect communities. For bats, habitat quality is determined by sufficient diversity and quantity of food, and by the availability of proper roosting sites.

Identifying bats is not an easy task, and all methods require special expertise. Colonies are surveyed in buildings and in caves. In order to avoid disturbance, animals are not handled unless it is really necessary. In the frame of HBMS, several methods have been used for monitoring bat communities since 2005.

Daylight counts are used for colonies that live in buildings. Using a strong torch, experts walk around in the roosting site, identify species and estimate the number of adults.

Monitoring of bats in caves is an even more special task, and in Hungary only a few experts combine the skills of bat identification and caving. Caves and mines must be monitored in the winter. The bats hibernate at this time, making accurate identification and counting possible. Although monitoring of mating caves is not suitable for making national population estimates, but reflects well the relative density of species in a given area. If necessary, mistnetting can also be used for monitoring. In order to identify and take measurements of bats at mating caves, it is unavoidable to mistnet and handle them, but this also allows ringing of some specimens. Ringing license for bats is issued to those that pass a special exam.

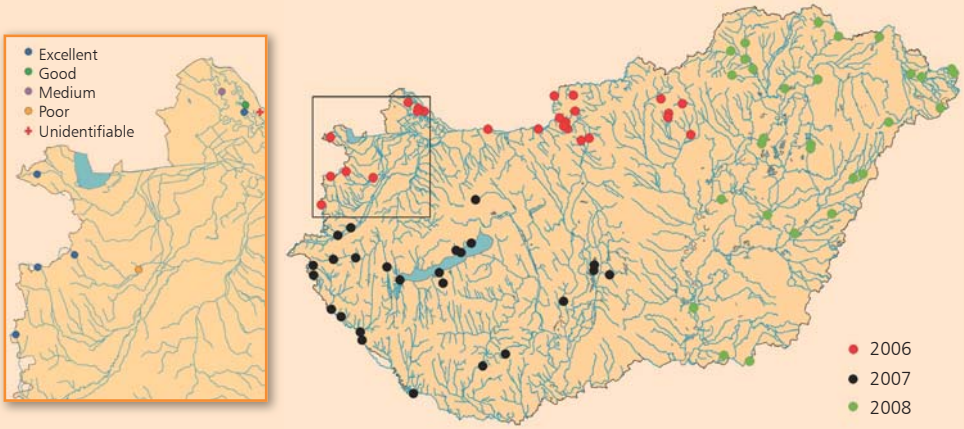
Nationally coordinated monitoring of bats does not have a long history. The first year was 2005, when monitoring was carried out in 139 buildings within 73 settlements. A total of 23,947 specimens belonging to 9 species were observed. During winter, 49 underground localities (caves and mines) were visited, where a total of 16,116 specimens of 18 species were identified. At 25 mating caves, 3,220 specimens of 21 species were mistnetted. Despite the large quantity of data, direction and rate of changes will only be highlighted by annually repeated surveys.

MONITORING OF WETLAND ECOSYSTEMS

Although their overall extension has considerably shrunk and their character has been significantly modified by river regulations and other human activities, wetlands still hold important natural assets. The assessment of aquatic and wetland-dependent communities is not easy, as it requires special expertise. The aim is to observe changes and trends in the populations of selected species and in their communities in order to assess the status of habitats. Water is very diverse as a habitat, and sampling methods must be adapted to this. Therefore, there is no general sampling methodology for the different types of water bodie, such as standing waters, small watercourses, medium-sized and large rivers. The methods applied vary from type to type. The actually used sampling methods for fish and aquatic macroinvertebrates have been developed using practical experience of several years of research and in line with the requirements of the European Union.

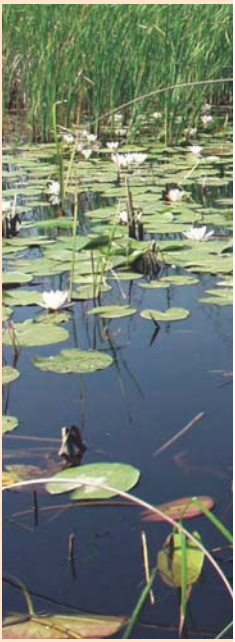
Monitoring of fish communities

In ichthyological surveys, electric fishing is applied in harmony with international practise and with the recommendations of the European Union. In large lakes, this method is complemented by gillnet sampling. Sampling plots must be carefully selected and should be representative for the given waterbody and include a diversity of habitats in order to enable conclusions on the fish composition of the whole waterbody. The quantitative assessment of fish populations and communities also raises several scientific problems. In commercially fished waters, the composition and proportion of species is not natural, and continuous human intervention makes it difficult to interpret changes in the community. On a national scale, surveying of fish communities is carried out in few water bodies, but with large intensity, repeated annually at constant sampling spots. This ensures that changes in communities are tracked and evaluated as accurately as possible in spite of natural and often very large yearly, seasonal and daily fluctuations. Since its launching, the programme has also provided numerous interesting faunistic records.



Monitoring of aquatic macroscopic invertebrate communities

The term 'aquatic macroinvertebrates' embraces a number of different taxonomic groups that are visible among field conditions and are dependent on water during at least one stage of their lifecycles. Because of their sensitivity, they are perfectly suitable for habitat and environment qualification, in which community level studies are particularly important. The monitoring programme began by testing the previously elaborated sampling protocol on a national scale in 2001. Sampling frequency varies between two or three annually, depending on the type of water body, and timing is adjusted to the lifecycles of macroscopic invertebrates. When EU requirements entered into force in Hungary, mainly qualitative sampling methods were replaced by a quantitative sampling method that can be employed in all Hungarian water types after adaptation, taking into account the distribution pattern and proportions of habitat types and enabling statistical analysis. The country's 75 sampling plots are triannually sampled (25 plots each year) and include previously used sampling plots as well as the possible reference points identified for water body types and sampled in 2005 by the programme supporting the implementation of the EU Water Framework Directive in Hungary (ECOSURV). The following taxa are identified to species from the samples: snails, mussels, leeches, crustaceans, mayflies, dragonflies, water bugs, stoneflies, water beetles and caddisflies. In addition to objectively determining species composition, abundance and diversity values, the results of quantitative sampling methods such as AQEM are suitable for a type-specific qualification of ecological status in a system developed for Hungary's water types and help to refine the classification system even further. Out of the 25 sampling plots studied in 2006, 15 rank as excellent, 1 good, 2 medium, 1 poor and 6 did not fit in any of the presently existing ecological classification units (see enlarged map).



MONITORING OF AMPHIBIANS AND REPTILES

The standardised, long-term study of Hungary's amphibian and reptile fauna began in 2001. Monitoring under HBMS initially covered various habitats in the Őrség-Vendvidék area, the Pilis-Visegrád Hills, the Ócsa swamp, the Gödöllő Hills and the Aggtelek Karst, and was extended in 2005 to Lake Fehér at Kardoskút and its surroundings. These surveys are carried out under guidance of specialised experts, and following HBMS protocols for amphibians and reptiles, using numerous methods (counting of adults or spawns, acoustic detection and estimation, night search by torchlight and bottle trapping).

Out of the 18 amphibian species occurring in Hungary, data have been collected from the six selected regions on population changes of 17 species. This represents 94.4 % of Hungary's amphibian species. The highest number of species (12) can be found in the Őrség-Vendvidék area and in the Aggtelek Karst. In nearly all species, populations were found to fluctuate heavily, often extremely, between years in response to changes of the living and inanimate environment. The analysis of data on 26,000 specimens identified in 4 regions and 5 years of monitoring shows that the Common Toad (Bufo bufo) is the most dominant species in three of the regions.

Out of the 15 reptile species living in Hungary, only the 4 rarest do not occur in the sampling plots. Among the 11 species (73.3 %) that have been found, Sand Lizard *(Lacerta agilis)* and Grass Snake *(Natrix natrix)* can be considered the commonest, while Viviparous Lizard *(Zootoca vivipara)* was only observed in one of the regions. With regard to the presence and species diversity of reptiles, the Gödöllő Hills were found to be the most valuable with 8 species. Six species were observed in three other regions, while the number of observed reptile species is surprisingly low in the others. The composition of the fauna and the number of species detected in a given year showed much greater variation in reptiles than in amphibians, which can be probably explained not only by lower population density but also by much poorer detectability in the natural environment.

MONITORING OF ORTHOPTERANS

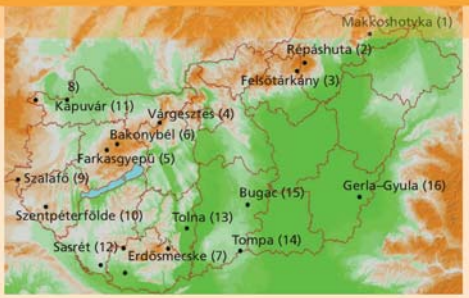
The orthopteran fauna (crickets, grasshoppers and locusts) numbers 974 species in Europe, 120 of which occur in Hungary. From a wildlife conservation aspect, their monitoring is important, since they form the most massive part of grassland-inhabiting insect communities. They are perfectly suitable for monitoring purposes, being relatively easy to collect and, with sufficient practise, unambiguously identifiable to species. Most of them have well-recognisable, species-specific chirping, which, using proper equipment, makes them detectable with great certainty even in low density.

Within HBMS, orthopteran monitoring is carried out at the community level. Several methods are used, including line transect sweep-netting, manual collection and acoustic identification (also using ultrasound detectors). On a national scale, the species composition and abundance of populations in orthopteran communities are surveyed biannually in given plant associations of 70 constant sampling sites with a variety of habitat conditions.

In addition to community level monitoring, the protocol-based surveying under project XI for the six species of community importance occurring in Hungary also started in 2005. These species are: *Isophya costata, I. stysi, Paracaloptenus caloptenoides, Stenobothrus eurasius, Odontopodisma rubripes and Pholidoptera transsylvanica.* In the past two years, occurrences within Natura 2000 sites were identified more accurately for several species, new occurrences of *Odontopodisma rubripes* were found and several older records were confirmed.

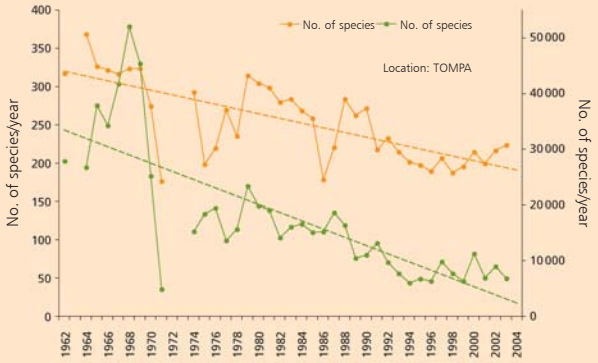
Monitoring provides information not only on the species of community importance but also on other protected and endangered species. In the 2006 community level studies, distribution data were collected on altogether 58 species, representing almost half of the Hungarian fauna (120 species), in a total of 154 sampling sites.

MONITORING OF LARGE MOTHS BY LIGHT-TRAPS



The light-trap network of the forestry service has been operated since 1962 by the Scientific Institute for Forestry (ERTI) for forest protection forecasting purposes. In addition to surveying pest species, the entire large moth *(Macrolepidoptera)* material is constantly sorted out and identified. The HBMS also makes use of the several-decade-long data sets. Interpretation, and thus usefulness of the data is greatly improved by the ecological classification system that characterises every lepidopteran species occurring in Hungary according to its distribution, habitat requirements and lifecycle.

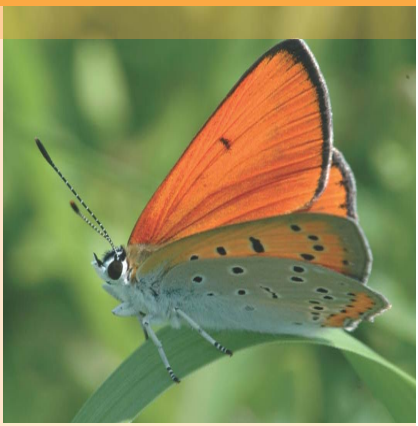
In the last 8 years, experts analysed capture data from 16 light-traps from all over the country. The data sets of four decades show that both the numbers of species and specimens of large moths made a long-term decline of varying size at 11 of the 16 light traps, i.e. in 70% of the studied communities. The change is more significant in species loss, averaging around 2–4 species/year. Species diversity, a quantitative parameter correlating with the changes in species diversity showed a negative trend (decline) in 12 cases, i.e. in three-fourth of the studied forests. Several factors can be suspected to cause these long-term changes in large moth communities (e.g. climate change, landscape use change, aging of forests). However, there are also examples among the light-traps for stability in species richness, or even increases. In the light of these monitoring results, recommendations can be made to halt or possibly reverse unfavourable processes and to re-inforce favourable factors.



As an example, the above diagramme shows the results of data analysis from the forestry light-trap at Tompa. Compared to the 1960s, the light-trap nowadays collects 120 species fewer on a yearly average. The decline is even steeper in the number of specimens: the average annual catch was about 30-50,000 in the 1960s, whereas this figure is typically around 7-8,000 in the years 2000.

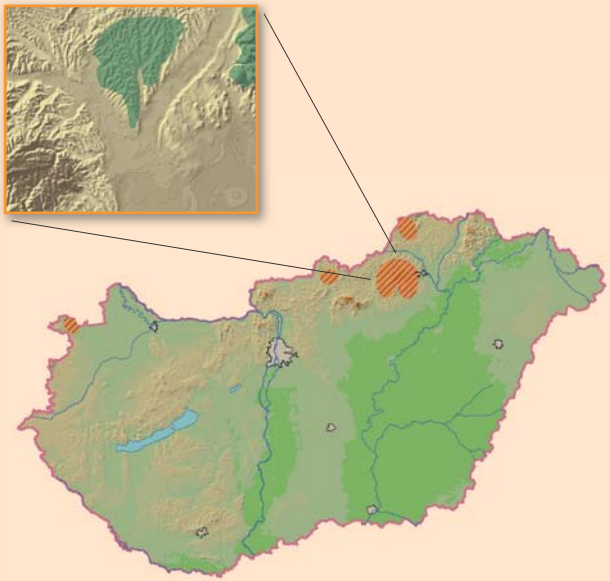
The first step in monitoring butterflies was to collect distribution data and to process archive (museum) capture data and to prepare species range maps on this basis. The next step was to compare these maps and to select the sampling sites. In the frame of HBMS, 6 protected butterflies linked to wet habitats have been monitored by an expert team since 2004. Some of the populations surveyed live in protected areas (used as control sites), but there are also sites in non-protected areas. Thus, environmental impacts can be detected.

The results show that three of the studied species are widespread throughout the country: these are Large Copper *(Lycaena dispar)*, Scarce Large Blue *(Maculinea teleius)* and Alcon Blue *(Maculinea alcon)*, while the other three species, that is Dusky Large Blue *(Maculinea nausithous)*, Geranium Argus (Eumedonia eumedon) and False Ringlet *(Coenonympha oedippus)* are highly localised and the last species occurs in only one locality. As monitoring has only recently begun, long-term trends can hardly be established yet due to the heavy annual fluctuations of the populations. However, it is already clear that information gathered during the monitoring of the six species can greatly support the planning of site management and species protection measures, in general, the efficiency of conservation efforts.

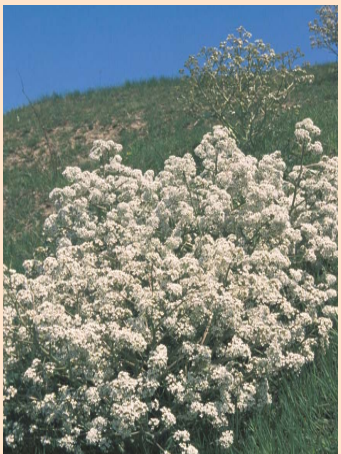


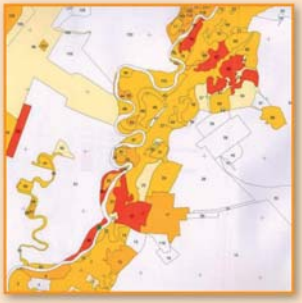
MONITORING OF PLANT SPECIES

In the frame of HBMS, populations of 105 protected and endangered plant species, including those of community importance, have been surveyed since 1998.



The populations of endangered species are surveyed every three years. The most commonly used method is population size estimation by sample counting or by an estimation of coverage. In some cases, population mapping can also be necessary, primarily to keep track of changes in the number of populations of some sporadic species.





Density of *Solidago gigantea* in different habitat patches (in Alsódobsza)

Distribution of Cabomba carolina in 2000
Appeared in 2001
Appeared in 2002
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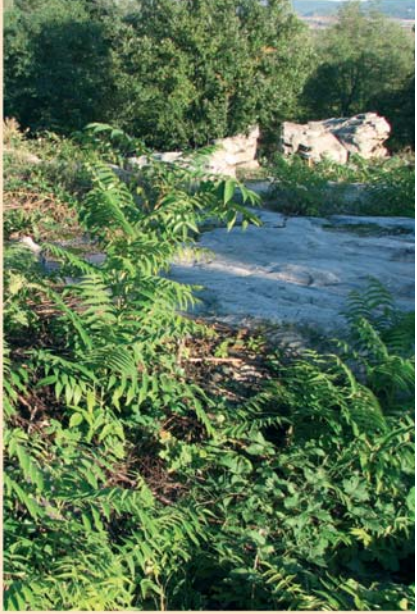
Appeared in 2005

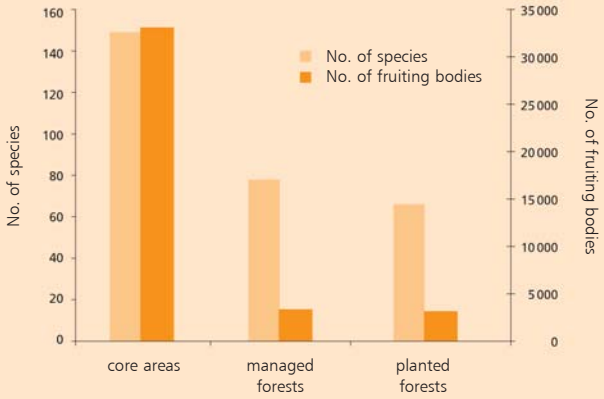


In plant monitoring, the surveillance of invasive species is also outstandingly important. Invasive species rapidly spread over large areas, in the long term supplanting native plant and animal species, leading to an overall reduction in the species richness of communities and associations. Today, it is obvious that in addition to the loss and fragmentation of habitats, one of the greatest threats to biodiversity is posed by the spreading of invasive species. Five of the invasive plants that cause the biggest problems throughout the country are surveyed in the frame of habitat mapping under HBMS: Tree-of-Heaven *(Ailanthus altissima)*, Common Milkweed *(Asclepias syriaca)*, False Indigo *(Amorpha fruticosa)*, Giant Goldenrod *(Solidago gigantea)* and Canada Goldenrod *(S. canadensis)*. The maps thus produced show the degree of infestation in the form of habitat patches.

Cabomba caroliana is a water plant popularly kept in aquariums. Once it gets into wild waters, it spreads rapidly and is capable of supplanting the native floating vegetation entirely. The species has been monitored since 2001 in canals situated in the Danube-Tisza Interfluve, and its year-to-year expansion has been demonstrated (see large map).

The qualitative and quantitative methods for the examination of fungus communities essentially differ from the methods used in botany or zoology. The monitoring of fungi is primarily based on observing the fruiting body, since collection and identification of the underground, vegetative mycelia and mycorrhizae are very difficult. The examination of the fruiting body is also rendered more difficult by several factors: their short lifespan and their considerably weather-dependent, periodic and fluctuating formation.

Taking these problems into consideration, a group of experts has elaborated a method for monitoring fungi. Under the programme launched in 2000, the presence and quantity of species are recorded at permanent sampling sites in three-year periods. Monitoring of fungi is carried out primarily in forest reserves, in core areas and managed stands, both in natural and in artificially afforested stands, within the Bükk, Bakony, Mecsek, Őrség, Zala, Zselic and Börzsöny. The results of two forest reserves clearly show that the amount of dead wood is extremely important in maintining the biological diversity of epiphytic saprophytes and parasites, and that undisturbed habitats are also favourable for mycorrhizal species. In artificially afforested stands, both the numbers of species and individuals were much lower.



For large fungi, the most favourable habitat (mainly due to the amount of dead wood) is in the core areas not managed by forestry, which is also reflected in the outstandingly high numbers of species and individuals.



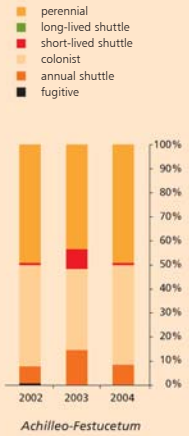
Many of Hungary's moss species are not only rare and threatened at a national, but also at an European or international level. The Bern Convention on the Conservation of European Wildlife and Natural Habitats as well as the EU Habitats Directive list several moss species that occur in Hungary. Monitoring of their populations is an obligation of Member States. In Hungary, localities of 3 moss species known from data collected in HBMS were taken into account on developing the Natura 2000 network.

During the initial stages of monitoring, even finding the populations mentioned in literature often proves extremely difficult, as detectability depends on the lifecycles of species, disturbance of the habitat and weather conditions.

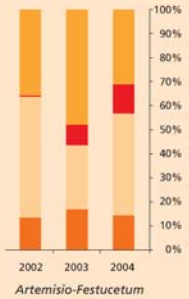
The experts started by revisiting the known occurrences of 6 moss species and several potential sites, and continue by monitoring the populations found. For two species *(Drepanocladus vernicosus, Orthotrichum rogeri)*, no population was found to exist in Hungary at present. Even in the other four species *(Buxbaumia viridis, Dicranum viride, Mannia triandra, Pyramidula tetragona)*, survival in many former sites could not be confirmed.

Monitoring of moss communities is also a part of several projects under the HBMS, therefore mosses are sampled in wetlands, forests, dry grasslands, and saline habitats in sites where plant community monitoring also takes place. Among the habitats surveyed, the moss communities of dry grasslands showed the highest diversity. The moss flora of wetlands is adapted to more constant habitat conditions, but still showed much greater dynamics than expected. The diversity of ground-dwelling moss communities in forests is basically determined by the diversity of substrates. The species richness of epiphytic moss communities is greatly increased if light conditions are favourable and if large trees are present.

The composition of the moss flora and the annual proportions of various life strategies varies significantly from year to year. In Apaj, for instance, in the *Artemisio-Festucetum* association, numerous colonist and annual shuttle species are absent or present in varying amounts in the different years, which is a normal part of their natural population dynamics. This is a natural phenomenon and is not a sign of ecological changes in the habitat.



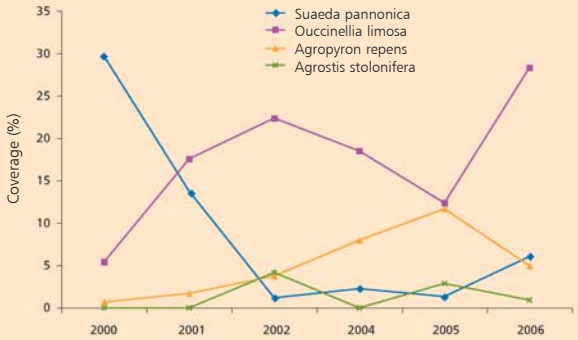
Achilleo-Festucetum



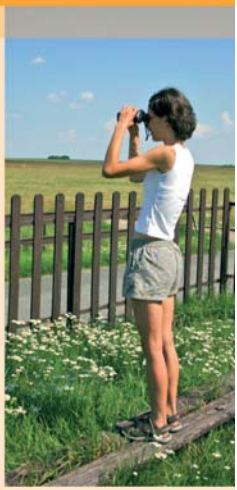
Artemisio-Festucetum

In 1999, the launching of micro-quadrat sampling, a practise used widely in international practise for monitoring plant associations, raised numerous problems. The greatest difficulties included delimiting the stands designated for monitoring, assigning the typical localities, dealing with the transitional forms and with the sudden advance of degradation processes.

The first sampling cycle was finished in 2002, and as repeated surveys are made every 1-4 years depending on the association type, data are available from more than one year for several habitat types. The programme includes monitoring of 5 floating and reedbed associations in 13 plots, while 16 arborescent associations are studied in 33 sampling sites. The 38 grassland associations selected for monitoring are surveyed in 100 plots throughout the country, following the prescribed methodology.



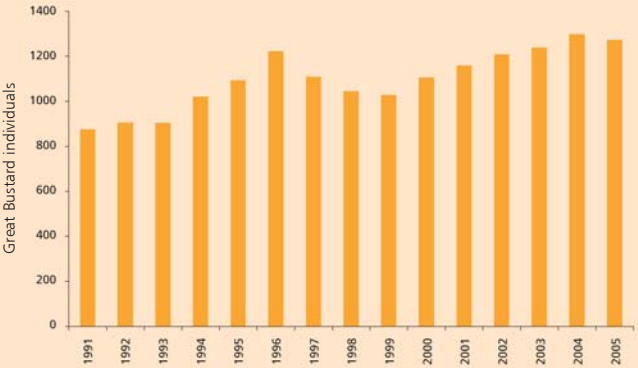
For example, data collected at Maka-szék (2000-2006) on four halophytic species with different ecological demands show very well that the association *Suaedetum pannonicae* is characterised by intensive internal population dynamics, as is usual in saline communities. This character is the result of rapid, sometimes even annually detectable re-arrangement of the fine pattern of habitat patches, primarily caused by weather factors. The mosaic pattern thus created ensures high biological diversity even at a small scale.



The observation of bird species has a particularly long history, especially in Europe, and is one of the most rapidly developing nature conservation activities with the longest tradition and the largest scientific databases. Hungary also has several decades of experience in bird monitoring. Several organisations carry out standardised bird monitoring activities in Hungary, so in order to avoid unnecessary overlaps, the experts of BirdLife Hungary were also involved in elaborating the bird monitoring methodology for HBMS. State nature conservancy and HBMS maintain strong connections with all existing bird monitoring projects.

Monitoring of rare and colonially-nesting birds, including species of Annex I species on the Birds Directive was started in 2001 by the Authority for Nature Conservation. In this project, experts of national park directorates estimate the populations of selected bird species annually. As part of the programme, archive data are also analysed (see figure below). For example, data from the last one and a half decades show that the Great Bustard population is stable in Hungary and the trend seems favourable.

Co-ordinated by the Monitoring Centre of BirdLife Hungary, surveys are done for the populations of selected bird species and also at the community level. The Common Bird Monitoring has been operated since 1999, collecting data in a standardised system by volunteer observers on common bird species. The results also contribute to the general assessment of changes in the status of nature in Hungary. BirdLife Hungary also runs a monitoring programme for rare and colonially nesting bird species.

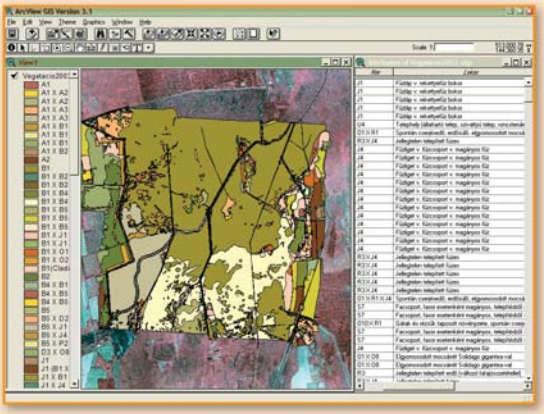


Co-ordinated by the University of Western Hungary, waterfowl censuses are carried out monthly from August to April in 23 constant sites.

There is a strong link between certain bird surveys and some other projects: for example, the survey of sousliks partly concentrates on nesting sites of large raptors or the sampling of small rodents is carried out from barn owl pellets.

At present, two regional nature monitoring projects are operated continuously in Hungary, one in the Kis-Balaton marsh, and one along the river Dráva. They have several linkages to other projects of the HBMS, but they are run independently, co-ordinated by the Balatoni and the Duna-Dráva National Park Directorates. Nevertheless, because of the strong connections, both regional monitoring programmes are regarded as projects of the HBMS.

Nature conservation targeted monitoring project in the Kis-Balaton



The Kis-Balaton is a large wetland with a uniquely rich flora and fauna. Besides its natural values, the Kis-Balaton also forms part of a water-quality improvement system on the River Zala.

In 1992, a monitoring programme was started to survey the effects of the water quality protection system on the natural environment. Since 1998 this project has been aligned with the requirements of the HBMS. Some of the research has been carried out since 2005 by the experts of the Balatoni National Park Directorate.

The following species and species groups are monitored: birds (rare and colonially nesting, reed-dwelling and reed-nesting birds), small mammals (primarily the Root Vole), fish, molluscs, leeches, biting mosquitoes, dragonflies, rotatorians and algae. In addition, vegetation changes are also studied, and there are regular population surveys for protected as well as invasive plant species, bats, amphibians, reptiles, carabid beetles and spiders that can be collected in soil traps. A GIS database is made from the data.

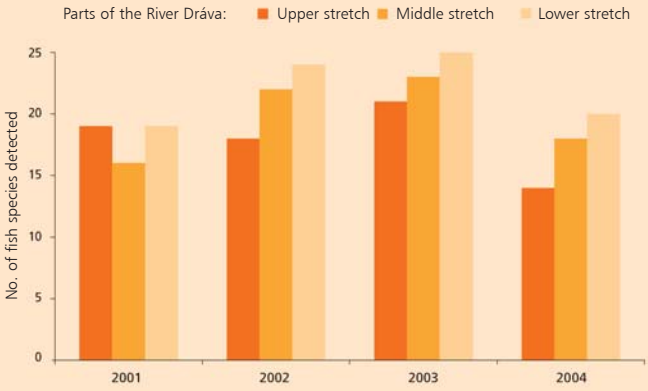
Human interventions have significantly changed water levels, causing habitat changes. For instance, the studies show that changes were favourable to certain bird species, e.g. to the Reed Warbler *(Acrocephalus scirpaceus)*, the Great Reed Warbler *(A. arundinaceus)*, while others suffered from habitat loss (e.g. the Sedge Warbler *(A. schoenobaenus)*).

Nature conservation targeted monitoring project at the River Dráva

From a nature conservation point of view, the River Dráva and its flood plain form some of the most valuable regions in Hungary. Monitoring is carried out in sampling plots arranged in three sections along the river. Within this long-term programme, selected habitats and taxonomic groups are continuously observed with standard methods. Setting up this monitoring project became necessary to assess the potential effects of the formerly planned water dam in Croatia. Even though the dam will hopefully never be built, monitoring continues with regard to the highly valuable data already collected and to the significance of the river in the border zone. A considerable part of the monitoring efforts focus on the area of the Danube-Dráva National Park. The theoretical grounds of the project were established in harmony with the methodology of the HBMS, in 1999, and field monitoring commenced the next year.

The examined components are: plant associations, protected plant species, molluscs, zooplankton, dragonflies, mayflies, butterflies, large moths, beetles, fishes, amphibians, birds, bats, small mammals and small carnivores. The data collected are continuously fed into a GIS database.

For one of the most important components, fishes, repeated surveys showed stable species numbers for the whole length of the river during 2000–2004.

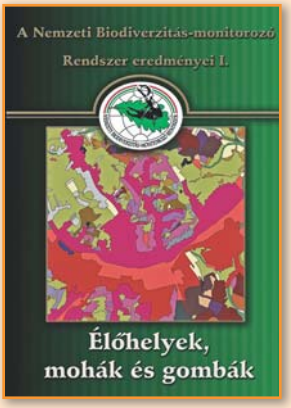




The most essential parts of the HBMS had been developed by 2001. The personal and institutional background has been established, while the conditions and regulation of operating the system have been refined through amendments. Standard protocols have been completed and tested for the majority of the components. Several archive data sets have been incorporated, and the number of examined components increase year by year.

During 2003-2005, data collection under HBMS was revised by experts. As a result, the system operation was improved, but HBMS still cannot be considered as a fully-fledged programme because of the lack of a central information system, which impedes the full-scale use of data collected by monitoring projects. An important lesson is that the level of standardisation should be even higher and participants have to carry out reporting even more precisely. In order to process the data stored at present in the form of reports, the personal capacity of the monitoring centre should be increased. The national, GIS-based Nature Conservation Information System is being developed and is expected to be operational from 2008 onwards.

Publication series



In 2006, a new series was begun to publish the results of nearly ten years of far-ranging activities under HBMS, including the development of methodologies and the field surveys. The first volume deals with habitats, mosses and fungi, presenting the first results and interpreting the data. The planned second volume will analyse zoological themes.

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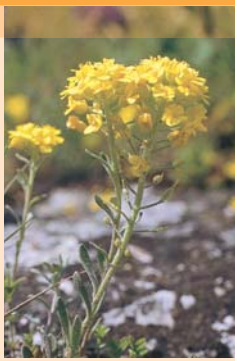

Török, K., Fodor, L. (ed.) 2006. Nemzeti Biodiverzitás-monitorozó Rendszer Eredményei I.: Élőhelyek, mohák, gombák. Ministry of Environment and Water, Office for Nature Conservation, Budapest

Horváth, F., Rapcsák, T., Szilágyi, G. (ed.) 1997. Nemzeti Biodiverzitás-monitorozó Rendszer I. Informatikai alapozás, Magyar Természettudományi Múzeum, Budapest

Fekete, G., Molnár, Zs., Horváth, F. (ed.) 1997. Nemzeti Biodiverzitás-monitorozó Rendszer II. A magyarországi élőhelyek leírása, határozója és a Nemzeti Élőhely-osztályozási Rendszer. Hungarian Museum of Natural History, Budapest

Kovácsné Láng, E., Török, K. (ed.) 1997. Nemzeti Biodiverzitás-monitorozó Rendszer III. Növénytársulások. Hungarian Museum of Natural History, Budapest

Török, K. (ed.) 1997. Nemzeti Biodiverzitás-monitorozó Rendszer IV. Növényfajok. Hungarian Museum of Natural History, Budapest

Forró, L. (ed.) 1997. Nemzeti Biodiverzitás-monitorozó Rendszer V. Rákok, szitakötők, egyenesszárnyúak. Hungarian Museum of Natural History, Budapest

Merkl, O., Kovács, T. 1997. Nemzeti Biodiverzitás-monitorozó Rendszer VI. Bogarak. Hungarian Museum of Natural History, Budapest

Ronkay, L. 1997. Nemzeti Biodiverzitás-monitorozó Rendszer VII. Lepkék. Hungarian Museum of Natural History, Budapest

Korsós, Z. 1997. Nemzeti Biodiverzitás-monitorozó Rendszer VIII. Kétéltűek és hüllők. Hungarian Museum of Natural History, Budapest

Báldi, A., Moskát, Cs., Szép T. 1997. Nemzeti Biodiverzitás-monitorozó Rendszer IX. Madarak. Hungarian Museum of Natural History, Budapest

Csorba, G., Pecsenye, K. 1997. Nemzeti Biodiverzitás-monitorozó Rendszer X. Emlősök és a genetikai sokféleség monitorozása. Hungarian Museum of Natural History, Budapest

Kun, A., Molnár, Zs. 1999. Nemzeti Biodiverzitás-monitorozó Rendszer XI. Élőhely-térképezés. Scientia Kiadó, Budapest