RESEARCH IN AGGTELEK NATIONAL PARK AND BIOSPHERE RESERVE

Edited by Erika Tóth & Róbert Horváth
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ANP



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Conference

Aggtelek
Hungary, 1-5 May 1996

Volume II.

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INTRODUCTION

INTRODUCTION

THEORETICAL BASIS FOR THE COMPLEX ECOLOGICAL STATE ASSESSMENT IN THE AGGTELEK NATIONAL PARK

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Introduction

Protection of Environment and National Parks

Nature protection is a conscientious human activity preserving in situ the external informal natural resources of civilisation. This is the minimal condition of nature conservation, its sine qua non. Activities of national parks are beyond this basic task, besides preserving information, its carriers and sources, as a basic activity, it also deals with evaluation of this information (status survey, monitoring, research) and with publishing this information (hiking, tourism, education, public lectures). All these activities are done in a defined topographical unit. In a fortunate situation a national park can do all its basic duties within this area. Realisation and operation of a national park demands theoretical division of each task and after it - practical and mainly territorial co-ordination of them.

Some people treated state surveys and their evaluation as the main condition of administrative decision making (declaration about protection, limitations), though others were sure that the most important decisions are based on acceptance of main principles, rather than on procession of factual information. For instance, determination of zones (and even declaration about protection) cannot exclusively be based on state survey and state evaluation, because in this case we obtain topographical formula of impracticable size and form. It is fairly characteristic the way we implemented - some say to national suggestions - the system of three conditions established in IUCN (which was actually a statement of conditions). Just to recall it, here are some facts: Our national parks will be allowed to get (back) into the second category (i.e. national parks) of the international system of criteria, if they meet the following three conditions:

1. There is a need for an ecological survey of state.
2. Management zones of the national park must be determined and established.
3. Ownership must be sorted out (i.e. headquarters of national parks must be granted majority of ownership / management of property of the territory of the national park).

Survey of state and biomonitoring of nature conservation.

First of all we need to state: as to our point of view, **nature conservation monitoring is nothing else but series of state surveys.** It monitors changes happening in the state of natural living structures as such, rather than detecting changes in the state of formal civilisation environment according to a misinterpreted concept of indicators. That is why it is very important to evaluate patterns in time and space carrying the most internal information about organisms. Even with far not complete faunistic surveys, we need to aim at as broad sample collection as possible, i.e. trying to evaluate all the collected material within a big taxonomic unit (like an order of insects). The axiom of the principle indicandum - indicator - stating that any change in the system may change any element of it, but there is no way of making further conclusions about the behaviour of other elements in the system or that of the whole system itself by these changes in the individual element - is certainly true in our case as well. There is no royal way, **surveys should be carried out with big sample sizes, more frequently as with as many group of organisms as possible.** (An other additional point about similarity is the fact that in our case the indicator and the indicandum are the same, because instead of investigating events with their environmental - climatological, geological, etc. - background, we examine them by comparing the different abstract levels of living structures, each of which (population, cenosis, taxon, etc.) equally consist of single organisms.
Which are the limiting facts counter indicating the above mentioned principles?

- Narrow research capacity. There has not been brought up a new generation of taxonomists due to the ever changing tendencies in teaching of biology and the official policies in scientific life. Furthermore state surveys were made in the very same time all over the country, which only made the situation even more difficult.

- Sparing of territories and living organisms. Sample taking of too high frequency and big size could lead to changes in the sample area besides unnecessary devastation, which may cause decrease of representativity. In zone A there is a need for avoiding sample taking destruction of eliminating material. It even makes the situation more limited that different methods and locations of sample taking must be selected for each group of living organisms. (Complex evaluation of a smaller sample area is useless carrying very little information).

- Inadequacy of some groups of living organisms for state surveys, e.g.: due to their rarer appearance, hidden way of living, unclear taxonomic state, unsystematic migration or erratic gradation. Here we should mention all the cases when not finding a species does not count as a piece of information, for its occurrence is so rare and its appearance if so eventual.

- Limited financial resources. In the first couple of years 2-3 million HUF annually seemed to be more than enough compared to research capacities. By today - on the account of information and the new regulation on taxation and social security contributions - the above rate has changed vice versa.

- Unpredictable economy. Nature conservation monitoring should only be implemented in a reserve or on territories cultivated by traditional extensive methods. In our national parks, from time to time woods are cut down, stands of the same age and species are grown, plans of cuttings are set up, i.e. people rudely and permanently intrude into spontaneous processes which are in the centre of our attention.

Stating the relationship between state surveys and monitoring, we think that **the first one is the basic phase of the second one.** Its consequences are as follows:

-Locations for sampling must be determined in a most careful way with proper indication for further chances to repeat sampling (representativity and reproducibility).
The most important of them are botanical permanent quadrates.

-When choosing the methods of sample taking, reconstructability was more important than quantitative criteria, which are otherwise also important, since here we aimed at monitoring changes of living structures inhabiting certain areas as time passed, rather than comparing different areas. For this purpose it is adequate to use the same method of data collection at the same location, even if the method can be strongly criticised, for example from the point of view of diverzitometry (e.g.: unequal collection of different species). The method of Malaise traps applied by Dr. Tóth Sándor could serve as a good example, though it is a clearly faunistic method.

-We do not agree with any ideas identifying monitoring as a simplified or automated way of state survey. This is the so called concept of indicator species which is adequate for the purpose of environmental monitoring, especially when there are no funds for equipment... Thus we see that monitoring cannot be done as an acquired skill, participation are indispensable in the future, and as a consequence of the axiom, we need to broaden the "taxonomical spectrum" as much as possible.

- There should have been a plan and subsequently a start of a satellite imagery and arial photo interpretation program at the very beginning, which is still to be expected due to lacking funds.

-Since nature conservation monitoring is not at all a means to substitute any equipment, climatic background data presented by long term ecological surveys and integration of such survey series into the monitoring itself are of special importance.

Difficulties in state surveys

The beginning of the 1990s has brought significant changes into the history of research in nature conservation. It was the first time that regional authorities have received independent opportunities and funding, which enabled them to arrange and start investigations on their own initiative. Elimination of the ill famed centralised practice was appreciated by local specialists, while difficulties rising from the new opportunities also came up. They are as follows in brief:

-In lack of methodology for state surveys at the starting point of the program, its creation needed central funding as well. Having sorted out the main principles, there were no sources left for computer development. Some headquarters recognising its necessity, made their contributions to work done in the workshop of the Hortobágy National Part, while others were reluctant to do so. (Finally the demand for unified and central information services resulted in the Information Service of Nature Conservation).

-In certain fields there was lack of research capacity, thus e.g.: determination and survey of permanent quadrates in the vegetation survey were carried out in an uneven size and unproportional quality.

-Some methodological problems were sorted out only on the run, so each single regional authority had to go its own way. Thus, for instance, it was not clear at the beginning that we must determine different units and locations for sample taking in case of every single group of organisms. This way we could not even think of a complex survey of a certain permanent quadrate or transsect, which situation led to useless work and arguments everywhere. On the other hand though, it is also a basic principle to use different operative taxons for characterisation of bigger regional units, that is why it is not practical and impossible in the same time to make the whole methodology unified. (It is senseless to choose fish for state survey of sand dunes at Bugac, and dragon flies do not provide information about the region.)

Survey and evaluation of state.

It is interesting to know that the necessity of ecological state survey was claimed earlier - with a bit of international help - than its definition. However professional discussions aiming to clarify this issue have arose and answered some basic questions in connection with nature conservation. Though surveys and evaluation of state can be separated logically, and seem to be actually separated, however the two items have merged into each other due to special conditions of national nature conservation. Our national nature conservation is not an organisation operating on the basis of public property owning and managing centred way of thinking, but it is an

institution operated through means of authority (unfortunately as the single means provided). Both declaration about protection and maintenance need up-to-date information concerning evaluation of certain regions and objects, since these are administrative rather than democratic decisions, claiming the reasons for decisions by being tolerant with farmers causing damage and expressing this damage in money. Decision makers - being the managers not specialists of nature protection - expect objective, defensible, current and quantitative information for their decision preparation and decision making work in the form of regional breakdown indicating topographical lot numbers, which elements are characteristic only for decrees of public administration. It is interesting to note that some researchers motivated by the least professional reason of money also confirmed this point causing the false illusion of an objective yardstick scoring different regions as comparable.

However the above bureaucratic claims could be met only if:

a./ the applied sampling method is quick and can be acquired as a skill, and evaluation is automatic (done mechanically by a simple algorithm), or if

b./ sampling and survey is done by such an experienced specialist who is able to do the survey and the evaluation in sequence. In this case objectivity is granted by his professional credit, acknowledgement and scientific position.

Fortunately, by the beginning of the natural state survey both ideas failed, of course due to practical reasons and not its principal unreality. With the first method it was unsuccessful to collect adequate quantity of data required for statistical evaluation, because only one or two occurred of the taxons chosen as indicators in each area. While the second method failed due to unexpected rise of demand. It is also important to speak about developing internal opposition of specialists in nature conservation, and that of external opposition of the upgrowing research generation against such fund consuming pseudo - objective solutions producing sham results.

Determination of zones and principles of reservations

An other trend in the professional dispute was about the way of treatment of national parks and other protected territories, more accurately about zones themselves and basic principles of their determination. In an authority operating with negative measures, the zones would mean nothing else but the opportunity of limiting certain activities. Such is, for instance, the so called strictly protected area where all kinds of direct intrusion of civilisation can be limited or prohibited by legal and administrative measures. According to this attitude, the most valuable territories should be protected in the best way from utilisers and users, so areas with the most natural values must be declared as natural zones. Regarding the fact that majority of our most valuable regions are of cultural importance where the

condition of preservation is provision or imitation of the traditional way of use, the above view point will lead to antagonistic internal contradictions. Together with the argument about zonation has rose an other important principle of nature protection, which has always existed, though it was suppressed by specific national conditions. This principle had far going consequences on the matters of state surveys, nature conservation monitoring and donation as well. In Hungary traditionally the starting point of nature protection strategies is the attempt to identify each natural value and to try to preserve it. In regions where there is a dense concentration of values, they can be effectively protected by declaring them protected or strictly protected areas with the practically existing negative measures of authorisation or the theoretically existing positive means (subvention, technical equipment). This point of view assumes an ideal condition, maintenance or restoration of which would be the goal of nature conservation. This attitude was spread in practice in the 1980s, despising the classical reservation principle in nature conservation, because it is not as effective as the modern way of it operating through active intervention. Of course the real reason was that areas worth utilisation were cultivated further on, though territories not worth it economically were too small but too valuable to undertake the risk of not-managing them. Thus there were no regions left suitable for monitoring of spontaneous changes in the country: there were cases when antropogenic intervention was caused by cultivation and farming, or it was due to transformation of nature with the slogan of nature conservation. Though the other strategic principle was legally granted in the nature conservation practice - in the form of biosphere reserves - it has always functioned as moral reasoning against economic organisations as the international objective and evidence of value. In practice all that happened is that establishment and international registration of our biosphere reservations were counted as international success, while uselessly small and dismembered territories were managed to be protected by more or less strict regulations and measures. After some abortive attempt to establish biosphere reservations for the sake of its monitoring, the idea completely died out. (It could not have been successful anyway, due to the above described.) To make the two theories meet we need to accept one logically clear principle: Any value oriented activity should be preceded by some value selection. This selection cannot lack in subjective elements. In Hungary nature conservation is inevitably species oriented whether it is declared to be interested in biotopes, whether it discusses protection of land or it jabbers about biodiversity. The only determining reason is the number of protected species and their individuals. It means that we consider any measurement a given quantity forgetting that it was chosen by us. (And in the meantime we do not notice the most threatened species.) So work done in nature conservation can be made more efficient

by breading protected species and their individuals, and by declaring new species and their biotopes protected. Of course, inorganic objects, especially geobiocultural complex formations like the land itself cannot be measured this way so we try to divide them into analytical units with indicated quantitative values. An other unreasonable demand is that synthetic abstracts should be declared protected as well like certain plant communities, which are problematic even for specialists to determine, thus they are impossible for either citizens of authorities.

The above problems can be solved only by introduction and parallel operation of a different criterion system of value selection. According to this system we give value to a certain management method instead of valuing an object to protect This could either be some systematic method of area utilisation, or the acceptance of non - intrusion as an absolute category of values. International practice regards national parks and protected areas of different categories as the manifest of management standards. A national park is made not by its regional particulars, but by the fact that they are managed as national parks. In means that first of all provision of intact procedures are ranked as most important, independent from antecedents. All this concerns biosphere reservations as well.

As we have seen in the introduction, nature conservation is an activity preserving information, making it useful for the society. Utilisation can be of scientific importance (state survey, monitoring, in one : research), or important for the mental sector (arts, recreation, aesthetics). This approach determines the three levels of tasks as responsibilities of nature conservation or that of national parks in a broader sense: preserve, research, description.

Preserve of threatened individual or compositional unicalities, information and information producing organisms is the objective of land protection as part of nature conservation. Its system of measures and methods of management - as a rule - differ from those of reserves. It is quite clear that regions of land protection are a bigger challenge for nature conservation from professional view, hence the optimum here is not implementation of certain management standards, but dynamic (changing in location and time, but stationary in its proportions) reconstruction and maintenance of landmarks regarded optimal.

Due to development of the Hungarian legistlation and the lack of professional workshops in natore conservation, names of protected areas do not reflect their real character, management goals and strategies of information preserve behind their activities, but refer partially to the size of territory and its values. Doctrines of nature conservation not having been logically thought over, gave way to much subjectivity, not mentioning the deplorable fact that even plans worked out systematically were unimplementable owing to counter interested owners or users. Protection by

all means of individual values resulted in discord of specialists. Where it was possible, nature conservation resembled more to management of a botanical garden. Lack of historic knowledge and insufficient interpretation of processes and happening led to experts and researchers being stuck to the status quo, which meant attempts not to change landmarks. In connection with this, views on reserves were even of less importance. To make the whole thing even more complicated there were some who were talking about reserves equal to protected areas forming the slogan: We must step out of the borders of reserves, although we did not have reserves at all...

Survey of state and determination of zones in the Aggtelek National Park

I. Principles of zonation

Realising the above described, we tried to determine and co-ordinate the double task (state survey and zonation) in the Aggtelek National Park. We did not follow the idea of determining management zones based on the results of state surveys since zones are expression of their management goals rather than that of their inner characteristics. Furthermore zones demand different survey methods. (In a core area we should avoid sample taking causing intrusion and devastation). Based on consultation with experts knowing the region best - mainly with dr. Varga Zoltán (KLTE) and owning recent information, we were able to establish a theoretic and topographic concept concerning management and zonation, which was later only refined. Of course, at the beginning we did not have to decide whether we wanted to establish a national park, or a landscape protection area. In the latter there would have been no sense for management zones. The status of biosphere reserve, a seemingly favourable socio-political background for establishing a real national park, excellent biogeographical location and spontaneous richness of the region gave an easy solution to the question. However we had to face the dilemma caused by the extraordinary richness and unicality of a cultural land in the neighbourhood of settlements. (vineyards, meadows, fields, etc.). We had to find the concept which makes a basically landscape protection activity consistent with the objectives of a reserve, separating them regionally in the same time. We started out from the ideal future image that protection measures of granted by the owner and the authority are the same throughout the whole territory. It is exclusively the environment protector's competence to decide which and of what size of areas are used for the three main activities of the national park.

Main task of each of the three zones is conservation. In zone-A it means exclusive and reserve like management, while in zones B and C there are

other activities consistent with the basic activity. (i.e. forestry and hunting serving outside interests of are seized, and other activities - like tourism, extensive animal keeping are co-ordinated by the Headquarters.)

Zones have got the following functions:

- Zone-A_1 meets the criteria of a scientific reserve. Management is done only with preserve purposes in the form of mowing highlands, and eliminating land alien flora in Zone A_2. Research can be carried out only with environment friendly methods. The zone is equal to the extended core territory of a biosphere reserve.
- Zone-B is a buffer to zone-A. Besides this its functions are research and presentation with professional and educational purposes. There are traditional forms of extensive farming in the region, like pasturing, mowing. Jósvafő with its vineyards and special grassland belongs here.
- Further tasks of zone-C are tourist exhibition and recreation. Here we can find settlements, paths, hiking tracks, tourist-caves, look-out towers, information centres and service facilities. Forestry and wood cutting should be as little as possible in this region (only for local needs). There should not be hunting of outside interests allowed with the exception of regulation of wild stock with preserve purposes.

See the Zonation map of ANP on page 30.

II. Implementation of state survey in ANP.

The survey began in an unstable professional and political environment burdened with a moral shock caused by disqualification, however at the promising beginning of a new political era.

Here are some of the experiences resulting from the above enumerated ideas and dilemmas providing a basis for further tasks in state surveys:

- the task of state surveys must be assigned to a taxonomist who will do it from the beginning sample taking until the process of identification. These experts should be familiar with the field, have previous information and proper references.
-the process of state survey must be separated from that of state evaluation.
- such groups of creatures should be selected which can be regarded as operative taxons for monitoring.
- sufficient number of species and wide spread distribution in Hungary
- sufficient number of national experts
- at least a relatively quantitative sampling possibility.

As we all can see, criteria like rarity, protection, biogeographical type, sensitivity to environment are irrelevant from the point of the survey. It means that the survey itself and monitoring are both based on the paradox that certain characteristics occur during the survey, so while evaluating, we

need to feed back and correct data. To be able to work out a unified methodology of evaluation, there is a need for a regularly updated database containing specific particulars of species and the current nomenclature as well.

There have been totally different views formed on investigation of the so called ecological background. Ideas identifying the collection of information about the climate, base rock, and soil as an alien from ecological surveys activity disappeared. However there were people who assumed it enough to obtain collected and published by others data for the process of evaluation, concentrating on measurement of physico-chemical parameters of the environment, which could not be obtained otherwise. While others, just like the writer of present lines, followed the principle of saving data about reserves on as many data carriers as possible. Long term serial measurements have got special importance even if they detect hardly changing environment parameters. The value of these data is in their unpredictability. Unfortunately due to lacking funds we could not have new background registration (such is worth started only from granted long term funding), furthermore we were not able to save already existing data due to structural changes (karst research station, containers in the Béke cave). We have come to the common conclusion that certain important information cannot be recalled from the past. These procedures should be continued permanently from courtesy to coming generations, e.g.: there are photos taken and archived about space, however no shots of continuous air photography can be found.

There exist such slowly changing environment particulars which cannot be described by state surveys. E.g.: geological survey of a given area. However, information should be evaluated from time to time, since science changes fairly quickly even if changes in the state of the earth's crust take place slowly. Geological mapping of the Aggtelek-Rudabánya mountain including the territory of the national park as wee, was completed in the late 1980s, but the monograph planned has not been published yet. The headquarters of ANP together with the authors have had a material written based on specific ecological aspects. Among others the most important map is that of lithology (concerning types of rock and not their age) being the most determining background information about vegetation. The hydrogeological map is of similar importance. Data on soils - in lack of recent information - have not been included in the survey material.

Unfortunately, a unified measuring practice of so called ecological background parameters, first of all in connection with physical and chemical state of the atmosphere could not become a part of state surveys, but they will be inevitably clarified in the phase of monitoring.

A KOMPLEX EKOLÓGIAI ÁLLAPOTFELVÉTEL ELMÉLETI ALAPJAI AZ AGGTELEKI NEMZETI PARKBAN

SALAMON GÁBOR
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Bevezetés

Természetvédelem és nemzeti parkok

A természetvédelem a civilizáció külső informális környezeti erőforrásait in situ megőrző tudatos emberi tevékenység. Ez a természetvédelem minimumfeltétele, sine qua non-ja. A nemzeti parkok tevékenysége ezen az alapfeladaton túlmutat, az információk, információhordozó és információtermelő struktúrák megőrzésén kívül az információk rendszeres leképezésével (állapotfelvétel, monitoring, kutatás) és átadásával (turisztika, idegenforgalom, oktatás, ismeretterjesztés) is alaptevékenység-szinten foglalkozik. Mindezt egy meghatározott topográfiai egységben végzi. Szerencsés esetben a nemzeti park összes alapfeladatát ezen a területen belül kell tudni elvégezni. A nemzeti park megvalósítása, működtetése az egyes feladatkörök elvi szétválasztását, majd gyakorlati és - főként - területi elvű összehangolását igényli.

Egyesek az állapotfelvételt és értékelést a közigazgatási döntések (védetté nyilvánítások, korlátozások) alapfeltételeként kezelték, mások tisztában voltak azzal, hogy a legfontosabb döntéseknek lényeges elvek elfogadásán és nem tényszerű információk feldolgozásán kell alapulniuk. A zónabeosztás (sőt a védetté nyilvánítás is) például nem alapulhat kizárólag állapotfelvételen és állapotértékelésen, mert akkor kezelhetetlen méretű és formájú topográfiai alakzatokat kapunk. Teljesen jellemző, hogy az IUCN - egyes állítások szerint hazai sugallatra - felállított hármas feltételrendszerét (lényegében ultimátumát) hogyan hajtottuk végre. Emlékeztetőül, ez nagyjából a következőt jelentette: Hazai nemzeti parkjaink akkor kerülhetnek (vissza) a nemzetközi kritériumrendszer kettes (nemzeti parkok) kategóriájába, ha megfelelünk a következő három feltételnek:

1. Ekológiai állapotfelvételt kell csinálni.
2. Ki kell jelölni és *létre kell hozni* a nemzeti parkok kezelési zónáit,
3. Rendezni kell a tulajdonviszonyokat. (Azaz a nemzeti park igazgatóságoknak döntő tulajdonosi/vagyonkezelői hányadot kell biztosítani a nemzeti parkok területén.)

Az állapotfelvétel és a természetvédelmi biomonitoring.

Előre is le kell szögezzük: Álláspontunk szerint **a természetvédelmi monitoring nem más, mint állapotfelvételek sorozata.** A

természetvédelmi monitoring a természetes élő rendszereknek, mint magábanvalóságoknak az állapotában bekövetkezett változásokat kívánja nyomon követni, nem pedig valamiféle homályosan felfogott indikátorkoncepció jegyében, a civilizáció formális környezetében bekövetkezett állapotváltozásokat detektálni. Ezért különös jelentősége van az organizmusok belső információtartalmára a leginkább utaló tér és időbeli mintázatok leképezésének. Még a szükségszerűen a teljesség igénye nélkül fellépő faunisztikai vizsgálatok esetén is a lehető legszélesebb körű mintavételre kell törekedni, azaz egy-egy nagyobb taxonómiai egységen belül (mint pl. egy-egy rovarrend) a teljes gyűjtött anyag feldolgozására kell törekedni. Az indikandum-indikátor elv axiómája, mely szerint *a rendszer bármilyen megváltozása annak bármely elemét megváltoztathatja, de az elemek megváltozásából nem lehet a rendszer többi elemére, valamint a rendszer egészének viselkedésére érvényes következtetésre jutni,* természetesen esetünkben is igaz, és ebből egyértelmű következtetés adódik: Nincs királyi út, **minél nagyobb mintaszámban, minél nagyobb gyakorisággal, minél többféle élőlénycsoportra kell a vizsgálatokat kiterjeszteni.**

(Másik megjegyzendő vonás, hogy esetünkben az indikátor és az indikandum fizikailag egybeesik, hiszen itt nem a környezeti - klimatikus, geológiai stb. -háttérváltozások tükrében szemléljük az eseményeket, hanem az élő rendszerek különböző absztrakt szintjeit összehasonlítva, márpedig ezek mindegyike (populáció, cenózis, taxon stb.) egyformán egyedekből áll.)

Melyek azok a korlátozó tényezők, melyek a fenti elvet ellentételezik ?

- A kutatói kapacitás szűkössége. A biológiaoktatás és a hivatalos tudománypolitika irányváltásai következtében kihaltak és nem termelődtek újjá a taxonómus specialisták. Ráadásul az egész ország területén egyszerre zajlott az állapotfelvétel, mely tovább nehezítette a helyzetet.

- A területek és az élő szervezetek kímélete. A túl gyakori és nagymértékű mintavétel a fölösleges pusztításon kívül a mintaterületek megváltoztatásához vezethet, mely a reprezentativitás csökkenéséhez vezet. Az A-zónában kerülni kell a pusztítással és anyageltávolítással járó mintavételeket. Fokozza ezt a korlátot, hogy gyakorlatilag minden egyes élőlénycsoporthoz más más mintavételi módszert és helyet kell választani. (Egy-egy kisebb mintaterület „komplex" feldolgozása értelmetlen, rendkívül csekély információt szolgáltató vállalkozás.)

- Egyes élőlénycsoportok állapotfelvételre való „alkalmatlansága" pl. rendkívüli ritkaságuk, rejtett életmódjuk, taxonómiai helyzetük tisztázatlansága, vagy rendszertelen vándorlásuk ill. kiszámíthatatlan gradációik miatt. Ide tartoznak mindazok az esetek, amikor egy faj *nem* megtalálása nem számít információnak, az előfordulás annyira ritka és a megtalálás annyira esetleges.

- Az anyagi források véges volta. Az első években az évi két-három millió forint nagyon elegendőnek bizonyult a kutatói kapacitáshoz képest. Mára - hála az inflációnak, valamint az újabb és újabb adó és társadalombiztosítási terheknek - az arányok megfordultak.

A gazdálkodás léte és kiszámíthatatlansága. Természetvédelmi monitoringot célszerűen csak rezervátumban, vagy hagyományos külterjes módon hasznosított területeken érdemes végezni. A mi nemzeti parkjainkban időről időre kivágják az erdőt, egykorú és fajszegény állományokat nevelnek, vágásfordulókat és vágásérettségi korokat állapítanak meg, azaz közvetlenül, durván és állandóan beavatkoznak azokba a spontán folyamatokba, melyekre érdeklődésünket összpontosítjuk.

Az állapotfelvétel és a monitoring viszonyáról szóló állításunkat másképp kifejtve **az állapotfelvételt a természetvédelmi monitoring alapfázisának tekinthetjük**. Ennek következményei az alábbiak:

- A mintavételi helyeket a lehető leggondosabban kellett kiválasztani, és maradandó módon meg kellett jelölni a későbbi ismételhetőség végett. (Reprezentativitás és reprodukálhatóság.) Legfontosabbak ezek közül a botanikai tartóskvadrátok.

- A mintavételi módszerek kiválasztásánál a rekonstruálhatóság fontosabb volt, mint az egyébként lényeges kvantitativitási kritériumok, hiszen itt nem különböző területek összehasonlítása volt a cél, hanem egyes területek élővilágának változásait nyomonkövetni az időben. Erre pedig alkalmas egy ugyanazon a helyen ugyanolyan módszerrel végzett adatgyűjtés, akkor is, ha a módszer pl. diverzitometriai szempontból erősen kritizálható. (pl.egyenetlenül gyűjt különféle fajokat.) Jó példa erre a dr. Tóth Sándor által alkalmazott Malaise-csapda, mely elsősorban tisztán faunisztikai módszer, vagy a nem túl nagy területre világító fénycsapdák.

- Eleve bukásra ítéltnek kell tartanunk minden olyan nézetet, mely a monitoringot egyszerűsített, vagy automatizált állapotfelvételnek gondolja. Ez az ún. indikátorfaj-koncepció, mely - mint könnyen belátható - legfeljebb környezetmonitoring céljára alkalmas, legalábbis, ha nincs pénz műszerekre.... A monitoring tehát nem végezhető betanított munkaként, a specialisták a jövőben sem nélkülözhetők, sőt fenti axiómából következően a „taxonómiai spektrumot" lehetőség szerint szélesíteni is kell.

- Már a kezdet kezdetén meg kellett volna tervezni és el kellett volna indítani a rendszeres távérzékelést, ez azonban anyagi források hiányában azóta is várat magára.

- Mivel a természetvédelmi monitoring hangsúlyozottan nem műszerhelyettesítő eszköz, különös jelentősége van a hosszútávú ekológiai vizsgálatok szolgáltatta klimatikus háttéradatoknak, ill. az ilyen vizsgálatsorozatok folytatásának a terrmészetvédelmi monitoringba történő integrálás révén.

Az állapotfelvétel nehézségei

Az 1990-es évek eleje döntő változást jelentett a hazai természetvédelmi kutatások történetében. A területi szervek első ízben jutottak önálló lehetőséghez, komoly pénzeszközökhöz, mely lehetővé tette saját kezdeményezésű kutatások megszervezését, beindítását. A rossz értelemben központosított addigi gyakorlat megszűnését a területi szakemberek nagy megelégedéssel vették tudomásul, ugyanakkor azonnal jelenkeztek az új lehetőségekből adódó nehézségek is. Ezek röviden a következők:

- Mivel a program indulásának pillanatában nem volt kidolgozott állapotfelvételi metodika, annak kidolgozására központi forrásokra is szükség volt. Az elvi alapok tisztázása után a konkrét informatikai fejlesztésre már nem voltak források. Egyes igazgatóságok , akik felismerték ennek szükségességét, hozzájárultak a Hortobágyi Nemzeti Park Igazgatóság szakmai műhelyében folyó munkához, mások nem. (Az egységesítés és központi informatikai szolgáltatások iránti igény szülte meg végül a Természetvédelmi Informatikai Szolgálatot...)
- Egyes szakterületeken kutatói kapacitáshiány jelentkezett, ezért pl. a vegetációfelmérés tartóskvadrátjainak kijelölése és felvételezése egyenlőtlen mennyiségben és színvonalon készült el.
- Bizonyos metodikai problémák menet közben tisztázódtak, emiatt a vargabetűket minden területi szerv külön-külön leírta. Így például az elején nem volt világos, hogy szinte minden egyes élőlénycsoporthoz más-más mintavételi egységet és főként helyet kell kijelölni, ezért az alapcélkitűzés némileg egyszerűsítő elképzelései egy-egy tartóskvadrát ill. transzszektum „komplex" vizsgálatáról hamar reménytelenné váltak, szinte mindenütt felesleges munkát és szakmai vitákat előidézve. A másik oldalról ugyanilyen alapigazság, hogy nagyobb területegységek jellemzésére is különböző operatív taxonokat kell választani, ezért a teljes metodikai egységesítés nemcsak célszerűtlen, hanem lehetetlen is. (A Bugaci homokbuckák állapotjellemzésére értelmetlen a halakat választani, a szitakötők pedig nem az adott területről szolgáltatnak információkat.)

Állapotfelvétel és állapotértékelés.

Érdekes módon hamarabb született meg az ekológiai állapotfelvétel szükségessége - némi nemzetközi segédlettel - mint magának az állapotfelvételnek a definiálása. Ennek tisztázására irányuló szakmai viták viszont felvetettek - és némi szerénytelenséggel állíthatjuk, hogy meg is válaszoltak - több a természetvédelemmel kapcsolatos alapkérdést. Bár az állapotfelvétel és az értékelés logikailag teljesen szétválaszthatónak, sőt elkülönülőnek tűnik, a magyar természetvédelem speciális viszonyainak következtében a két dolog mégis összemosódott. A hazai

természetvédelem ugyanis nem (köz)tulajdonközpontú, vagyonkezelői elven felépített és működtetett szervezet, hanem hatósági eszközökkel operáló (mert szinte csak ezekkel rendelkező) organizmus. Mind a védetté nyilvánítással, mind a fenntartással kapcsolatos döntések a területek ill. objektumok értékére (értékességére) vonatkozó naprakész információkat igényelnek, hiszen nem demokratikusan, hanem államigazgatási vonalon hozott döntésekről van szó, melyek megkívánják a döntések indoklását, a gazdálkodók által okozott károk közül a legkevésbé rossz kiválasztását, a bírságolások terén az okozott kár pénzbeli kifejezését. A döntéshozók - elsősorban tehát a természetvédelem vezetői és nem a szakemberek - az állapotfelvételtől azt várták, hogy objektív, védhető, naprakész és számszerűsíthető döntéselőkészítő, sőt ügydöntő információkhoz jutnak általa, ráadásul a specifikus államigazgatási eljárásban szükséges területi felbontásban, erdőterületek esetén erdőrészletre, más esetekben helyrajzi számra vonatkoztatva. Érdekes módon ezt a szakmainak nemigen nevezhető szempontot egyes pénzért minden igényt kiszolgáló kutatók is alátámasztották, azt a hamis illúziót keltve, hogy létezhet a különböző területek egymáshoz hasonlítását is lehetővé tevő objektív értékskála.
A fenti bürokratikus igények kielégítése viszont csak akkor lehetséges, ha

a./az alkalmazott felvételi módszer gyors, és betanított munkával is elvégezhető, az értékelés pedig automatikus (egyértelmú algoritmus alkalmazásával mechanikusan történik),vagy pedig

b./ a felvételt olyan nagy tapasztalatú szakember végzi, aki egy lépcsőben képes felvételezni és értékelni. Ebben az esetben az objektivitást az illető szakember szakmai hitele, súlya, elismertsége, tudománypolitikai pozíciója jelenti.

A természeti állapotfelvételi program kezdetére szerencsére mindkét elképzelés megbukott, természetesen nem elvi képtelensége, hanem merőben gyakorlati okok miatt. Az első módszerrel nem sikerült statisztikai kiértékelésre alkalmas adatmennyiséget összegyűjteni, mert a kiválasztott „indikátor" fajok ill. taxonok közül egy-egy vizsgált területen egy-kettő fordult elő, a második módszer pedig a hirtelen megnövekedett igények miatt vált lehetetlenné. Ugyancsak jelentős volt a természetvédelmi szakma kibontakozó belső - és az ifjabb kutatói nemzedék külső - ellenállása az ilyen látszateredményeket produkáló álobjektív, de nagy anyagi ráfordítást igénylő megoldásokkal szemben.

A zónabeosztás és a rezervátumelv.

Az események másik vonulatát az a szakmai vita jelentette, amely a nemzeti parkok és egyéb védett területek kezelésével, konkrétan a védettségi zónák mibenlétével és kijelölésének elvi alapjaival kapcsolatban bontakozott ki. A negatív eszközökkel operáló hatósági szervezet számára az egyes zónák a tevékenységek korlátozhatóságának különböző fokozatait

kell, hogy képviseljék. Ilyen pl. az ún fokozottan védett terület, ahol mindenfajta közvetlen civilizációs beavatkozást jogi, államigazgatási eszközökkel erősen lehet korlátozni, vagy tiltani. Ez a szemlélet feltételezi, hogy a legértékesebb területeket kell a legjobban védeni a hasznosítótól, vagy használótól, ezért a legtöbb természeti értéket hordozó területeket kell az ún. természeti zónába sorolni. Tekintettel arra, hogy legértékesebb területeink jó része kultúrtáj, ahol az értékek megőrzésének feltétele a hagyományos területhasználati mód fenntartása, vagy imitálása, ennek a szemléletnek az alkalmazása feloldhatatlan belső ellentmondásokhoz vezet. Éppen a zonációval kapcsolatos szakmai viták során bontakozott ki a természetvédelem mindig is meglévő, de a speciális hazai viszonyok között háttérbe szorult másik alapelvének megfogalmazása, melynek messzemenő következményei lettek mind az állapotfelvétel és az ebből kifejlődő természetvédelmi monitoring, mind a zonációbeosztásra vonatkozóan. A - nálunk - hagyományos természetvédelmi stratégia abból indul ki, hogy azonosítani kell az egyes természeti értékeket, és ezeket meg kell próbálni megőrizni. Ahol adott területen nagy az értékek koncentrációja, ott nagy hatékonysággal lehet ezeket megvédeni a terület védetté, ill. fokozottan védetté nyilvánítása révén, a gyakorlatilag létező alapvetően negatív hatósági és az elvileg létező pozitív (dotációs, műszaki, stb.) eszközök alkalmazásával. Ez a szemlélet feltételez egy ideális állapotot, melynek fenntartása, vagy visszaállítása jelenti az alapvető természetvédelmi célt. Ez a nézet egyébként a nyolcvanas években burjánzott el a hazai természetvédelmi gyakorlatban, némi lenézéssel illetve a „klasszikus" rezervátumelvű természetvédelmet, mely nem olyan „hatékony", mint az „aktív" beavatkozásokkal operáló „modern" természetvédelem. A valódi ok természetesen az volt, hogy a gazdaságilag hasznosítható földterületeket továbbra is hasznosították, a nem hasznosítható, gazdaságilag értéktelennek minősített területek pedig túl kicsik és túl értékesek voltak ahhoz, hogy a nem kezeléssel járó kockázatot érdemes lett volna vállalni. Így aztán a bioszférában spontán lejátszódó állapotváltozások monitorozására alkalmas terület úgyszólván nem maradt az országban: hol a gazdálkodás jelentett antropogén beavatkozást, hol a „természetvédelmi célú természetátalakítás." A másik természetvédelmi stratégiai elv ugyan megjelent a hazai jogban és természetvédelmi gyakorlatban - a bioszféra rezervátumok révén -, de összemosódva a tárgyi értékelvűséggel, lényegében a gazdálkodókkal szembeni erkölcsi érvként funkcionálva, mint az értékesség nemzetközileg objektivált bizonyítéka. A gyakorlatban mindössze annyi történt, hogy idehaza nemzetközi sikerként lehetett eladni a bioszféra rezervátumok létrehozását és nemzetközi lajstromba vételét, mindeközben kizárólag a hasznavehetetlenül kicsire kijelölt és szétdarabolt magterületekre sikerült a fokozottan védett területeknél hellyel-közzel erősebb védelmi intézkedéseket foganatosítani.

Az, hogy a bioszféra rezervátumok célja a bioszféra monitorozása, néhány alapvetően elhibázott próbálkozás után teljesen a feledésbe merült. (És a fentiek miatt egyébként sem vezetett volna eredményre.) A két szemlélet összebékítéséhez el kell fogadnunk egy logikailag világos alapelvet: Mindenfajta értékorientált tevékenységet valamiféle értékválasztásnak kell megelőznie. Ez az értékválasztás nem nélkülözheti a szubjektív elemeket. A természetvédelem minálunk egyértelműen fajközpontú, akkor is, amikor élőhelycentrikusnak mondja magát, akkor is, amikor tájvédelemről értekezik, akkor is, amikor „biodiverzitásról" halandzsázik. A fajsúlyos érv ugyanis a védett fajok és a hozzájuk tartozó egyedek száma. Azaz a mértéket adottnak fogjuk fel, és el szoktunk róla feledkezni, hogy ezt is magunk választottuk. (Közben a legritkább, legveszélyeztetettebb fajokat valószínűleg észre sem vesszük.) A természetvédelmi munka eredményessége tehát a már védett fajok és egyedeik szaporításával, előfordulási helyeik, vagy újabb fajok védetté nyilvánításával fokozható. Az élettelen objektumok, pláne az olyan geobiokulturális komplex alakulatok, mint a táj természetesen kilógnak ebből a megközelítésből, ezért ezeket is megpróbálják analitikus egységekre bontani és ezekhez számszerűsíthető értéket rendelni. A másik képtelen következmény, hogy olyan szintetikus absztraktumok védetté nyilvánítását is determinálja, mint pl. egyes növénytársulások, melyeknek topográfiai lehatárolása még szakemberek számára is problematikus, azaz az állampolgár-hatóság viszonylatban teljességgel kezelhetetlen.

Az előbbi problémákat csak egy másik értékválasztási kritériumrendszer bevezetésével és párhuzamos alkalmazásával lehet megoldani. Eszerint nem a védendő objektumokhoz rendelünk értéket, hanem egyfajta kezelési módhoz. Ez éppúgy lehet valamiféle következetes területhasználati mód, mint a *nem beavatkozás* abszolút értékkategóriaként történő elfogadása. A nemzetközi gyakorlat a nemzeti parkokat és egyéb kategóriájú védett területeket, mint egy-egy kezelési standard manifesztumát értelmezi. Egy nemzeti parkot nem a terület sajátosságai tesznek nemzeti parkká (még kevésbé a jogalkotói döntés), hanem az, hogy *nemzeti parkként kezelik*. Azaz legfőképpen és mindenekelőtt a területen lejátszódó spontán folyamatok szabadságának biztosítását helyezik előtérbe, függetlenül az előzményektől. Fokozottan vonatkozik ez a bioszféra rezervátumokra.

Mint a bevezetőben láttuk, a természetvédelem minden esetben információmegőrző tevékenység, mely kézzelfogható hasznot a megőrzött információk társadalmi leképezése által képes hajtani. Ez a leképezés lehet tudományos igényű (állapotfelvétel, monitoring, röviden: kutatás), vagy a szellemi szféra egyéb tartományait érintő (művészeti, rekreációs célú, esztétikai stb.) Ez a megközelítés egyben kijelöli a természetvédelem legteljesebben a nemzeti parkokban kiteljesedő háromosztatú feladatrendszerét: **megőrzés, kutatás, bemutatás**.

A valamely kultúrához kapcsolódó területhasználati mód következtében kialakult, vagy klimatikus eredetű, de a használat révén akaratlanul is fenntartott *veszélyeztetett* egyedi és kompozicionális unikalitások, információk és információtermelő organizmusok megőrzése a természetvédelmi fogantatású tájvédelem feladata. A tájvédelem eszközrendszere, kezelési megoldásai tehát szükségszerűen eltérnek a rezervátumokétól. Egyszersmind világos, hogy a tájvédelmi területek sokkal komolyabb szakmai kihívást jelentenek a természetvédelmi szakma számára, hiszen itt nem valamiféle kezelési sztenderd megvalósítása jelenti az optimumot, hanem egyfajta optimálisnak tekintett dinamikus (térben és időben változó, de arányait tekintve stacionárius) tájmintázat rekonstrukciója ill. fenntartása.

A hazai jogfejlődés és a szakmai műhelyeket sajnálatosan nélkülöző természetvédelem sajátosságai folytán a védett területek elnevezései nem tükrözik azok valódi jellegét, a név részben területnagyságra, részben értékességre utal, legkevésbé tükrözve a kezelési célkitűzést és a mögötte sejthető információmegőrzési stratégiát. A logikailag végig nem vezetett természetvédelmi doktrina természetesen a konkrét védelmi tevékenység során tág teret adott a szubjektivitásnak, nem beszélve arról a sajnálatos tényről, hogy a mégoly következetesen kidolgozott kezelési tervek is végrehajthatatlanok voltak az idegen érdekeltségű tulajdonosok és egyéb címen gazdálkodók ellenérdekeltsége miatt. Az egyedi értékek féltése és mindenáron való megőrzésük szándéka gyakorta a szakemberek belső meghasonlását is okozta. Ahol lehetőség volt rá, a természetvédelmi munka inkább emlékeztetett egy botanikus kert ápolására, mint természetvédelmi kezelésre. A történeti ismeretek hiányos volta és ezzel összefüggésben a folyamatok, történések elégtelen interpretációja a szakemberek és kutatók status quohoz történő ragaszkodását idézték elő, azaz a tájmintázat „befagyasztására" törekedtek. Ezzel összefüggésben még jobban háttérbe szorult a rezervátumszemlélet. Hogy a dolog még cifrább legyen, egyesek a rezervátumokat elkezdték a védett területek szinonímájaként kezelni, megszülvén az új irányvonalat kifejező jelszót : „Ki kell lépnünk a rezervátumok keretei közül", miközben egyáltalán nem léteztek rezervátumaink...

Állapotfelvétel és zónakijelölés az Aggteleki Nemzeti Parkban

I. A zónakijelölés elvei

Az Aggteleki Nemzeti Parkban fenti felismerésektől vezettetve próbáltuk a kettős feladatot (az állapotfelvételt és a kezelési zónák kijelölését) meghatározni, és összehangolni. Nem tehettük magunkévá azt az egyszerű logikán alapuló elképzelést, hogy az állapotfelvétel eredményei alapján jelöljük ki a kezelési zónákat, hiszen a zónák nem belső tulajdonságaik,

hanem kezelési céljaink kifejeződései. Ráadásul a zónák különböző vizsgálati módokat is meghatároznak. (Magterületen mellőzni kell a zavarással, pusztítással járó mintavételt.) A területet legjobban ismerő kutatókkal - elsősorban Dr. Varga Zoltánnal (KLTE)- történt konzultációk alapján az addigi információk birtokában ki tudtunk alakítani egy a kezelési zónabeosztásra vonatkozó elvi és topográfiailag is megjelenített koncepciót, melyen a későbbiekben csak finomítások történtek. A dolog természetesen nem onnan kezdődött, hogy el kellett döntenünk, nemzeti parkot, vagy tájvédelmi körzetet akarunk-e csinálni. Tájvédelmi körzetben a kezelési zónáknak eleve nem lett volna értelme. A Bioszféra Rezervátum státusz, a tényleges nemzeti park kialakításához kedvezőnek látszó társadalmi-politikai környezet, a terület rendkívül kedvező biogeográfiai helyzete és élettereinek spontán gazdagsága egyértelműen eldöntötte a kérdést. Mindazonáltal meg kellett küzdeni azzal a dilemmával, amit a településekhez közeli kultúrtáj-részletek rendkívüli gazdagsága és unikalitása jelentett. (Aggteleki kavicshát szekunder szukcessziósora, szőlőhegyek gyepei, kaszálórétek, legelők stb.) Meg kellett találnunk azt a koncepciót, amely egy alapvetően tájvédelmi szemléletű tevékenységet a rezervátum céljaival összeegyeztet, területileg lehetőleg egyértelműen elválasztva, ugyanakkor nem valamiféle értékítéletet megjelenítve. Abból az ideális jövőképből indultunk ki, hogy a tulajdonosi és a hatósági jellegű védelmi eszközök az egész területen azonosak. Kizárólag a természetvédelmi kezelő döntésén múlik, hogy mely területeket hogyan és milyen mértékben vesz igénybe a nemzeti park három alapfeladatának ellátására. Mindhárom zóna alapfunkciója a megőrzés. Az A-zónában ez kizárólagos és a rezervátumelvű kezelést jelenti, a B és C zónákban a megőrzéssel, mint alapfunkcióval összeegyeztethető egyéb tevékenységek is lehetségesek, ill. kívánatosak. (Azaz az idegen gazdálkodói érdeket megjelenítő erdőgazdálkodás, vadászat a terület szinte teljes egészén gyakorlatilag megszűnik, az egyéb tevékenységeket - idegenforgalom, külterjes állattartás, stb. - pedig az Igazgatóság koordinálja.)

Az egyes zónák az alábbi funkciókat teljesítik:

- Az A_1-zóna megfelel a tudományos rezervátum kritériumainak. Kezelés kizárólag természetvédelmi céllal, és minimális területrészeken történik, egyes fennsíki rétek kaszálása, korábbi tájidegen növénytelepítések végleges eltávolítása révén az A_2-zónában. Kutatás környezetkímélő módszerekkel történhet. Megfelel a bioszféra rezervátum kibővített magterületének.
- A B-zóna az A-zóna pufferzónája. Funkciója ezenkívül a kutatás, kizárólag szakmai és oktatási célú bemutatás. Hagyományos külterjes gazdálkodási formák lehetségesek ill. kívánatosak pl. legeltetés, kaszálás. Ide tartozik Jósvafő szőlőhegye, speciális gyepeivel.

-A C-zóna további feladata az idegenforgalmi bemutatás, rekreáció, itt találhatók a lakott területek, tanösvények, turistautak, idegenforgalmi és turisztikai barlangok, kilátók, információs centrumok, kiszolgáló létesítmények stb. Ebben a zónában is a minimálisra kell korlátozni az erdészeti beavatkozást és fatermesztési célú igénybevételt (csak helyi szükségletre.) Önálló érdekeltségű vadgazdálkodás nem jelenhet meg, kizárólag természetvédelmi célú állományszabályozás lehetséges.

II. Az állapotfelvétel megvalósulása az ANP-ben

Az állapotfelvétel tehát egy szakmailag és politikailag cseppfolyós közegben kezdődött el a „visszaminősítés" okozta morális sokk és az akkor még (legalábbis a természetvédelem sorsát illetően) optimizmusra is okot adó politikai rendszerváltás hajnalán.
A fentebb említett megfontolásokból, tapasztalatokból a következő tanulságok születtek, melyek megalapozták az állapotfelvétel további teendőit:

- az állapotfelvételi munkával elsősorban taxonomus szakembereket kell megbízni, olyanokat, akik a mintavételtől az identifikálásig elvégzik a feladatukat, azaz a terepen otthonosan mozognak. Elsősorban a területen már ismerős, előzetes információkkal rendelkező, és számunkra is megfelelő referenciával bíró szakemberek jöhettek szóba.
- el kell választani egymástól az állapotfelvétel és állapotértékelés folyamatát.
- olyan élőlénycsoportokat célszerű kiválasztani, melyek megvalósítják a monitoring szempontjából operatív taxon fogalmát.
- elegendő fajszám és megfelelően széles hazai elterjedés
- elegendő számú hazai specialista
- legalább relatíve kvantitatív regisztrálhatóság.

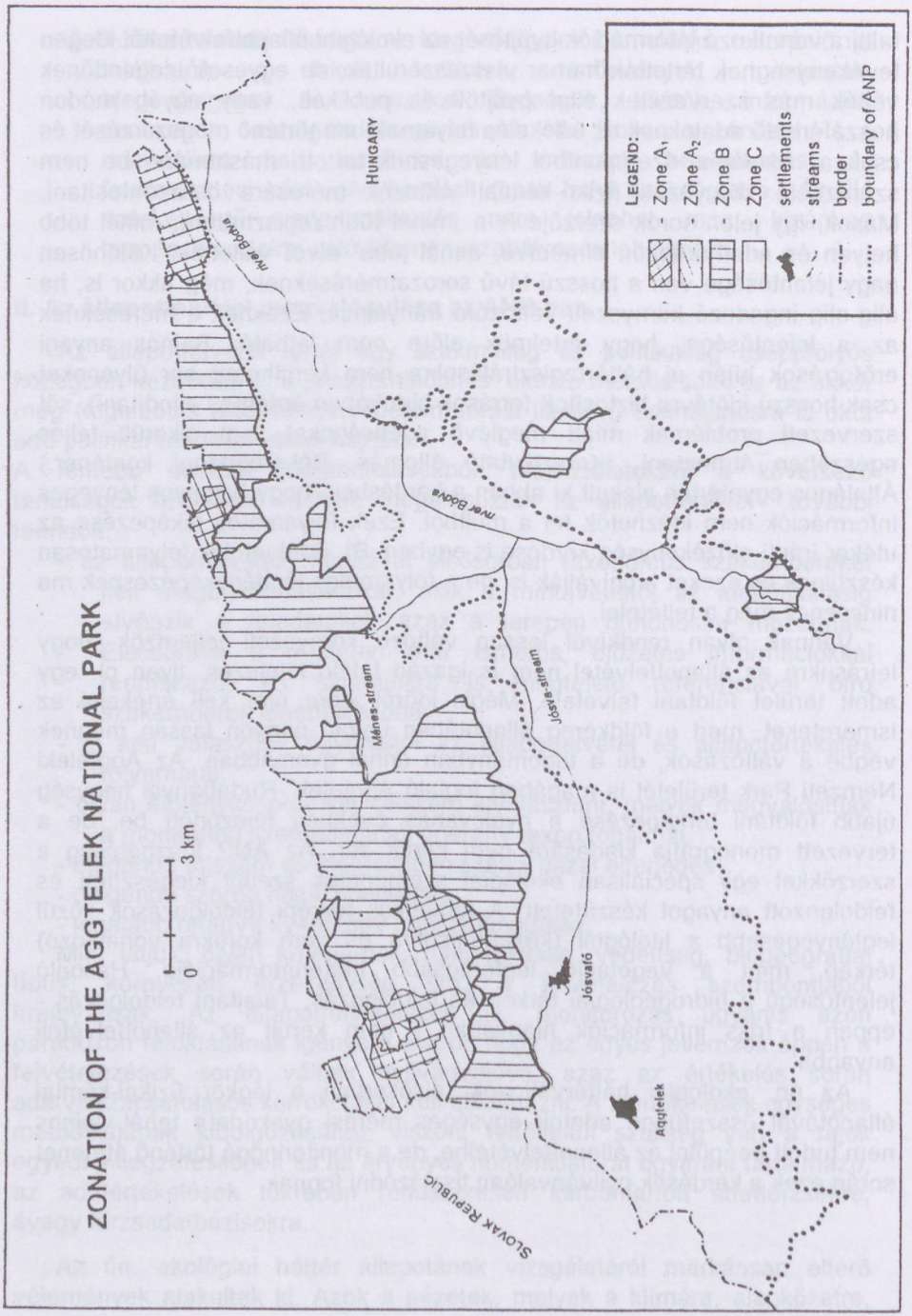
Mint látjuk, olyan kritériumok, mint ritkaság, védettség, biogeográfiai típus, környezeti érzékenység stb. a felvételezés szempontjából irrelevánsak. Az állapotfelvételezés ill. monitorozás ugyanis azon paradoxon feloldásának igényére alapul, hogy az egyes jellemzők éppen a felvételezések során válnak nyilvánvalóvá, azaz az értékelés során adatvisszacsatolásos korrekciókat kell alkalmazni. A kiértékelések egységes metodikájának kidolgozásához viszont feltétlenül szükség van a fajok egyedi jellegzetességeit és az érvényes nomenklatúrát egyaránt tartalmazó, az adatértékelések tükrében rendszeresen karbantartott adattörzsekre, avagy törzsadatbázisokra.

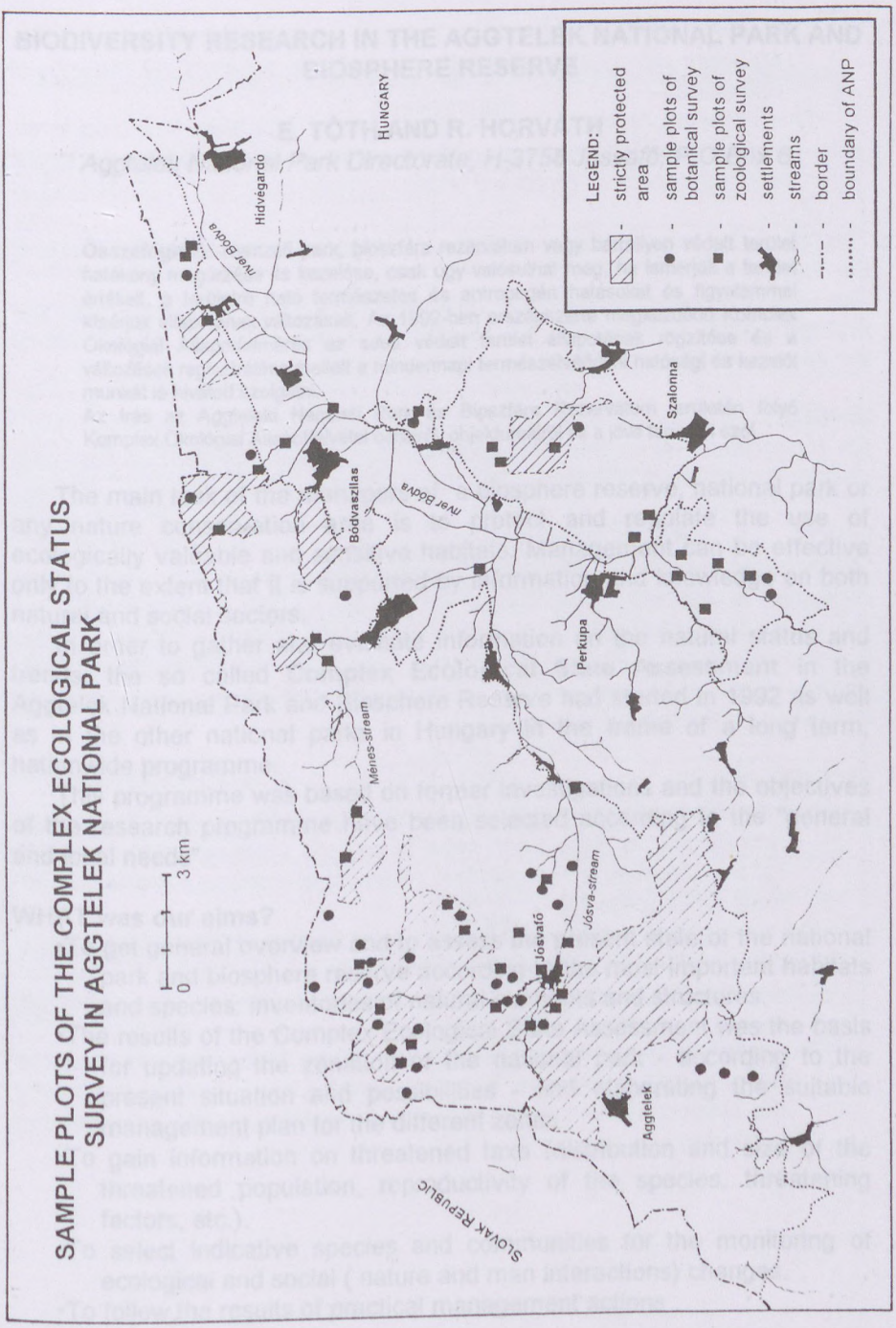
Az ún. ekológiai háttér állapotának vizsgálatáról markánsan eltérő vélemények alakultak ki. Azok a nézetek, melyek a klímára, alapkőzetre,

talajra vonatkozó információk gyűjtését az ekológiai állapotfelvételtől idegen tevékenységnek tartották hamar visszaszorultak, de egyesek elegendőnek vélték más szervezetek által gyűjtött és publikált, vagy egyéb módon hozzáférhető adatoknak az értékelés folyamatában történő megszerzését és csak az ekológiai szempontból lényegesnek tartott, máshonnan be nem szerezhető környezeti fiziko-kémiai változók mérésére összpontosítani. Mások, így jelen sorok szerzője is a „minél több regisztrátum, minél több helyen és adathordozón elmentve, annál jobb" elvét vallották. Különösen nagy jelentősége van a hosszú távú sorozatméréseknek, még akkor is, ha alig-alig ingadozó környezeti változóra irányulnak. Ezeknek a méréseknek az a jelentősége, hogy értelmük előre nem látható. Sajnos anyagi erőforrások híján új háttérregisztrálásokra nem kerülhetett sor (ilyeneket csak hosszú időtávra biztosított források birtokában érdemes elindítani), sőt szervezeti problémák miatt meglévő adottságokat sem sikerült teljes egészében átmenteni. (Karsztkutató állomás, Béke-barlangi konténer.) Általános egyetértés alakult ki abban a kérdésben, hogy bizonyos lényeges információk nem idézhetők fel a múltból. Ezek folyamatos leképezése az utókor iránti előzékenység kérdése is egyben. Pl. űrfelvételek folyamatosan készülnek és ezeket archiválják is, de a folyamatos légifényképezésnek ma nincsenek meg a feltételei.

Vannak olyan rendkívül lassan változó környezeti jellemzők, hogy leírásukra az állapotfelvétel nem is igazán találó kifejezés. Ilyen pl. egy adott terület földtani felvétele. Mégis időről időre újra kell értékelni az ismereteket, mert a földkéreg állapotában ugyan nagyon lassan mennek végbe a változások, de a tudományban annál gyorsabban. Az Aggteleki Nemzeti Park területét is magában foglaló Aggtelek -Rudabányai hegység újabb földtani térképezése a nyolcvanas években fejeződött be, de a tervezett monográfia kiadására nem került sor. Az ANP Igazgatóság a szerzőkkel egy speciálisan ekológiai szempontok szerint kiegészített és feldolgozott anyagot készíttetett. A tematikus térképi feldolgozások közül leglényegesebb a litológiai (kőzettípusokra és nem korokra vonatkozó) térkép, mint a vegetáció legfontosabb háttérinformációja. Hasonló jelentőségű a hidrogeológiai térkép és feldolgozás. Talajtani feldolgozás - éppen a friss információk hiányában - nem került az állapotfelvételi anyagba.

Az ún. ekológiai háttérváltozók, elsősorban a légkör fizikai-kémiai állapotával összefüggő adatok egységes mérési gyakorlata tehát sajnos nem tudott beépülni az állapotfelvételbe, de a monitoringgá történő átmenet során ezek a kérdések nyilvánvalóan tisztázódni fognak.


ZONATION OF THE AGGTELEK NATIONAL PARK
LEGEND:
- Zone A1
- Zone A2
- Zone B
- Zone C
- settlements
- streams
- border
- boundary of ANP
HUNGARY
SLOVAK REPUBLIC
River Bódva
Ménes-stream
Jósva-stream
Jósvafő
Aggtelek
0
3 km


SAMPLE PLOTS OF THE COMPLEX ECOLOGICAL STATUS SURVEY IN AGGTELEK NATIONAL PARK
LEGEND:
- strictly protected area
- sample plots of botanical survey
- sample plots of zoological survey
- settlements
- streams
- border
- boundary of ANP
HUNGARY
SLOVAK REPUBLIC
Hidvégardó
Nyer Bódva
Bódvaszilas
Szalonna
Perkupa
Méhes-stream
Jósvafő
Jósva-stream
Aggtelek
0
3 km



BIODIVERSITY RESEARCH IN THE AGGTELEK NATIONAL PARK AND BIOSPHERE RESERVE

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Összefoglaló: Nemzeti park, bioszféra rezervátum vagy bármilyen védett terület hatékony megőrzése és kezelése, csak úgy valósulhat meg, ha ismerjük a terület értékeit, a területre ható természetes és antropogén hatásokat és figyelemmel kísérjük állapotának változásait. Az 1992-ben országszerte megkezdődő Komplex Ökológiai Állapotfelmérés az adott védett terület állapotának rögzítése és a változások regisztrálása mellett a mindennapi természetvédelmi hatósági és kezelői munkát is hivatott szolgálni.
Az írás az Aggteleki Nemzeti Park és Bioszféra Rezervátum területén folyó Komplex Ökológiai Állapotfelvétel céljairól, objektumairól és a jövő terveiről szól.

The main task of the managers of a biosphere reserve, national park or any nature conservation area is to protect and regulate the use of ecologically valuable and sensitive habitats. Management can be effective only to the extent that it is supported by information and knowledge on both natural and social sectors.

In order to gather and evaluate information on the natural status and trends, the so called **Complex Ecological State Assessment** in the Aggtelek National Park and Biosphere Reserve had started in 1992 as well as in the other national parks in Hungary in the frame of a long term, nationwide programme.

This programme was based on former investigations and the objectives of the research programme have been selected according to the "general and local needs".

WHAT was our aims?

- To get general overview and to assess the present state of the national park and biosphere reserve according to the most important habitats and species: inventories of natural elements and structures.
- The results of the Complex Ecological State Assessment was the basis for updating the zonation of the national park - according to the present situation and possibilities - and elaborating the suitable management plan for the different zones.
- To gain information on threatened taxa (distribution and size of the threatened population, reproductivity of the species, threatening factors, etc.).
- To select indicative species and communities for the monitoring of ecological and social (nature and man interactions) changes.
- To follow the results of practical management actions

- To provide for the staff of the national park as nature conservation authority with useful information in order to substantiate the official decisions.
- This complex research project would be the first step of a long term, nationwide biodiversity monitoring program which will be applied not only for survey of protected areas

The research program: the studied taxa and the methods are summerized in the Table 1 and 2.
The project concerns not only the wildlife of the National Park, but meteorological, hidrological, etc investigations and the state assesment of the caves were also conducted.

WHERE?
All zones were taken into consideration during the selection of sampling sites and permanent quadrats. (See the map on pages 30-31.)

WHO?
Independent research institutes (universities, museums, etc.) and professional researchers were hired for this work under the coordination of the specialised staff of the National Park. The scientific advisor of the Complex Ecological State Assessment in Aggtelek National Park is Prof. Zoltán Varga, the Head of the Department of Evolutionary Zoology of Kossuth L. University, Debrecen.

FUTURE PLANS:
- Vegetation mapping on the whole territory of Aggtelek National Park and Biosphere Reserve in order to provide with baseline informaton for the planning and regulating (forest and grassland management, local development)
- Monitoring of invading weed species (e.g. *Solidago gigantea*)
- Extension of investigated animal groups
- Open new study areas on the uninvestigated patches of the national park.
- Extension of the complex assessment to the buffer zone outside the national park borders to help the planning process and establishing the system of Environmentally Sensitive Areas in the neighbouring territories.

Table 1.

Zoological investigations in the farme of Complex Ecological State Assessment

Target groups	Methods of sampling
MAMMALOGICAL and ORNITHOLOGICAL survey:	
Survey of small-mammals	- live traps
Estimation of game population:	- observation (method of Langvatn)
Population-dynamical investigations and survey of bird communities	- revier mapping - Passeriformes: 3x10 ha - spot mapping - birds of prey on 20 000 ha - line mapping: 4 line
Species research: Hazelhen, Corncrace, Red-backed shrike, Barn owl, White stork	- revier mapping - nest mapping
Survey of taxa living in antropogenic environment (bats, Barn owls, White stork)	- observation - ringing
Data of bird migration	- ringing
HERPETOLOGICAL survey:	- observation
PISCES-faunistical survey:	- towing net (0.8 cm mesh size) - electric fishing machine
MALACO-faunistical survey:	- observation - analysis of the pitfall traps of Carabidae survey
ORTHOPTERA-faunistical survey:	- dish trap - observation
LEPIDOPTEROLOGICAL survey:	- singling - light trap - observation
MICRO-LEPIDOPTERA survey:	- singling - light trap
TRICHOPTERA, PLECOPTERA and EPHEMEROPTERA surveys:	- singling - light trap
ODONATA survey:	- singling - collection and identification of the grub remnant
ARANEIDEA survey	- trap
Comparative survey of CARABIDAE populations:	- pitfall traps
Survey of DIPTERA:	- Malaise traps - singling

Table 2.

Botanical investigations in the farme of Complex Ecological State Assessment

Aims of the investigations	
Check-list of VASCULAR PLANTS of Aggtelek National Park	- based on the Herbaria of Hungarian Natural History Museum - based on scientific literature - based on the reports of former phytocoenological and floristical investigation - observation
Survey of the CRYPTOGAMIC FLORA (Lichens and Mosses)	- based on the Herbaria of Hungarian Nature History Museum and the Esterhazy Teachers Training College in Eger - based on scientific literature - collection - observation (in case of rare species)
State assessment of typical HABITATS of Aggtelek Karst	- coenological relevé - 40 plots
SPECIES RESEARCH: Investigation of ecological requirements of Onosma tornense and effects of the spontaneously spreading Pinus nigra on its endangered population	- 3 study plots : 10 x 10 m quadrats and transects divided into 0.5 x 0.5 m microquadrats
Estimation of damage and disturbances caused by GAME GRAZING	- 6 isolated quadrats (10 x 10 m) with 6 controll area
To follow the changes of VEGETATION and LAND-USE over 30 years	- analysis of aerial photo series (1952, 1971, 1988)

References

Heywood, V.H. (executive ed.) (1996) Global Biodiversity Assessment. Published by UNEP. Cambridge Univ. Press.

BIODIVERSITY RESEARCH

Table 2.

Botanical investigations in the frame of Complex Ecological State Assessment

Aims of the investigations	
Check-list of VASCULAR PLANTS of Aggtelek National Park	- based on the Herbaria of Hungarian Natural History Museum - based on scientific literature - based on the reports of former phytocenological and floristical investigation - observation
Survey of the CRYPTOGAMIC FLORA (Lichens and Mosses)	- based on the Herbaria of Hungarian Nature History Museum and the Eszterházy Teachers Training College in Eger - based on scientific literature - collection - identification (in case of rare species)
State assessment of typical HABITATS of Aggtelek Karst	- phytocenological relevé - 40 pieces
SPECIES RESEARCH: investigation of ecological requirements of characteristic species and effects of the environmentally impacting Pinus nigra on its endangered populations	- 3 study plots - 10 x 10 m quadrats and they are divided into 0.5 x 0.5 m microquadrats
Estimation of damages caused by GAME GRAZING	- 5 control
To follow the changes of VEGETATION and LAND-USE over 30 years	- analyses of aerial photo series (1952, 1971, 1989)

References

Heywood, V.H. (executive ed.) (1995) Global Biodiversity Assessment. Published by UNEP, Cambridge Univ. Press

THE MACROSCOPIC FUNGI (*BASIDIOMYCETES*) OF THE "AGGTELEKI-KARSZT"

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Összefoglaló: Az "Aggteleki-karszt" gombaflóráját (*Basidioycetes*) 6 évig (1987-1992) tanulmányoztuk (Locsmándi 1994). Ez a munka hézagpótló, mivel eddig ezen a területen sem gombaflorisztikai sem gombataxonómiai vizsgálatokat nem végeztek.
A begyűjtöttt gombaanyag preparálását és megőrzését három különböző módszerrel végeztük el: 1. a termőtesteket (közel 900 példányt) a módosított Herpell féle módszerrel preparáltunk (Lowy 1958), 2. a típusanyagokat és több más ritka fajt (közel 400 példányt) fagyasztva szárítással tartósítottunk (Vasas 1993), 3. az "Aggteleki-karszton" gyűjtött néhány fajból készült tiszta tenyészetet (28 izolátumot), genetikai állományuk megőrzése érdekében folyékony nitrogénben helyeztünk el (Locsmándi 1992).
A területről két, új taxont írtunk le: *Macrolepiota citrinascens* Vasas, *Rhodocybe mundula* (Lasch) Sing. var. *rubescens* Locsmándi & Vasas.
A *Macrolepiota citrinascens*-t Szelcepuszta közelében levő lucosban gyűjtöttük 1988. 09. 14-én. Ennek a fajnak a húsa vágásra sárgul, eltérően a hozzá hasonló *M. puellaris*-tól. A *Macrolepiota citrinascens*-nek csőrszerű nyúlvánnyal ellátott bunkóalakú cisztídái vannak (Vasas 1990).
A *Rhodocybe mundula* var. *rubescens*-t Aggtelek közelében levő tölgyesben gyűjtöttük 1990. 06. 25.-én. E változat húsának vörösödése jellegzetes tulajdonság (Babos & Bohus & Locsmándi & Vasas 1994).
A legmagasabb fajszámúnak a *Russula* (61) (Vasas 1991), a *Lactarius* (30), az *Agaricus* (26) és a *Cortinarius* (26) nemzetséget találtuk.
A kijelölt hét mintaterületet cluster-analisissel összehasonlítva megállapítottuk, hogy a "Kecske-kút-völgy" és a "Mohos-galya" gombaflórája áll legközelebb egymáshoz. A legtöbb faj (164) a "Kecske-kút-völgyből", a legkevesebb a "Bérc-tetőről" került elő.

The fungus flora (*Basidiomycetes*) of the "Aggteleki-karszt" was studied during six (1987-1992) years (Locsmándi 1994). We collected mushrooms on the territory at about 36 times, first of all in the rainy period of early summer and autumn.

The investigations fill a gap on this field because it has been carried out neither floristical nor taxonomic examinations on the fungi of this region.

Methods for preservation of fungi

The collected fungus material is prepared and preserved with three different methods

1. The fruit-bodies (approx. 900 specimens) are prepared with Herpell's method (Lowy 1958).

2. The type material of *Rhodocybe mundula* var. *rubescens* and a lot of other important species (approx. 400 specimens) are prepared with freeze-drying, a technic for preserving fruit-bodies in their natural but not living state which has been initiated in Hungary by the authors (Vasas 1993).
3. The pure cultures of several species (28 isolates) collected in the "Aggteleki-karszt" are stored in liquid nitrogen for a long time to avoid genetic damage of the isolates. The Culture Collection established by the author serves as depository for a lot of species of floristical and taxonomic importance (Locsmándi 1992).

Taxonomic results from the "Aggteleki-karszt"

As a result of 36 collections 2313 records of 526 taxa (32 species new for Hungary and 103 rare) are documented.

Two new taxa were described from the area:
Macrolepiota citrinascens Vasas
Rhodocybe mundula (Lasch) Sing. var. *rubescens* Locsmándi et Vasas

New taxa described from the "Aggteleki karszt"

Macrolepiota citrinascens Vasas was collected near Szelcepuszta in piceeto on 14.09.1988. This species differs from the closely related *M. puellaris* in its flesh which turns yellow on cutting. Cystidia of *M. citrinascens* are clavate with beak-shaped protuberances (Vasas 1990).

Rhodocybe mundula var. *rubescens* was collected near Aggtelek in querceto on 25.06.1990. The reddening flesh is characteristic on this variety (Babos, Bohus, Locsmándi & Vasas 1994).

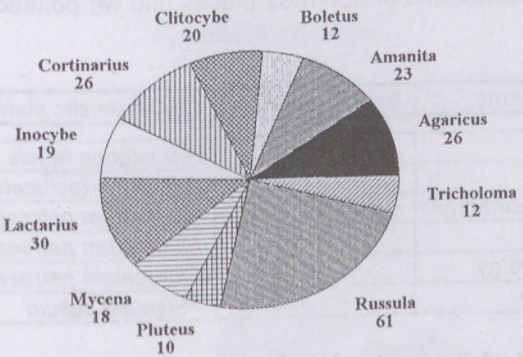
New species for Hungary

Agaricus arvensis Schff. et Fr. ssp. *macrolepis* Boh.
Agaricus nivescens (Moell.) Moell. var. *parkensis* (Moell.) Moell.
Agaricus purpurellus (Moell.) Moell.
Agaricus sylvaticus Schff. ex Secr. var. *fusco-squamatus* (Moell.) Moell.
Amanita argentea Huijsman
Amanita regalis (Fr.) Michael
Amanita rubescens (Pers. ex Fr.) Gray var. *annulosulphurea* Gillet
Boletus caucasicus (Sing) Sing.
Clitocybe anisata Vel. sensu Harmaja
Collybia ingrata (Schum. et Fr.) Quél.
Cortinarius jubarinus Fr.
Cortinarius junghuhnii Fr.
Cortinarius subarquatus (Mos.) Mos.

Cortinarius strobilaceus Mos.
Crepidotus lundellii Pilat
Dermoloma pseudocuneifolium (Pers. ex Pers.) Herink
Entoloma serrulatum (Pers. ex Fr.) Hesler
Entoloma griseo-cyaneum (Fr.) Quél.
Hygrocybe ceracea (Wulf. ex Fr.) Karst.
Inocybe margaritispora (Berk.) Sacc.
Inocybe obscuroides P.D. Orton
Inocybe perbrevis (Weinm.) Gill.
Lyophyllum semitale (Fr.) Kühn.
Macrolepiota permixta (Barla) Mos.
Melanoleuca subpulverolenta (Pers.) Metr.
Russula cyanoxantha Schff. ex Fr. fm. *peltereaui* Sing.
Russula font-queri Sing.
Russula fragrantissima Romagn.
Russula melzeri Zv.
Russula persicina Kromb. ex Mlz.-Zv. var. *rubrata* Romagn.
Tricholoma cingulatum (Fr.) Jacobasch
Xerocomus lanatus (Rostk.) Sing.

The myco-floristical evaluation of the "Aggteleki-karszt"

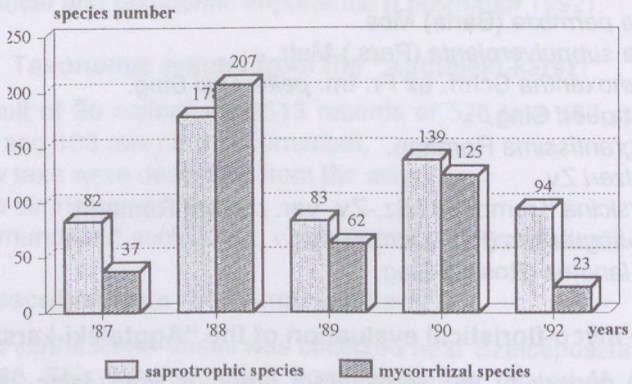
The two genera of the xerotolerant order of *Russulales*, the *Russula* genus (61 species) and the *Lactarius* genus (30 species) have the highest species numbers. It is the the *Cortinarius* genus which has the third highest number of species (26). 77 % of the species was found in 1988, after a longer rainy period. The abundance of the *Agaricus* genus (26 species) is noteworthy as well.



Characteristic genera with species numbers

The mycological characteristics of the investigation period

From the five years investigated, 1988 proved to be the best one from mycological point of view. It is proved by the higher number of mycorrhizal species (207) compared with the saprotrophic species (178). This year 385 taxa were found among which 1 species is new for the science (Vasas 1990). Concerning the territory of Hungary 23 species were new and 62 species were relatively rare.



Distribution of saprotrophic and mycorrhizal species number in the years 1987-1992

Sample plots in "Aggteleki-karszt"

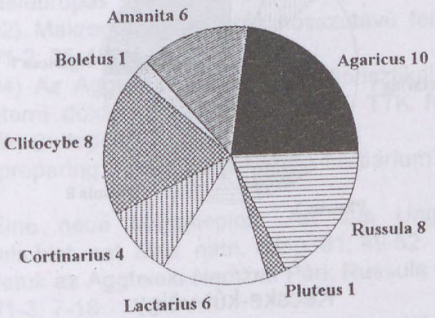
We collected mushrooms at about 62 places and we pointed out six sample plots.

Geographical name	Species number	Characteristic plant association
1. Bacsó-nyak	123	*Agrostetum tenuis*
2. Bérc-tető	33	*Diplachno-festucetum*
3. Szabadság-barlang	111	*Quercetum petraeae-Carpinetum*
4. Holló-fészek	80	*Quercetum petraeae-cerris*
5. Kecske-kút-völgy	164	*Quercetum petraeae-cerris*
6. Kopasz-hegy	103	*Piceetum cultum*

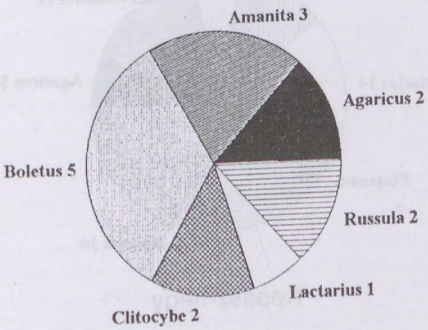
The comparison of 7 sample plots by cluster-analysis showed highest flora similarity between "Kecske-kút-völgy" and "Mohos-galya". High abundance could be detected in "Kecske-kút-völgy" (164 species), low abundance in

"Bérc-tető" (33 species). The number of the most important genera of the sample plots were illustrated by circle diagrams.

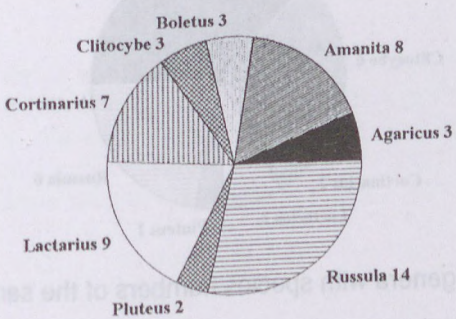
Bacsó-nyak



Bérc-tető

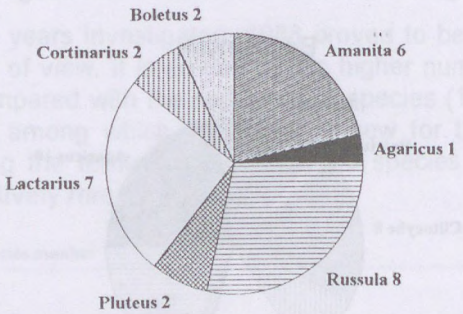


Szabadság-barlang

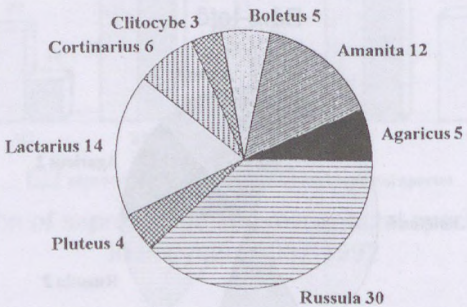


Important genera with species numbers of the sample plots

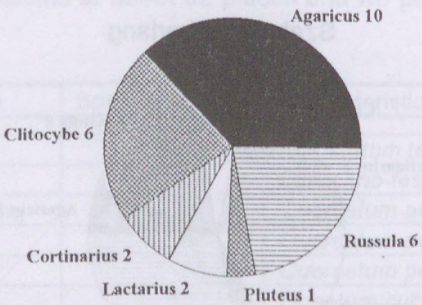
Hollófészek-völgy



Kecske-kút-völgy



Kopasz-hegy



Important genera with species numbers of the sample plots

The highest numbers of species were detected in the genus *Russula* (61) (Vasas 1991), *Lactarius* (30), *Agaricus* (26) and *Cortinarius* (26).

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BIOINDICATION OF HABITAT CONDITIONS WITH BRYOPHYTES AT SOME STREAMS IN AGGTELEK NATIONAL PARK AND BALATON-FELVIDÉK REGION, HUNGARY

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Összefoglaló: Az Aggteleki Nemzeti Park 6 patakján (Telekes-, Henc-, Bolyamér-, Kopolya-, Kecső- és Jósva-patak) 12 mintavételi helyen vizsgáltuk a vízben illetve a víz közvetlen közelében élő mohavegetációt 1993-94-ben. Az egyes szakaszokon megbecsültük a különböző mohafajok mennyiségét, valamint néhány vízminőségi paraméter mérésére is sor került (pH, keménység, áramlási sebesség, NO_3, NO_2, NH_4, PO_4) évente 3 alkalommal. Összehasonlításként felhasználtuk néhány Balaton-felvidéki patakon (5 vizsgálati pont) végzett mérésünk során nyert adatainkat is.
A mohavegetáció alapján végzett cluster-analízis szerint a Telekes-völgy nagyon elkülönül. A mohaegyüttest csaknem teljes egészében az állandó életkörülményekhez alkalmazkodott évelő fajok alkotják (90-100%). Magas a szubmediterrán, szubatlantikus karakterű fajok aránya. A mohavegetáció hasonlít egyes görögországi patakokéra.
A Henc-völgy patakja szintén különáll a többiektől. Ez a patak enyhén szennyezettnek bizonyult a vízminőségi paraméterek alapján. Az 194-es nyári mintában az NO_2 0.1 mg/l, míg a NH_4 elérte a 0,07 mg/l-es értéket. A moha fajszám kicsi. A szennyeződést jól toleráló *Amblystegium riparium* figyelemreméltó mennyiségben fordul elő a vizsgált szakaszon.
A többi vizsgált patak két csoportot alkot a dendrogrammon. Az egyik csoportban foglalnak helyet a Jósva-patak forrásvidékén, valamint a Kecső-patakon található vizsgálati pontok. A másik csoportot a többi aggteleki patak, valamint a balaton-felvidéki patakok alkotják. Annak ellenére, hogy a Balaton-felvidéken vizsgált patakokon a víz NO_3 tartalma és keménysége is jóval nagyobb, a mohavegetáció sok hasonlóságot mutat egyes aggteleki patakok mohaegyüttesével.
Néhány patak esetében a kolonista mohafajok aránya elég magas, mint pl. a Jósva forrásvidéke illetve a Szin falunál lévő mintavételi pont, a Kecső-patak és két Balaton-felvidéki hely (az örvényesi vizimalom és az Aszófői-séd alsó szakasza a campingnél). A kolonista fajok előretörése, amelyek képesek gyorsan elfoglalni újonan felszabadult élőhelyeket, a zavaró hatások erősödését jelzi.

Introduction

The quality of water and near-water or aquatic habitats are often brought into the focus of nature conservation. Chemical and physical parameters are generally used for the determination of water quality. However, these parameters are continuously changing and average values give only superficial information about the influence exercised on the inhabitant organisms.

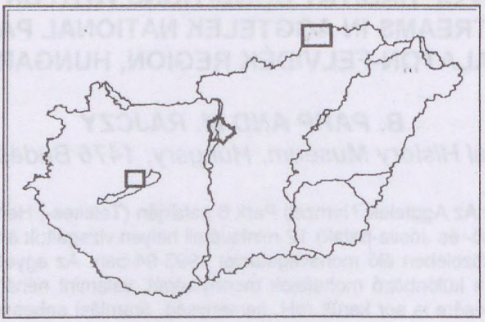


Fig. 1.a The location of the study areas in Hungary

Bacteria, algae, aquatic invertebrates and fish are often used for bioindication of water quality, especially saprobity (the organic material dissimilation capacity of the water ecosystem, which is related to the quantity of organic materials in the water). There are data available on the use of bryophytes living in running water (Frahm 1974, Empain 1973, 1978, Peñuelas & Sabater 1987, VrhovŠek& al. 1984, 1985).

Investigations on the correlation between bryophyte vegetation and water quality were carried out in several mountain streams in Hungary. Hereby the results of research at two calcareous areas (Aggteleki-karst and Balaton-felvidék region) are presented.

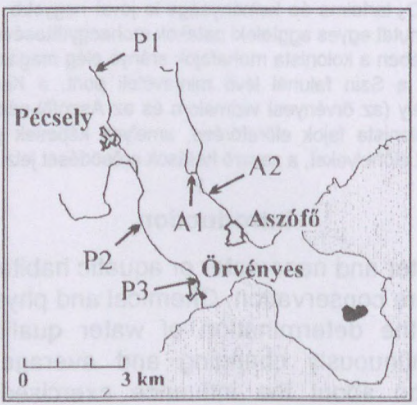


Fig. 1.b The location of the sampling sites in Balaton-felvidék region



Fig. 1.c The location of the sampling sites in Aggteleki-karst

Material and methods

The bryophyte vegetation influenced by the water was investigated in 1993-94 at 12 sampling points of 6 streams of the Aggteleki-karst such as Telekes- (T1, T2), Henc- (H), Bolyamér- (B), Kopolya- (Ko1, Ko2) valley, Kecső- (Ke), Jósva- (J1, J2, J3, J4, J5) stream and at 5 sampling sites in Aszófői-séd (A1, A2) and Pécsely-stream (P1, P2, P3) at the Balaton-felvidék region (Fig. 1)

Frequency of each bryophyte species was estimated on a 1-4 scale along about 100 m sections of the streams and some chemical, physical parameters such as pH, total hardness, NO_3, NO_2, NH_4, PO_4 by portable Macherey-Nagel water analytical tests (Duotest, Aquadur, Visocolor tests) and flow velocity were measured 3 times a year at each sampling point.

Hierarchical cluster analysis (percentage similarity, UPGMA fusion technique) of the program package SYN-TAX (Podani 1993) were carried out to compare the bryophyte vegetation of the sampling sites.

Life strategy (During 1979, Orbán 1984) and European distribution categories (Düll 1983, 1984, 1985) of bryophytes weighted by species frequencies and some chemical parameters (NO_2, NH_4, NO_3, total hardness) were used to characterize the different habitat conditions.

Results and discussion

According to the results of the cluster analysis based on the bryophyte vegetation, the Telekes-valley (T1, T2) is very different from the other streams. Henc-valley (H) is also separated from the others. The other

streams are arranged into two groups. One group contains the sampling points of the source area of Jósva-stream (J1, J2, J3) and Kecső-stream (Ke). These stream sections are situated close to each other in the Aggteleki-karst. The other group consists of the rest of the sampling points of the Aggteleki-karst and all sites of the Balaton-felvidék region (Fig. 2).

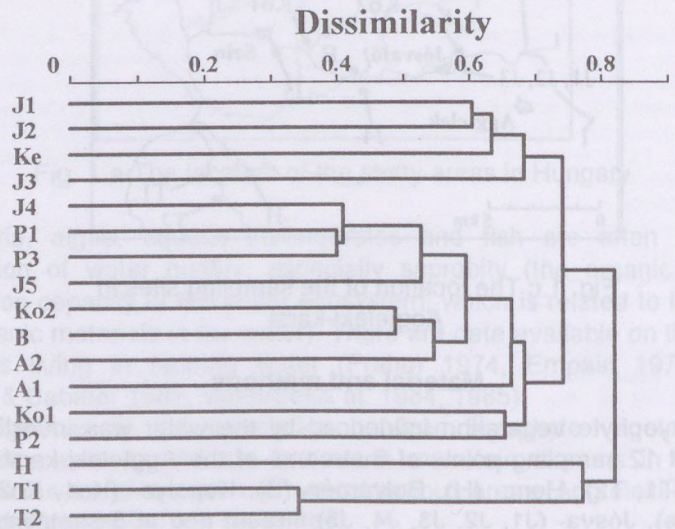


Fig. 2. The dendrogram of the studied stream section

Along the stream of the Telekes valley the quantity of perennial species, which require constant environmental conditions, is very high (90-100%). The proportion of perennials and species with similar life strategy, the so-called long lived shuttle species is usually high in the other sites, too. But the quantity of colonist species is noteworthy in some stream sections such as at the source area (J1, J2) and a site near Szin village (J5) of Jósva stream, and two sites of the Balaton-felvidék region (at the mill of Örvényes (P3) and near the Camping in Aszófői-séd (A2)). The colonist species are capable of quickly occupying newly formed habitats and their high proportion is an indication of disturbing effects (Fig. 3).

The bryophyte flora of Telekes-stream (T1, T2) is really unique. The proportion of submediterranean, subatlantic species is high. The quantity of submediterranean species is also high on Kecső-stream (Ke). It is noteworthy, that along the streams of the Balaton-felvidék region, where the higher plant communities have considerable submediterranean character, the proportion of submediterranean bryophytes is lower than in the above mentioned streams of the Aggteleki-karst (Fig. 4).

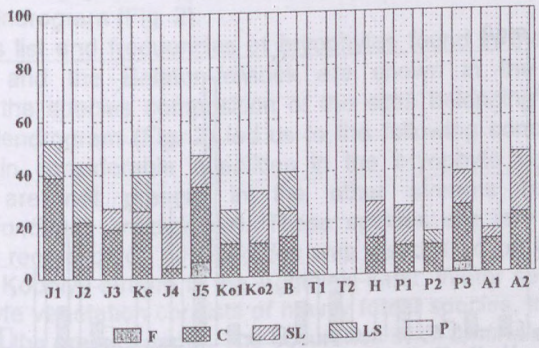


Fig. 3. Life strategy categories weighted by species frequencies in the studied stream sections

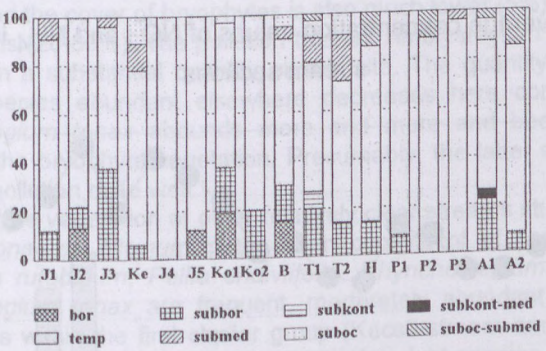


Fig. 4. European distribution character categories weighted by species frequencies in the studied stream sections

The measured chemical parameters show that the Henc-stream (H) is slightly polluted. The values of average concentration of NO_2 and NH_4, are much higher in this stream than in the other sites (Fig. 5.). In a summer sample in 1994 the NO_2 concentration reached 0.1 mg/l, and the concentration of NH_4 was 0.07 mg/l. The average concentrations of NO_2 were also higher on Telekes-stream (T1, T2) and on a section of Pécsely-stream (P2).

The average NO_3 concentrations and total hardness are usually much higher in the streams of the Balaton-felvidék region, than in those of the Aggteleki-karst (Fig. 6). In spite of this, the bryophyte vegetation the streams of the Balaton-felvidék is similar to a part of the streams of

Aggtelek, because they are included in the same group generated by cluster analysis (Fig. 2).

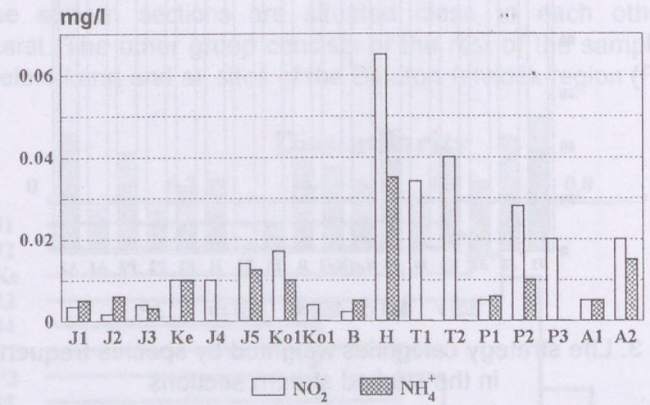


Fig. 5. The average concentration values of NO_2 and NH_4 in the studied stream sections

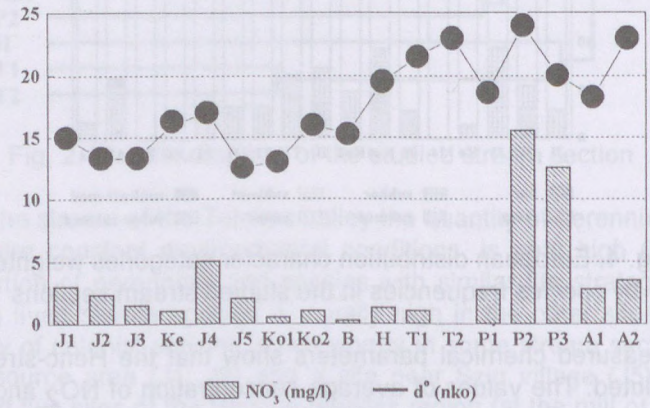


Fig. 6. The average NO_3 concentrations and total hardness (d°) in the studied stream section

It seems that latter parameters in this range probably do not influence the species composition.The bryophyte vegetation of waters with total hardness from 15 nko to 25 nko is similar. The NO_3 concentration of 10-15 mg/l is still tolerated by the bryophytes. But, as we have seen it above, in the stream of Henc-valley the higher concentration of NO_2 and NH_4 causes

big changes in the bryophyte vegetation, because this site is separated from the others on the dendrogram (Fig. 2).

The species list and frequencies of bryophytes found in the streams of the Aggteleki-karst and the Balaton-felvidék are shown in the Table 1. The examination of the species composition of the sites belonging to the different groups of the dendrogram (Fig. 2) led us to the following conclusions. Several species found in considerable quantities in the bryophyte vegetation of the Telekes-valley are not present in the other streams (e.g. *Cinclidotus fontinaloides, Fontinalis antipyretica*). These species are rare in Hungary. In addition, a new record of *C. fontinaloides* was discovered on the rocks at the upper spring of Kopolya-stream in the Aggteleki-karst. Water seldom flows here and the bryophyte vegetation consists of mainly forest species, therefore this site is not included in the present paper. The occurence of *C. fontinaloides* reminds us of an era with aboundant water supply.

There is a reduced bryophyte species number in the stream of Henc-valley that proved to be moderately polluted as it was shown by the water quality parameters, and the cover of bryophytes is also much lower (5%) than in the case of other streams (20-80%). The pollution tolerant *Amblystegium riparium* (FRAHM 1974) occurs in a substantial quantity on this site. The quantity of *Cratoneuron filicinum*, a species abundant elsewhere decreases here considerably, while *Hygroamblystegium tenax* abounds more and more and becomes the main constituent of the bryophyte vegetation. Presumably, the latter species tolerates the moderate pollution quite well.

The bryophyte vegetation of other relatively clear streams studied shows high diversity. *Cratoneuron filicinum* is the main constituent of practicaly all sites. *Brachythecium rutabulum*, *Pellia endiviifolia*, *Rhynchostegium riparioides* and *Hygroamblystegium tenax* are frequent, moderately abundant species. In the stream sections within the first cluster group (Kecső-stream and source area of Jósva-stream) there are many comparatively abundant species, that are rare or absent in the other streams (e.g. *Bryoerythrophyllum recurvirostre*, *Fissidens viridulus*, *Hygrohypnum luridum*, some *Plagiomnium* species as *P. cuspidatum*, *P. rostratum*, *P. undulatum*, and several *Didymodon* species as *D. luridus*, *D. rigidulus*, *D. tophaceus*).

The bryophyte vegetation of the streams of the Aggteleki-karst has a high diversity, with many species rare in Hungary (e.g. *Bryum bimum*, *Bryum pallens*, *Cinclidotus fontinaloides*, *Didymodon vinealis* ssp. *cylindrica*, *Didymodon luridus*, *Fissidens exiguus*, *Fissidens exilis*, *Fontinalis antipyretica*, *Plagiomnium elatum*). In the streams of the Balaton-felvidék region there are also several rare species (e.g. *Didymodon sinuosus*, *Eurhynchium speciosum*, *Fissidens exiguus*, *Rhynchostegium murale*, *Isothecium myosuroides*). These less spectacular cryptogams often need protection, too. On the other hand, as we have seen it, they are good indicators of the changes of habitat conditions. Therefore we recomend them to the attention of nature conservation.

Taxa	J1	J2	J3	J4	J5	H	KE	Ko1	Ko2	B	T1	T2	P1	P2	P3	A1	A2
Amblystegium riparium (Hedw.) B., S. & G.	-	-	-	2	-	3	-	-	-	-	-	2	-	2	-	-	-
Amblystegium serpens (Hedw.) B., S. & G. var. juratzkanum (Schimp.) Rau & Herv.	-	1	2	-	-	2	-	1	-	-	-	-	1	-	-	-	-
Amblystegium serpens (Hedw.) B., S. & G.	-	-	3	2	-	-	3	1	-	2	-	-	-	-	-	-	-
Amblystegium varium (Hedw.) Lindb.	-	-	-	2	-	-	-	2	-	-	1	-	-	1	-	-	2
Anomodon attenuatus (Hedw.) Hueb.	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
Anomodon viticulosus (Hedw.) Hook. & Tayl.	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-
Barbula convoluta Hedw.	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Brachythecium populeum (Hedw.) B., S. & G.	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-
Brachythecium rivulare B., S. & G.	2	-	-	-	-	-	-	1	3	3	-	-	1	-	-	1	-
Brachythecium rutabulum (Hedw.) B., S. & G.	-	2	-	2	1	-	4	3	3	-	3	3	4	3	2	1	-
Brachythecium salebrosum (Web. & Mohr) B., S. & G.	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bryoerythrophyllum recurvirostrum (Hedw.) Chen	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bryum barnesii Wood	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Bryum caespiticium Hedw.	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Bryum laevifilum Syed	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	2	-
Bryum pallens (Brid.) Sw. ex Roehl.	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
Bryum pseudotriquetrum (Hedw.) Gaertn., Meyer & Scherb. var. pseudotriquetrum	-	1	-	1	2	-	-	2	-	-	-	-	1	-	-	-	-
Bryum pseudotriq. var. bimum (Schreb.) Lilj.	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bryum sp. 1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bryum sp. 2	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Calliergonella cuspidata (Hedw.) Loeske	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Campylium stellatum (Hedw.) C. Jens.	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-
Ceratodon purpureus (Hedw.) Brid.	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Chiloscyphus polyanthos (L.) Corda in Opiz	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cinclidotus fontinaloides (Hedw.) P. Beauv.	-	-	-	-	-	-	-	-	-	-	3	4	-	-	-	-	-
Cirriphyllum crassinervium (Tayl.) Loeske & Fleisch.	-	-	-	-	-	-	2	-	-	-	2	2	-	-	-	1	-
Cratoneuron filicinum (Hedw.) Spruce	4	3	4	4	4	1	4	4	4	4	-	-	4	4	4	4	4

Taxa	J1	J2	J3	J4	J5	H	KE	Ko1	Ko2	B	T1	T2	P1	P2	P3	A1	A2
Didymodon vinealis (Brid.) Zander var. flaccida (Bruch & Schimp.) Zander	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Didymodon fallax (Hedw.) Zander	1	-	-	-	1	-	2	-	-	1	-	-	-	-	-	-	-
Didymodon luridus Hornsch.	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Didymodon rigidulus Hedw.	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Didymodon sinuosus (Mitt.) Delogn.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2
Didymodon spadiceus (Mitt.) Limpr.	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Didymodon tophaceus (Brid.) Lisa	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2	-	-
Encalypta streptocarpa Hedw.	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eurhynchium hians (Hedw.) Sande Lac.	-	-	-	-	-	-	2	4	-	2	-	-	3	1	-	2	1
Eurhynchium speciosum (Brid.) Jur.	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	1	-
Fissidens adianthoides Hedw.	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-
Fissidens exiguus Sull.	-	-	-	-	-	2	-	-	-	-	-	-	-	2	-	-	-
Fissidens exilis Hedw.	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Fissidens taxifolius Hedw.	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Fissidens viridulus (Sw.) Wahlenb.	3	-	-	-	-	-	2	-	-	1	-	-	-	-	-	-	-
Fontinalis antipyretica Hedw.	-	-	-	-	-	-	-	-	-	-	4	3	-	-	-	-	-
Funaria hygrometrica Hedw.	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-	-
Homalothecium philippeanum (Spruce) B., S. & G.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Homalothecium sericeum (Hedw.) B., S. & G.	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Homomallium incurvatum (Brid.) Loeske	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
Hygroamblystegium tenax (Hedw.) Jenn.	3	1	1	2	2	4	-	-	-	-	3	4	2	-	4	-	-
Hygrohypnum luridum (Hedw.) Jenn.	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Isothecium myosuroides Brid.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Lophocolea heterophylla (Schrad.) Dum.	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-

Taxa	J1	J2	J3	J4	J5	H	KE	Ko1	Ko2	B	T1	T2	P1	P2	P3	A1	A2
Lophocolea minor Nees	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Marchantia polymorpha L. emend. Burgeff	3	2	2	-	-	-	-	-	-	-	-	-	1	-	2	-	-
Mnium marginatum (With.) Brid. ex P. Beauv.	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Neckera complanata (Hedw.) Hueb.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Pellia endiviifolia (Dicks.) Dum.	2	-	2	4	2	2	1	-	3	2	-	-	4	-	3	1	3
Plagiomnium cuspidatum (Hedw.) T. Kop.	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-
Plagiomnium elatum (B. & S.) T. Kop.	-	-	-	-	-	-	-	3	-	3	-	-	-	-	-	-	-
Plagiomnium rostratum (Schrad.) T. Kop.	2	4	-	-	-	-	3	-	-	-	2	-	-	1	-	-	-
Plagiomnium undulatum (Hedw.) T. Kop.	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pohlia melanodon (Brid.) J. Shaw	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Pohlia wahlenbergii (Web. & Mohr) Andr.	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Pohlia sp.	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Porella platyphylla (L.) Pfeiff.	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Pylaisia polyantha (Hedw.) Schimp.	1	-	2	-	-	-	-	-	-	-	1	-	-	-	-	2	-
Rhizomnium punctatum (Hedw.) T. Kop.	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Rhynchostegium murale (Hedw.) B., S. & G.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Rhynchostegium riparioides (Hedw.) C. Jens.	4	2	1	3	-	-	2	-	-	-	4	3	2	-	4	-	-
Taxiphyllum wissgrillii (Garov.) Wijk & Marg.	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-
Thamnobryum alopecurum (Hedw.) Gang.	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-

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PHYTOCENOLOGY OF SEMI-DRY GRASSLANDS IN THE AGGTELEK KARST AREA (N. HUNGARY)

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Összefoglaló: A kontinentális jellegű félszáraz gyepek itt zömmel a xerotherm tölgyesek (*Corno-Quercetum pubescentis-petraeae*) és a száraz, sekély termőrétegű gyertyános-tölgyesek (*Querco petraeae-Carpinetum waldsteinietosum*) helyén alakultak ki, amelyek az edafikus körülmények miatt eredetileg is gazdagok voltak erdőssztyepp-elemekben. Ezeket a fél-természetes sztyepprét-szerű gyepeket a hagyományos használat stabilizálta. Használatuk azonban a hatvanas-hetvenes években abbamaradt. Ezért az erdőszegélyekre jellemző polikormon-képző és a magaskórós növényfajok borítása jelentősen megnőtt (un. szegélyesedés,"Versaumung").

Az edafikus körülmények (mészkő alapkőzet, gyakran bázisokban gazdag vörös agyaggal, un. "terra rossa"-val borítva) rendkívül kedvezőek fajgazdag félszáraz gyepek kialakulására. Ezek főleg a *Cirsio-Brachypodion* asszociáció-csoportba tartoznak, a *Bromion erecti* csoportba tartozó társulások jelenléte kérdéses. A domináns és a karakterfajok fő csoportjai az alábbiak:

- *Cirsio-Brachypodion* karakterfajok és a félszáraz gyepek egyéb helyi karakterfajai: *Cirsium pannonicum*, *Polygala major* és *Danthonia alpina*, *Alyssum montanum* ssp. *brymii*, resp.
- *Festucion valesiacae* szárazgyep-fajok: *Adonis vernalis*, *Aster linosyris*, *Centaurea sadleriana*, *Dianthus pontederae*, *Echium russicum*, *Nonea pulla*, *Phlomis tuberosa*, *Pulsatilla grandis*, *Stipa joannis*.
- *Festuco-Brometea* fajok nagy borítással a *Cirsio-Brachypodion*-társulásokban: *Aster amellus*, *Centaurea triumfetti* ssp. *axillaris*, *Campanula sibirica* ssp. *divergentiformis*, *Centaurea scabiosa*, *C. spinulosa*, *Hypochoeris maculata*, *Inula ensifolia*, *Jurinea mollis*, *Lathyrus pannonicus*, *Linum flavum*, *L. hirsutum*, *L. tenuifolium*, *Scorzonera purpurea*, *Thesium linophyllon*.
- *Festuco-Brometea* fajok nagy borítással a hagyományos használatú gyepekben: *Anthyllis vulneraria* ssp. *polyphylla*, *Coronilla varia*, *Onobrychis viciifolia*, *Rhinanthus minor*, *Salvia pratensis*, *Trifolium montanum*, *Vicia tenuifolia*.
- Xerotherm erdőszegélyek ("*Trifolio-Geranietea*") fajai: *Anemone sylvestris*, *Cytisus albus*, *C. hirsutus* ssp. *leucotrichus*, *Dorycnium germanicum*, *Geranium sanguineum*, *Inula hirta*, *I. salicina*, *Lathyrus latifolius*, *Libanotis pyrenaica*, *Peucedanum cervaria*, *Teucrium chamaedrys*, *Thymus kosteleckyanus*, *Trifolium alpestre*, *Veronica austriaca* ssp. *teucrium*.
- Száraz (dolomit-) sziklagyepek fajai: *Poa badensis*, *Anacamptis pyramidalis*, *Arenaria micradena*, *Cytisus procumbens*, *Globularia punctata*, *Iris pumila*.
- Nagy természetvédelmi értékű, ritka reliktumfajok: *Dracocephalum austriacum*, *Pulsatilla halleri* ssp. *slavica*, *P. patens* (only at the Slovakian side)

Cönológiai felvételeinket az alábbi asszociációkban készítettük:

Polygalo (majori)-Brachypodietum pinnati Wagner: magasfüvű társulás, nagyszámú kétszikű fajjal; a magasabb fennsíkok dolináiban az üdébb termőhelyek fő gyeptípusa.

Hypochoerio-Brachypodietum pinnati Less (talán csak az előző társulás szubasszociációja): magasfüvű társulás, az előzőhöz hasonló, két altípusra tagolható:

i, *stipetosum*, a száraz, törmelékes talajú gerinceken, sok sziklagyep- és sztyepp-fajjal,

ii, *danthonietosum*, mélyebb termőrétegű talajokon, több rétsztyepp-lakó fajjal.
Lino (tenuifolio)-Brachypodietum pinnati Dostál (lehetséges, hogy csak az előzőnek szubasszociációja vagy szukcessziós stádiuma): a magaskórós fajok jelentős borításával (*Linum* spp., *Apiaceae*, *Asteraceae*).
Poo badensis-Caricetum montanae Dostál: rövidfüvű társulás az erős fizikai aprózódású, kilúgzott helyeken. Jellemző rá a dolomit-sziklagyep fajok jelenléte.
Mindezen társulások nemcsak faji összetételük és borítás-arányaik révén, hanem termőhelyeik ökológiai sajátságai alapján is jól jellemezhetők.

Abstract: Continental semi-dry grasslands replaced here the xerothermic oak forests (*Corno-Quercetum pubescentis-petraeae*) and dry oak-hornbeam forests (*Querco petraeae-Carpinetum waldsteinietosum*). They were also originally rich in forest-steppe elements due to the edaphic conditions. The semi-natural steppe-like grasslands were stabilised by the traditional use. They were abandoned in the sixties-seventies. Thus, the cover of polycormon-forming and tall-forb species, typical for the forest-skirts, has increased ("Versaumung").

The edaphic conditions (calcareous substrate, often covered by a red clay: "terra rossa", rich in basic minerals) are rather suitable for developing of semi-dry grasslands, rich in species. They belong mainly to the federation *Cirsio-Brachypodion*, the representation of *Bromion erecti* is questionable. Main groups of dominant and characteristic plant species are as follows.
- Character species of *Cirsio-Brachypodion* and local character species of semi-dry grasslands: *Cirsium pannonicum*, *Polygala major* and *Danthonia alpina*, *Alyssum montanum* ssp. *brymii*, resp.
- *Festucion valesiacae* dry grassland species: *Adonis vernalis*, *Aster linosyris*, *Centaurea sadleriana*, *Dianthus pontederae*, *Echium russicum*, *Nonea pulla*, *Phlomis tuberosa*, *Pulsatilla grandis*, *Stipa joannis*.
-*Festuco-Brometea* species of high cover in *Cirsio-Brachypodion*: *Aster amellus*, *Centaurea triumfetti* ssp. *axillaris*, *Campanula sibirica* ssp. *divergentiformis*, *Centaurea scabiosa*, *C. spinulosa*, *Hypochoeris maculata*, *Inula ensifolia*, *Jurinea mollis*, *Lathyrus pannonicus*, *Linum flavum*, *L. hirsutum*, *L. tenuifolium*, *Scorzonera purpurea*, *Thesium linophyllon*.
- *Festuco-Brometea* species of high cover in traditionally managed grasslands: *Anthyllis vulneraria* ssp. *polyphylla*, *Coronilla varia*, *Onobrychis viciifolia*, *Rhinanthus minor*, *Salvia pratensis*, *Trifolium montanum*, *Vicia tenuifolia*.
- Species of xerothermic forest-skirts ("*Trifolio-Geranietea*"): *Anemone sylvestris*, *Cytisus albus*, *C. hirsutus* ssp. *leucotrichus*, *Dorycnium germanicum*, *Geranium sanguineum*, *Inula hirta*, *I. salicina*, *Lathyrus latifolius*, *Libanotis pyrenaica*, *Peucedanum cervaria*, *Teucrium chamaedrys*, *Thymus kosteleckyanus*, *Trifolium alpestre*, *Veronica austriaca* ssp. *teucrium*.
- Character species of dry rocky (dolomitic) grasslands: *Poa badensis*, *Anacamptis pyramidalis*, *Arenaria micradena*, *Cytisus procumbens*, *Globularia punctata*, *Iris pumila*.
- Rare biogeographical components of high conservation value: *Dracocephalum austriacum*, *Pulsatilla halleri* ssp. *slavica*, *P. patens* (only at the Slovakian side)

Our relevés can be grouped into the following associations:
Polygalo (majori)-Brachypodietum pinnati Wagner: tall-grass association with many dicots, dominant grassland type of the mesic sites of dolinas on the higher plateaus.
Hypochoerio-Brachypodietum pinnati Less (perhaps only a sub-association of the former one): tall-grass association, similar to the former one; with two sub-types:
i, *stipetosum*, on dry, gravel-rich ridges, with rocky and steppe grassland species;
ii, *danthonietosum*, on deeper soil, with many meadow steppe tall dicots.
Lino (tenuifolio)-Brachypodietum pinnati Dostál (perhaps only a sub-association or a succession stage of the former one): with high cover of tall-forb species (*Linum* spp., *Apiaceae*, *Asteraceae*).

Poo badensis-Caricetum montanae ass. nova: short-grass association of sites with physical weathering and eluation. Characteristic is the presence of dolomit grassland species.

All these associations can be characterised not only by quantitative differences in species composition and cover, but also in ecological features of their sites.

Introduction

Phytogeographical and phytosociological status, origins:

Semi-dry grasslands ("Halbtrockenrasen", *Brometalia erecti* Braun-Blanquet 1936) are widely distributed in Central Europe in regions of sub-Mediterranean climatic influences (Pott 1992, Mucina & Kolbek 1993). They include several federations, differentiated according to the occurrence of sub-Atlantic (*Bromion erecti* Koch 1926: "*Mesobromion*" auct., *Koelerio-Phleion phleoidis* Korneck 1974, *Xerobromion* Braun-Blanquet & Moor 1938), de-Alpine (*Seslerio-Mesobromion* Oberdorfer 1957, *Seslerio-Xerobromion* Oberdorfer 1957) and continental, Ponto-Pannonian (*Cirsio-Brachypodion* Hadac & Klika 1944, *Danthonio-Stipion tirsae* Soó 1947) phytogeographical elements, respectively. They recently were, based on some preceding studies (Braun-Blanquet 1936, Braun-Blanquet 1948-49, Dostal 1933, Klika 1938, Klika & Hadac 1944, Knapp 1942, Meusel 1939, Soó 1947, H. Wagner 1941), extensively studied in some countries of Central Europe (e.g. Bornkamm 1960, Gauckler 1957, Eisink & al. 1978, Franz 1988, Halder 1991, Hundt & Hübl 1983, Karrer 1985, Korneck 1974, 1978, Mahn 1965, Th. Müller 1968, Oberdorfer 1957, Royer 1987, Thurner 1987). There are, however, many questionable and unsolved problems (reviews: Mucina & Kolbek 1993, Pott 1992, Soó 1964-80). They emerge from the following facts:

- -These communities occur in climatically and biogeographically transitional regions.
- -They occupy a transitional position between forested and grassland formations, because they represent a successional stage after clear-cutting of forests which can be preserved by traditional use (mowing).
- -They occupy an intermediate phytosociological position between the "tall-forb skirts" especially *Geranion sanguinei* R. Tüxen in Th. Müller 1961) and (sub-continental dry grasslands (*Festucion rupicolae* Soó 1929, syn.: *Festucion valesiacae* Klika 1931) and consequently:
- -They display a very high level of compositional diversity in both regards:
  a, richness in floristic elements
  b, richness in phytosociological components.

Grasslands of this type can be evaluated as very characteristic for south-eastern Central Europe ("Carpatho-Europe"), because of overlapping

of Central European, sub-Atlantic, sub-Mediterranean, Balkanic, Carpathian and continental (Ponto-Pannonian, Pontic, Subpontic, Southern Siberian) biogeographical influences. This accumulated occurrence of diverse floristic components is especially evident in frontier zones between forest vs. forest-steppe climate, i.e. in some marginal areas of the Carpathian Basin (Varga 1989, 1995), e.g. the pre-Alpine western Transdanubia, the Pre-Illyrean southern Transdanubia, parts of Transsylvania (e.g. the mountains around the "Iron Gate", in Banat, the Mti. Apuseni-W-Transsylvanian-Bihar Mts., in the Transsylvanian Basin etc.) and-last but not least-in the belt of overlapping of Pannonian and Carpathic influences, e.g. several hilly and mountaneous parts of N. Hungary and S. Slovakia.

From all these facts we can come to the conclusion that these grasslands are typical semi-natural communities of considerable level of biodiversity which have a very high conservation value and which can be maintained only by active conservation measures.

Material and methods

A large number of phytosociological relevés were prepared during the periods 1983-87 and 1992-1994, resp. Relevés were taken usually two times in a year: end of May-early June and August, respectively. In the former period mostly the surveys of the mown and unmanaged oldfields were compared, combined with a study of pioneer-like successional phases of them. Some difficulties arose from the very high number and heterogeneity (different years) of our analytical tables (in a total sum more than 300 relevés, from which the tables of the oldfields have been omitted and about 100 more recent ones were evaluated). Here only the results of the phytosociological relevés of the years 1992-1994 are presented. The sites and number of relevés are enumerated at the end of the synthetic phytosociological table. All relevés are of 4 m^2 extension, because this size was chosen also for the permanent plots of our surveys. Thus, our results can be easily compared with other surveys carried out in grasslands of Hungary with the same, widely accepted method. A-D values were also estimated according to the simplified Central European method, widely used by Hungarian geobotanists. More statistical comparisons will be given in a next paper. In our cenological tables the ceno-taxonomical relegation of the species was accepted which is given in the most recent and comprehensive cenotaxonomical monographs (Mucina & Kolbek 1993, Pott 1992). The synthetic table of Less (1991) was included, because his survey area and the methods of his surveys proved to be well comparable with our ones. Because of missing of these preconditions, the tables of H. Wagner (1941) and Soó (1947) were only evaluated, but not included into the synthetic table, given by us.

Floristic composition of sites in the Aggtelek karst mountains

The semi-dry grasslands of the Aggtelek karst mostly replace dry, rocky oak-hornbeam forests (*Querco petraeae-Carpinetum waldsteinietosum* Jakucs & Jurko 1967, = *Waldsteinio-Querco-Carpinetum* [Jakucs & Jurko] Soó 1971) and xerothermic mixed oak forests (*Corno-Quercetum pubescentis-petraeae* Jakucs & Zólyomi 1958, *Cirsio pannonicae-Quercetum virgilianae-petraeae* [Less 1991] corr. V. Sipos & Varga h.l.) after clearcutting and mowing. Some of their stands, however, can be regarded as edaphic ones with clastic rocky topsoil, mainly on ridges consisting of dolomit (Wetterstein facies) or limestone (Szinpetri, in some former publications Campili facies). Semi-dry grassland-like communities recently arose from oldfields, too, abandoned in the 60-70-es. They extend mostly on more or less even surfaces covered by red clay ("terra rossa") which is a fossil soil (weathering product of bauxit) and parent material for recent soil formation, as well. Nearly all traditional uses discontinued during the 70-es, only very limited grazing (cattles and "hucul" horses) and mowing (mostly on the "wineyard-hill" of Jósvafő and on the Haragistya-plateau, N from Jósvafő) are still going on. Some grasslands of the plateaus serve as grazing places of red deers which hinders the re-forestation.

The semi-dry grasslands of this area display a very typical vertical stratification. The upper level is formed by tall grass species (dominants: *Arrhenaterum elatius*, *Avenula pratensis*, *A. pubescens*, *Bromus erectus*, locally also *Danthonia alpina* and *Stipa joannis*) and tall forbs as species of *Aster (amellus*, *linosyris)*, *Campanula (bononiensis*, *cervicaria*, *glomerata*, *sibirica* ssp. *divergentiformis)*, *Centaurea*, *(*group *scabiosa-sadleriana)*, *Cirsium pannonicum*, *Echium russicum*, *Hypochoeris maculata*, *Jurinea mollis*, *Linum flavum* and *hirsutum*, tall *Apiaceae* as *Libanotis pyrenaica*, *Peucedanum cervaria*, *P. alsaticum*, *Seseli osseum* etc.

Polycormon-forming "forest-skirt" species usually predominate, e.g. *Chamaecytisus albus*, *Lembotropis nigricans*, *Geranium sanguineum*, *Inula ensifolia*, *I. hirta*, *I. salicina*, *Thymus kosteleckyanus*, *Th. marschallianus*, *Teucrium chamaedrys*, *T. montanum*, *Trifolium alpestre* etc.

The lower layer is formed by *Brachypodium pinnatum*, *Briza media*, *Carex michelii*, *C. montana* and *Festuca rupicola.* Characteristic and dominant dicots are: *Adonis vernalis*, *Cytisus procumbens*, *Dianthus pontederae*, *Genista tinctoria*, *Helianthemum ovatum*, *Hippocrepis comosa*, *Lathyrus latifolius & pannonicus* ssp. *collinus*, *Polygala major*, *Prunella grandiflora*, *Pulsatilla grandis* etc. The occurrence of some valuable species is connected to patches with peculiar edaphic conditions (clastic, humus-rich topsoil of rendzina type combined with fluctuating humidity): *Anacamptis pyramidalis*, *Dracocephalum austriacum*, *Globularia punctata*, *Iris pumila*, *Poa badensis*. Some more or less acidofrequent species (*Antennaria dioica*,

Hieracium pilosella agg., *Luzula campestris*) are confined to eluated places (by early melting of the snow).

Comparing the phytosociological components of these grasslands, we could constate a very even pattern of distribution:

Cirsio-Brachypodion and *Brometalia* species: 32 species
Festucetalia and *Festucion valesiacae* sp., resp.: 26 species
Stipo pulcherrimae-Festucetalia pallentis sp.: 15 species
general *Festuco-Brometea* (dry grassland) sp.: 38 species
Trifolio-Geranietea and *Geranion sanguinei* sp., resp.: 50 species

Phytosociological and cenotaxonomical results

Our relevés can be practically subdivided according to their geographical localisation, elevation, phytostructure and floristic composition as follows:

1. Habitats on the lower hilly level, near to the Jósva-valley ("wineyard-hill"):
   a) on limestone covered by a clay-like substrate ("terra rossa"),
   b) on limestone with clastic topsoil.

At these places we had 10 permanent plots of 4 x 4 m (studied 1991-95) and 16 further survey areas of about the same size (see: cenological table).

2. Habitats on the lower hilly level, on sides and on the ridge between the Tohonya- and Lófej-valleys:
   a) rocky slope of an uvala with south-western exposition,
   b) steep slopes of the Tohonya-valley with eastern exposition,
   c) slopes of the Lófej-valley with eastern exposition.

At these places we had 6 permanent plots of 4 x 4 m (studied 1991-95) and 14 further survey areas of about the same size (see: cenological table).

3. Habitats on the plateau of Szilice: Haragistya, Verőtető and Nagyoldal:
   a) western part of Haragistya: around Ocsisnya-tető and Mogyorós-bérc,
   b) slopes of a large dolina at the Hungarian-Slovakian frontier (BR core area),
   c) dolomitic ridge on the Verőtető with clastic topsoil,
   d) southern slope between Verőtető and Nagyoldal (site of *Dracocephalum*),
   e) slopes of a dolina and a dolomitic ridge near Mihály-láza.

At these places we had 9 permanent plots of 4 x 4 m (studied 1991-1995) and 32 further survey areas of about the same size (see: cenological table).

Our surveys were compared with those of the following authors: H. Wagner (1941, Lower Austria), Soó (1947, Transsylvanian basin) and Less (1991, Ph.D. diss., Bükk Mts.).

It has been constated that a major part of characteristic species (e.g. *Adonis vernalis*, *Anacamptis pyramidalis*, *Cirsium pannonicum*, *Dianthus pontederae*, *Hypochoeris maculata*, *Linum flavum*, *L. hirsutum*, *Pulsatilla grandis* etc.) is common in all (or most) of these surveys and their composition agrees well with the characterisation of the cenotaxa *Brometalia erecti* and *Cirsio-Brachypodion*, given by Mucina & Kolbek (1993) and Pott (1992). Regional differences can be pointed out: *Centaurea rhenana*, *Ophrys fuciflora*, *Scabiosa columbaria*, *Scorzonera austriaca*, *S. hispanica* etc. occur in the western, Lower Austrian stands, while the dolomitic areas of the southern part of the Bükk-Mts. can be characterised by their conspicuous richness in *Orchideaceae* (e.g. *Anacamptis pyramidalis*, *Cypripedium calceolus*, *Epipactis atrorubens*, *E. helleborine*, *Gymnadenia odoratissima*), by the presence of some Pannonian endemics (*Erysimum odoratum* ssp. *buekkense*, *Thlaspi jankae*) etc. The communities of the Transsylvanian basin seem to be mostly differentiated by the presence of numerous eastern and Transsylvanian (endemic) elements (e.g. *Genista sagittalis*, *Jurinea transsylvanica*, *Pedicularis campestris*, *Pulsatilla australis*, *P. patens*, *Salvia nutans*, *Thlaspi kovatsii*), and also by the presence of a relatively large number of mesophilous and forest species (e.g. *Anemone ranunculoides*, *Erythronium dens-canis*, *Gladiolus imbricatus*, *Lilium martagon*, *Narcissus stellaris*, *Trollius europaeus*, *Viola mirabilis* etc.).

We arrived at the conclusion that the stands studied by us occupy an intermediate position between the western and eastern extremes within the Carpathian basin. They represent semi-dry grasslands which contain most of the typical species of *Brometalia erecti* and *Cirsio pannonicae - Brachypodion*, resp. Thus, their cenotaxonomical relegation as belonging to *Cirsio pannonicae-Brachypodion* seems to be incontestable. They are not especially rich in spectacular *Orchideaceae* species and most of them are scarce, indeed. Their floristic richness is composed of the following sources:

- a large number of ponto-pannonian steppe and forest-steppe species (as *Adonis vernalis*, *Anemone silvestris*, *Aster linosyris*, *Chamaecytisus procumbens*, *Dracocephalum austriacum*, *Echium russicum*, *Jurinea mollis*, *Lathyrus pannonicus*, *Linum flavum*, *L. hirsutum*, *Nonea pulla*, *Polygala major*, *Thymus kosteleckyanus*, *Veronica austriaca* ssp. *teucrium* etc.);

- a high number of "forest-steppe" species, typical for dry tall-forb formations, forest skirts and light forests of the forest-steppe zone (see: cenological table);
- presence of species, typical for rocky grasslands (*Stipo pulcherrimae-Festucetalia pallentis* and *Seslerio-Festucion pallentis*) inhabiting mostly the dolomitic places and the sites with clastic topsoil.

Phytosociological relegation of the communities studied. Characterization and description of the cenotaxa

Based on the comparisons mentioned above, we propose here the following cenotaxonomical relegation of the communities studied:

1. *Hypochoerio-Brachypodietum pinnati* Less, 1991.

According to our opinion, the xerothermic stands of the lower, colline-submontane level with strong submediterranean and pontic-pannonian influences can be characterised as agreeing well with those of the southern part of the Bükk Mts. Three sub-types, however, are to differentiate:

1.1. Typical, more or less mesophilous stands with many species of the forest-skirts and meadow steppes (e.g. loess grasslands). Most of them was formerly used as hayfield or a traditional combination of hayfield and orchard ("Streuobstwiese" in German). They extend mainly on gently sloping, not very rocky surfaces which are more or less covered by red clay. Their original vegetation probably was a mixed xerothermic oak forest (*Corno-Quercetum pubescentis-petraeae*, closely related to the *Cirsio pannonicae-Quercetum virgilianae-petraeae* oak forest association of the southern part of the Bükk Mts., described by Less (1991).

1.2. Stands of the gently sloping higher ridges of the "wineyard-hills" which were used long time as hayfields of the forestry. These grasslands are extremely rich in species, with occurrence also of some differential species, e.g. *Danthonia alpina* which is here one of the co-dominant grass species. This type of community was named by us as *Hypochoerio-Brachypodietum danthonietosum*. Based on not numerous differential species and very limited surface of this site, it seems to be unjustified to describe this community as a separate asssociation.

1.3. Stands of the stony ridges and more steep slopes with clastic topsoil and without any red clay cover. They can be characterised by the high dominance of *Stipa joannis* and by the presence of *Stipo pulcherrimae-Festucetalia pallentis* and *Seslerio-Festucetum pallentis* open, rocky grassland species. Their occurrence is caused by the strong physical weathering of the substrate. We named this type of grassland as *Hypochoerio-Brachypodietum stipetosum*, not

separated it as an association on its own right, because the set of its species mostly agrees with that of the typical association. It displays, however, some kind of transition to *Campanulo-Stipetum tirsae* which is typical for oldfields of former wineyards on volcanic substrate.

2. *Polygalo majori-Brachypodietum pinnati* H. Wagner (stat. provis.).

Because of the large number and heterogeneity of our analytical tables, the relegation of the more mesophilous stands of the valleys Tohonya and Lófej, and those of the higher plateau of Szilice was a difficult decision. It was motivated partly by our field experience visiting some *Polygalo-Brachypodietum* sites in a hilly area near Sopron (under the guidance of I. Csapody; his results remained, unfortunately, unpublished), which proved to be in many respects very similar to the stands studied by us. The other reason of our decision was the floristic similarity to the detailed analytical tables, given by Wagner, and the differences in composition, as opposed to the association *Lino tenuifolio-Brachypodietum* Dostál (1933). It is possible, of course, that the descriptions of Dostál and Wagner represent only geographical or/and successional variations of the same association. In this case, the name, given by Dostál, should be used based on priority. A more detailed, comparative study, however, seems to be necessary in a further paper. We could differentiate a very peculiar stand of this association, named *Polygalo-Brachypodietum danthonietosum*, characterized by the dominance of *Danthonia alpina* and by presence of *Dracocephalum austriacum* (see: column 7 in the cenological table).

3. *Poo badensis-Caricetum montanae* ass. nova. (Not identical with *Poo badensis-Caricetum humilis* (Dostál) Soó 1971!)

It can be characterised by the presence of species of rocky grasslands, usually occurring on dolomitic substrate, characterised by the strong physical weathering. As its local character species can be mentioned: *Anacamptis pyramidalis*, *Arenaria micradena*, *Globularia punctata*, *Orchis ustulata* (transgr.), *Poa badensis*. Almost all character species of *Cirsio-Brachypodion* occur here (*Brachypodium pinnatum*, *Cirsium pannonicum*, *Crepis pannonica*, *Hypochoeris maculata*, *Polygala major*, *Scorzonera purpurea*). Characteristic is the missing of the meadow steppe species and the very decimated presence of the forest-skirt ("Waldsteppe") elements and also of the forest-dwelling ones (as opposed to *Polygalo-Brachypodietum* and *Hypochoerio-Brachypodietum*).

Discussion of the results

Beech and with beech mixed broadleaved forests (*Fagion silvaticae medioeuropaeum* federation) can be regarded as the zonal vegetation of most Central European sites of *Brometalia erecti* (Pott 1992). This agrees

only with the pre-conditions of some (not all!) semi-dry grasslands described from the plateau of the Bükk Mts. (Northern Hungary). The consequence of this situation is the missing or under-representation of Festucion valesiacae and "forest-steppe" (*Trifolio-Geranietea* and *Geranion sanguinei*, resp.) elements in these communities. This may be a quite natural feature of Central European stands of "*Mesobromion*" (*Bromion erecti*). The very rich representation of forest-steppe species in semi-dry grasslands (*Polygalo-Brachypodietum* H.Wagner sec. Vojtkó 1993) growing on steep slopes of carstic dolinas of the Bükk-plateau (e.g. *Iris variegata*, *I. graminea*, *Anemone sylvestris*, *Geranium sanguineum*, *Libanotis pyrenaica*, *Peucedanum cervaria*) indicates that they cannot be derived by clear-cutting of a zonal beech-forest, but by deforestation of a scarcely forested habitat which was dominated by some intra-zonal communities of this vegetation level, e.g. rocky forests (*Tilio-Fraxinetum*) with *Corylus* "mantel" and *Geranion sanguinei* "skirt". The fact, that these semi-dry grasslands recently are tending to replace the *Festucion rubrae* hayfield meadows and *Nardion* turfs, can be interpreted as an initial stage of slow "re-naturation" of the original "cool-continental" forest-steppe conditions (n.b.: *Avenula pratensis*, *A. pubescens*, *Brachypodium pinnatum*, *Dracocephalum ruyschiana* etc.) belong to the species of the Southern Siberian "geoelement" of Kleopow (1941) and Walter & Straka (1970). Other stands of *Polygalo-Brachypodietum* on the hills of Sopron ("Szárhalmi erdő"), studied by Csapody and semi-dry grasslands of the southern part of the Bükk Mts., described as *Hypochoerio-Brachypodietum* by Less (1991, Ph.D. diss.), also show the presence of a high number of thermophilous forest-steppe and steppe grassland species. The composition of several types of semi-dry grasslands, described in this paper, generally agrees-including some floristical differentiation (see: 3 and 5.1-5.3)-with the conditions mentioned above. It may be concluded that the high representation of those cenotaxonomical groups of species can be evaluated as a general feature of associations belonging to the *Cirsio pannonicae-Brachypodion* Klika federation. (The federation *Carduo-Brachypodion* Mucina & Maglocky i.l., mentioned by Háberová in Rozložnik & Karasová, 1995, can be regarded here provisorically as synonymous with the former federation. The associations enumerated under this federation, without any cenological characterization, need further revision in a subsequent, more detailed paper.) It means that these semi-dry grasslands mostly replace *Aceri-Quercion* forests of continental type or those *Quercion pubescentis-petraeae* forests which are already rich in *Aceri-Quercion* and *Geranion sanguinei* species. It can be also concluded that some of these grasslands may have a nature-like, edaphical origin, because *Aceri-Quercion* forest-steppe forests usually are interspersed by edaphically caused plots of unforested communities. They could be expanded and stabilized by a long-term

traditional use, i.e. by grazing and coppicing ("Niederwaldbau"). It seems to be also quite typical that these semi-dry grasslands can be only very slowly and discontinuously re-forested. Compared with the managed sites, they can be differentiated mostly only by the expansion of the polycormon-forming and tall-forb herbaceous or dwarf-scrub species which results in a rather varied patchy pattern of vegetation. Our permanent plot experiments, which will be evaluated in a subsequent paper, clearly demonstrate the different stages of these processes.

Practical conclusions for conservation and management

Because all these communities have developed and have been maintained under traditional use, their differentiated and professional management is a pre-requisite of their conservation in order to save their exceptional biodiversity. The next step will be to outline a finely differentiated management plan in which the sites, mown every year, every second, third etc. years and the completely unmanaged plots conserved by natural succession, are defined, described and mapped. It will be necessary to establish a system of differently managed and unmanaged permanent plots within the monitoring system of the National Park and Biosphere Reserve, resp. A close cooperation between nature conservation, forestry and game management, based on conservation priorities, is a pre-requisite of the successful implementation of the management plan. Those private land owners should be financially supported who sustain the traditional forms of management which promote the biodiversity conservation.

The reason that zoologists have also participated in this work, lies in the fact that these stands are habitats of many valuable, threatened and protected insect species, as well, e.g. *Arcyptera fusca*, *Paracaloptenus caloptenoides*, *Pholidoptera transsylvanica*, *Saga pedo*, *Stenobothrus eurasius (Orthoptera)*, *Aricia artaxerxes issekutzi*, *Chersotis fimbriola baloghi*, *Cucullia gnaphalii*, *C. xeranthemi*, *Dichagyris musiva*, *D. nigrescens*, *Euxoa birivia*, *E. hastifera*, *Melitaea telona kovacsi (Lepidoptera)*.

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Table 1.

	H-B t S		H-B D S		H-B S S		H-B B L		P-B TL		P-B 20		P-B D		P-B H		P-C t 20		P-C S V	
	1		2		3		4		5		6		7		8		9		10	
Cirsio-Brachypodion (character-)species																				
Brachypodium pinnatum	1-3	V.	1-3	V.	1-2	V	3-4	V	2-4	V	1-3	V	1-3	V	2-4	V	1-2	V	1-2	V
Carlina vulgaris	+	I	+	I	-	-	-	-	+	I	+	I	-	-	-	-	+	II	-	-
Cirsium pannonicum	+-1	V	+-1	V	+-1	V	+-2	IV	+-1	IV	+-2	V	+-2	V	+-2	IV	+-1	IV	+-1	IV
Crepis pannonica	+-1	III	+	II	+	I	-	-	+	I	-	-	+	I	-	-	-	-	+	I
Danthonia alpina	+	I	+-2	IV	-	-	-	-	+	I	-	-	1-2	IV	-	-	-	-	+	I
Hypochoeris maculata	+-1	IV	+-1	V	+	IV	+-1	V	+	III	3	III	+	II	+	III	+	II	+	III
Linum flavum	+-1	III	+	II	+-1	III	+	I	+-1	III	+	I	-	-	+-1	II	+-1	II	+	I
Polygala maior	+	IV	+	IV	+	V	+	I	+	III	+-1	IV	+	V	+-1	IV	+-1	IV	+-1	IV
Scorzonera purpurea	+	IV	+	III	+	IV	+	II	+	III	+	III	+	II	+	III	+	II	+	I
Brometalia erecti species																				
Alllium montanum	+	I	+	II	+-1	IV	+	III	+	I	+	II	+-1	IV	+	I	+-1	IV	+-1	IV
Anacamptis pyramidalis	-	-	-	-	-	-	+	II	-	-	-	-	-	-	-	-	-	-	+	III
Anthyllis vulneraria ssp. polyphylla	+-1	III	+	II	+	II	+	i	+-1	III	+-1	IV	+	III	+-1	IV	+-1	III	+-1	IV
Briza media	+-1	IV	+	III	+	III	+-2	IV	+-1	V	+-1	V	+	III	+-1	IV	+-1	IV	+-1	IV
Bromus erectus	+-1	II	1-2	IV	+-1	II	-	-	1-2	III	+-2	IV	+-2	III	+-2	IV	+-1	II	1	I
Campanula bononiensis	+	II	+	I	-	-	-	-	+	I	+	I	-	-	-	-	+	II	+	I
Campanula cervicaria	-	-	+	I	-	-	-	-	-	-	+	I	+	I	-	-	-	-	-	-
Campanula glomerata	+	II	+	III	+	III	+	III	+	I	+	II	+	I	+	I	-	-	-	-
Carex michelii	+-1	II	1	III	+-1	I	+-2	III	+-2	III	+-1	I	+-1	II	1	I	-	-	-	-
Carex montana	1-2	V	1-3	IV	1-2	IV	-	-	1-2	IV	+-2	V	1-2	V	+-2	IV	1-3	V	+-3	V
Carlina acaulis	+	II	+	IV	-	-	-	-	+	III	+-1	IV	+	II	+-1	II	+-1	II	+-1	II
Centaurea triumfettii	+	I	+	I	+	II	-	-	+	I	+	II	+	I	+	I	+-1	II	+	II
Gentiana cruciata	-	-	+	I	-	-	-	-	+	I	+	II	-	-	+	I	-	-	-	-
Gentianella ciliata	-	-	+	I	-	-	-	-	-	-	+	II	+	I	+	I	+	I	+	I
Gymnadenia conopsea	+	I	+	II	-	-	+	III	+	I	+-1	III	-	-	+	II	+	I	+	II
Gymnadenia odoratissima	-	-	-	-	-	-	+	I	-	-	-	-	-	-	-	-	-	-	-	-
Orchis ustulata	-	-	+	I	-	-	-	-	-	-	+	III	+	I	+	I	+	II	+	I
Lathyrus latifolius	1-2	IV	+-1	IV	+-2	IV	+	I	+-1	III	+-1	III	+	I	+-1	II	+-1	I	+-1	I
Plantago media	+-1	IV	+-1	V	+	III	+	II	+	IV	+	III	+	II	+	IV	+	II	+	III
Polygala comosa	+	II	+	II	+	I	-	-	+	I	+-1	III	+	II	+	II	+	II	+	II
Prunella grandiflora	+-1	II	1	I	+	I	+	II	+	I	+	I	+	II	+	I	-	-	-	-
Rhinanthus minor	+-2	III	+-1	II	+-1	II	-	-	+-1	III	+	I	-	-	+	II	-	-	-	-
Trifolium montanum	+-1	IV	+	IV	+	III	-	-	+	IV	+-1	IV	+	II	+	IV	+-1	III	+	IV
Vicia tenuifolia	+-2	III	+-1	II	+-1	II	-	-	+-2	IV	+-1	III	+	I	+-1	III	-	-	-	-
Festucetalia valesiacae and **Festucion valesiacae** species																				
Achillea pannonica	+-1	II	+-1	III	+	I	-	-	+	I	-	-	-	-	-	-	-	-	-	-
Adonis vernalis	+-1	V	+-1	V	+-1	IV	+-1	I	+-2	IV	+-2	V	+-1	IV	+-1	III	+-1	V	+-1	
Galium glaucum	+-1	II	+-1	III	+-1	III	+-1	I	+	I	+	I	-	-	+	II	+-1	II	+	I
Aster linosyris	+-1	II	+-1	II	+-2	IV	-	-	+	I	+	I	-	-	-	-	+	I	+-1	III
Campanula sibirica ssp. divergentif.	+	IV	+-1	IV	+-1	V	-	-	+	II	+-1	III	+-1	IV	+	II	+-1	IV	+-1	IV
Carduus collinus	-	-	-	-	+	I	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Centaurea sadleriana	+-1	IV	+-1	II	+-2	III	+-1	V	+	II	+-1	II	-	-	-	-	+	II	+-1	I
Cruciata pedemontana	+	III	+	III	+	II	-	-	+	II	+	III	+	I	+	I	-	-	-	-
Dianthus pontederae	+	V	+	V	+	IV	+	III	+-1	IV	+-1	V	+	III	+	IV	+	IV	+	IV
Dracocephalum austriacum	-	-	-	-	1	I	-	-	1	I	-	-	+	I	-	-	-	-	+	I
Echium russicum	1	III	1	IV	1-2	III	-	-	+	I	-	-	-	-	-	-	-	-	-	-
Festuca rupicola	1-3	V	1-3	V	1-2	V	+-2	III	1-3	IV	+-2	V	1-2	V	1-2	IV	+-2	V	1-2	V
Festuca valesiaca	1	II	+-1	II	1-2	III	-	-	1	II	+	II	1-2	IV	+-1	II	+-1	II	+-1	II
Inula ensifolia	1-2	II	1-2	III	1-2	V	+-1	IV	+-2	III	+-1	I	+-1	III	1	I	+-1	IV	+-1	III
Lathyrus pannonicus	+	I	+	III	+	III	-	-	+	I	+	I	+	IV	-	-	+	III	+-1	III

	H-B t S		H-B D S		H-B S S		H-B B L		P-B TL		P-B 20		P-B D		P-B H		P-C t 20		P-C S V	
	1		2		3		4		5		6		7		8		9		10	
Linum hirsutum	+-1	II	-	-	+-1	III	-	-	+-2	III	+	I	-	-	-	-	-	-	-	-
Muscari bothryoides	-	-	-	-	+	II	-	-	-	-	-	-	-	-	-	-	+	II	+	I
Muscari tenuiflorum	+	II	+	II	+	I	-	-	+	II	+-1	III	+	I	+	I	-	-	-	-
Nonnea pulla	+	I	-	-	+	I	-	-	+	I	+	I	-	-	-	-	-	-	-	-
Phlomis tuberosa	-	-	-	-	-	-	-	-	-	-	-	-	+	I	-	-	-	-	-	-
Potentilla arenaria	+-1	IV	+-1	III	+-1	IV	-	-	+-1	III	+-1	II	+-1	IV	+	II	+-1	V	+-1	II
Scabiosa ochroleuca	+	III	+	II	+	II	+-1	IV	+	II	+	III	+	I	+	II	+	II	+	II
Taraxacum serotinum	-	-	+	I	+	I	-	-	-	-	-	-	-	-	-	-	+	II	+	I
Thymus kosteleckyanus	+-1	III	+-2	III	1-2	II	-	-	+-1	II	1	I	1-2	II	+-1	I	+-2	IV	+-1	IV
Verbascum phoeniceum	+	I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	I
Vinca herbacea	+	i	+	i	+-1	ii	-	-	-	-	-	-	+-1	II	-	-	-	-	-	-
Stipo pulcherrimae - Festucetalia pallentis species																				
Allium flavum	-	-	-	-	+	II	-	-	-	-	-	-	-	-	-	-	-	-	+	I
Alyssum montanum (ssp. brymii)	+	I	+	II	+-1	IV	-	-	+	II	+-1	III	+-1	IV	+	I	+-1	V	+-1	IV
Asyneuma canescens	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	I	+	I
Campanula rotundifolia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	I	+-1	II
Carex humilis	-	-	-	-	1	II	-	-	-	-	-	-	-	-	-	-	+-1	II	+-1	II
Hippocrepis comosa	+-1	IV	+-1	IV	+-2	IV	-	-	+	I	+-1	II	+-1	IV	+	I	+-1	V	+-1	V
Iris pumila	-	-	-	-	1-2	II	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jurinea mollis	+-1	IV	+	II	+-1	IV	-	-	+	II	+	I	+	II	-	-	+-1	II	+	II
Linum tenuifolium	-	-	-	-	+	I	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Melica ciliata	-	-	1	I	1	II	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Onosma visianii	-	-	-	-	1	I	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pulsatilla grandis (incl. slavica)	1-2	V	1-2	IV	1-3	V	+	I	+-2	IV	+-1	II	+-1	IV	+	II	+	III	+-1	IV
Seseli osseum	+	I	-	-	+-1	III	-	-	-	-	-	-	+	I	-	-	-	-	-	-
Stipa joannis	-	-	+-1	I	+-2	V	-	-	-	-	+	I	+-1	III	+	I	+-1	I	+-2	V
Trinia glauca	+	I	+	I	+	II	-	-	+	I	+	I	+	II	-	-	+-1	II	+	I
Festuco-Brometea species																				
Agropyron caninum	+-2	II	1-2	II	+-1	I	-	-	+-1	IV	+-1	III	+-1	III	+-1	II	+-1	II	+-1	III
Anthericum ramosum	+	III	+	II	+	II	+-1	V	+-1	IV	+-1	IV	+-1	III	+	II	+-1	V	+-1	IV
Asperula cynanchica	+-1	IV	+-1	IV	+	III	-	-	+	II	+-1	III	+	III	+	II	+-1	IV	+-1	IV
Bromus mollis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+-1	II	+	I
Carex caryophyllea	+-1	III	+-1	IV	+	II	-	-	+-1	III	+-1	III	-	-	+	I	+-1	II	+	I
Centaurea scabiosa	+-1	IV	+-1	IV	+-1	III	-	-	+-2	IV	+-2	III	+-1	II	+-2	II	+-1	III	+-1	II
Centaurea spinulosa	+-1	II	+-1	III	+-1	II	-	-	+-1	II	+-1	IV	-	-	+-1	II	-	-	-	-
Eryngium campestre	+	II	+	II	+	I	-	-	+	I	-	-	-	-	-	-	-	-	-	-
Erysimum pannonicum	-	-	-	-	+	I	-	-	+	I	-	-	+	II	-	-	+	I	-	-
Erysimum odoratum ssp. buekkense	-	-	-	-	-	-	+	II	-	-	-	-	-	-	-	-	-	-	-	-
Euphorbia cyparissias	1	III	+-1	IV	+-1	IV	+-1	IV	+-1	IV	+-1	V	+	III	+-1	III	+-1	IV	+	III
Euphrasia stricta	+	II	+-1	IV	+	II	-	-	+-1	I	-	-	+	II	-	-	-	-	-	-
Filipendula vulgaris	+-2	IV	+-1	IV	+-1	III	+	I	+-2	IV	+-1	V	+	III	+-1	IV	+-1	II	+	II
Galium verum	+-1	V	+-1	V	+-1	IV	-	-	+-2	IV	+-1	IV	+	II	+-1	III	+-1	II	+	I
Helianthemum ovatum	+-1	IV	+	III	+	III	+-1	IV	+-1	III	+-1	V	+-1	V	+-1	IV	+-1	IV	+-1	IV
Hypericum perforatum	+	II	+	III	+	II	-	-	1	I	+-1	II	-	-	+	II	-	-	-	-
Koeleria pyramidata	+-1	III	1	I	+-1	II	-	-	+	I	+	I	-	-	-	-	+	I	+	I
Linaria genistifolia	+	II	+	I	+	II	-	-	+-1	II	-	-	-	-	-	-	-	-	-	-
Linum austriacum	+	I	-	-	+	I	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Linum catharticum	+	II	+	II	+	IV	-	-	+	I	+	III	+	III	+	II	+-1	V	+	IV
Medicago falcata	+	II	+	I	+	I	+	I	+	II	-	-	-	-	-	-	-	-	-	-
Muscari comosum	+	I	-	-	-	-	-	-	+	II	-	-	-	-	+	II	-	-	-	-
Orobanche lutea	-	-	-	-	-	-	+	I	-	-	-	-	-	-	-	-	-	-	-	-
Ornithogalum pyramidale	+	I	-	-	-	-	-	-	+	II	-	-	-	-	-	-	-	-	-	-

	H-B t S		H-B D S		H-B S S		H-B B L		P-B TL		P-B 20		P-B D		P-B H		P-C t 20		P-C S V	
	1		2		3		4		5		6		7		8		9		10	
Pimpinella saxifraga	+	IV	+	II	+	I	+	II	+	II	+	III	+	II	+	II	+	II	+	I
Prunella laciniata	+-1	II	+-1	II	+	III	-	-	+-1	I	+-1	IV	+-1	III	+	II	+	III	+	III
Salvia pratensis	+	IV	+-1	V	+	III	-	-	+-1	IV	+-1	IV	+-1	II	+	III	+	I	-	-
Salvia verticillata	+-1	III	+	III	+-1	II	-	-	+-2	III	+-1	III	-	-	+-1	II	+	III	+-1	III
Sanguisorba minor	+-1	III	+	IV	+-1	IV	-	-	+-1	II	+-1	III	+-1	IV	+	II	+-1	IV	+-1	IV
Silene otites	+-1	II	1	I	+-1	III	-	-	+	I	+	I	-	-	-	-	+	I	-	-
Stachys recta	+-1	IV	+-1	IV	+-1	V	-	-	+-1	IV	+-1	III	+	III	+	III	+	II	+	II
Thesium linophyllon	+	IV	+	IV	+	III	+-1	I	+	III	+-1	IV	+	III	+	III	+	IV	+	III
Thlaspi jankae	-	-	-	-	-	-	+	I	-	-	-	-	-	-	-	-	-	-	-	-
Thymus marschallianus	+-2	III	1-2	III	+-1	II	-	-	+-1	IV	+-1	IV	+-1	III	+-1	II	+-1	II	+-1	III
Verbascum lychnitis	-	-	-	-	-	-	+	I	-	-	-	-	-	-	+	I	-	-	-	-
Veronica austriaca ssp. austriaca	-	-	-	-	-	-	+-1	I	-	-	-	-	-	-	-	-	-	-	-	-
Veronica prostrata	1	I	+-1	I	1	II	-	-	1	I	-	-	-	-	-	-	+-1	II	+-1	II
Veronica spicata	+	IV	+	III	+	III	-	-	+	III	+-1	III	+	IV	+	II	+-1	III	+	III
Arrhenateretalia and **Arrhenaterion** species																				
Arrhenaterum elatius	+-1	IV	+-2	III	1	I	+-1	IV	+-2	III	+-2	V	+-1	II	1-2	IV	+	I	-	-
Avenula pubescens	+-1	III	+-1	II	+-1	II	-	-	+-1	III	+-1	IV	1-2	III	+-1	II	+-1	II	+-1	III
Chrysanthemum leucanthemum	+	IV	+-1	IV	+	II	+	II	+	IV	+-1	V	+	II	+-1	IV	+	III	+	III
Dactylis glomerata	+	II	+-1	III	-	-	-	-	+-1	II	+-1	III	-	-	1	I	-	-	-	-
Dianthus deltoides	-	-	-	-	-	-	-	-	+	I	+	I	-	-	-	-	-	-	-	-
Knautia arvensis	+	IV	+	II	+	II	-	-	+	II	+	III	+	I	+	II	+	I	+	I
Pastinaca sativa	+	I	-	-	-	-	-	-	+	I	-	-	-	-	-	-	-	-	-	-
Phleum phleoides	+-1	III	+-1	II	+-1	II	+-1	I	+-1	II	+	III	+-1	II	-	-	+	II	+	II
Poa pratensis ssp. angustifolia	1	I	+-1	II	-	-	+-1	IV	+-1	IV	+-1	II	-	-	+-1	IV	-	-	-	-
Ranunculus acer	+	II	+	I	-	-	-	-	+	I	+	I	-	-	+	II	-	-	-	-
Ranunculus polyanthemos	+	I	+	II	+	I	-	-	+	I	+	II	-	-	+	I	-	-	-	-
Stellaria graminea	-	-	+	I	-	-	-	-	+	I	-	-	-	-	-	-	-	-	-	-
Seslerio-Festucion pallentis (dolomit-grassland) species																				
Arenaria micradena	-	-	+	II	+	I	-	-	+-1	I	-	-	-	-	-	-	+	II	+-1	III
Cytisus procumbens	+-1	II	+-1	III	+-1	III	-	-	+-1	II	+-1	III	+-1	III	+-1	II	+-1	IV	+-1	IV
Globularia punctata	-	-	+	I	+-1	II	-	-	-	-	-	-	-	-	-	-	+-2	V	+-1	V
Poa badensis	-	-	-	-	1	I	-	-	-	-	-	-	-	-	-	-	+-1	IV	+-1	III
Trifolio-Geranietea and **Geranion sanguinei** species																				
Ajuga genevensis	+	I	+-1	II	-	-	-	-	+-1	II	+-1	II	+	I	+-1	II	-	-	-	-
Anemone sylvestris	+-1	II	+-1	II	1	II	-	-	+-2	II	+-1	III	+	II	+-2	II	+-1	II	+-1	II
Asparagus officinalis	1	I	1	I	-	-	-	-	1	I	-	-	-	-	+-1	I	-	-	-	-
Aster amellus	+-1	V	+-1	IV	+-1	IV	-	-	+-1	II	+-1	IV	+-1	IV	+	II	+-1	III	+	III
Betonica officinalis	+-1	II	+-1	III	+	I	+	II	+-1	II	+-1	V	1	I	+-1	IV	-	-	-	-
Bupleurum falcatum	+	I	+	II	+	I	-	-	+	I	-	-	-	-	-	-	-	-	-	-
Chamaecytisus albus	1	II	1-2	II	+-1	II	+	II	+-1	II	+-1	II	-	-	+-1	I	+-1	I	1	I
Chamaecytisus austriacus	+-1	I	1	I	1	I	-	-	-	-	+	II	-	-	-	-	-	-	-	-
Chamaecytisus h. ssp. leucotrichus	-	-	1	I	-	-	-	-	1	I	-	-	-	-	-	-	-	-	-	
Clematis recta	1	I	+-1	I	-	-	-	-	1	I	+	I	-	-	-	-	-	-	-	-
Clinopodium vulgare	-	-	+	I	-	-	+	I	-	-	-	-	-	-	-	-	-	-	-	-
Coronilla varia	+-1	II	1	I	-	-	-	-	+-1	II	-	-	-	-	+	I	-	-	-	-
Digitalis grandiflora	-	-	1	I	-	-	+-1	II	-	-	+-1	II	-	-	-	-	-	-	-	-
Dorycnium germanicum	+-1	IV	+-1	III	+-1	IV	-	-	+-1	IV	+-1	III	+-1	II	+	II	+-1	III	+	II
Fragaria collina	1	II	1	III	+-1	II	+-1	IV	+-1	III	+-1	IV	-	-	+	II	+-1	III	+-1	II

	H-B t S		H-B D S		H-B S S		H-B B L		P-B TL		P-B 20		P-B D		P-B H		P-C t 20		P-C S V	
	1		2		3		4		5		6		7		8		9		10	
Genista tinctoria ssp. elata	+-1	IV	1-2	V	+-1	III	+	V	+-1	III	+-1	IV	+-1	V	+-1	III	+	II	+-1	III
Geranium sanguineum	+-1	II	+-2	III	+-1	III	+-1	V	+-1	IV	+-1	III	+-1	II	+-1	II	+-1	II	+-1	II
Inula hirta	+-1	IV	+-2	IV	+-1	II	+-1	IV	+-1	III	+-1	I	-	-	+-1	I	-	-	-	-
Inula salicina	+-1	IV	1	III	-	-	-	-	+-1	II	+-1	II	-	-	+-1	I	-	-	-	-
Iris graminea	-	-	-	-	-	-	+	I	-	-	-	-	-	-	-	-	-	-	-	-
Iris variegata	-	-	-	-	-	-	+-1	II	-	-	-	-	-	-	-	-	-	-	-	-
Laserpitium latifolium	-	-	-	-	-	-	+-1	II	-	-	-	-	-	-	-	-	-	-	-	-
Lembotropis nigricans	-	-	+	I	-	-	+-1	III	-	-	+-1	I	-	-	-	-	-	-	-	-
Libanotis pyrenaica	+-1	II	-	-	-	-	-	-	1	I	+-1	II	-	-	-	-	-	-	-	-
Melampyrum arvense	+-2	III	+-1	II	+-1	II	-	-	+-1	III	-	-	-	-	-	-	-	-	-	-
Orchis militaris	-	-	-	-	-	-	+	II	-	-	-	-	-	-	-	-	-	-	-	-
Orchis purpurea	+	I	-	-	-	-	-	-	+	I	+	I	-	-	-	-	-	-	-	-
Origanum vulgare	+-1	I	+-1	II	-	-	+-1	III	+-1	II	-	-	-	-	+-1	I	+	I	+	I
Peucedanum alsaticum	+-1	II	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Peucedanum cervaria	1-2	V	1-2	IV	+-2	IV	-	-	+-2	IV	+-1	III	+-1	II	+-1	II	+-1	III	+-1	III
Polygonatum odoratum	1	I	+-1	I	-	-	+-1	IV	+-1	I	-	-	-	-	+-1	I	-	-	-	-
Potentilla recta	-	-	+	I	-	-	-	-	+	I	-	-	-	-	+	I	-	-	-	-
Prunus fruticosa	1	I	+-1	I	1-2	II	-	-	1	I	-	-	-	-	-	-	-	-	-	-
Rosa pimpinellifolia	-	-	1	I	-	-	-	-	-	-	-	-	+-1	I	-	-	-	-	-	-
Selinum carvifolia	+	I	+	I	-	-	-	-	-	-	-	-	+	I	-	-	+	I	+	I
Silaum peucedanoides	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	I	+	I
Silene cucubalus	+	I	+	I	-	-	+-1	IV	+	I	+	I	-	-	+	I	-	-	-	-
Silene nemoralis	-	-	-	-	-	-	+	II	-	-	-	-	-	-	-	-	-	-	-	-
Silene nutans	+	i	+	I	-	-	-	-	+	I	+	I	+	I	-	-	-	-	-	-
Solidago virga-aurea	+	II	+-1	III	+	II	-	-	+-1	III	+-1	IV	+	II	+-1	II	+-1	III	+-1	III
Teucrium chamaedrys	+-1	III	+-1	IV	+-1	III	+-1	V	+-1	II	+-1	III	+-1	III	+-1	II	+-1	II	+-1	II
Teucrium montanum	1	I	+-1	II	+-1	II	-	-	+-1	I	-	-	+-1	III	-	-	+-1	III	+-1	III
Trifolium alpestre	+	I	+-1	III	+	I	1	I	+-1	I	+	II	-	-	+	I	+	II	+-1	II
Trifolium incarnatum	-	-	-	-	-	-	-	-	-	-	-	-	+	I	-	-	-	-	-	-
Trifolium medium	-	-	+	I	-	-	-	-	+	I	-	-	-	-	-	-	-	-	-	-
Trifolium rubens	+	I	-	-	-	-	-	-	-	-	+	I	-	-	-	-	-	-	-	-
Veronica austriaca ssp. teucrium	1	I	+-1	II	-	-	-	-	+-1	II	+-1	II	-	-	+-1	I	+	I	+-1	I
Veronica chamaedrys	+-1	I	+-1	I	-	-	-	-	+-1	II	+-1	III	-	-	+	I	-	-	-	-
Viola hirta	-	-	-	-	-	-	+	II	-	-	-	-	-	-	-	-	-	-	-	-
Vincetoxicum hirundinaria	1	I	+-1	II	1	I	+-2	V	+-1	II	+-1	IV	+-1	I	+-1	II	+-1	III	+-1	II
Querco-Fagetea, Quercetalia pubescenti-petraeae and Aceri-Quercion species																				
Astragalus glyciphyllus	-	-	+-1	I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Campanula persicifolia	-	-	+	I	-	-	+	I	-	-	+-1	III	-	-	+	I	-	-	-	-
Campanula rapunculoides	+	I	-	-	-	-	+	I	-	-	+	I	-	-	-	-	-	-	-	-
Carpinus betulus (shrub)	1	I	-	-	-	-	-	-	+	I	-	-	-	-	+	I	-	-	-	-
Cephalanthera rubra	-	-	-	-	-	-	+	I	-	-	-	-	-	-	-	-	-	-	-	-
Chrysanthemum corymbosum	+-1	II	+-1	III	+	I	+-1	II	+	I	+	III	+	II	+	III	+	II	+-1	I
Convallaria majalis	-	-	-	-	-	-	+-1	III	-	-	-	-	-	-	-	-	-	-	-	-
Cornus mas	1	I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	I	-	-
Corylus avellana	-	-	1	I	-	-	-	-	+	I	-	-	-	-	+	I	+	I	+	I
Crataegus monogyna	+-1	I	+	I	-	-	+	I	-	-	-	-	-	-	-	-	-	-	+	I
Cruciata glabra	-	-	-	-	-	-	+	II	-	-	-	-	-	-	+	I	-	-	-	-
Dactylis polygama	-	-	+	I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Epipactis atrorubens	-	-	-	-	-	-	+	II	-	-	-	-	-	-	-	-	-	-	-	-
Epipactis helleborine	-	-	-	-	-	-	+	IV	-	-	-	-	-	-	-	-	-	-	-	-
Euphorbia polychroma	+-1	I	1	I	+-1	I	-	-	+	I	+-1	I	-	-	-	-	-	-	-	-
Fagus silvatica (seedling)	-	-	-	-	-	-	+	I	-	-	-	-	-	-	-	-	-	-	-	-

	H-B t S		H-B D S		H-B S S		H-B B L		P-B TL		P-B 20		P-B D		P-B H		P-C t 20		P-C S V	
	1		2		3		4		5		6		7		8		9		10	
Festuca heterophylla	-	-	-	-	-	-	+-1	II	-	-	-	-	-	-	-	-	-	-	-	-
Galium mollugo	-	-	-	-	+	I	-	-	+	I	-	-	-	-	-	-	-	-	-	-
Helleborus purpurasens	-	-	-	-	-	-	+	I	-	-	-	-	-	-	-	-	-	-	-	-
Hieracium cymosum	-	-	-	-	-	-	-	-	-	-	+	I	-	-	-	-	-	-	-	-
Ligustrum vulgare	+	I	+-1	I	-	-	-	-	+	I	+	I	-	-	-	-	-	-	-	-
Lilium martagon	-	-	-	-	-	-	+	II	+	I	-	-	-	-	-	-	-	-	-	-
Melampyrum nemorosum	-	-	-	-	-	-	+-1	I	+-1	I	-	-	-	-	-	-	-	-	-	-
Melittis grandiflora	-	-	+	I	-	-	-	-	-	-	-	-	-	-	+	I	-	-	-	-
Potentilla alba	-	-	-	-	-	-	-	-	-	-	+-1	III	-	-	+	II	-	-	-	-
Primula veris	+	I	+	I	-	-	+-1	III	+	I	-	-	-	-	+	I	-	-	-	-
Prunus mahaleb	-	-	-	-	1	I	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Prunus spinosa	+-1	I	-	-	-	-	-	-	+-1	I	-	-	-	-	-	-	-	-	-	-
Pulmonaria mollissima							+	I	-	-	-	-	-	-	-	-	-	-	-	-
Pulmonaria officinalis	+	I	+	I	-	-	-	-	+	I	+	I	-	-	+	II	-	-	-	-
Pyrus piraster	-	-	1	I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quercus cerris (seedling)	-	-	-	-	-	-	+	I	-	-	-	-	-	-	-	-	-	-	-	-
Quercus petraea (seedling and shrub)	1	I	1	I	+-1	I	+	II	+	I	+	I	-	-	+	I	+	I	+	I
Quercus pubescens (shrub)	+-1	I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quercus virgiliana (shrub)	1	I	-	-	1	I	-	-	-	-	-	-	-	-	-	-	-	-	+	I
Ranunculus cassubicus	+	I	+	II	-	-	-	-	-	-	+	I	-	-	+	II	-	-	-	-
Rosa canina	-	-	+-1	I	-	-	+	I	-	-	-	-	-	-	-	-	-	-	-	-
Rosa gallica	-	-	-	-	1	I	-	-	+	I	+	I	-	-	-	-	-	-	+	I
Rosa pimpinellifolia	-	-	-	-	+-1	I	-	-	-	-	-	-	-	-	-	-	+	I	-	-
Sedum maximum	+	I	+	II	-	-	-	-	+	I	-	-	+	I	-	-	-	-	-	-
Sorbus aria agg.	-	-	-	-	-	-	-	-	-	-	+	I	+	I	-	-	+	I	+	I
Sorbus torminalis	-	-	1	I	-	-	-	-	-	-	-	-	+	I	-	-	-	-	-	-
Symphytum tuberosum	-	-	+	I	-	-	-	-	-	-	-	-	-	-	+	I	-	-	-	-
Waldsteinia geoides	-	-	+	I	+	I	-	-	+	I	-	-	+	I	-	-	-	-	-	-
Festucion rubrae and **Nardion** species																				
Antennaria dioica	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+-1	I	-	-
Anthoxanthum odoratum	-	-	-	-	-	-	-	-	-	-	+	I	-	-	-	-	+	I	-	-
Calamagrostis arundinacea	-	-	-	-	-	-	-	-	-	-	+-1	I	-	-	-	-	-	-	-	-
Erigeron podolicus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	I	-	-
Festuca rubra	-	-	-	-	-	-	-	-	-	-	+	I	-	-	+	I	-	-	-	-
Gentianella livonica	-	-	-	-	-	-	-	-	-	-	+	II	-	-	-	-	-	-	-	-
Hieracium pilosella (agg.)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+-2	V	+-1	IV
Luzula campestris	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	II	-	-
Other species																				
Achillea millefolium	+	I	-	-	-	-	+	II	+	II	+	III	-	-	+	II	-	-	-	-
Adonis aestivalis	-	-	-	-	-	-	-	-	+	I	-	-	-	-	-	-	-	-	-	-
Agrimonia eupatoria	+	I	+	I	+	I	-	-	+	I	+-1	II	-	-	+	I	-	-	-	-
Agrostemma githago	-	-	-	-	-	-	-	-	+	I	-	-	-	-	-	-	-	-	-	-
Bifora radians																				
Carduus nutans	+	I	-	-	-	-	-	-	+	I	-	-	-	-	-	-	-	-	-	-
Convulvulus arvensis	+	I	-	-	+	I	-	-	+	I	-	-	-	-	-	-	-	-	-	-
Daucus carota	+	I	+	i	-	-	-	-	+	I	+	I	-	-	-	-	-	-	-	-
Echium vulgare	+	I	-	-	-	-	-	-	+	I	+	I	-	-	-	-	-	-	-	-
Cuscuta arvensis	+-1	I	+-1	I	1	I	-	-	+-1	I	-	-	-	-	-	-	-	-	+	I
Falcaria vulgaris	+	I	-	-	-	-	-	-	+	I	-	-	-	-	-	-	-	-	-	-
Glechoma hederaçea	-	-	+-1	I	-	-	-	-	-	-	-	-	-	-	+	i	-	-	-	-

	H-B t S		H-B D S		H-B S S		H-B B L		P-B TL		P-B 20		P-B D		P-B H		P-C t 20		P-C S V	
	1		2		3		4		5		6		7		8		9		10	
Leontodon hispidus	+	II	+	I	+	I	+-1	III	+-1	IV	+-1	IV	-	-	+	III	+	II	+	I
Lotus corniculatus	+	II	-	-	-	-	-	-	+	III	+	III	+	I	+	III	-	-	-	-
Medicago lupulina	+	I	-	-	+	I	-	-	+	II	-	-	-	-	-	-	-	-	-	-
Melilotus officinalis	+	I	-	-	-	-	-	-	+	I	-	-	-	-	-	-	-	-	-	-
Myosostis arvensis	-	-	-	-	-	-	-	-	+	I	-	-	-	-	-	-	-	-	-	-
Pinus silvestris (seedling)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	I	-	-	-	-
Reseda lutea	+	I	-	-	-	-	-	-	+	I	-	-	-	-	-	-	-	-	-	-
Rumex acetosa	+	I	+-1	II	-	-	+	II	+	II	+	II	-	-	+	II	+	I	+	I
Senecio integrifolia	-	-	-	-	-	-	+-1	IV	-		+	I	-	-	-	-	-	-	-	-
Senecio jacobaea	-	-	-	-	-	-	+	I	+	I	-	-	-	-	-	-	-	-	-	-
Serratula tinctoria	-	-	-	-	-	-	-	-	-	-	+	I	-	-	+	I	-	-	-	-
Stenactis annua	-	-	-	-	-	-	-	-	+	I	-	-	-	-	-	-	-	-	-	-
Taraxacum laevigatum	-	-	-	-	-	-	-	-	+	I	+	II	-	-	+	I	+	II	+	II
Taraxacum officinale	+	II	+	I	-	-	-	-	+	IV	+	II	-	-	+	II	-	-	-	-
Tragopogon floccosus	+	I	+	I	-	-	-	-	+	II	+-1	II	-	-	+	I	-	-	-	-
Urtica dioica									+	I	+-1	I	-	-	-	-	-	-	-	-
Valeriana officinalis	-	-	-	-	-	-	+	I	-	-	+	I	-	-	-	-	-	-	-	-

Legends

1. **H-B t S**: Hypochoerio -Brachypodietum pinnati Less, 1991., typical stand, Szőlőhegy, lower level and the upper forest margin (8 relevés)
2. **H-B D S**: Hypochoerio-Brachypodietum pinnati Less, 1991., danthonietosum, Szőlőhegy, higher level, old hayfield of the Forestry (5 relevés)
3. **H-B S S**: Hypochoerio-Brachypodietum pinnati Less, 1991., stipetosum, Szőlőhegy, middle and higher level, on ridge (5 relevés)
4. **H-B B L**: Hypochoerio-Brachypodietum pinnati Less, 1991, Bükk Mts., on dolomit (5 relevés of Nándor Less)
5. **P-B T L**: Polygalo maiori-Brachypodietum pinnati H. Wagner, 1941., slopes of Tohonya- and Lófej-valleys (25 relevés)
6. **P-B 20**: Polygalo maiori-Brachypodietum pinnati H. Wagner , 1941., core area of BR at the Hungarian-Slovakian border (10 relevés)
7. **P-B D**: Polygalo maiori-Brachypodietum pinnati H. Wagner, 1941., danthonietosum, 2 km (NW) far from Nagyoldal (5 relevés)
8. **P-B H**: Polygalo maiori-Brachypodietum pinnati H. Wagner., 1941., western part of Haragistya (Ocsisnya-tető, Mogyorós-bérc, 15 relevés)
9. **P-C t 20**: Poo badensis-Caricetum montanae ass. nova , core area of BR at the Hungarian-Slovakian border, Buffer I. near Mihály-láza (15 relevés)
10. **P-C SV**: Poo badensis - Caricetum montanae ass. nova, stipetosum, Verőtető, dolomit ridge (5 relevés)

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INULA ENSIFOLIA (*ASTERACEAE*) AS FOOD PLANT PREFERED BY DAILY BUTTERFLIES (*LEPIDOPTERA: RHOPALOCERA*)

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Összefoglaló: Az ANP területén több éve végzünk kutatásokat. Ezekben arra kívánunk választ kapni, hogy mi biztosítja a kapcsolatot a virághlátogató nappali lepkék (*Lepidoptera: Rhopalocera*) és tápnövényeik között. A megfigyelt fajok kiválasztása az előző (1989.-1992.) évek vizsgálatai alapján történt. Eszerint az öt kiválasztott nappali lepke - *Maniola jurtina* L., *Mellicta athalia* Rott., *M. aurelia* Nick., *M. britomartis* Assm., *Melitaea didyma* Esp. - fordult elő a legnagyobb gyakorisággal a kijelölt területen. A kiválasztott mintaterületen a lepkék fő tápnövényének az *Inula ensifolia* bizonyult, amely jelentős méretű telepeket alkotott.

A lepkefajok többségénél jelentősen nagyobb volt annak a területnek a látogatottsága, ahol a nagyobb sarjtelepek találhatók. Tehát a foltnagyság erős befolyásoló tényezőnek látszik a táplálékkeresésben. A nektár megtalálásában nagy valószínűséggel döntő szerep jut a virágon található UV- mintázatnak. Ez az *Inula ensifolia* esetében mindig az éppen nyíló virágkör bibeszálain van. A lepke körbemegy a nyíló virágok mentén, eközben rátapad a bibén lévő virágpor. Az *Inula ensifolia* nektáriuma kis méretű, a bibeszál tövénél található és gyűrűszerűen veszi körül a stylust. A vizsgált lepkefajok virághlátogatásában van bizonyos napi ritmus, azonban ezt még nem tudtuk a nektártermelés napi ritmusával összehasonlítani.

A megfigyelési idő alatt jelentős mennyiségű virághlátogatást regisztráltunk az *Inula ensifolia*-n. Ennek számából ítélve úgy tűnik, hogy a kiválasztott lepkefajoknak a vizsgált növénytelepek elég nagyok voltak ahhoz, hogy elfogadható táplálélforrások legyenek. Egy megporzási rendszerben mindkét fél számára biztosítani kell a minimális populációméretet. A terület állapotának fenntartása elengedhetetlen, mert a pollinátorok megléte lényeges tényező az egész biocönózis fennmaradása szempontjából.

Introduction

The connections of plants and phytophag species give the majority of ecological interactions. The phytophag insects play the main role in the vegetative sphere of plants either consumer or participant of mutualistic relations. We dealed with one of these latters, namely with food searching of daily butterflies, at the same time with their pollination role. Coevolution process goes on between the plant and the pollinator populations (Jermy, 1987.). This coadaptation process forms those plant species which are the main foods. In a phytocenosis there are many zoophyl plant species and this fact is in correlation with heterogenous structure and colour of flowers, they are various lure (Vogel & Westerkamp, 1991.). Despite of the variety of flowers we should pay attention to the fact that most of daily butterflies have mixed nutrition, and spread flower individuums are not acceptable sources (Gonseth, 1992., Vogel & Westerkamp, 1991.). Thus in visits on flowers there are time and place division.

The aim of these studies is to find out what assures the connections between daily butterflies (*Lepidoptera: Rhopalocera*) and their food plant.

Methods

The choice of butterfly species to the observation is based on studies between 1989 and 1992. According to this five butterfly species - *Maniola jurtina* L., *Mellicta athalia* Rott., *M. aurelia* Nick., *M. britomartis* Assm., *Melitaea didyma* Esp. - were the most abundant at the observation area. On this area Inula ensifolia proved to be the main food plant of butterflies mentioned above.

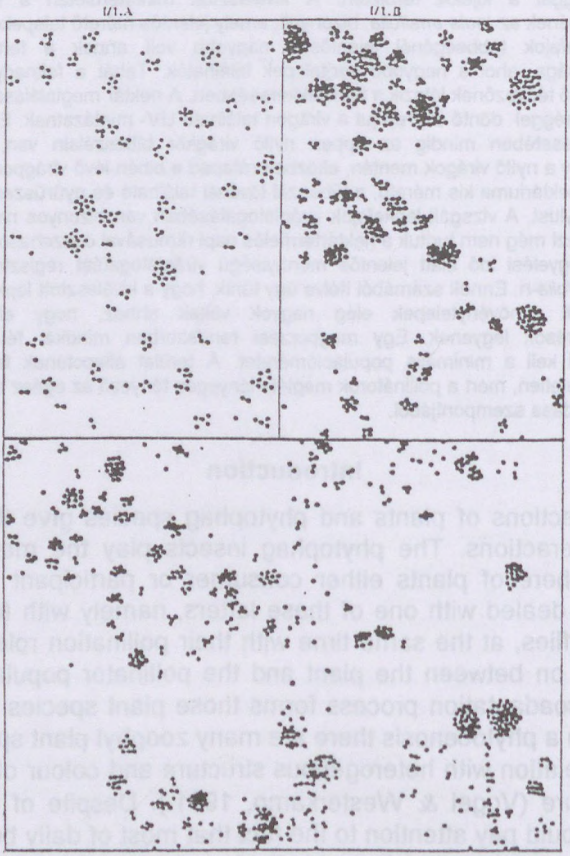


Fig. 1. Localization of *Inula ensifolia* polycormons on the examination area.

The area (10m x 15m) is in a slope of Tohonya Valley of Aggtelek.

At first, we took into account the polycormon of Inula ensifolia. The chosen area was divided into three parts so that we could observe the area more effectively. The three parts are the followings: the size of the first two (I./1.A. and I./1.B) is the same but the polycormon was smaller in the I./1.A area so the number of flowers were consequently less. The sizes of I./1.A and the I./1.B area equalled the area of the I./2., the number of the examined plants were much the same and the sizes of the polycormons were similar (Fig.1). The observation took place from 8:00 to 18:00 every day in July. The above period was divided to 15 minutes subperiods in order to increase the exactness of the evaluation.

Results

During evaluating the data, we made two comparisons:

1. We compered the I./1.A and the I./1.B area.

In case of *Maniola jurtina*, *Mellicta athalia*, *M. aurelia* and *M. britomartis* we concluded that the visiting of he area was more significant where the bigger Inula ensifolia polycormons were found (Fig.2). There is no difference in the number of visiting of the area at Melitaea didyma.

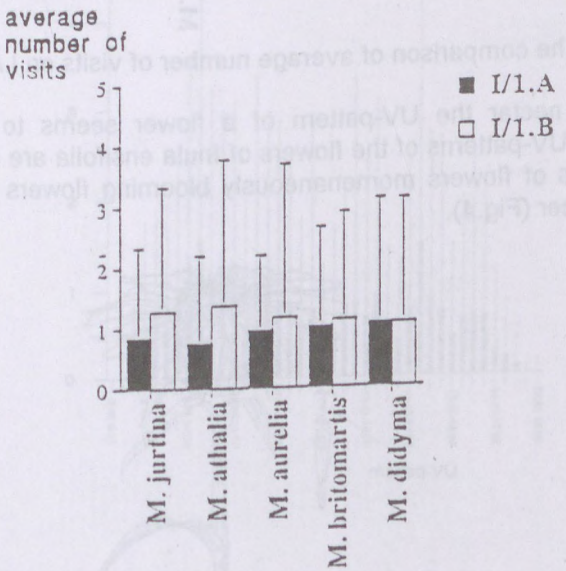


Fig.2. The comparisons of average number of visits on I./1.A and I./1.B

2. We also compered the I./1. and the I./2. area.
We found that the visiting of the I./1. area was different that of the I./2. area in case of the above mentioned four species. As to *Melitaea didyma*, it preferred the I./2. area (Fig.3).

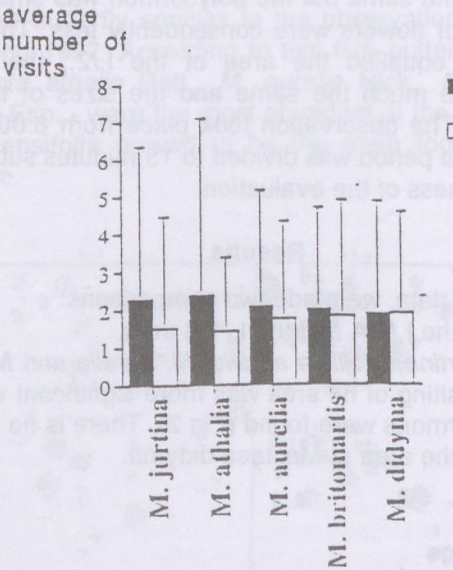


Fig. 3. The comparison of average number of visits on I./1. and I./2.

To find nectar the UV-pattern of a flower seems to have a great importance. UV-patterns of the flowers of Inula ensifolia are always situated on the styles of flowers momenaneously blooming flowers while pollen is adhering to her (Fig.4).

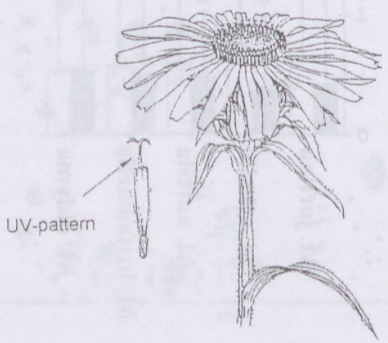


Fig. 4. Flower of *Inula ensifolia*

Butterflies visit flowers in hope of nectar-acquiring. Nectar is the product of the nectary. The nectary of Inula ensifolia is small. It is located at the base of style and forms a ring around it. Most of nectar is produced by the outer flowers, less is by the inner ones (these are smaller, their syle is reduced).

Researches in connection with *Asteraceae* proved that at the species of *Tubuliflorae* subfamily the nectar-secretion gives curve with three peaks (Pesti,1980.) This periodic production can be attributed to endogenous rhythm (Halmágyi- Keresztesi, 1991., Pesti,1980.). The question arise up if the daily visits rhythm of chosen butterflies adjust to this. Visits of the observed butterflies have some kind of a daily rhythm, but we could not compare it with the daily rhythm of nectar production yet (Fig. 6.-10).

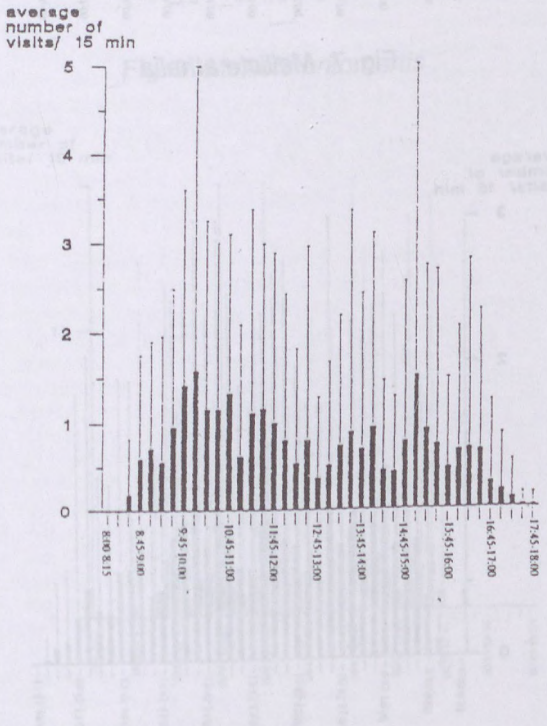


Fig. 6. *Maniola jurtina*

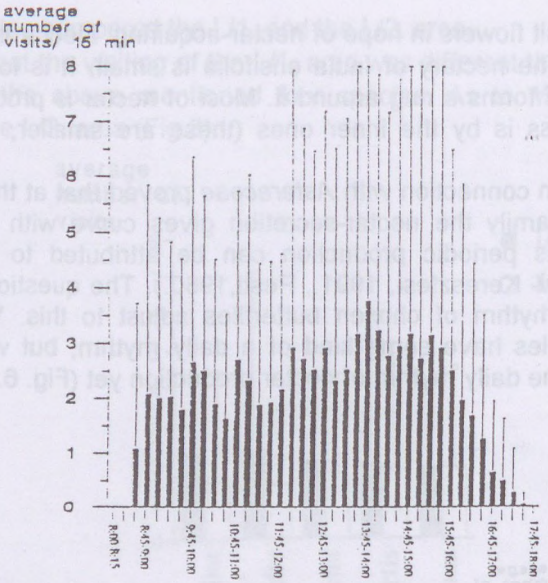


Fig. 7. *Mellicta athalia*

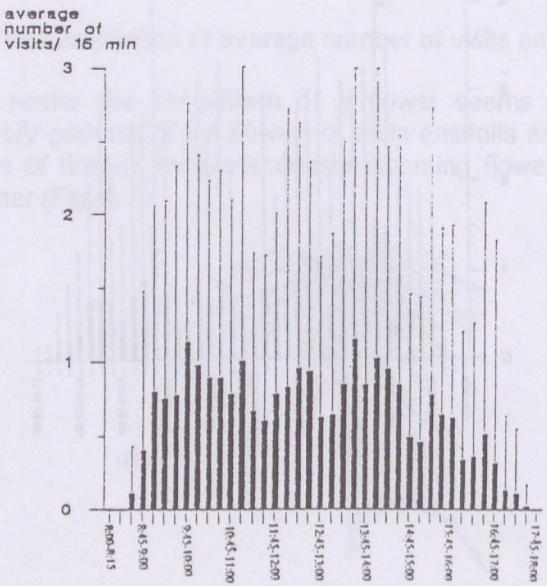


Fig. 8. *Mellicta aurelia*

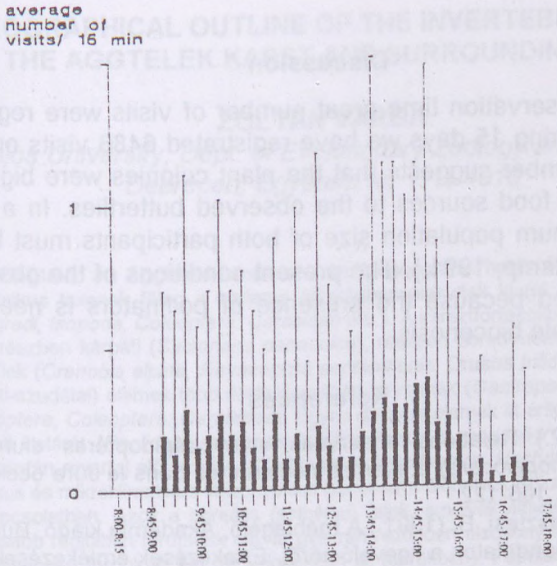


Fig. 9. *Mellicta britomartis*

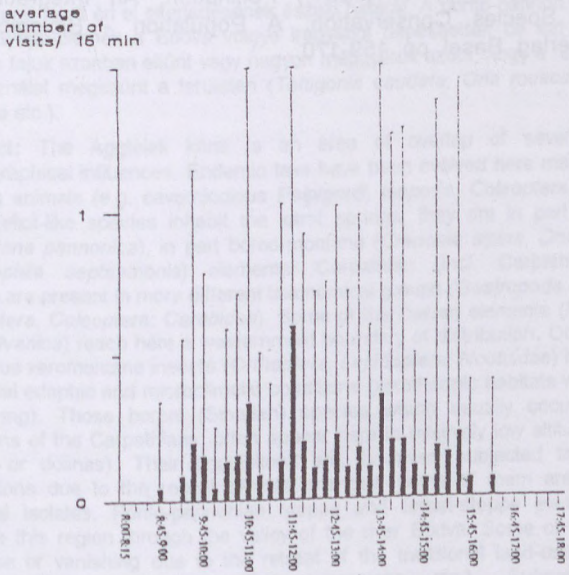


Fig. 10. *Melitaea didyma*

Discussion

During the observation time great number of visits were registrated on *Inula ensifolia* (during 15 days we have registrated 6486 visits on one plant species). This number suggests that the plant colonies were big enough to be acceptable as food sources to the observed butterflies. In a pollination system the minimum population size of both participants must be assured (Vogel & Westerkamp, 1991.). The present conditions of the observed area must be preserved because the presence of pollinators is needed to the survive of the whole biocenosis.

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BIOGEOGRAPHICAL OUTLINE OF THE INVERTEBRATE FAUNA OF THE AGGTELEK KARST AND SURROUNDING AREAS

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Összefoglaló: Az Aggteleki-karszt számos biogeográfiai hatás átfedési területe. Endemikus taxonok főleg a barlangi élővilágban alakultak ki (pl. valódi barlangi *Palpigradi, Isopoda, Coleoptera: Carabidae* stb.). A karsztforrásokban élő reliktum-fajok részben kárpáti (*Sadleriana pannonica*), részben boreo-montán (-szubalpin) jellegűek (*Crenobia alpina, Rhyacophila septentrionis, Drusus trifidus*). Kárpáti (ill. kárpáti-szudétai) elemek több állatcsoportban is vannak (*Gastropoda, Orthoptera, Trichoptera, Coleoptera: Carabidae*). Egyes dacikus elemek itt érik el elterjedésük nyugati határát (*Pholidoptera transsylvanica, Isophya modestior stysi*). Számos xeromontán rovarfaj előfordulása (*Orthoptera, Lepidoptera: Noctuidae*) a speciális edafikus és mikroklimatikus viszonyokkal (xerotherm élőhelyek fizikai aprózódással) áll kapcsolatban. Azok a boreális (szibériai) fajok, amelyek általában a Kárpátok magasabb régióiban fordulnak elő, itt gyakran feltűnően alacsony tengerszintfeletti magasságban fordulnak elő (szurdokokban ill. töbrökben). Populációik azonban a jelenlegi klíma-változásoknak köszönhetően jelentős ingadozásoknak vannak alávetve. Több közülük veszélyeztetett elterjedés-peremi izolátum. A szubmediterrán-pontomediterrán fajok gyakoriak a melegkedvelő tölgyesekben, a molyhostölgyes-bokorerdőkben a sztyepplejtőkön és sziklagyepekben. Számos ilyen jellegű faj itt éri el elterjedésének északi határát. A ponto-pannon sztyepp- és erdőssztyepp-elemek a Bódva völgye irányából népesítették be ezt a területet. Számos fajuk azonban eltűnt vagy nagyon meggyérült azóta, hogy a hagyományos földhasználat megszűnt a területen (*Tettigonia caudata, Oria musculosa, Odice arcuinna* etc.).

Abstract: The Aggtelek karst is an area of overlap of several different biogeographical influences. Endemic taxa have been evolved here mainly in cave-dwelling animals (e.g. cavernicolous *Palpigradi, Isopoda, Coleoptera: Carabidae* etc.). Relict-like species inhabit the karst springs, they are in part Carpathian (*Sadleriana pannonica*), in part boreo-montane (*Crenobia alpina, Drusus trifidus, Rhyacophila septentrionis*) elements. Carpathian (incl. Carpathian-Sudetic) species are present in more different taxonomical groups (*Gastropoda, Orthoptera, Trichoptera, Coleoptera: Carabidae*). Some of the Dacian elements (*Pholidoptera transsylvanica*) reach here a westernmost boundary of distribution. Occurrence of numerous xeromontane insects (*Orthoptera, Lepidoptera: Noctuidae*) is connected to special edaphic and microclimatic conditions (xerothermic habitats with physical weathering). Those boreal (Siberian) species which usually occur at higher elevations of the Carpathians, often appear here in relatively low altitudes (e.g. in gorges or dolinas). Their populations are, however, subjected to significant fluctuations due to the recent climate changes; some of them are threatened marginal isolates. Ponto-pannonian steppe and forest-steppe elements could colonise this region through the valley of the river Bódva. Some of them are in decrease or vanishing due to the retreat of the traditional land-use (*Tettigonia caudata, Oria musculosa, Odice arcuinna* etc.). Submediterranean-pontomediterranean species are abundant in xerothermic oak forests, white oak scrub forests, steppe and rocky grasslands. Numerous species of this type reach here a northernmost limit of their geographical range.

Introduction

The Aggtelek karst and the Slovakian karst belong to the Gömör-Torna karst area, which is the southernmost part of the inner limestone zone of the Northern Carpathians. Most part of these mountains are formed by lower and middle Triassic limestones and dolomites. The lower karst plateaux are often covered by a fossil soil: terra rossa (red clay). At the southern part of the mountains, limestone is covered by limeless gravel. Geographically and biogeographically this hilly or lower mountaneous region displays a mosaic-like transition between the higher mountains of the Carpathians and the lowlands and hilly regions of the Pannonian basin. Due to this transitional position, it is an area of overlap of several different biogeographical influences. As a consequence of these circumstances, flora and fauna are rich in species and diverse in biogeographical components, as well. A major part of this area is covered by nature-like or semi-natural ecosystems with diverse ecotones and complexes of plant communities ("sigma-associations"). These factors promote the dispersal or retreat of different biogeographical elements, which follow the short- or long-term climatic fluctuations and/or changes of anthropogenic influences. Caves and karstic surface morphology often act as effective barriers, hence they are responsible for the evolution of endemic taxa.

Endemism and autochtonous evolution

Snails (*Gastropoda*) are often represented by endemic taxa in calcareous mountains. *Alopia clathrata* (*Clausiliidae*) is one of the most famous endemic species of the Slovakian karst. It is closely related to the Transsylvanian *A. bielzi* and has been recently evolved as a neo-endemic species due to the geographical isolation from it. The spring-dwelling snail *Sadleriana pannonica* belongs to the Tertiary relicts, it is confined to some neighbouring limestone mountains (Bükk mts., Aggtelek and Slovakian karst). Some closely related species of the genus *Hauffenia* occur only in the karstic mountains of the western part of the Balcan peninsula.

Endemic species have been evolved here almost exclusively in cave-dwelling arthropods. They are relict-like forms which occur at the northern boundary of the true cavernicolous fauna in Europe. The cavernicolous *Amphipoda: Niphargus aggtelekiensis* (related to *N. tatrensis*) belong to a taxonomically rather complicated species group. It is widely distributed in the running waters of the larger caves (Baradla-cave, Béke-cave etc.) of this region. Occasionally some individuals are drifted out by carstic springs into the surface. The cavernicolous *Isopoda: Mesoniscus graniger* is probably the most common cavernicolous arthropod of this region. *Duvalius hungaricus* belong to a genus of ground beetles (*Coleoptera: Carabidae*) which is widely distributed in different cave systems of the Carpathian basin

(Mecsek mts., Carpathians and W. Transsylvanian mts.). This species is represented by numerous local subspecies in different cave systems of the Aggtelek and Slovakian karst. Other, stricly localised endemic species of this genus occur in the caves of the Slovakian karst (e.g. *D. bokori* in the ice-dome near Silica). The lower chelicerate: *Eukoenenia austriaca vagvoelgyii* (*Palpigradi*) was discovered in the funnel-like cave of Vecsembükk, but subsequently found also in some other caves. It was originally described as a separate species; by a subsequent revision, however, united with the nominate taxon *E. austriaca*, described from the Austrian N. Limestone Alps ("Totes Gebirge").

Endemic zootaxa have been evolved in wingless or short-winged insect groups. The short-winged bush-cricket *Isophya bei-bienkoi* is considered as an endemic species of the Aggtelek and Slovakian karst. The wingless curculionid beetle *Otiorrhynchus roubali* has been discovered in the Slovakian karst, but it was recently found also near Aggtelek and Szögliget.

Last years two highly isolated *Microlepidoptera* species have been described from the Slovakian karst region: *Stigmella inopinata* (*Nepticulidae*), living on *Spiraea media* scrubs and *Bembecia puella* (*Sesiidae*) which develops in the roots of *Astragalus glyciphyllus*. It is, of course, highly questionable that they are true endemics of this area.

Endemic taxa of flying insects are usually only slightly differentiated subspecific ones. The grasshopper *Stenobothrus eurasius slovacus* is a marginal subspecies of a widely distributed eurasian continental (from Lower Austria to Northern Mongolia), steppe-dwelling animal. The noctuid moth *Chersotis fimbriola baloghi* belongs to the northermost marginal isolates of a Mediterranean-xeromontane species. It strikingly contrasts with the nominate subspecies which occurs from the westernmost boundary of the Carpathian basin ("porta Hungarica": Lower Austria and SW Slovakia) to the dolomite hills of Buda. Other peculiar subspecies of this area have a wider distribution. *Maculinea alcon curiosa*, a myrmecophilous Blue of complicated taxonomical relegation (*Lycaenidae: Polyommatini*), connected to *Gentiana cruciata*, (closely related to the Central European *M. alcon xerophila*) occurs from the Bükk mts. (N. Hungary) to the Muránská planina (S. Slovakia). *Aricia artaxerxes issekutzi*, belonging also to *Polyommatini*, has a wide range in the Carpathians and karstic mountains surrounding the Pannonian basin (Bükk, Aggtelek karst, Slovakian karst, Slovenski ráj, W. Transsylvanian mts., mts. of Banat etc.).

Photedes captiuncula delattini (*Noctuidae*) differs both from the Alpine nominotypic subspecies and other populations, which are widely distributed from the northern part of the British Isles to eastern Siberia, but is closely related to the populations of the high mountains of the Balcan peninsula. Carpathic-balcanic biogeographical connections are also typical for land snails (*Gastropoda: Pulmonata*) and for several insect groups (*Orthoptera*,

Coleoptera: Carabidae, Trichoptera, Lepidoptera: e.g. genus *Erebia* etc.), they will be analysed in the next paragraph.

Carpathic influences

Sink-holes (dolina) and gorges often cause the inversion of vertical zones, connected with the occurrence of high-mountain species in surprisingly low altitudes. The land-snail (*Gastropoda: Pulmonata*) assembly which populated the plateau of the "Nagyoldal" in the cool periods of the early Holocene, could survive the climatic changes in the gorge-like parts of the Ménes-valley. Karstic springs with an even temperature near to the annual mean (about 10°C) are habitats of many stenothermic species, typical for higher regions of the Carpathians, e.g. some boreo-montane elements: *Crenobia alpina* (*Turbellaria*), *Drusus trifidus, Rhyacophila septentrionis* (*Trichoptera*).

Carpathian (incl. Carpathian-Sudetic) species are present in several different taxonomical groups (*Gastropoda, Orthoptera, Trichoptera, Coleoptera: Carabidae*). The western Carpathian snail (*Gastropoda*) species *Cochlodina cerata* and several Carpathian (*Bielzia coerulans, Oxychilus orientalis, Macrogastra latestriata, Faustina faustina, Perforatella vicina*) or Carpathian - eastern-Alpine ones (*Trichia unidentata*) occur both in the Slovakian and Hungarian part of the karst region. The high-mountain species *Faustina rossmaessleri, Vestia gulo* and the Eastern Carpathian *Perforatella dibothrion* and *Pseudalinda stabilis* seem to be confined to the higher, Slovakian part of the karst region.

The short-winged Carpathian bush-crickets *Isophya brevipennis* and *Pholidoptera aptera slovaca* are discovered in the Slovakian karst. The eastern Carpathian ("Dacian") element *Pholidoptera transsylvanica* reaches here a western boundary of distribution on the southern part of the Szilice plateau where it seems to be locally an abundant species (Haragistya, Lófej-valley, Nagyoldal, Ménes-valley). *Ph. aptera* and *Ph. transsylvanica* strictly exclude each other in their habitats.

Numerous Carpathian ground-beetles (*Carabidae*) occur in humid mountain forests of the deeper valleys or dolinas of the higher karst plateaux, e.g. *Carabus obsoletus, C. zawadszkyi, C. montivagus* (a Carpathian-Balcanic species), *Abax schueppeli rendschmidti, Trichotichnus laevicollis carpathicus. Carabus linnei* and *Leistus piceus* were found only at higher parts of the Slovakian part (Zádielska planina).

Xeromontane species

Occurrence of numerous xeromontane insects (*Orthoptera, Lepidoptera: Noctuidae*) belong to the most significant biogeographical features of the Gömör-.Torna karst region. Their populations are connected to not or only

sparsely forested, relict-like habitats with special edaphic and microclimatic conditions (xerothermic habitats on dolomite or clastic limestone with prevailing physical weathering). The Mediterranean-xeromontane short-winged grasshopper *Paracaloptenus caloptenoides* (*Orthoptera, Ensifera: Catantopinae*) is confined to short-grass habitats with clastic soil. It seems to occur only on some spots of the Hungarian part of the plateau of Silica (Haragistya, Verőtető, Nagyoldal).

Accumulated occurrence of xeromontane noctuid moths has been observed also on the lower, xerothermic parts of the Aggtelek karst, e.g. near Jósvafő and Szin (*Euxoa birivia, E. hastifera, E. distinguenda, Dichagyris [Yigoga] nigrescens, D. [Y.] forcipula, D. musiva, Chersotis margaritacea* etc.). Their best habitats extend, however, on the southern, rocky escarpments of the higher plateaux: Nagyoldal, Alsóhegy with the occurrence of the species, enumerated above and with abundant populations of some others, e.g. *Chersotis fimbriola baloghi, Ch. rectangula, Ch. multangula, Oligia literosa, Apamea platinea, Gnophos pullatus.*

Boreo-continental (Siberian, Angarian) and boreo-montane species

Boreal (Siberian) or boreo-montane species which usually occur at higher elevations of the Carpathians, often appear here in relatively low altitudes (e.g. in humid, cool habitats of gorges or dolinas), e.g. the moth species *Trichopteryx sertata, Chloroclystis debiliata,Hypena crassalis, H. obesalis, Apamea rubrirena, Amphipoea lucens, Hyppa rectilinea, Blepharita adusta, Lasionycta proxima, Eurois occulta, Rhyacia [Epipsilia] latens, Euxoa recussa*. Their populations are, however, subjected to significant fluctuations due to the recent climate changes; some of them are threatened marginal isolates. Their stable populations inhabit usually the higher and cooler Slovakian part of the karst area. Some of them have been discovered only in that area, e.g. *Lasiommata petropolitana, Baptria tibiale,Colostygia kollararia, C. aptata, Xestia collina*. Other species, e.g. *Thera stragulata, Th. albonigrata, Elophos dilucidarius, Deileptenia ribeata, Panthaea coenobita, Syngrapha interrogationis, S. ain* are connected to Coniferous stands. Additional important species are living here on *Populus tremula*, e.g. *Notodonta torva, Phyllodesma ilicifolia, Lomaspilis opis* or the recently discovered *Arichanna melanaria* inhabiting usually peat-bogs with *Vaccinium uliginosum* and *Ledum palustre*. *Aricia (Eumedonia) eumedon* occurs in small, isolated populations on tall-grass meadows in the valleys (Zádielska dolina, Ménes, Bolyamér and Szelce valleys); it belongs to the mostly threatened butterfly species of Hungary.

Numerous more common, expansive Siberian *Lepidoptera* belong to the dominant species of mountain forests (*Alcis bastelbergeri, Gonodontis bidentata, Hydriomena furcata, Lampropteryx suffumata, Lygris prunata, Anaplectoides prasina, Diarsia brunnea, Xestia ditrapezium* etc.), humid tall-

forb communities (*Chrysaspidia bractea, Autographa iota, A. pulchrina*) and semi-dry or humid meadows (*Amphipoea fucosa, A. oculea, Hydraecia micacea, Pabulatrix pabulatricula, Apamea illyrea, Cerapteryx graminis, Orthosia opima, Eriopygodes imbecilla, Leucania comma, Mythimna impura, M. pudorina, M. conigera, Mamestra persicariae, Lacanobia splendens, L. pisi, L. aliena, Brenthis ino, Clossiana selene, Melitaea diamina, Erebia medusa, E. aethiops*). They are widely distributed on the lower levels of the plateaux and in the valleys of streamlets, as well. Other Siberian species have a strip-like distribution along the forest-steppe-zone or near the southern boundary of the forested belts. They are typical for wetlands of the lowlands or the colline level, e.g. *Plusia zosimi, Athetis lepigone, Eucarta amethystina, Goonallica virgo*; localised and fairly rare in the karst area.

The Siberian faunal type is well-represented in orthopterous insects, too. Some of them populate the humid or wet meadows of the valleys or bottoms of dolinas e.g. *Roeseliana roeseli, Chrysochraon dispar, Omocestus viridulus.* Other species are typical, however, of the semi-dry grasslands of the higher plateaux: *Metrioptera brachyptera, Psophus stridulus, Stauroderus scalaris, Chorthippus (Glyptobothrus) apricarius, Arcyptera fusca.* They seem to be montane species in the European part of their range, called "Angarian elements" by Uvarov.

Southern continental (ponto-pannonian) species

Ponto-pannonian steppe and forest-steppe elements are typical for the lowland and colline levels of the Pannonian basin. They could colonise this region through the valleys of River Bódva and larger tributaries. They occur in xerothermic habitats of the lower levels, e.g. on oldfields, extensive pastures, dry and semi-dry grasslands, rocky grasslands and on clearings of dry oak forests. Numerous species of this biogeographical type belong to the dominant species of such ecosystems, e.g. the bush-crickets (*Tettigonoidea*) and grasshoppers (*Acridoidea*): *Bicolorana bicolor, Stenobothrus crassipes, Euchorthippus declivus.* Others seem to be localised to dry tall-forb formations, e.g. the bush-crickets *Leptophyes discoidalis, Poecilimon fussi*, or to extreme rocky or clastic grasslands: *Stenobothrus eurasius, Euchorthippus pulvinatus.* Some of them are in decrease or vanishing due to the retreat of the traditional land-use (*Gampsocleis glabra, Tettigonia caudata*).

Numerous moths and butterflies also belong to this biogeographical type. Some of them can be regarded as faunistical rarities, e.g. the Noctuid moths *Metachrostis dardouini, Odice arcuinna, Panchrysia deaurata, Euchalcia consona, Cucullia xeranthemi, C. gnaphalii, Hadena irregularis* or the butterfly *Colias myrmidone*; others can be mentioned as typical for lowland and hilly steppe habitats: *Ocnogyna parasita* (*Arctiidae*), *Perigrapha i-cinctum* (*Noctuidae*). Some dominant species of xerothermic habitats, e.g.

the Geometrid species *Tephrina arenacearia, T. murinaria, Idaea rubraria, I. obsoletaria,* the Arctiid moths *Eucharia deserta, Chelis maculosa* and the butterflies *Brenthis hecate, Melitaea trivia* belong to this biogeographic type, too. Some species, connected to traditionally used grasslands or weeds became extremely rare or vanishing during the last two decades: *Porphyrinia respersa, Periphanes delphinii, Oria musculosa* etc.).

Mediterranean influences

Aggtelek and Slovakian karst areas are equally rich in xerothermic habitats with warm mixed oak forests and association complexes of white oak scrub forests and rocky steppe grasslands. Numerous sub-Mediterranean - ponto-Mediterranean species are breeding here in abundant populations; some of them reach here the northernmost limit of their geographical range. Some of the typical Mediterranean - ponto-Mediterranean species are connected to the open, rocky grassland mosaics, e.g. the large, predatory, parthenogenetic bush-cricket *Saga pedo* or to the skirt of forested patches, e.g. the smaller bush-cricket species *Rhacocléeis germanica* and *Pachytrachys gracilis.* Typical species of rocky grasslands are often herbaceous food-plant specialists, as the Geometrid moths *Discia conspersaria* living on *Artemisia alba* and *A. absinthium*, *Eupithecia denticulata* (on *Asyneuma canescens*), *E. alliaria* (on *Allium flavum*) or the *Noctuidae: Cucullia campanulae* (on *Campanula rotundifolia*). Larvae of some typical moth species of xerothermic oak forests develop on the white oak species *Quercus pubescens* and *Q. virgiliana*, e.g. *Ennomos quercarius*, Achlya ruficollis*, Phalera bucephaloides*, Ocneria rubea, Catocala nymphagoga, Dichonia aeruginea, Dryobotodes monochroma* etc. Other species are connected to diverse scrubs, e.g. to *Cerasus mahaleb*: *Ectoedemia mahalebella*, to *Ligustrum vulgare*: *Peribatodes umbraria** and *Polyphaenis sericata*, to *Cotinus coggygria*: *Eutelia adulatrix*.* Warm oak forests are usually very rich in species, some of them can be mentioned as faunistical rarities, e.g. the oak hawk moth *Marumba quercus*, the Geometrid species *Boarmia viertlii** and the Noctuid moth *Asteroscopus syriacus decipulae*.* (Species noted with * reach here the northern boundary of their geographical range.)

Conclusions

The result of this biogeographical diversity of the fauna is the richness in species in several groups of Invertebrates, especially land snails (*Gastropoda*), orthopterous insects (*Ensifera & Caelifera*), ground beetles (*Coleoptera: Carabidae*), caddisflies (*Trichoptera*), moths and butterflies (*Lepidoptera*). A large number of Invertebrate groups are, of course, hitherto very insufficiently studied. We are now not able to give an approximately

complete inventory of species and biogeographical components of the fauna. This paper can be only a first sketch on some basic features of the biogeographic position and recent faunal changes of this very remarkable region.

Conservation of this high level of biodiversity needs well-designed and differentiated measures. Endemic taxa should be preserved in their completely undisturbed habitats: in stricly protected caves and in the core areas of the biosphere reserve. High level of compositional diversity is characteristic for mosaic-like habitats, e.g. which consist of xerothermic forest and rocky grassland patches. High number of biogeographically important species often typifies, however, also the semi-natural, traditionally managed habitats which serve as dispersal tracks of different faunal components, e.g. species of meadows or steppe grasslands during short-term climatic changes. Hence, the maintenance of those habitats by their sustainable use effectively serves biodiversity conservation.

MALACOFAUNALISTICAL RESEARCHES IN THE AGGTELEK NATIONAL PARK

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Összefoglaló: Az Aggteleki Nemzeti Park területén 1994 óta végzek malakofaunisztikai vizsgálatokat. Kutatásaimat a Ménes-völgyben kezdtem, de később kiterjesztettem az ANP más jelentősebb területeire is. Eddigi munkám során több mint 65 fajt regisztráltam, amelyből 55 fajt a Ménes-völgy égereseiből gyűjtöttem. A fauna meglepő hasonlóságot mutat a Nagy-oldali-zsomboly posztglaciális faunájával, így a talált fauna kora-holocén reliktumnak tekinthető.

Systematic malacofaunistical investigation has not been carried out on the territory of Aggtelek National Park before. Expect for a few sporadic data, the malacofauna of the region is almost completely unknown.

The aim of my research work is to reveal and give a detailed characterization of the territories which are rich in Carpathian elements. I have carried out research works in the Ménes-valley and in its connected smaller valleys (Lizina-springs, Hidegvíz-kút, Patkós-valley) since 1994. I also analysed the material of those soil traps wich were placed at different points of the forests on the Haragistya platoue by Tibor Magura.

Together with the older data, I registered 78 land snail species on the territory of the National Park. Out of these species, 55 were discovered in the forests of different composition in the Ménes-valley. The odd thing about the fauna discovered here is that, the fauna expect for a few species, shows similarity with the fauna of the holocen formation of the Nagy-oldal shaft-cave wich is rich in original elements. Out of this original forest fauna, according to the data available, only just a few species could survive on other parts of the National Park. So on the basis of its land snail fauna this territory, with good reason, can be characterised as a holocen forest refugium.

To provide vidence for this we will have to examine the holocen material of the holes and caverns of Ménes-valley and other areas, and to carry out the malacofaunistical research of further biotopes.

On the basis of the list of species it is obvious that Ménes-valley contains an outstandingly rich fauna. More than 90% of the fauna elements can be found in the alder-wood stands so the protection of this wood-community is of a prior importance because of the snails and other communities.

Examining the formation of the Mollusc fauna the holocen relict elements and elements of Carpathian distribution can be considered to be the most interesting species. Species belonging to the first group are (*Acicula polita*, *Vertigo pusilla*, *Discus perspectivus*, *Daudebardia ssp.*, *Macrogastra ventricosa*, *etc.*). We mention only a few out of the Middle-European closed-forest and the Carpathian elements (*Oxychilus orientalis*, *Bielzia coerulans*, *Cochlodina orthostoma*, *Cochlodina cerata*, *Macrogastra latestriata*, *Perforatella vicina*, *Trichia unidentata*, *Chilostoma faustinum*).

Table 1. The snail fauna of the Aggtelek National Park

	Name of the species:	I.	II.	III.	IV.
1.	*Acicula polita* (Hartmann, 1840)	+	+	-	-
2.	*Carychium minimum* O. F. Müller, 1774	+	-	-	-
3.	*Carychium tridentatum* (Risso, 1826)	+	+	-	-
4.	*Succinea oblonga* Draparnaud, 1801	+	-	-	-
5.	*Oxyloma elegans* (Risso, 1826)				
6.	*Cochlicopa lubrica* (O. F. Müller, 1774)	+	-	+	-
7.	*Cochlicopa lubricella* (Porro, 1838)	+	-	+	-
8.	*Pyramidula rupestris* (Draparnaud, 1801)	-	+	-	-
9.	*Columella edentula* (Draparnaud, 1805)	+	+	-	-
10.	*Vertigo pusilla* O. F. Müller, 1774	+	+	-	-
11.	*Vertgo antivertigo* (Draparnaud, 1801)	+	-	-	-
12.	*Vertigo pygmaea* (Draparnaud, 1801)	+	-	-	-
13.	*Vertigo angustior* Jeffreys, 1830	+	-	-	-
14.	*Orcula dolium* (Draparnaud, 1801)	-	+	-	-
15.	*Sphyradium doliolum* (Bruguiére, 1792)	+	+	-	-
16.	*Granaria frumentum* (Draparnaud, 1801)	-	+	-	-
17.	*Chondrina clienta* (Westerlund, 1883)	+	+	-	-
18.	*Pupilla muscorum* (Linnaeus, 1758)	+	-	-	-
19.	*Vallonia costata* (O. F. Müller, 1774)	+	+	-	-
20.	*Vallonia pulchella* (O. F. Müller, 1774)	+	+	-	-
21.	*Vallonia enniensis* (Gredler, 1856)	+	-	-	-
22.	*Acanthinula aculeata* (O. F. Müller, 1774)	+	+	-	-
23.	*Ena obscura* (O. F. Müller, 1774)	+	+	+	+
24.	*Chondrula tridens* (O. F. Müller, 1774)	-	+	-	-
25.	*Punctum pygmaeum* (Draparnaud, 1801)	+	+	-	-
26.	*Discus perspectivus* (M. von Mühlfeld, 1816)	+	+	-	-
27.	*Vitrina pellucida* (O. F. Müller, 1774)	+	-	+	-
28.	*Vitrea diaphana* (Studer, 1820)	+	+	-	-
29.	*Vitrea subrimata* (Reinhardt, 1871)	-	+	-	-
30.	*Vitrea contracta* (Westerlund, 1871)	+	+	-	-
31.	*Aegopinella pura* (Alder, 1830)	+	+	+	-
32.	*Aegopinella minor* (Stabile, 1864)	+	+	+	-
33.	*Nesovitrea hammonis* (Ström, 1756)	+	-	+	-
34.	*Oxychilus draparnaudi* (Beck, 1837)	+	-	-	-

	Name of the species:	I.	II.	III.	IV.
35.	*Oxychilus orientalis* (Clessin, 1887)	-	-	-	+
36.	*Oxychilus glaber* (Rossmassler, 1835)	+	+	-	-
37.	*Daudebardia rufa* (Draparnaud, 1805)	+	+	-	-
38.	*Daudebardia brevipes* (Draparnaud, 1805)	+	+	-	-
39.	*Zonitoides nitidus* (O. F. Müller, 1774)	+	-	-	-
40.	*Limax maximus* Linnaeus, 1758	+	+	-	-
41.	*Bielzia coerulans* (M. Bielz, 1851)	+	-	-	-
42.	*Euconulus fulvus* (O. F. Müller, 1774)	+	+	+	-
43.	*Cochlodina laminata* (Montagu, 1803)	+	+	-	-
44.	*Cochlodina orthostoma* (Menke, 1830)	+	+	-	-
45.	*Cochlodina cerata* (Rossmassler, 1836)	+	+	+	+
46.	*Ruthenica filograna* (Rossmässler, 1836)	-	+	-	-
47.	*Macrogastra ventricosa* (Draparnaud, 1801)	+	+	-	-
48.	*Macrogastra plicatula* (Draparnaud, 1801)	-	+	+	-
49.	*Macrogastra latestriata* (A. Schmidt, 1857)	+	+	-	-
50.	*Clausilia dubia* Draparnaud, 1805	+	-	-	-
51.	*Clausilia pumila* C. Pfeiffer, 1828	-	+	+	-
52.	*Laciniaria plicata* (Draparnaud, 1801)	+	+	-	-
53.	*Balea biplicata* (Montagu, 1803)	+	+	-	+
54.	*Bulgarica cana* (Held, 1836)	-	+	-	-
55.	*Bradybaena fruticum* (O. F. Müller, 1774)	+	+	+	+
56.	*Perforatella incarnata* (O. F. Müller, 1774)	+	+	+	+
57.	*Perforatella vicina* (Rossmassler, 1842)	+	+	-	+
58.	*Perforatella rubiginosa* (A. Schmidt, 1853)	+	-	-	-
59.	*Trichia unidentata* (Draparnaud, 1805)	+	+	-	-
60.	*Euomphalia strigella* (Draparnaud, 1801)	+	+	+	+
61.	*Helicodonta obvoluta* (O. F. Müller, 1774)	+	+	+	+
62.	*Chilostoma faustinum* (Rossmassler, 1835)	+	+	-	+
63.	*Isognomostoma isognomostoma* (Schröter, 1784)	+	+	-	-
64.	*Cepaea vindobonensis* (Férussac, 1821)	+	+	-	-
65.	*Helix pomatia* Linnaeus, 1758	+	+	-	+

I. Ménes-valley
II. The holocen fauna of the Nagyoldal shaft-cave
III. Haragistya plateau
IV. Lófej-valley

Data available from related studies (PINTÉR *et al.*1979):
Succinea putris (Linnaeus 1758), *Truncatellina cylindrica*(Férussac 1807), *Truncatellina claustralis* (Gredler 1856), *Vitrea crystallina*(O. F. Müller 1774), *Oxychilus inopinatus* (Ulicny 1887), *Cecilioides acicula* (O. F. Müller 1774), *Clausilia cruciata* Studer 1820, *Bulgarica vetusta* (Rossmässler 1836),

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STUDIES ON THE ORTHOPTERA FAUNA OF THE AGGTELEK KARST

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Összefoglaló: Az egyenesszárnyú fauna kutatása a faunisztikai feltárással a Bioszféra Rezervátum, illetve a Nemzeti Park kialakításához szolgáltatott adatokat, majd a különböző gyeptársulásokhoz kötődő egyenesszárnyú együttesek összehasonlító elemzésével a védett területek kezelésének tudományos megalapozása volt a cél. Kutatásaink során az egyenesszárnyúak két rendjének 71 faját mutattuk ki. Az elterjedési és az életforma típusok elemzése meglehetősen diverz, sajátos összetételű faunát mutat, melyben jellemző módon keverednek a tágabban értelmezett szibíriai és mediterrán elemek mintegy átmeneti zónát képezve, ugyanakkor bizonyos kárpáti hatások (*Isophya modestior stysi*, *Pholidoptera transsylvanica*) is érvényesülnek. Eredményeink alátámasztják a terület védelmének szükségességét és megszabják a természetvédelmi kezelési módokat is, hiszen a természetes vagy féltermészetes gyepek zavarása, illetve az antropogén eredtű gyepek művelésének felhagyása egyaránt az ott élő egyenesszárnyú együttesek elszegényedését, az érzékeny fajok eltűnését eredményezi.

Introduction

(Research history, purposes)

Research of the Orthoptera fauna of this region, which is a very promising one in a faunistic and biogeographic point of view because of its geographic situation as well as surface and climatic conditions, began from the late 50's, and became to be regular from the middle of the 70's (Table 1).

Zoltán Varga	1958-
István Rácz	1975-
Dénes Parragh	1981-1985.
Hedvig Mező	1987-1993.
Kirill Márk Orci	1994-

Table 1. Participants and research periods of the Orthoptera fauna in the Aggtelek Karst

In the beginning the only purpose was to explore this group, which is so important in the grassland associations, as entirely as possible. In the knowledge of the results and having floristic and coenological data, and

data of other investigated insect group of high importance (*Lepidoptera: Diurna and Noctuidae; Coleoptera: Carabidae*), beyond the above mentioned studies, we could undertake a role in declaring the territory to be a Nature Protection Area, and, later, in the formation of the National Park.

Quantitative collections supplemented microclimatic measures (Parragh 1987, Mező 1990, 1991) aimed at complex quantitative (faunistic, biogeographic, life-form types) studies to identify Orthoptera associations of some characteristic grass associations, and to trace their changes. Importance of these studies is that Orthoptera assemblages belonging to grass associations of near-natural, abandoned and different antropogenic areas could be simultaneously studied in a relatively small area.

Simultaneously, by population-dynamic study (capture-recapture) of some species (Mező 1992), we would like to answer the following questions:

(1) how populations of these species are closed or opened, i.e., how sensitive they are for changes of the relevant environmental factors,

(2) if there is territorial behavior of males of the studied species or not.

During the recent period of our research spreading pattern of Orthoptera species (Orci 1996) as well as life-form spectrum of Orthoptera associations of the different grass associations (Rácz and Varga 1996) were analyzed.

As a result, we would like to get data that are proper to found decisions about nature protection management of grass associations of different history and condition.

Results and discussion

In our research 71 species of two Orthoptera orders (*Ensifera*: 35, *Caelifera* 36) were identified. Their names, taxonomy, area structures, types of faunisctic elements and life-forms are shown in Table 2. The favored species are written in *italics*. It can be stated, therefore, that richness in Orthoptera species in the semi-arid grassland of collin-submountainous zone of the Aggtelek Karst is quite high: 62,3 % of the Orthoptera fauna of Hungary. Of course, this fact is a result of the common effect of several factors.

Table 2. Faunal elements and life forms type of *Orthoptera* in the Aggtelek Karst (N Hungary).

Taxon	Geographical range	Faunal type	Life forms
ENSIFERA			
Tettigonioidea			
Phaneroptera falcata (Poda) 1761	Eu-Si	Si-Pc	Th
Phaneroptera nana nana Fieber 1853	S-Eu	Holo-Med	Th

Taxon	Geographical range	Faunal type	Life forms
Isophya pyrenea (Serville) 1893	C-S-E-Eu	Ba(II)	Ch
Isophya modestior stysi Cejchan 1957	N-E-Car	Da	Ch
Barbitistes constrictus Brunner v. W. 1878	C-E-Eu	Ba(Moe)	Th
Leptophyes albovittata (Kollar) 1833	Eu	Po-Med	Th
Leptophyes punctatissima Bosc. 1872	Eu	Po-Ca	Th
Poecilimon fussi Brunner v. W. 1878	S-E-Eu	Po-Pan	Th
Meconema thalassinum DeGeer 1773	Eu	Extra-Med	Th
Conocephalus discolor Thunberg 1815	Eu-Si	Si-Pc	Th
Conocephalus dorsalis (Latreille) 1804	Eu-W-As	Po-Ca	Th
Homorocoryphus nitidulus (Scopoli) 1786	Af-Eu-Si	Af	Th
Tettigonia viridissima Linneus 1758	Eu-Si	Si-Pc	Th
Tettigonia caudata (Charpentier) 1845	C-E-Eu	Po-Ca	Ch-Th
Tettigonia cantans (Fuessly) 1775	Eu-Si	Si	Th
Decticus verrucivorus Linneus 1785	Eu-Si	An	Ch-Th
Paltycleis grisea (Fabricius) 1781	SE-Eu	Po-Ca	Ch
Platycleis affinis Fieber 1853	SE-Eu	Po-Ca	Ch
Metrioptera brachyptera (Linneus) 1761	Eu-Si	Si-Pc	Ch
Bicolorana bicolor (Philippi) 1830	Eu-Si	An	Ch
Roeseliana roeselii (Hagenbach) 1822	Eu	Po-Ca	Ch
Pholidoptera transsylvanica (Fischer) 1853	N-E-Car	Da	Th
Pholidoptera fallax (Fischer) 1853	S-Eu	Po-Med	Th
Pholidoptera griseoptera (DeGeer) 1773	Eu	Po-Ca	Th
Pachytrachys gracilis (Brunner v. W.) 1861	SE-Eu	Po-Med	Th
Rhacocleis germanica Herrich-Schaeffer 1840	S-Eu	Po-Med	Th
Gampsocleis glabra (Herbst) 1786	Eu-Am	Po-Ca	Th
Saga pedo (Pallas) 1771	Eu-Si-Am	Po-Ca	Ch-Th
Ephippiger ephippiger ephippiger (Fieber) 1784	C-E-Eu	Po-Med	Th
Grylloidea			
Gryllus campestris Linneus 1758	Af-Eu-W-As	Af	Fi
Melanogryllus desertus (Pallas) 1771	Eu-Si	Po-Med	Fi
Modicogryllus frontalis (Fieber) 1844	E-C-Eu-W-As	Po-Med	Fi
Tartarogryllus burdigalensis (Latreille) 1804	S-SE-Eu	Med	Fi
Oecanthus pellucens (Scopoli) 1763	S-Eu	Po-Med	Th
CAELIFERA			
Acridoidea			
Pseudopodisma fieberi (Scudd) 1898	C-Eu	Po-Med-M	Ch
Calliptamus italicus (Linneus) 1758	Eu-Si	An	Geo-Ch
Paracaloptenus caloptenoides (Brunner v.W.) 1861	C-SE-Eu	Ba(II)	Geo-Ch
Psophus stridulus (Linneus) 1758	Eu-Si	An	Geo-Ch
Oedaleus decorus (Germar) 1826	Eu-As	Pc	Geo
Oedipoda coerulescens (Linneus) 1758	Eu-As	Pc	Geo
Aiolopus thalassinus (Fabricius) 1781	Cos	Af	Geo-Ch
Mecosthetus grossus (Linneus) 1758	Eu-Si	Ma	Ch
Parapleurus alliaceus (Germar) 1817	Eu-Si	Ma	Ch
Chrysochraon dispar (Germar) 1834	Eu-Si	An	Ch
Euthystria brachyptera (Ocskay) 1826	Eu-Si	An	Ch
Stenobothrus eurasius Zubowski 1898	C-Eu,W-As	An	Ch-Geo

Taxon	Geographical range	Faunal type	Life forms
Stenobothrus crassipes (Charpentier) 1825	E-Eu	Po-Med	Ch-Geo
Stenobothrus lineatus (Panzer) 1796	Eu-Si	An	Ch
Stenobothrus nigromaculatus (Herrich-Schaeffer) 1840	Eu-Si	An	Ch
Stenobothrus stigmaticus (Rambour) 1838	S-SE-Eu	Po-Ca	Ch-Geo
Omocestus viridulus (Linne) 1758	Eu-Si	An	Ch
Omocestus ventralis (Zetterstedt) 1821	Eu-Si	An	Ch
Dirschius haemorrhoidalis (Charpentier) 1825	Eu-Si	An	Geo-Ch
Dirschius petraeus (Brisout) 1855	Eu-Si	An	Geo-Ch
Stauroderus scalaris (Fischer-Waldheim) 1846	Eu-Si	An	Ch
Glyptobothrus apricarius (Linneus) 1758	Eu-Si	An	Ch
Glyptobothrus biguttulus (Linneus) 1758	Eu	Po-Ca	Ch-Geo
Glyptobothrus brunneus (Thunberg) 1815	Eu-Si	An	Ch-Geo
Glyptobothrus mollis (Charpentier) 1825	Eu-Si	An	Ch
Chorthippus albomarginatus (DeGeer) 1773	Eu-Si	Si-Pc	Ch
Chorthippus dorsatus (Zetterstedt) 1821	Eu-Si	Si-Pc	Ch
Chorthippus parallelus Zetterstedt 1821	Eu-Si	An	Ch
Chorthippus montanus (Charpentier) 1825	Eu-Si	An	Ch
Euchorthippus declivus (Brisout) 1848	S-Eu	N-Med-Pc	Geo-Ch
Euchorthippus pulvinatus pulvinatus (Fischer-Waldheim) 1846	S-E-Eu, W-As	Po-Ca-Tur	Geo-Ch
Gomphocerus rufus (Linneus) 1758	Eu-Si	An	Ch
Arcyptera fusca (Pallas) 1773	Eu-Si	An	Geo-Ch
Tetrigoidea			
Tetrix subulata (Linneus) 1758	Ho	Eu-Pc	Ch
Tetratetrix bipunctata (Linneus) 1758	Pa	Si-Pc	Ch
Tetratetrix nutans Hagenbach 1822	Pa	Si-Pc	Ch

ABBREVIATIONS:

Af = African (Ethiopian)
Am = Asia minor
An = Angarian
As = Asian
Ba = Balcanic
C = Central
Ca = Caspian
Car = Carpathian
Ch = Chortobiont
Cos = Cosmpolitan
Da = Dacian
E = East
Eu = European
Geo = Geobiont
Il = Illyrian
Ir = Iranian
Ho = Holarctic
M = Mountain
Ma = Manchurian
Med = Mediterranean
Moe = Moesian
N = North
Pa = Palaearctic
Pan = Pannonian
Pc = Policentric
Po = Pontic
S = South
Si = Siberian
Th = Thamnobiont
Tu = Turanian
Tur = Turcesthanian
W = West

Partly by morphometric data (Bei-Bienko 1950, Pravdin 1978), and partly by our field experiences (Rácz and Varga 1996), seven life-forms types were separated. Their percentile distribution is characteristic (Fig. 1), similarly to that of faunisctic elements (Fig. 2).

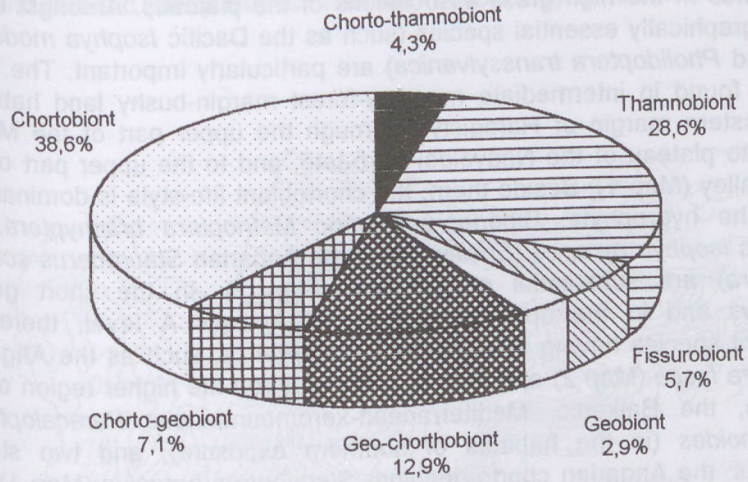


Fig. 1. Life forms of Orthoptera in the Aggtelek Karst (N Hungary)

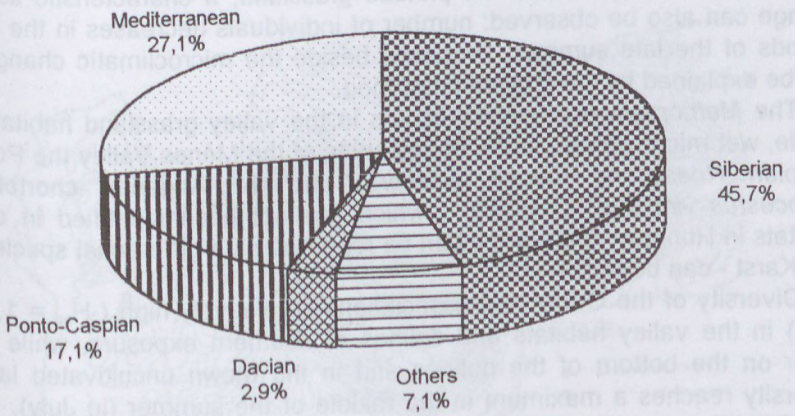


Fig. 2. Faunal types of Orthoptera in the Aggtelek Karst (N Hungary)

The thamnobiont Tettigonoideae are mainly present with higher dominance in the high grass associations of the plateaus. Amongst them, the biographically essential species (such as the Dacitic *Isophya modestior stysi* and *Pholidoptera transsylvanica*) are particularly important. The latter can be found in intermediate meadow-forest margin-bushy land habitats, from eastern margin of Haragistya, through the upper part of the Ménes Valley, to plateau of the Nagyoldal-Verő-tető, and to the upper part of the Lófej Valley (Map 1). Beside them, the chortobiont life-style is dominant, in which the hygrophyte, Siberian-policentric *Metrioptera brachyptera*, the Balkanic *Isophya pyrenea* (*Ensifera*) and the Angarian *Stauroderus scalaris* (*Caelifera*) are substantial components (Map 2). In the short grassy meadows and in the open grasslands with clastic A level, there are dominant species having biogeographic importance, such as the Angarian *Arcyptera fusca* (Map 2) and *Psophos stridulus* (on the higher region of the plateau), the Balkanic, Mediterranean-xeromountainous *Paracaloptenus caloptenoides* (in the habitats of southern exposure), and two steppe elements: the Angarian chorto-geobiont *Stenobotrus eurasius* (Map 1) and the Ponto-Caspian-Turkestanian chorto-geobiont *Euchortippus pulvinatus* (in the limestone rocky grasslands of the Nagyoldal). At the same time, however, the plateau grasslands are diverse regarding the dominance conditions of the Orthoptera associations because the above mentioned species are also proper differential species for the grassland types.

The generally occurring chorto- and chortogeobiont species are characteristic for the habitats of the valley, e.g. species of *Chorthippus* and *Glyptobotrus* orders, *Euthystira brachyptera* and *Stenobothrus crassipes* (*Caelifera*). Contrasted with the plateau grassland, a characteristic aspect change can also be observed: number of individuals decreases in the drier periods of the late summer. Probably, beside the microclimatic change, it can be explained by the diminution of food.

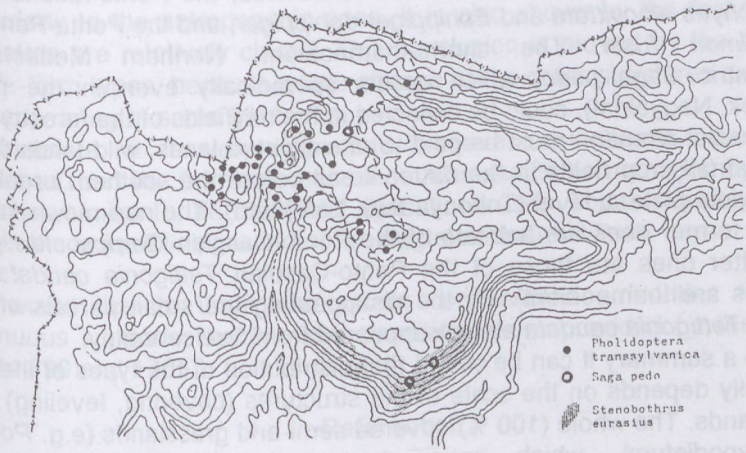
The *Metrioptera brachyptera* occurs in the valley grassland habitats of stable, wet microclimate, in the boggy spots of the Ménes Valley the Ponto-Caspian *Roeseliana roeseli* (*Ensifera*) and the Angarian chortobiont *Omocestus viridulus* (*Caelifera*) - which has not been identified in other habitats in Hungary, therefore it can be regarded as a differential species of this Karst - can be observed.

Diversity of the Orthoptera associations is relatively high ($-H_{sp}$ = 1,74 - 2,24) in the valley habitats and dolines of southern exposure, while it is lower on the bottom of the dolines and in the mown uncultivated lands. Diversity reaches a maximum in the middle of the summer (in July), and, parallel with advance of the vegetation period, it becomes lower and lower.

Habitats in the Szőlőhegy near Jósvafő village are significantly different: these are either cultivated or abandoned grasslands, and, as a result of the

edaphic (Campilian limestone with similar weathering to dolomite, fossil red clay) and climatic (steep slopes of southern exposure) conditions, ratio of

Map 1.



Map 2.



Mediterranean (*Caelifera: Stenobothrus crassipes*, *Stenobothrus stigmaticus*) and geo-chortobiont (*Caelifera: Calliptamus italicus*, *Psophus stridulus*, *Omocestus haemorrhoidalis*) species is high. There are relatively many thamnobiont, Mediterranean *Ensifera* in the bushy margins and in the areas of high dry stalks (*Peucedanum cervaria*). The more important species are the Moesian *Barbitistes constrictus*, the Ponto-Mediterranean *Leptophyes albovittata* and *Ephippiger ephippiger*, and the Ponto-Pannonian *Poecilimon fussi*. The chorto-thamnobiont, Northern Mediterranean policentric *Saga pedo*, which occurs sporadically even in the plateau (Luzsok, Nagyoldal), could be collected in the hayfields of the forestry.

Special attention must be paid to uncultivated lands, wild lands and the lot of small crop fields in the flatter areas before the southern breaking of the middle plateau level (Tohonya-tető, Lófej-tető). The non-mown varieties of the former ones are habitats of the Ponto-Caspian *Gampsocleis glabra*, the latter ones are those of the Ponto-Caspian *Tettigonia caudata* (both species are thamnobiont). By the disappearing the small parcels of crops lands, *Tettigonia caudata* also disappeared from Szelce Valley.

As a summary it can be stated that distribution of the types of life styles basically depends on the scale of the structures (covering, leveling) of the grasslands. The whole (100 %) covered semi-arid grasslands (e.g. *Polygalo-Brachypodietum*), which have short and tall grass species and dicotyledonous soft stemmed plants, and, in this way, have high leveling, are characterized by chorto-geo-, chorto-, chorto-thamno- and thamnobiont *Orthoptera* species with the dominance of the chortobiont ones. Grasslands having also open soil and/or rock surface (e.g. *Carici-Brachypodietum*), however, geo-chortobiont species appear, and they become to be dominant in the different types of *Hypochoerio-Brachypodietum*.

The analysis of the distribution types shows a fauna of special composition in which the Siberian and the Mediterranean elements (in a wider sense) characteristically mix forming an intermediate zone, and, at the same time, some Carpathian effects can be also observed. The Siberian, cold steppe elements (which, extend to the colder valleys with decreasing number of species) are dominant in the grasslands of the plateau, beside them the Eastern Carpathian, Dacitic species are important coloring elements. The northern sides of dolines, the falls facing south and slopes of southern exposure are the accumulation areas of species of southern character. Number of the southern elements decreases towards the sides of dolines in the Szőlőhegy-Nagyoldal plateau.

In the cases of the studied *Pholidoptera transsylvanica*, *Decticus verrucivorus* (*Ensifera*), *Paracaloptemus caloptenoides*, *Psophus stridulus*, *Stauroderus scalaris* and *Arciptera fusca* (*Caelifera*) species, the analysis shows that populations of these species more or less closed.

On the basis of the above mentioned facts it can be stated that the studied area - beside its other values - can be regarded as a particular one because of number and composition of the *Orthoptera* species. It represents essential biogeographical values by their coloring elements that either are endemic ones or reach their distribution limits. In both cases, there are isolated populations which have sensitivity to the environment effects, particularly to the antropogenic ones. It is also shown by the fact that the population are relatively closed. This conclusion is proved by the study of the life-form types, because a little change of the grass structures can result in disappearing of some life forms.

Therefore, it is very important to have semi-natural associations untouched, and the formerly cultivated areas should be managed by nature protection similar to the traditional agricultural uses. This is the only way to sustain the unique living world of the Aggtelek National Park.

(We would like to thank the nature conservation authorities for their continuous support. The financial conditions were provided by the OTKA Grants 896 and 1705.)

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A COMPARATIVE STUDY ON GRASSHOPPER (ORTHOPTERA) COMMUNITIES IN THE AGGTELEK BIOSPHERE RESERVE

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Összefoglaló: A Szilicei fennsík és a jósvafői Szőlőhegy jellegzetes élőhelyeiről (36 mintavétel hely) tálcsapdás és fűhálós módszerrel 49 egyenesszárnyú faj 17143 példányát gyűjtöttük be. A felvételek ordinációjával és klasszifikációjával kimutattuk, hogy két, jól jellemezhető csoportra különülnek el. A szőlőhegyi együttesek egy elég homogén, nagy hőigényű és cserjelakó fajokkal jellemzhető csoportot alkotnak, szemben a jóval heterogénebb fennsíki együttes csoporttal, amelyre általában a nagyobb nedvességigényű, hűvösebb mikroklímát igénylő fajok jellemzőek. Átmeneti helyzetűek a Lófej-völgy egyenesszárnyú együttesei. A két jól elkülönült csoportot nemcsak egyeneszárnyú együtteseik kvantitatív összetételének különbözősége, hanem eltérő fajspektruma is jellemzi.

12052 grasshoppers were collected using a sweep-net and special 25cm-diameter-pitfall-traps at 25 sampling sites in 9 locations (Fig. 1) within the ABR in August 1994 and 1995. The two sampling methods were carried out in a parallel way.



Fig. 1. Sampling locations (I.-IX.) in the surroundings of Jósvafő

Brief description of the sampling sites

(The numbers -written after the names of the sites- refer to the samples taken by:sweep-net / pitfall trap.These numbers are used in Figures 2-7.)

The sampling sites on the Szőlő Hill 1-7/1-12

I. South-facing slope of Szőlő Hill: 1-5/1-9
   a) higher part of the slope - *Cirsio-Brachypodion* 1/1,2
   b) middle part of the slope - *Pulsatillo-Festucetum rupicolae stipetosum* 2,3/3,4,5
   c) lower part of the slope- *Cirsio-Brachypodion* 4,5/6,7,8,9

II. Forest clearing - *Poligalo majori-Brachypodium pinnati danthonietosom* 6,7/10,11,12

Lófej Valley:

III. East-facing slope - *Polygalo m.-Brachypodietum p.* 8,9/13,14,15,16

The sampling sites belonging to the higher plateau 10-24/17-25

IV. gently sloping, south-facing grassland lying south-west of Mihály-láza - *Pulsatillo-Festucetum rupicolae stipetosum* 10,11/17,18

V. Double-bottomed dolina lying south of Mihály-láza:
   a) eastern edge - *Carico montanae-Brachypodietum* 12/19,20
   b) west-facing slope - *Polygalo-Brachypodietum* 13/21,22
   c) southern edge - *Polygalo-Brachypodietum* 14/23
   d) east-faceing slope covered by shortgrass connected to a *Coryletum* 15/24
   e) north-west-facing slope covered by tallgrass (mainly *Calamagrostis epigeios*) - /25

VI. "Border angle" dolina:
   a) southern edge - *Carico montanae-Brachypodietum* 17/ -
   b) north-facing slope - *Poligalo-Brachypodietum* 16/ -

VII. "Mogyorós-bérc" dolina:
   a) bottom - tallgrass with *Betonica officinalis* and *Cirsium pannonicum* 18/ -
   b) slope - *Polygalo-Brachypodietum* with *Betonica off.* and *Cirsium p.* 20/ -
   c) edge - typical *Polygalo-Brachypodietum* 19/ -

VIII. Dolina lying west of Ocsisnya Mountain:
   a) a shallow depression covered by tallgrass (mainly *Betonica* and *Cirsium*) 23/ -
   b) edge - *Carico montanae-Brachypodietum pinnati* 22/ -
   c) slope - *Polygalo-Brachypodietum* 21/ -

IX. Pászor Valley: gently sloping grassland - *Polygalo-Brachypodietum* 24/ -

Principal co-ordinate analysis (PCoA) was used to find out if the communities can be classified (Fig. 2-3). We have found that the communities form two definitely separate groups(1-7 | 8-24 in Fig. 2. and 1-12 | 13-25 in Fig. 3.) and one uncertain, transitional group (the sampling sites of Lófej Valley). This latter can be recognised only by the results of cluster analysis, if the resemblance matrix was counted by a binary distance function (Jaccard): in this case the sweep-net samples from Lófej Valley are in the "Szőlő Mountain group" while the pitfall-trap samples collected from the same location are in the "Szilice Plateau group" (Fig. 4-5). Counting with a quantitative resemblance function (Matusita) the results (Fig. 6-7) are similar to the outcome of PCoA .

The following results have been counted and drawn by NuCoSa 1.04 (Tóthmérész B. 1993: Number Chruncher for Community studies and other Ecological Applications, Abstracta Botanica 7:283-287.)

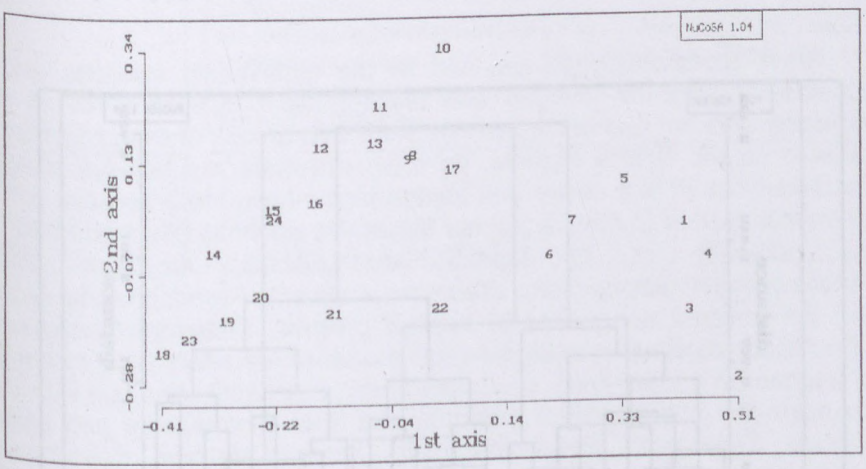


Fig. 2. PCoA based on sweep-net samples
(resemblance function: Matusita; information-loss: 30.64%)

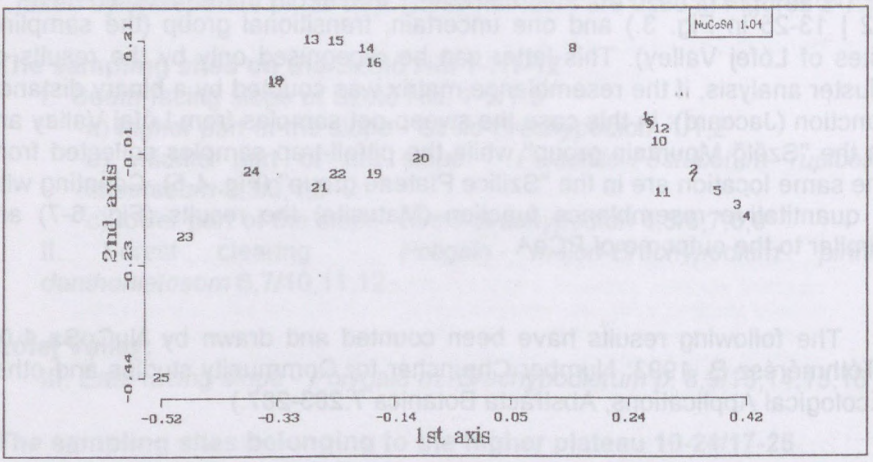


Fig. 3. PCoA based on pitfall-trap samples
(resemblance function: Matusita; information-loss: 30.01%)

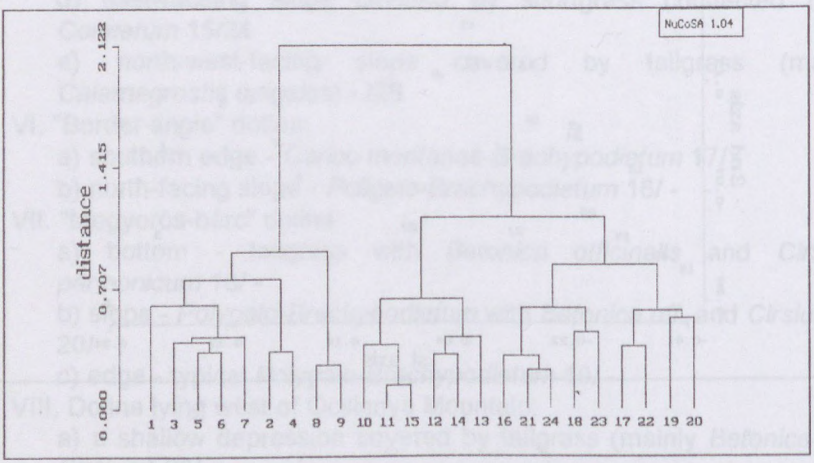


Fig. 4. Cluster analysis based on sweep-net samples
(comparative function: Jaccard, fusion method: MISSQ)

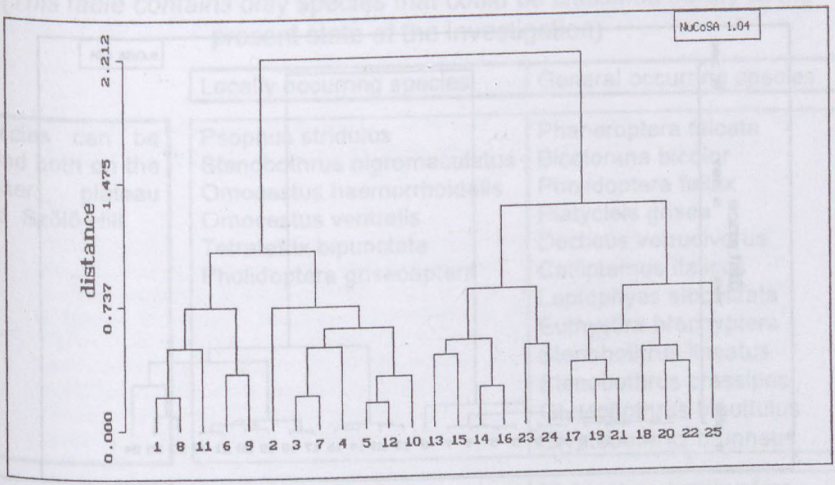


Fig. 5. Cluster analysis based on pitfall-trap samples
(comparative function: Jaccard, fusion method: MISSQ)

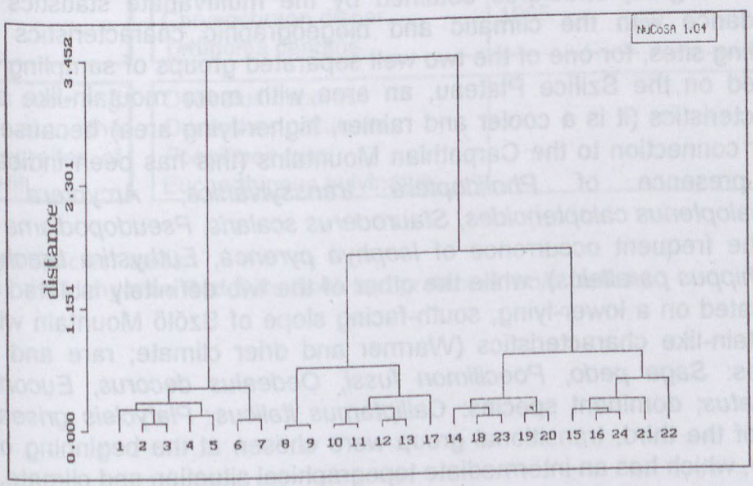


Fig. 6. Cluster analysis based on sweep-net samples
(resemblance function: Matusita; fusion method: MISSQ)

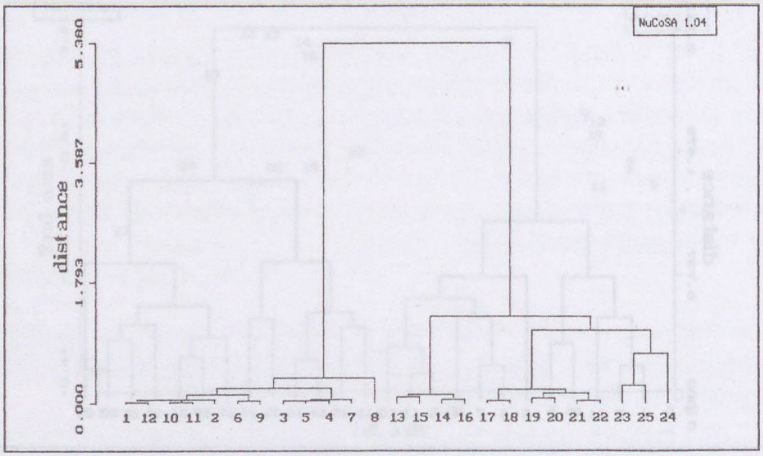


Fig. 7. Cluster analysis based on pitfall-trap samples
(resemblance function: Matusita; fusion method: MISSQ)

These group-structures obtained by the multivariate statistics are in accordance with the climatic and biogeographic characteristics of the sampling sites, for one of the two well separated groups of sampling sites is situated on the Szilíce Plateau, an area with more moutain-like climatic characteristics (it is a cooler and rainier, higher-lying area) because of the closer connection to the Carpathian Mountains (this has been indicated by the presence of *Pholidoptera transsylvanica, Arcyptera fusca, Paracaloptenus caloptenoides, Stauroderus scalaris, Pseudopodisma fieberii* and the frequent occurrence of *Isophya pyrenea, Euthystira brachyptera, Chorthippus parallelus*), while the other of the two definitely isolated groups is situated on a lower-lying, south-facing slope of Szőlő Mountain with less mountain-like characteristics (Warmer and drier climate; rare and typical species: *Saga pedo, Poecilimon fussi, Oedealus decorus, Eucorthippus pulvinatus*; dominant species: *Calliptamus italicus, Platycleis grisea*); The sites of the third, transitional group were chosen at the beginning of Lófej Valley, which has an intermediate topographical situation and climate.

The two well separated groups of communities have not only different quantitative composition, but different species-spectra as well (Table 1).

Table 1. An arrangement of the species found based on their occurrence (This table contains only species that could be classified surely at the present state of the investigation)

	Locally occurring species	General occurring species
Species can be found both on the higher plateau and Szőlő Hill	Psophus stridulus Stenobothrus nigromaculatus Omocestus haemorrhoidalis Omocestus ventralis Tetratetrix bipunctata Pholidoptera griseoaptera	Phaneroptera falcata Bicolorana bicolor Pholidoptera fallax Platycleis grisea Decticus verrucivorus Calliptamus italicus Leptophyes albovittata Euthystira brachyptera Stenobothrus lineatus Stenobothrus crassipes Glyptobothrus biguttulus Glyptobothrus brunneus
Species occuring only on Szilice Plateau	*Arcyptera fusca* Stauroderus scalaris Pseudopodisma fieber ***Paracaloptenus caloptenoides*** ***Pholidoptera transsylvanica*** Roeseliana roeselii Chrysochraon dispar Tettigonia cantans	Metrioptera brachyptera Isophya pyrenea* *This species was also found on the Szőlő Hill in 1995.
Species occurring only at the sampling sites of Szőlő Hill	Oedealus decorus Oecanthus pellucens *Poecilimon fussi* Euchorthippus pulvinatus	

(Marks:
Protected species: *italics*,
Listed by the Hungarian Red Data Book and protected: ***bold italics.)***

COMPARISON OF THE CARABID FAUNA OF THE MÉNES-VALLEY AND A HIGHER KARST PLATEAU (*COLEOPTERA: CARABIDAE*)

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Összefoglaló: A Ménes-völgy és a magasabb karsztfennsík futóbogár faunáját vizsgáltuk az Aggteleki Nemzeti Park területén talajcsapdás mintavétellel. Cluster-analízis segítségével megállapítható, hogy a völgy futóbogár faunája markánsan elkülönül a vizsgált magasabb karsztfennsík faunájától. A hideg, hűvös mikroklímájú völgyben számos higrofil (pl. *Pterosticus anthracinus* (Illiger 1798), *Pterostichus nigrita* (Fabricius 1792), montán (*Cychrus caraboides* (Linnaeus 1758), *Licinus hoffmannseggi* (Panzer 1797), *Cymindis cingulata* Dejean 1825 és kárpáti elterjedésű (*Carabus obsoletus* Sturm 1815, *Trichotichnus laevicollis carpathicus* Schauberger 1936, *Abax schueppeli* Palliardi 1825) futóbogár faj fordul elő, melyek a magasabb karsztfennsíkon nem találják meg optimális életfeltételeiket. A Ménes-völgyből előkerült a *Cymindis cingulata* Dejean 1825, mely hazánk futóbogár faunájára nézve új faj.

Carabid fauna of the valley of the Ménes-brook and a higher plateau was studied in the N-Hungarian Mountains in the Aggtelek National Park using pitfall traps. Carabid communities of the stream valley and the higher karst plateau can be definitely separated by cluster analysis. It can be explained with the fact that several hygrophilous (e.g. *Pterosticus anthracinus* (Illiger, 1798), *Pterostichus nigrita* (Fabricius, 1792)), montane (*Cychrus caraboides* (Linnaeus, 1758), *Licinus hoffmannseggi* (Panzer, 1797), *Cymindis cingulata* Dejean, 1825) and Carpathian (*Carabus obsoletus* Sturm, 1815, *Trichotichnus laevicollis carpathicus* Schauberger, 1936, *Abax schueppeli* Palliardi, 1825) carabid species can be found in the stream valley, because of its cool, humid microclimate. On the studied higher plateau no optimal conditions can be found for these carabids. This fact proves the unique biogeographical feature of the stream valley. We proved the occurrence of *Cymindis cingulata* Dejean, 1825 in the Ménes-valley, which is a new species in the Hungarian fauna.

Introduction

Changes in the vegetation, in the structural conditions of the soil and in the microclimate are most probably reflected in the ground-dwelling insect fauna. Useful indicators of changes may be the carabid beetles (Coleoptera: Carabidae) since the species show different degrees of habitat selection, ranging from habitat specialists (confined to only one habitat) to habitat generalists (occurring in many habitats). Carabid beetles are highly diversified, they are sensitive to abiotic and biotic factors, and their ecology

and systematics are relatively well known. All these facts make carabids and their communities potentially good biological indicators of environmental changes (Thiele 1977).

Our study was aimed at the research of the carabid fauna of a mountain stream valley and higher karst plateau of the N-Hungarian Karst.

Material and Methods

Research area was located in the N-Hungarian Karst at the Aggtelek National Park. The carabid fauna of five areas was studied. Four of these (1-4) were on the higher karst plateau and one in the stream valley:

1. Hosszú-valley: an arid valley with *Querco-Carpinetum* forest, extrazonal *Melitti-Fagetum silvaticae* forest and *Tilio-Fraxinetum* association. The sampling was in 1986.
2. Káposztás-mountain (Haragistya): three dolinas with extrazonal submontane beech forest (*Melitti-Fagetum silvaticae)* and *Polygalo majori-Brachypodietum pinnati* association were studied in 1991 and 1992. More details see Magura (1995).
3. Alsó-mountain: extrazonal submontane beech forest, *Ceraso-Quercetum pubescentis* forest and plantations (forest and black pine plantation) were analysed in 1993.
4. Mogyorós-mountain (Haragistya): oak-hornbeam forest (*Querco-Carpinetum*) and plantations (spruce and black pine plantation) were studied in 1994 and 1995.
5. Ménes-valley: because of the Ménes-stream the valley has a particular microclimate, which is cooler and more humid, than the surrounding areas. *Alnetum glutinosae-incanae* forest, oak-hornbeam forest and spruce plantation were the sampling areas in 1986, 1995 and 1996.

During the sampling procedure pitfall traps were used. The traps contained ethylene-glycol as a killing-preserving solution. Trapped individuals were collected monthly from April to October (Niemelä et al. 1990). All carabid beetles taken in pitfall traps were identified to species using standard keys (Csiki 1905-08, Freude et al. 1976). Nomenclature follows Szél (1996).

Similarity of the carabid communities sampled in certain habitats in different years was calculated by Matusita dissimilarity. The similarity structure was displayed by cluster analysis (Gordon 1981). We have used the NuCoSA package (Tóthmérész 1993).

Results

21462 individuals belonging to 48 species were found in the five different areas during the research (Table 1). The carabid communities of

Ménes-valley were very similar. It is also true for the carabid communities of the higher plateau. To the contrary the carabid communities of Ménes-valley and the studied plateau areas significantly differed from each other (Figure 1).

Table 1. List of species collected in the different areas. 1. Hosszú-valley in 1986, 2-3. Káposztás-peak in 1991 and 1992, 4. Alsó-mountain in 1993, 5-6. Mogyorós-peak in 1994 and 1995, 7-9. Ménes-valley in 1986, in 1995 and 1996.

Species	1.	2.	3.	4.	5.	6.	7.	8.	9.
Cicindela campestris	-	-	2	1	-	-	-	-	-
Calosoma inquisitor	62	-	18	8	-	-	1	-	-
Carabus arcensis	3	15	6	-	54	30	1	-	3
Carabus convexus	198	52	227	44	27	11	21	48	28
Carabus coriaceus	37	24	48	12	8	5	61	26	21
Carabus granulatus	-	-	1	-	-	-	-	-	1
Carabus hortensis	111	34	49	-	24	65	77	2	24
Carabus intricatus	12	1	13	1	3	7	8	5	3
Carabus montivagus	-	-	-	12	-	-	-	7	3
Carabus nemoralis	7	13	69	-	24	39	38	26	13
Carabus obsoletus	-	-	-	-	-	-	155	29	81
Carabus scabriusculus	-	-	-	5	-	-	-	-	-
Carabus scheidleri	-	-	-	5	-	-	-	-	-
Carabus ullrichi	-	-	-	8	-	-	-	-	-
Carabus violaceus	35	48	25	11	38	19	16	2	2
Cychrus caraboides	-	-	-	-	-	-	68	13	5
Leistus piceus	-	-	-	-	-	-	2	-	-
Notiophilus biguttatus	-	-	-	-	5	5	-	-	-
Pogonus luridipennis	-	-	-	-	-	1	-	-	-
Trichotichnus laevicollis	-	-	-	-	-	-	3	-	-
Harpalus latus	-	1	2	-	2	-	1	-	-
Harpalus rufipes	2	-	-	30	5	3	-	-	2
Stomis pumicatus	-	-	-	-	-	1	-	-	-
Poecilus cupreus	1	-	-	-	-	-	-	-	-
Pterostichus anthracinus	-	-	-	-	-	-	-	-	6
Pterostichus burmeisteri	136	617	1039	92	243	110	156	90	270
Pterostichus melanarius	-	-	-	-	14	22	1	-	-
Pterostichus melas	1	-	-	-	-	-	1	-	-
Pterostichus niger	-	9	-	41	-	-	18	16	28
Pterostichus nigrita	-	-	-	-	-	-	-	1	1
Pterostichus oblongopunctatus	437	416	1314	170	1731	730	90	168	166
Pterostichus strenuus	-	-	-	-	11	-	-	-	-
Molops piceus	17	205	220	21	74	224	35	20	76
Abax carinatus	10	16	13	-	30	11	-	12	19
Abax ovalis	94	842	760	3	86	98	48	18	52
Abax parallelepipedus	181	777	961	187	769	1150	656	121	332
Abax parallelus	29	7	26	14	29	68	28	29	96
Abax schueppeli	-	-	-	-	-	-	172	31	110

Species	1.	2.	3.	4.	5.	6.	7.	8.	9.
Platyderus rufus	-	-	-	-	7	5	-	-	-
Platynus assimilis	-	-	-	2	21	9	8	66	89
Amara aenea	-	-	-	1	5	-	-	-	-
Amara saphyrea	-	2	-	2	-	-	-	1	-
Licinus depressus	-	2	-	-	-	-	-	-	-
Licinus hoffmannseggi	-	-	-	-	-	-	1	2	1
Panagaeus cruxmajor	-	1	-	-	1	-	-	-	-
Cymindis cingulata	-	-	-	-	-	-	-	-	1
Brachinus crepitans	-	-	-	1	-	-	-	-	-
Aptinus bombarda	531	323	718	61	25	44	100	22	61

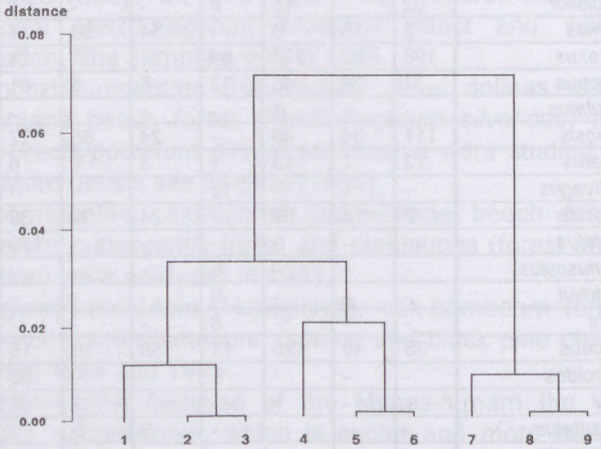


Figure 1. Similarity of the studied carabid communities by cluster analysis. Matusita similarity index and Ward fusion method was applied. 1. Hosszú-valley in 1986, 2-3. Káposztás-peak in 1991 and 1992, 4. Alsó-mountain in 1993, 5-6. Mogyorós-peak in 1994 and 1995, 7-9. Ménes-valley in 1986, in 1995 and 1996.

Discussion

We proved the occurrence of *Cymindis cingulata* Dejean, 1825 in the Ménes-valley, which is a new species in the Hungarian fauna. This species was caught in June 1996 in an *Alnetum glutinosae-incanae* forest near the Lizina-spring. The proving example can be found in the Hungarian Natural History Museum in Budapest. *Cymindis cingulata* Dejean, 1825 is a montane species and it is spread from the French Alps to the Carpathians and is very rare in Central Europe (Freude et al. 1976). But this species was also found in the Szatmár-Bereg plain in the Ukraine (Magura et al. 1997).

The collected carabid species (Table 1) also prove the peculiar biogeographical relations of the area (Varga 1995). The characteristic species of the canopied deciduous (and coniferous) forest of the hills and mountains (*Carabus hortensis* Linnaeus 1758, *Carabus intricatus* Linnaeus 1761, *Leistus piceus* Frölich 1799 *Pterostichus melas* (Creutzer 1799), *Molops piceus* (Panzer 1793), *Abax parallelus* (Duftschmid 1812), *Aptinus bombarda* (Illiger 1800)) are present and the Carpathian effect can be also observed. This contact with the Carpathians appears in the occurrence of several montane (e.g. *Carabus arcensis carpathus* Born 1902, *Carabus coriaceus pseudorugifer* Sokolar 1906, *Carabus montivagus* Palliardi 1825, *Carabus scheidleri pseudopreyssleri* Breuning 1932, *Carabus violaceus pseudoviolaceus* Kraatz 1866, *Pterostichus burmeisteri* Heer 1841, *Licinus hoffmannseggi* (Panzer 1797), *Cymindis cingulata* Dejean 1825) and Carpathian species (*Carabus obsoletus* Sturm 1815, *Trichotichnus laevicollis carpathicus* Schauberger 1936, *Abax schueppeli* Palliardi 1825). On the other hand because of the presence of *Ceraso-Quercetum pubescentis* forest and *Pulsatillo-Festucetum rupicolae* association steppe species (e.g. *Carabus scabriusculus scabriusculus* Olivier 1795) can also be found.

It is clear from the cluster analysis that the carabid communities of the Ménes-valley significantly differed from that of the studied higher karst plateau (Figure 1). It can be explained with the fact that Ménes-brook causes particular microclimatic conditions. This effect appears in permanently high air humidity and cool and humid conditions. Thus several hygrophilous (e.g. *Pterosticus anthracinus* (Illiger 1798), *Pterostichus nigrita* (Fabricius 1792)), montane (*Cychrus caraboides* (Linnaeus 1758), *Licinus hoffmannseggi* (Panzer 1797), *Cymindis cingulata* Dejean 1825) and Carpathian (*Carabus obsoletus* Sturm 1815, *Trichotichnus laevicollis carpathicus* Schauberger 1936, *Abax schueppeli* Palliardi 1825) carabid species can be found. These species can find the optimal essential conditions only under the peculiar microclimatic features of the stream valley. Carabid species mentioned above appear not even in the cooler dolinas with particular microclimatic conditions on the studied higher plateau.

Our research pointed out that because of the peculiar microclimate caused by the mountain stream unique carabid fauna can be observed, which significantly differs from that of the studied higher plateau. This stream valley may have a crucial role maintance and preservation of biodiversity therefore their conservation is essential.

Acknowledgements

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DIVERSITY AS AN INDICATOR IN ENVIRONMENTAL ASSESSMENT: A CASE STUDY FOR CARABIDS (*COLEOPTERA: CARABIDAE*)

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Abstract: We have compared the carabid communities of an extrazonal submontane beech forest and two pine plantations (black pine and Scotch fir) at the Aggtelek National Park using pitfall traps. The number of species, diversity statistics and diversity orderings were used. Diversity statistics and diversity profiles suggest that the carabid community of the Scotch fir forest is more diverse than the others. The ecological interpretation of the results is also discussed.

Methods

We have compared the carabid communities of an extrazonal submontane beech forest and two pine plantation (black pine and Scotch fir) at the Aggtelek National Park using pitfall traps.

The study area is located at the Alsóhegy in the Aggtelek National Park. The carabid communities of an extrazonal submontane beech forest, a Scotch fir and a black pine plantation were studied. There were 5 pitfall traps for each site. Samples were collected monthly from April to September. Classical diversity statistics and diversity profiles were used to compare the diversity of the studied communities.

The following diversity indices were used during the calculations:

Shannon diversity:

$$H = \sum_{i=1}^{s} p_i \log p_i$$

where p_i is the relative frequency of the i-th species and S is the number of species.

Brillouin diversity:

$$H = 1/N \ln (N!/n_1! n_2! \ldots N_s!)$$

where n_i is the number of individuals of the i-th species and $N = \sum_{i=1}^{s} n_i$

Simpson diversity:

$$D = 1 - [\sum_{i=1}^{s} n_i (n_i - 1) / N (N - 1)]$$

MacIntosh diversity:

$$M = (N - \sqrt{\sum n_i^2}) / (N - \sqrt{N})$$

The Rényi diversity index family is definied as follows ($a \geq 0$, $a \neq 1$):

$$H_\alpha = (\log \sum_{i=1}^{s} p_i^a) / (1-a)$$

where *a* is the scale parameter.

The logarithmic dominance ordering is defined by the following way:

$$Pi = [\log i, \sum_{j=i+1}^{s} p_{(j)}], \quad i = 1, 2, \ldots S$$

where $p_{(j)}$ means that the relative frequencies are arranged in a decreasing order.

Results and discussion

All the diversity statistics (the number of species, effective number of species, diversity indices etc.) suggest that the carabid community of the Scotch fir community is more diverse than the others (Table 1).

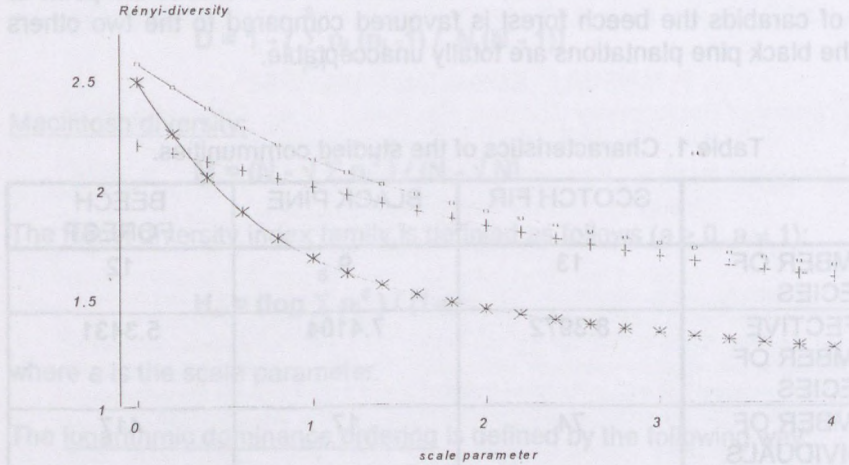
Diversity profiles suggest that the carabid community of the Scotch fir community is more diverse for the rare and frequent species than the others. The beech forest was less diverse for the whole range of scale parameter than the Scotch fir's carabid assemblage. It was also less diverse for the moderately frequent and dominant species than the black pine plantation's carabid community (Figure 1 and 2).

From a mechanical interpretation of the numerical results without a special regard of the studied ecological situation we could conclude that the pine plantations are favourable against the extrazonal beech forest. One of the most striking characters of the data set is, however, that the number of individuals in the beech forest was 417, while there were 17 individuals in the black pine plantation and 74 in the Scotch fir plantation (Table 1). It is very likely that the black pine plantation does not support a carabid community at all and the very few trapped individuals are just casual immigrants. The beech forest has a stable carabid community with large number of individuals which was just a slightly less diverse than the community of the Scotch fir plantation which also has a rather limited

number of individuals. Therefore, our conclusion is that from the point of view of carabids the beech forest is favoured compared to the two others and the black pine plantations are totally unacceptable.

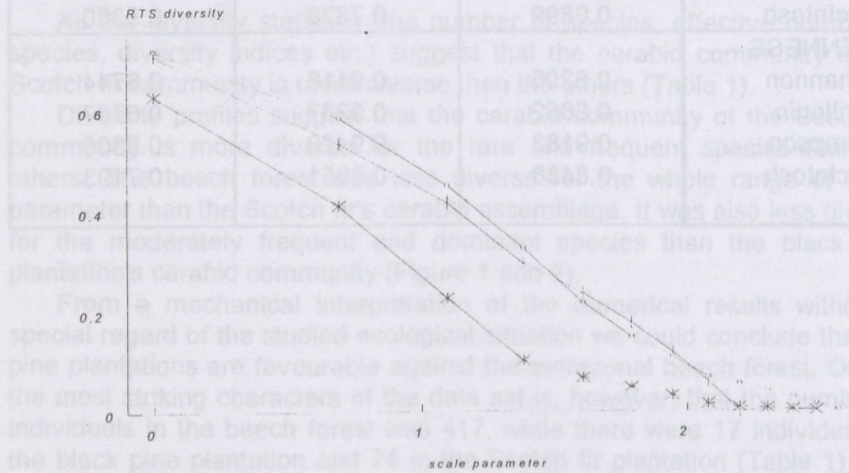
Table 1. Characteristics of the studied communities.

	SCOTCH FIR	BLACK PINE	BEECH FOREST
NUMBER OF SPECIES	13	9	12
EFFECTIVE NUMBER OF SPECIES	8.3972	7.4104	5.3431
NUMBER OF INDIVIDUALS	74	17	417
S/log(N)	3.020	3.177	1.989
S/log(A)	8.077	5.592	7.456
DIVERSITY			
Shannon	2.1279	2.0029	1.6758
Brillouin	1.8947	1.5023	1.6249
Simpson	0.8593	0.8897	0.7634
McIntosh	0.6899	0.7878	0.5380
EVENNESS			
Shannon	0.8296	0.9116	0.6744
Brillouin	0.8652	0.9367	0.6797
Simpson	0.9183	0.9420	0.8308
McIntosh	0.8438	0.8951	0.7193



| | - Forest pine plant. + - Black pine plant. * - Beech forest

Figure 1. Diversity profiles of the studied carabid communities by the Rényi diversity index family. The beech forest was less diverse for the whole range of scale parameter than the Scotch fir's carabid assemblage. It was also less diverse for the moderately frequent and dominant species than the black pine plantation's carabid community.



| | - Forest pine plant. + - Black pine plant. * - Beech forest

Figure 2. Diversity profiles by logarithmic dominance ordering. The carabid community of the Scotch fir and black pine produced quite similar diversity profiles.

EFFECT OF FOREST-EDGE TO MAINTAIN THE DIVERSITY OF A CARABID (*COLEOPTERA*) COMMUNITY

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Abstact: We have studied the carabid communities along a forest - forest edge transect in a *Querco-Carpinetum* forest using pitfall traps. We can discriminate the carabid communities of the different habitats by multivariate statistical methods, although they are not segregated strongly. We have found that the diversity of the carabid community is correlated with the diversity of the (herbaceous) vegetation. The diversity of the carabid community increased along the transect with the increment of the vegetation diversity. It was the highest in the forest edge. Therefore, the forest edge has a crucial role in the maintenance of the diversity of carabid communities. It may also serve as corridor for the migration of the individuals. They are important in preventing the isolation of the populations.

Methods

Carabid communities along a forest - forest edge transect in a ***Querco-Carpinetum*** forest were studied by using pitfall traps. The sample are was in the Aggtelek National Park on the Szilice Plateau. The research area is located in the Aggtelek National Park in the Northern part of the Hungarian Mountain Range. Its altitude is 450-550 above the sea level. It is covered by *Querco-Carpinetum* Forest.

We have established a transect from the forest towards the forest edge. The transect was 80 m long, and the pitfall traps were rooted on every 0.5 m along the transect. Trapped individuals were collected every month from April to October. The trapping period was 2 weeks and it was followed by a non-trapping period which also was 2 weeks.

In the first section of the transect (e.g. 30 m) the herbaceous vegetation was rather pure; in the second one (e.g. 20 m) it was moderate. The third section was approximately 14 m long and it was covered by rich herbaceous vegetation. The forest edge (e.g. 16 m) was especially shrubby with *Carpinus betulus*, *Prunus spinosa*, *Corylus avellana*.

Multivariate methods and diversity statistics were used during the analysis.

Results and Discussion

Dominance structures of the communities of the forest habitats are similar, while the margin's community is more species rich and the dominance-diversity curve of the community is less steep (Fig. 1). We can

discriminate the carabid communities of the different habitats by multivariate statistical methods, although they are not segregated strongly (Fig. 2). We have found that the diversity of the carabid community is correlated with the diversity of the (herbaceous) vegetation. The less diverse was the community in the first part of the transect where the vegetation was rather sparse. The diversity of the carabid community increased along the transect with the increment of the vegetation diversity. It was the highest in the forest edge (Table 1). The number of trapped individuals was much less in the forest edge than in the forest. It was relatively stable in the forest with slight increment towards the forest edge (Table 1). Although the diversity profiles of the forest habitats are quite similar, the diversity profiles of the forest edges' communities were above to the profiles of the forest's communities over the whole range of the scale parameter (Fig. 3). So communities of forest edges are more diverse than communities of forest habitats. There were a few species which were present only in the forest edge and in the forest along the margin (6 species out of 24; 25% of the caught species). Therefore, the forest edge has a crucial role in the maintenance of the diversity of carabid communities. It may also serve as corridor for the migration of the individuals. They are important in preventing the isolation of the populations.

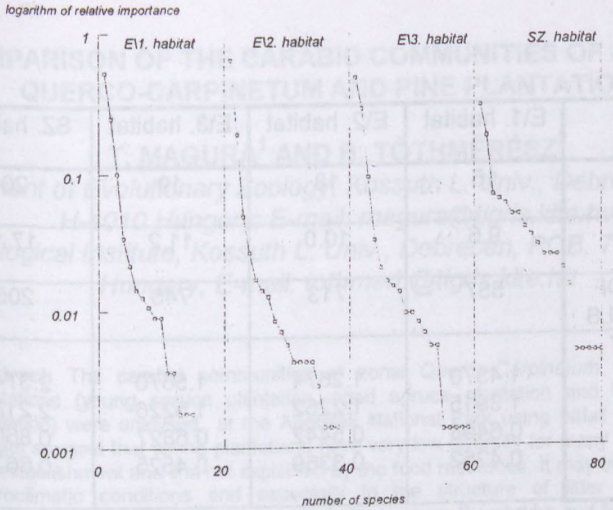


Fig. 1. Dominance-diversity curves of the studied carabid communities. E\1: Querco-Carpinetum without herbaceous level; E\2: Querco-Carpinetum with moderate herbs; E\3: Querco-Carpinetum with rich herbs; SZ: shrubby forest edge.

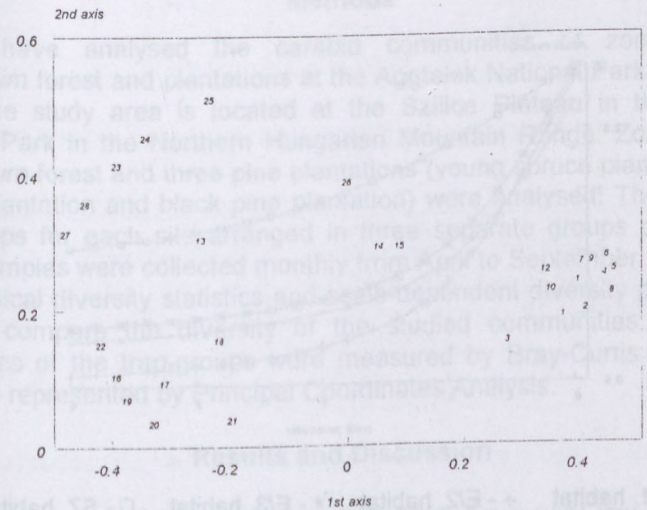
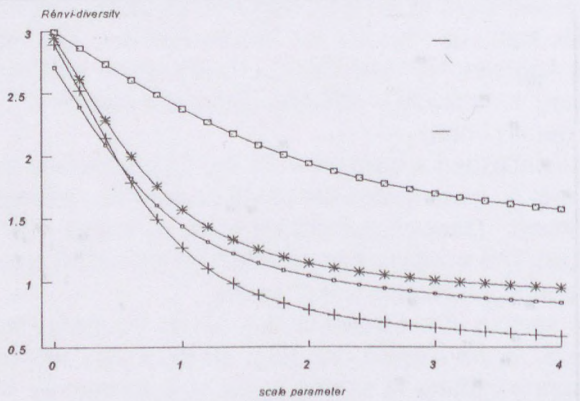


Fig. 2. Ordination diagram of the pitfall traps based on the number of individuals using the percentage similarity coefficient and principal coordinate analysis. 1: E\1 habitat in April, 2: E\1 in May, 3: E\1 in June, 4: E\1 in July, 5: E\1 in August, 6: E\1 in September, 7: E\1 in October, 8: E\2 habitat in April, etc.

	E\1. habitat	E\2. habitat	E\3. habitat	SZ. habitat
S (total)	15	18	19	20
S (100)	9.6	10.0	11.2	17.1
NUMBER OF INDIVIDUALS	557	713	746	205
DIVERSITY				
Shannon	1.4370	1.2674	1.5670	2.3741
Brillouin	1.3915	1.2252	1.5226	2.2182
Simpson	0.6498	0.5442	0.6827	0.8602
McIntosh	0.4252	0.3369	0.4525	0.6671

Table 1. Diversity of the carabid communities along the transect. S (total) is the total number of species of a community; S (100) is the number of species in a sample of 100 individuals.



□ - E/1. habitat + - E/2. habitat * - E/3. habitat □ - SZ. habitat

Fig. 3. Diversity profiles of the studied carabid communities. E\1: Querco-Carpinetum without herbaceous level; E\2: Querco-Carpinetum with moderate herbs; E\3: Querco-Carpinetum with rich herbs; SZ: shrubby forest edge.

COMPARISON OF THE CARABID COMMUNITIES OF A ZONAL QUERCO-CARPINETUM AND PINE PLANTATIONS

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Abstract: The carabid communities of zonal *Querco-Carpinetum* forest and plantations (young spruce plantation, aged spruce plantation and black pine plantation) were analysed at the Aggtelek National Park using pitfall traps. Our results suggest that young plantations have very low diversity for many years after the establishment and it is not explained by the food resources. It may be related to microclimatic conditions and especially to the structure of litter layer and herbaceous vegetation. In the aged plantations, where the shrubs and herbs of the native vegetation are present, the diversity and composition of the carabid communities are similar to the communities of zonal forests. So the adequate forestry treatment has an important role in the maintenance of the diversity of the carabid communities.

Methods

We have analysed the carabid communities of zonal *Querco-Carpinetum* forest and plantations at the Aggtelek National Park using pitfall traps. The study area is located at the Szilice Plateau in the Aggtelek National Park in the Northern Hungarian Mountain Range. Zonal *Querco-Carpinetum* forest and three pine plantations (young spruce plantation, aged spruce plantation and black pine plantation) were analysed. There were 18 pitfall traps for each site arranged in three separate groups containing 6 traps. Samples were collected monthly from April to September.

Classical diversity statistics and scale-dependent diversity profiles were used to compare the diversity of the studied communities. Faunistical differences of the trap-groups were measured by Bray-Curtis dissimilarity and were represented by Principal Coordinates Analysis.

Results and Discussion

Our results suggest that young plantations have very low diversity for many years after the establishment (Table 1 and Fig. 1) and it is not explained by the food resources (Table 2 and Fig. 2). It may be related to microclimatic conditions and especially to the structure of litter layer and herbaceous vegetation. In the aged plantations, where the shrubs and herbs of the native vegetation are present, the diversity and composition of the carabid communities are similar to the communities of zonal forests (Fig. 1

and 3). So the adequate forestry treatment has a crucial role in the maintenance of the diversity of the carabid communities.

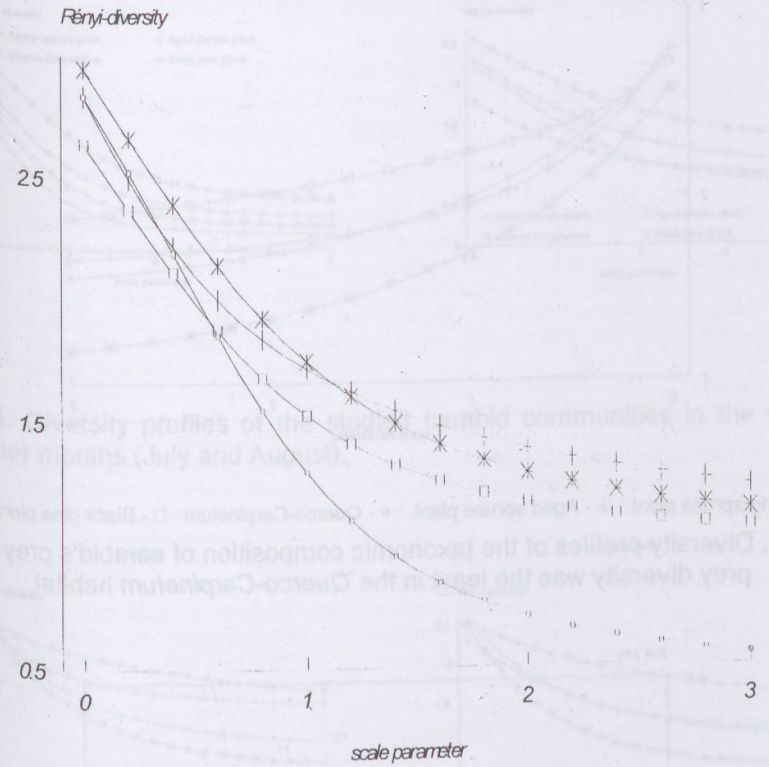
In the warm summer months (July and August) the conditions look more favourable in the aged spruce plantation than in the black pine plantation, therefore probably the duration of the diapausa is shorter. It is also not explained by the limited food resources (Fig. 4 and 5).

	YOUNG SPRUCE PLANTATIO N	AGED SPRUCE PLANTATION	QUERCO-CARPINETUM	BLACK PINE PLANTATION
NUMBER OF SPECIES	7	17	19	14
EFFECTIVE NUMBER OF SPECIES	3.6646	5.5780	5.7377	4.6220
NUMBER OF INDIVIDUAS	203	828	1199	427
DIVERSITY				
Shannon	1.2987	1.7188	1.7471	1.5308
Brillouin	1.1918	1.6827	1.7143	1.4749
Simpson	0.5066	0.7503	0.7243	0.6908
McIntosh	0.3181	0.5174	0.4884	0.4650

Table 1. Diversity statistics for the communities of the studied habitats.

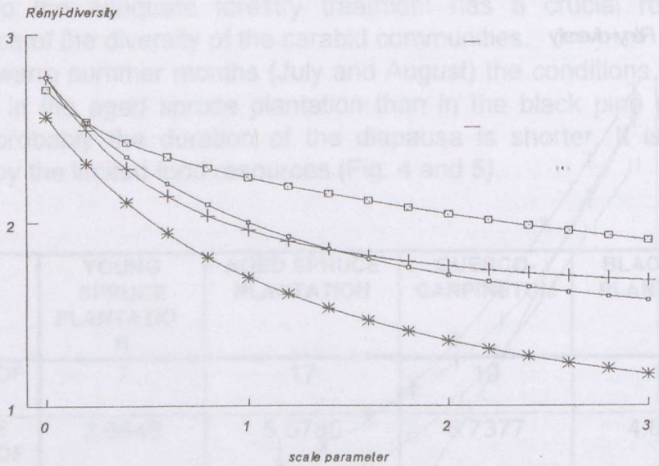
	YOUNG SPRUCE PLANTATION	AGED SPRUCE PLANTATION	QUERCO-CARPINETUM	BLACK PINE PLANTATION
NUMBER OF TAXONS	16	16	13	15
NUMBER OF INDIVIDUALS	3906	3038	4857	3756

Table 2. The number of prey species and their abundances.



▫ - Young spruce plant. + - Aged spruce plant. * - Querco-Carpinetum - Black pine plant.

Fig 1. Diversity profiles of the studied carabid communities. All the diversity profiles are quite similar. For the dominant species the young spruce plantation looks less diverse than the others.



▫ - Young spruce plant. + - Aged spruce plant. ∗ - Querco-Carpinetum □ - Black pine plant.

Fig. 2. Diversity profiles of the taxonomic composition of carabid's prey. The prey diversity was the least in the *Querco-Carpinetum* habitat.

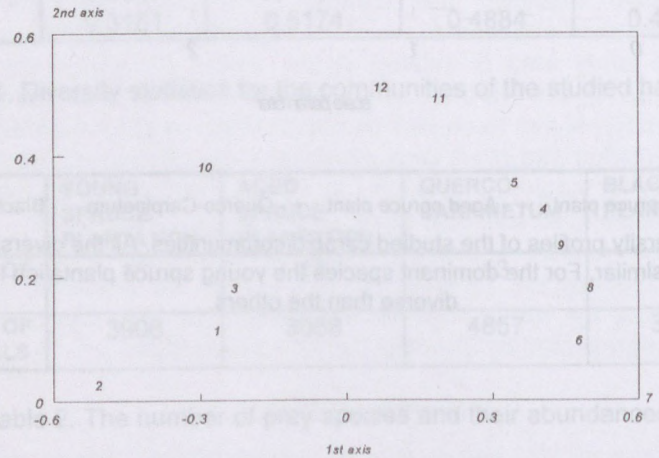


Fig. 3. Ordination of the pitfall-trap groups by Principal Coordinates Analysis. 1-3: young spruce plantation; 4-6: aged spruce plantation; 7-9: *Querco-Carpinetum*; 10-12: black pine plantation.

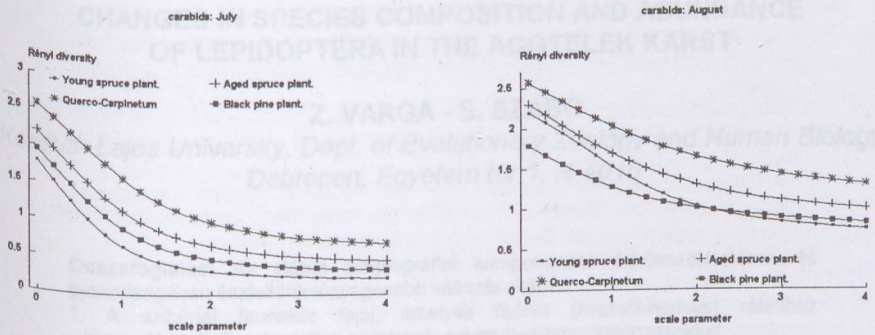


Fig. 4. Diversity profiles of the studied carabid communities in the warm summer months (July and August).

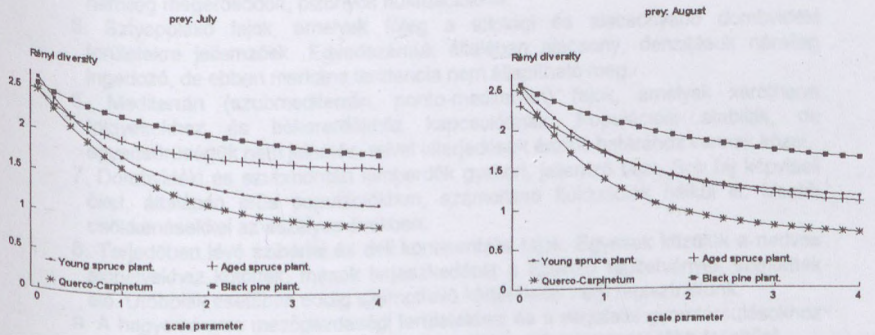
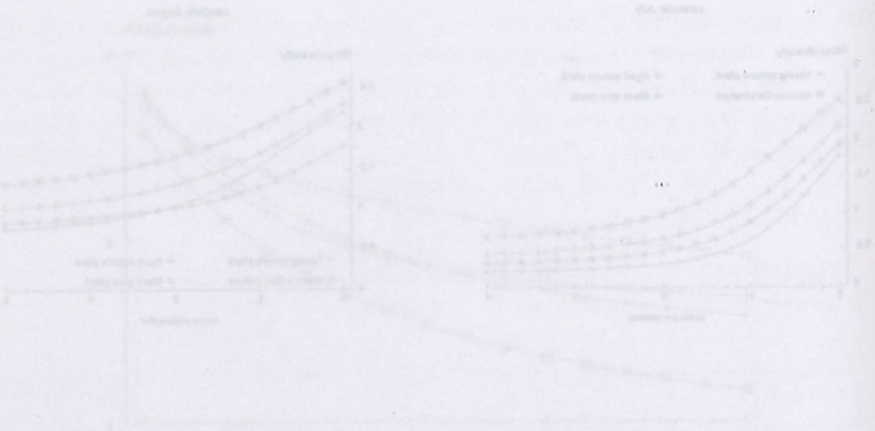


Fig. 5. Diversity profiles of the carabid's prey in the warm summer months (July and August).



CHANGES IN SPECIES COMPOSITION AND ABUNDANCE OF LEPIDOPTERA IN THE AGGTELEK KARST

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Összefoglalás: Az alábbi biogeográfiai komponensek faj-összetételében és gyakoriságában észleltünk lényegesebb változásokat.

1. A szibériai faunakör fajai, amelyek humid (mezofil-nedves) rétekhez kapcsolódnak. Tendenciájuk csökkenő, egyes években ingadozásokkal.
2. A szibériai faunakör olyan fajai, amelyek általában hegyvidékek montán-szubalpin övezeteire jellemzőek. Csak egyes években jelentkeznek, elterjedés-peremi fluktuációk eredményeként.
3. Xeromontán fajok, amelyek sziklagyepekhez kötöttek és populációik egyedsűrűsége gyér. Mivel fluktuációik az észlelhetőség alsó határa körül mozognak, csak meghatározott években észlelhetők.
4. Xeromontán fajok, amelyek sziklagyepekhez kötöttek és stabil populációkban tenyésznek. A karsztvidék leginkább tipikus és legértékesebb faunaelemei közé tartoznak. Az elmúlt kb. 15 éves arid időszakban populációik egyedszáma némileg megerősödött, bizonyos fluktuációkkal.
5. Sztyepplakó fajok, amelyek főleg a síksági és alacsonyabb dombvidéki területekre jellemzőek. Egyedszámuk általában alacsony, denzitásuk némileg ingadozó, de ebben markáns tendencia nem állapítható meg.
6. Mediterrán (szubmediterrán, ponto-mediterrán) fajok, amelyek xerotherm tölgyesekhez és bokorerdőkhöz kapcsolódnak. Populációik stabilak, de egyedsűrűségük nem jelentős, mivel elterjedésük északi határához vannak közel.
7. Dombvidéki és szubmontán lomberdők gyakori, jellemző fajai. Sok faj képviseli őket, általában erős populációkban, számottevő fluktuációk nélkül ill. kisebb csökkenésekkel az aszályos években.
8. Terjedőben lévő szibériai és déli kontinentális fajok. Egyesek közülük a nedves élőhelyekhez kötöttek, mások terjeszkedését a tűlevelű faültetvények segítették elő. Utóbbiak esetében eddig számottevő kártételeket nem regisztráltunk.
9. A hagyományos mezőgazdasági területekhez és a segetalis gyomtársulásokhoz kötött fajok. A 60-as évek vége óta erős csökkenésben vannak; több faj eltűnt.
10. Nagy természetvédelmi értékű védett fajok, amelyek az elegyes, fajgazdag lomberdőkhöz és természetközeli szegélyeikhez illetőleg mozaikos erdőssztyepp-társulásokhoz kötődnek. Mint ahogy Európában, úgy nálunk is országszerte csökkenőben vannak, veszélyeztetettek. Közülük többnek, pl. látványos, nagy nappali lepke-fajoknak a karsztvidék országosan az egyik legfontosabb menedékterülete, ma még erős populációkkal

Abstract: Characteristic changes in species composition and abundance were observed within the following biogeographical components.

1. Species of the Siberian faunal type, connected to humid (mesophilous-wet) meadows. General tendency: decrease, with fluctuations in some years.
2. Species of the Siberian faunal type, connected to montane-subalpine elevations. They can be observed only in some years as a consequence of marginal area fluctuations.
3. Xeromontaneaous species of rocky grasslands with scarce populations. Because they fluctuate near the lower limit of observability, they seem to appear only in some years.

4. Xeromontane species of rocky grasslands with stable populations. They belong to the most typical and valuable species of the karst area. A slight increase (with fluctuations) of their population densities was observed during the last 15 years of drought.
5. Steppe-grassland species, typical for lowland and lower colline areas. They have, as a rule, a low, slightly fluctuating density without any marked tendency of change.
6. Mediterranean (submediterranean, ponto-mediterranean) species connected to the xerothermic oak forests and scrub-forests. They have stable but not very dense populations, near to the northernmost boundary of distribution.
7. Generally distributed specxies of colline-submontane deciduous forests. They have a high species number and mostly strong populations with insignificant fluctuations incl. slight decline in years of drought.
8. Siberian and southern continental species being in extension of their geographical range. Some of them are connected to wetlands, others to coniferous plantations. They could not reach, however, a harmful level of density.
9. Species connected to the traditional land use and segetal weeds.They are vanishing since the end of the sixties.
10. Protected species of high conservation value, connected to mixed broadleaved forests and forest-skirts and forest-steppe association complexes. They are vanishing or at least seriously threatened almost in the whole country. The Karst area is one of the most important refuges of numerous such species.

Long-term light-trap surveys were carried out at the "PAPP FERENC" Karst Research Station, near Jósvafő (1970-1995). Their results were completed by personal collections (by light and daily samplings).

Characteristic changes in species composition and abundance were observed within the following biogeographical components.

1. Species of the Siberian faunal type, connected to humid (mesophilous-wet) meadows.

Such species of *Noctuidae* are, as follows: *Polia bombycina, Melanchra persicariae, M. pisi, Lacanobia splendens, L. contigua, Cerapteryx graminis, Eriopygodes imbecilla F., Mythimna impura, M. pudorina, M. conigera, Leucania comma, Apamea illyrea, A. ophiogramma, Pabulatrix pabulatricula, Amphipoea oculea, A. fucosa, Hydraecia micacea, Chortodes pygmina, Ch. fluxa, Ch. minima* etc. General tendency: decrease, with fluctuations in some years (Table 1). During more humid periods a lot of them belong to the dominant species. In the years of serious drought, however, these species become rare or seem to disappear.

2. Species of the Siberian faunal type, connected to montane-subalpine elevations.

Such species of *Noctuidae* are as follows: *Euxoa recussa, Lasionycta proxima, Apamea rubrirena, Mniotype adusta, Hyppa rectilinea, Syngrapha interrogationis, S. ain* etc. They occurred more regularly only in few years at the end of 70's; they generally can be observed only in some years as a consequence of marginal area fluctuations. The peat-

bog inhabiting Geometrid moth *Arichanna melanaria* appeared only in 1992, probably as a consequence of a very rare, local irruption outside of Hungary. The small Noctuid moth species *Photedes captiuncula delattini*, being typical for subalpine levels of the Carpathians, permanently occurs in abundant populations in or near the karstic dolinas of the plateaux in unusually low elevation of 400-600 m.

3. Xeromontane species of rocky grasslands with scarce populations.
Because they fluctuate near the lower limit of observability, they seem to appear only in some years. They are, however, probably continuously breeding in small, isolated populations, because they occur both in the Hungarian and Slovakian part of the karst area, but they do not in the surrounding mountains. Their life-history is, unfortunately, very insufficiently known. Such species of *Noctuidae* are as follows: *Euxoa decora, E. birivia, E. hastifera, Rhyacia (Epipsilia) latens, Apamea platinea*.. They belong to the biogeographically most characteristic and valuable species of the karst area.

4. Xeromontane species of rocky grasslands with stable populations.
They also belong to the most typical and valuable species of the karst area, e.g. the *Geometridae: Gnophos pullatus* , the *Noctuidae: Euxoa distinguenda, Dichagyris musiva*, D. (Yigoga) nigrescens*, D. (Y.) forcipula*, Chersotis fimbriola baloghi** (endemic subspecies of the Karst!), *Ch. margaritacea, Ch. rectangula*, Ch. multangula*, Oligia literosa**. Their best habitats are to be found at the southern escarpments of the higher plateaux near Plesivec and Zádiel in Slovakia and N of Jósvafő and Bódvaszilas-Tornanádaska in Hungary. Their occurrence on both sides of the karst region clearly demonstrates the biogeographical unity of this area, and also the interdependence of the faunistical changes on both sides. In the case of species noted with * a slight increase (with fluctuations) of population densities was observed during the last 15 years of drought.

5. Steppe-grassland species, typical for lowland and lower colline areas.
They have, as a rule, slightly fluctuating density without any marked tendency of change. A large number of species occur in nearly all grassland habitats, usually being frequent or dominant, e.g. the Arctiid moths *Eucharia deserta, Chelis maculosa and Spiris striata* , the *Noctuidae: Agrotis crassa,* the butterflies: *Colias australis, Polyommatus (Lysandra) coridon, P. (L.) bellargus, P. (Meleageria) daphnis,Brenthis hecate, Melitaea trivia, Arethusana arethusa.* Numerous faunistically important species also belong to this group which have a more or less constant, moderate frequency, e.g. the Arctiid moth *Ocnogyna parasita* and the *Noctuidae: Perigrapha i-cinctum, Cucullia gnaphalii, C. xeranthemi.* They do not display any significant fluctuations during the

last years, but they could be observed in an even but not high frequency in all years. Other species seem to be rather rare and they probably do not continuously breed in the Hungarian part of the Karst, e.g. *Panchrysia deaurata* (*Noctuidae*) or *Colias myrmidone* (*Pieridae*). A smaller number of species became, however, very scarce during the last years, probably as a consequence of discontinuing the traditional use of grasslands. Such species are as follows: *Euchalcia consona, Odice arcuinna, Leptosia dardouini* (*Noctuidae*) and perhaps also *Schisostege decussata* (*Geometridae*).

6. Mediterranean (submediterranean, ponto-mediterranean) species connected to the xerothermic oak forests and scrub-forests.

They have stable but not very dense populations, near to the northernmost boundary of distribution. Their abundance does not display any unidirectional trend. Some species became very scarce during the last 15 years in spite of the drought period, e.g. *Marumba quercus*, others display a low but fairly constant density, e.g. *Ennomos quercarius, Eriogaster catax, Achlya ruficollis, Phalera bucephaloides, Ocneria rubea, Dichonia aeruginea, Catocala nymphagoga* while further species show an apparent tendency of increasing abundance: *Boarmia viertlii, Peribatodes umbraria matrensis, Polyphaenis sericata, Catocala nymphagoga, Catephia alchymista.* Species, developing mostly on *Quercus pubescens* are often generally distributed in the xerothermic oak forests of the region, because the closely related *Quercus virgiliana*, which reaches here a northern boundary of distribution, appears to be generally distributed in all dryer oak forests of the karst area, included also the dryer oak-hornbeam forests.

7. Generally distributed species of colline-submontane deciduous forests.

They have a high species number and mostly strong populations with insignificant fluctuations or only a slight decline in years of drought. A relatively lower density of such species could be observed after very mild, poor in snow. Dominant Geometrid and Noctuid species often display periodical fluctuations, e.g. the winter moth species (*Agriopis, Erannis, Operophthera* spp.), the *Orthosia* (*Noctuidae*) spp. flying in early spring and also the autumnal Noctuid moths belonging to genera *Agrochola, Cirrhia, Eupsilia*, Lithophane*, Xylena*, Conistra** etc. The species of genera marked with * are hibernating as imagos. Winter moth species displayed nearly regular, 10 year periodical maxima in 1980 (1573 individuals) and 1990 (1867 individuals), with a secondary "peak" in 1988 (1115 individuals). Autumnal winter moths have shown, as a rule, more marked periodicity than the spring-flying ones. *Orthosia* species have shown a relative maximum of abundance in 1980 and, an other one in 1987-89. Autumnal Noctuid moths had only less obvious

fluctuations. They reached, however, a maximum of density in 1990, during the minima of *Orthosia* spp. On the other hand, *Notodontidae* species typifying the deciduous forests do not display any trend of density fluctuations. All these species groups are represented in the karst region by a high level of species diversity (both number of species and evenness of relative frequency).

8. Siberian and southern continental species, often being in extension of their geographical range.

Some of them are connected to wetlands, others to coniferous plantations. One part of wetland species belongs to *Noctuidae*, e.g. *Eucarta amethysthina, Goonallica virgo , Athetis lepigone, Diachrysia zosimi,* while others to diurnal families, e.g. *Lycaena dispar rutilus, Melitaea diamina, Clossiana selene, Brenthis ino.* Last species occurs in the karst area in two different ecological forms: one is living on wet, tall-grass meadows in strictly localised populations, with food-plant: *Filipendula ulmaria*, the other is abundant in all not too dry grasslands and is breeding in large, open populations, with food-plant: *Filipendula vulgaris.* Because in the 70's and 70's extended coniferous plantations were established, subventioned by the state, a large number of species became introduced into the karst area. Some of them occurs in the more nature-like spruce-stands of the higher plateaux, e.g. *Panthea coenobita, Deileptenia ribeata, Thera stragulata, Th. albonigrata.* Others belong to the generally distributed, common species, e.g. *Hyloicus pinastri, Dendrolimus pini, Bupalus piniarius, Panolis flammea.* They could not reach, however, a harmful level of density in the study period. *Lymantria monacha*, often damaging pine and spruce stands, does not belong to the common species in the karst region. It has a fairly even, moderate density and seems to be connected to deciduous (beach, oak-hornbeam) forests.

9. Species connected to the traditional land use and segetal weeds.

They are vanishing since the end of the sixties, because the traditional use of arable lands discontinued in most areas of the karst region. Some species, collected near Jósvafő in the sixties, could not be observed during the study period, e.g. *Oria musculosa, Porphyrinia respersa, Periphanes delphinii.* It is however possible that they occur in the Slovakian part of the karst region (or near Aggtelek in Hungary), because there the traditional land use could better survive.

10. Protected species of high conservation value, connected to mixed broadleaved forests and forest-skirts and forest-steppe association complexes.

Numerous large and beautiful butterflies belong to the protected species in Europe and also in Hungary. They are sensitive to environmental pollution and they need large, undisturbed breeding areas. They belong to the "K-strategists" which lay their eggs rather evenly dispersed over a larger area, having also a typical metapopulation structure. They are vanishing or at least seriously threatened almost in whole Europe and also in Hungary. The Karst area is one of the most important refuges of numerous such species, e.g. *Iphiclides podalirius, Euvanessa antiopa, Nymphalis polychloros, Limenitis populi, L. camilla, Apatura iris, A. ilia.* Their survival here is a consequence of the greatly undisturbed landscape structure and that their food-plants are abundant in the whole region.

Table 1.

Species/ Years	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Polia bombycina	78	101	173	421	217	227	59	82	41	72	87
Melanchra persicariae	28	26	71	52	47	81	27	57	18	61	80
Melanchra pisi	15	21	16	11	6	17	5	11	7	3	8
Cerapteryx graminis	126	134	499	108	87	611	201	56	17	12	26
Eriopygodes imbecilla	47	38	227	51	96	412	116	31	8	21	14
Mythimna impura	4	11	16	2	-	7	4	2	-	4	7
Mythimna conigera	91	82	217	31	19	54	61	17	11	5	41
Leucania comma	21	11	18	16	9	24	12	7	9	16	22
Pabulatrix pabulatricula	18	7	12	4	-	5	3	-	-	2	1
Amphipoea fucosa	411	198	627	81	47	211	102	28	5	3	8
Hydraecia micacea	22	18	41	26	5	11	8	4	1	-	2
Total	861	647	1800	803	533	1660	598	295	117	199	296

THE SPIDER FAUNA OF THE AGGTELEK NATIONAL PARK
A GUILD STRUCTURE EXAMINATION OF SOIL SURFACE-LIVING AND PLANT-LIVING SPIDER COMMUNITIES.

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Összefoglaló: Az Aggteleki Nemzeti Park területén 1992 óta végzek - jórészt gyepekben - Barber-csapdás és fűhálós gyűjtéseket. Ennek során eddig 16 pókcsalád 39 nemzetségének 72 faja került elő. A gyepek talajszintjében a legnagyobb gyakorisággal xerophil farkaspókfajok (*Lycosidae*) voltak megtalálhatók, mint például az *Alopecosa trabalis* Clerck, *A. sulzeri* Pavesi és a *Pardosa bifasciata* C. L. Koch, míg a növényzeti szintben az ugrópókok (*Salticidae*) közül az *Evarcha* fajok, illetve a *Pisaura mirabilis Clerck* (*Pisauridae*) voltak a leggyakrabban észlelhetők. A faunisztikai vizsgálatokon kívül elvégeztem a különböző területek pók-együtteseinek összehasonlítását cluster analízis és főkoordináta analízis segítségével. Ezek a fennsíki és a jósvafői szőlőhegyi pók-együtteseket jól elkülönítik egymástól. Szintén vizsgáltam a talajlakó és a növényzetlakó pók-együttesek guild összetételét, amelyben jelentős különbségeket találtam.

Introduction

I have investigated the spider fauna by using Barber traps and grass-net in the National Park since 1992. The traps were placed - mainly in grass communities - on the Plateau, the Szőlőhegy and in the Lófej valley. Furthermore in the Szőlőhegy area I have also collected spiders in the thermophil oak forest and in its edge. I compared the spider communities of different plant associations and areas by cluster analyses and Principal Coordinate Analysis (PCoA). I also examined guild structure of the spider communities that live on the soil surface and those on the plants.

Study area

I. Szőlőhegy-area

Bottom level. *Polygalo-Brachypodietum* and *Pulsatillo-Festucetum rupicolae*. Pitfall-traps, grass-net. Trap number: 7.Grass-net number: 21.

Middle level. *Pulsatillo-festucetum rupicolae*. Pitfall-traps, grass-net. Grass-net number: 22, 23.

High level. The plant communities resembled to *Geranio-Peucedanetum cervariae*, that was described in south Germany. Pitfall-traps, grass-net. Grass-net number: 24.

Forestry grass-land. *Polygalo majori-Brachypodietum pinnati danhonietosum alpinae*. The area hasn't been used for about 20 years. Pitfall-traps, grass-net..Grass-net number: 19, 20.

Thermophil oak forest. Pitfall-traps. Trap number: 4.

II. Lófej-valley *Polygalo-Brachipodietum*. Pitfall-traps, grass-net. Trap number: 2, 3. Grass-net number: 18.

III. Plateau

Mogyorósbérc-dolina. *Polygalo-Brachypodietum, Arrhenatheretum elatioris, Brometum erecti*. Pitfall-traps, grass-net. Grass-net number: 1, 2, 3, 4.

Dolina at boundary stone 20. *Polygalo-Brachypodietum* and *Carico montanae-Brachypodietum*. Grass-net. Grass-net number: 14, 15.

Dolina to the south of the Mihály-láza peak. *Carico montanae-Brachypodietum, Polygalo-Bracypodietum*, and closed *Calamagrostis epigeios* vegetation. Pitfall-traps, grass-net. Trap number: 1. Grass-net number: 8, 9, 10, 11.

Dolina to the south-west of the Mihály-láza peak. *Pulsatillo-Festucetum rupicolae stipetosum*. Pitfall-traps, grass-net. Trap number: 5, grass-net number: 12, 13.

Pásztor-valley. *Polygalo-Bracypodietum*. Grass-net. Grass-net number: 16,17.

Results

I. Results of the faunistic studies

In the study area I have found 72 species of 39 genera which belonged to 16 families. In the grassland areas xerophil species of wolf spiders were the most abundant on the soil surface (e.g. *Alopecosa trabalis* Clerck, *Alopecosa sulzeri* Pavesi, *Pardosa bifasciata* C.L. Koch) while the jump spiders and *Pisaura mirabilis* Clerck could be most often observed on plants.

The composition of spider communities differed according to the habitat needs of their species. This could be explained by the varying microclimatic feature of the area. Therefore, one could find spiders which need humid habitat and live on plants (e.g. *Araneus marmoreus* Clerck, *Argiope bruennichi* Scopoli) in the Plateau where otherwise the xerophil species dominated (e.g. *Gnaphosa bicolor* Hahn, *Zelotes subterraneus* C.L. Koch, *Pellenes tripunctatus* Walckenaer, *Evarcha* spp.)

In the warm and dry Szőlőhegy one could find spiders which need more humid habitats only in the forest (e.g. *Pardosa lugubris* Walckenaer, *Coelotes atropos* Walckenaer), otherwise the spiders of dry grasslands were the most abundant (e.g. *Alpecosa spp., Evarcha laetabunda* C.L. Koch, *Gnaphosa lucifuga* Walckenaer). In forest edges mixtures of dominating species of neighbouring habitats could be observed.

II. The results of cluster analyses and PCoA

I compared spider faunas of single sampling sites with cluster analyses and PCoA (NuCoSa program package, Quantitative Distance: Matusita, b-flex) in the soil-living and plant-living groups. I only considered data where sample sizes (grass-net sweep numbers and pitfall trap numbers) were equal, therefore, only a part of pitfall-trap data was analyzed.

The spider communities of the Plateau could be well separated from those of the Szőlőhegy by cluster analyses (Fig. 1-2)

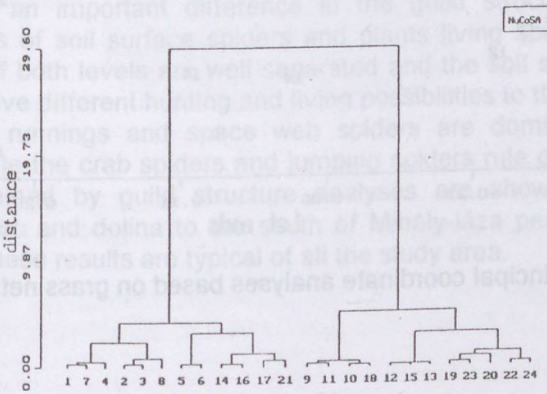


Figure 1.a. Cluster analyses based on grass net sampling.

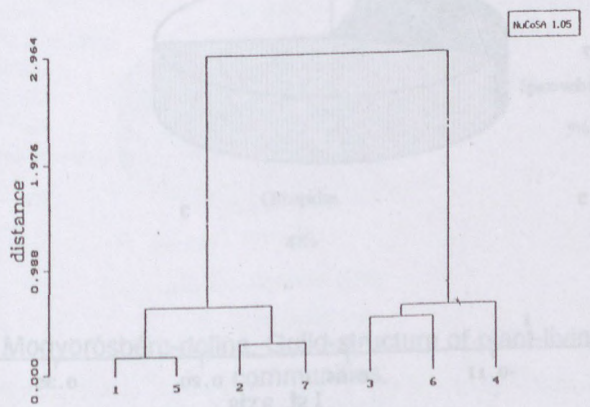


Figure 1.b. Cluster analyses based on pitfall trap sampling.

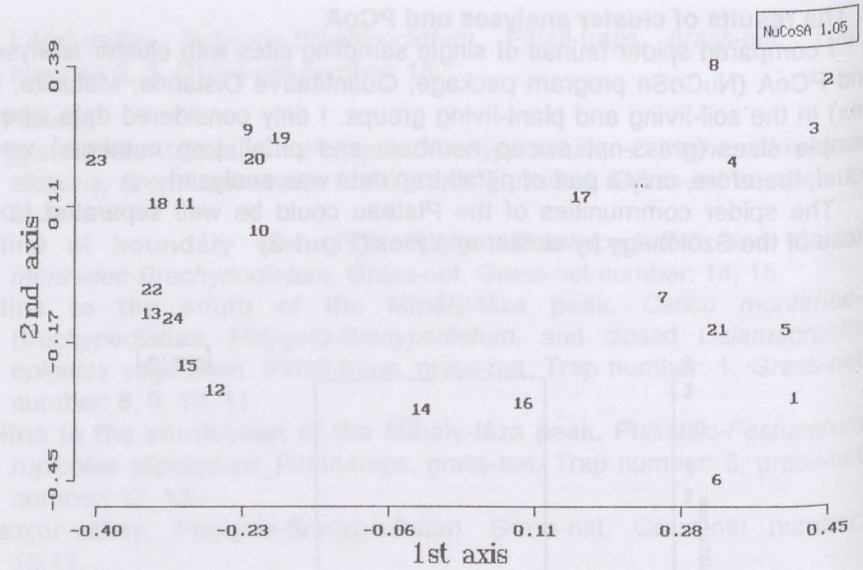


Fig. 2.a. Principal coordinate analyses based on grass net sampling.

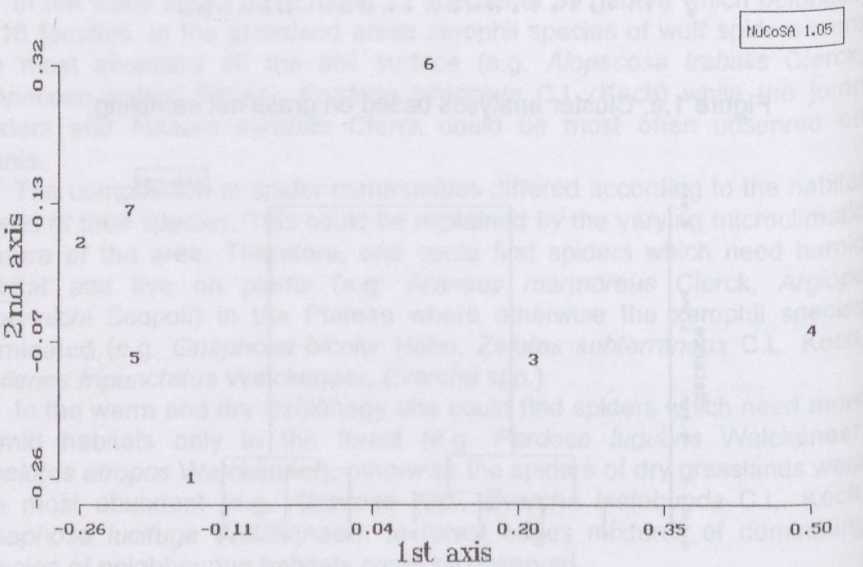


Fig. 2.b. Principal coordinate analyses based on pitfall trap sampling.

III. The results of guild structure analyses

The guild-concept frequently occurs in the arachnological literature. The expression, which was first introduced by Root (1973) practically matches the concept of syntrophium by Balogh & Loksa (1948). According to this latter definition a guild is a group of living organizm that exploit similar resources in an identical manner. Classification of spiders into guilds is based on their hunting strategies. Guild composition of the spider fauna of a given area serves information on life conditions provided by the area since it reflects the number of hunting strategies the area can support.

I found an important difference in the guild structure between the communities of soil surface spiders and plants living spiders. This shows that livers of both levels are well separated and the soil surface as well as the plants give different hunting and living possibilities to the spiders. Finally the diurnal runnings and space web spiders are dominant on the soil surface, while the crab spiders and jumping spiders rule on the plants. The results obtained by guild structure analyses are shown based on the Mogyorósbérc and dolina to the south of Mihály-láza peak sampling sites (Fig. 3-4); these results are typical of all the study area.

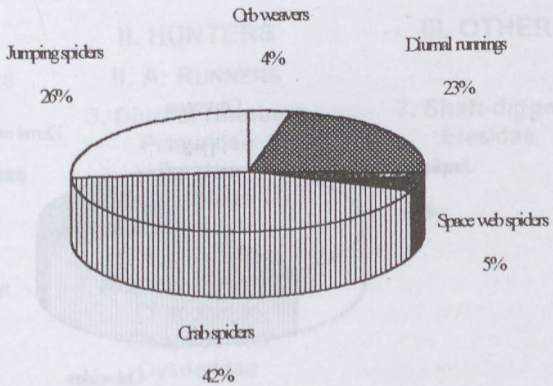


Fig. 3. Mogyorósbérc-dolina. Guild-structure of plant-living spiders communities.

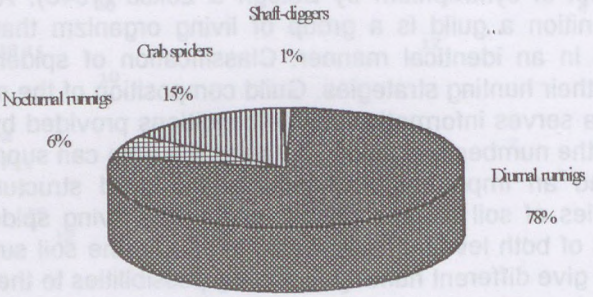


Fig. 3. Mogyorósbérc-dolina. Guild-structure of soil surface-living spiders communities.

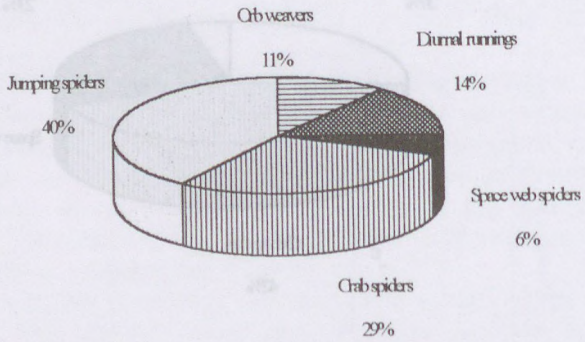


Fig. 4. Dolina to the south of the Mihály-láza peak. Guild-structure of plant - living spider communities.

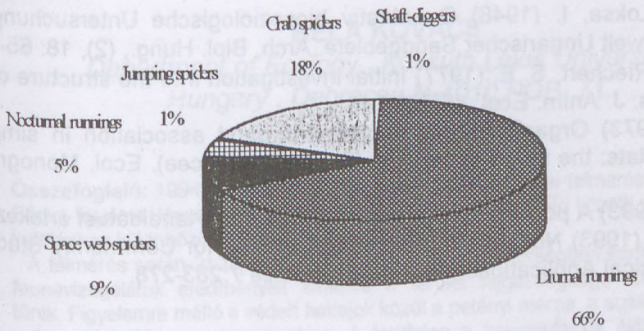


Figure 4. Dolina to the south of the Mihály-láza peak. Guild-structure of soil surface-living spider communities.

Classification of spider families collected in the Aggtelek National Park into guilds (following Szinetár 1993. and Post, W.M. & Riechert, S.E. 1977.)

I.

I. A: WEB BUILDERS

1. Orb weavers
Araneidae
2. Space web spiders
Agelenidae
Linyphiidae
Theridiidae

II. HUNTERS

II. A: RUNNERS

3. Diurnal runnings
Pisauridae
Zoridae
Oxyopidae
Lycosidae
Eusparassidae
4. Nocturnal runnings
Clubionidae
Gnaphosidae
Dysderidae

II. B: AMBUSHERS

5. Crab spiders
Philodromidae
Thomisidae
6. Jumping spiders
Salticidae

III. OTHER

7. Shaft-diggers
Eresidae

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FISHFAUNISTICAL DATA FROM RIVER BÓDVA IN THE AREA OF THE AGGTELEK NATIONAL PARK

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Összefoglaló: 1994 szeptember 9-16. között halfaunisztikai felmérést végeztem a Bódva-folyón a Jósva-patak torkolata és a szalonnai közúti híd közötti szakaszon. A kutatáshoz különböző típusú és méretű hálókat használtam.

A felmérés során 21 faj került elő. Ebből 8 védett. A térségben korábban végzett faunavizsgálatok eredményeit ismerve a terület fajgazdagsága elfogadhatónak tűnik. Figyelemre méltó a védett halfajok közül a petényi márna, a sujtásos küsz, és a homoki küllő nagy egyedszáma. A területen a halpopulációk élőhelytől függő mozaikkomplexe jellemző. A különböző élőhelyek lehetővé teszik a vizsgált szakaszon az alacsonyabb szinttájra jellemző fajok jelenlétét. Azonban az ilyen területek számának és kiterjedésének csökkenése következtében ezen halfajok szaporodása a vizsgált szakaszon nem valószínű. A márna szinttájra jellemző nagyobb testű halak (márna, paduc, domolykó, nyúldomlykó) kifejlett példányainak kis egyedszáma emberi beavatkozásra, esetleg évszakos vándorlásra utal.

Abstract: Between the 9th-16th of September 1994, I carried out a fishfaunistical survey on a section of river Bódva from the mouth of the stream Jósva to the road-bridge at Szalonna. The research was carried out with small-size nets.

I could catch altogether 21 species, among which there were 8 protected ones. Comparing this with the results of previous surveys the number of species seems to be acceptable. The *Barbus peloponnesius petényi*, the *Alburnoides bipunctatus* and the *Gobio kessleri* occured in large numbers among the protected species on the sample section. With the knowledge of earlier publications it seems that habitats of slowly flowing water have decreased on a large scale. The number of fish species typical of such habitats have fallen as spawning conditions are lacking. The small number of mature individuals of the *Leuciscus cephalus*, *L. leuciscus*, *Chondrostoma nasus* and the *Barbus barbus* indicates human interference or migration.

Hydrological features of the Aggtelek Karst are determined by Rivers Sajó and Bódva. The extential basin of River Bódva consists of the brooks situated to the northern part of the mountain. The Bódva itself originates in the Slovakian Erzgebirge, the two branches of it unite before crossing the border, and meanders to the Hungarian region. On both Slovakian and Hungarian sectiones a few smaller brooks with fluctuating rate of flow meet the Bódva, which flows into the Sajó near Sajóecseg. Its rate of flow is fluctuating, spring and summer time floods occur regularly. The average rate of flow of the river has decreased recently. Major water pollution has not taken place recently. Due to water regulations the number of habitats has decreased and the ratio of their different types has changed.

I studied the river section between the mouth of the stream Jósva and the road-bridge at Szalonna from 9th to 16th of September 1994.

The depth of water was between 30-160 cm on the examined section. Both the width and the depth of the river are determined by the current. The riverbed mostly consists of pebbles and at some places of bigger stones. Along the steep banks there is a major clay and mud deposit. At shallower parts there are patches of *Myriophyllum spicatum* and *Potamogeton* spp. At lower parts of the banks *Myosotis palustris* and *Glyceria maxima* are frequent. There is a degraded community of *Salicetum triandrae* along both banks. There is a *Phragmites australis* on the section about 50 metres before Perkupa. The samples were taken by small meshed nets of different size. I surveyed the whole area of the section mentioned above and the basis of the first results I repeatedly examined the typical habitats. The fish species were classified according to Nelson (1984). I created 5 category of frequency of the caught species.

Very frequent species: their individuals are abundant in an area, can be caught in great, sometimes in mass numbers during sampling.
Frequent species: they can be caught regularly during sampling sometimes or at some places in great numbers.
Moderately frequent species: less individuals can be caught. They are not frequent, but not rareties, their occurance is regular and usual.
Rare species: only few individuals can be found during sampling.
Very rare species: they get to the area by drifting, they occur occasionally, do not make up populations or if they do so they live in a very small, defined area due to certain reasons.

1. ***Esox lucius***: only one 3+ individual was found during the study. Very rare.

2. ***Rutilus rutilus***: two of them were caught. Both the previous and this species were found in a slower and wider section, where the bank was bordered by reed. Very rare.

3. ***Leuciscus leuciscus***: the juveniles were regularly caught in shallower water with dense pondweed and varec populations, larger individuals occured mainly in pits and among tree roots. Frequent.

4. ***Leuciscus cephalus***: occured at similar sites as the *L. leuciscus*. Also frequent.

5. ***Aspius aspius***: only one individual was caught at the same site as the *E. lucius* and the *R. rutilus*. Very rare.

6. ***Alburnus alburnus***: it was caught in every sampling in large number. Very frequent.

7. ***Alburnoides bipunctatus***: its occurance is typical to this section. Very frequent.

8. ***Vimba vimba***: it could be caught in deeper sections of varying substrates. Rare.

9. ***Tinca tinca***: four of them were caught at different sites coinciding with the ones of other limnofil species. Very rare.

10. ***Chondrostoma nasus***: adult individuals were caught only in deeper water. The juveniles were found in shallow water overgrown by pondweeds in small number. Moderately frequent.

11. ***Barbus barbus:*** only two adult individuals were caught. Juveniles, however, were found at similar sites as the previous species, in a great number. Despite this it belongs the category "rare".

12. ***Barbus peloponnesius petényi***: the frequency and the sites of its occurance are similar to those of *B. barbus*.

13. ***Gobio gobio***: it is the rarest out of the three *Gobio* species found in this area. Moderately frequent.

14. ***Gobio albipinnatus***: it is the most frequent *Gobio* species of the sampling area and could be found at the most different places. Frequent.

15. ***Gobio kessleri***: this species was first described by Botta *et al.* in 1984 in Hungary and it seems to find its living conditions in the Bódva. Its frequency is similar to the *G. albipinnatus*. All of the three *Gobio* species share the same habitat i.e. deeper water lacking aquatic plants. Frequent.

16. ***Rhodeus sericeus amarus***: a great number of it could be caught among aquatic plants. Very frequent.

17. ***Orthrias barbatulus***: despite individual was caught in the sampling area. It was in a shallow, fast flowing section that is quite frequent in the Jósva stream, only one near Perkupa. Very rare.

18. ***Cobitis taenia*** : the only sample was caught at the mouth of the Jósva in a deep muddy substrated section. Very rare.

19. ***Sabanejewia aurata***: juveniles and adults could be caught in great numbers both among aquatic plants and tree roots reaching the water. Moderately frequent.

20. ***Perca fluviatilis***: two of them were caught at the same site as the *E. lucius* and the *R. rutilus*. These were adults. It was the first founding in the middle section of the Bódva. Very rare.

21. ***Zingel streber***: one individual was caught in the streamline of a 1.2 m deep section. Very rare.

21 species was found during the sampling period, 8 of which are protected. Knowing the faunistical results of other waterflows in this region the number of species is acceptable in the sampling section.

The different habitats allow the existance of different types of associated fish populations and their variable structures construct a definite mosaic complex. This explains the presence of stagnofil and limnofil species in slower flowing sections with muddy substrate. The size of caught individuals and the lack of their offspring indicate that they are unable to breed in the given area. It is due to the decrease of proper breeding sites both in size and number. These species get here from tributaries. The great number of the *Barbus peloponnesius petényi*, the *Alburnoides bipunctatus* and the *Gobio kessleri* among protected species is remarkable. The adults of larger fish species in the barbel zone (*Barbus barbus* , *Chondrostoma nasus* , *Leuciscus cephalus* , *L. leuciscus*) occur in relatively smaller number compared with the juveniles. This fact suggests seasonal migration or human interference.

FISH-FAUNA OF THE WATERS IN THE AGGTELEK NATIONAL PARK

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Összefoglaló: Az Aggteleki Nemzeti Park és a tervezett Cserehát Tájvédelmi Körzet területén található patakok a Bódva valamint a Sajó folyóba folynak. A kis vízfolyások közül néhány mint a Barakonyi-, Réti-, Telkes-patak csapadékszegény években kiszáradnak. A többi patakban minden évszakban található víz. Ezek a vizsgált vizek: Sas-, Ragya-, Debrétei-, Vecsem-, Pasnyak-, Jósva-, Ménes-, Rakaca-, Szuha-patak, Bódva-folyó és a Tornanádaskánál található láp.

A területről 1984 óta gyűjtünk adatokat, de 1987-ben és 1993-ban nagy átfogó fölmérésbe kezdtünk, hogy képet kapjunk a fauna változásáról és a jelenlegi állapotról.

A faunisztikai felmérés mellett vizsgáltuk a populációk korösszetételét és egyes fajok növekedését. Ökológiai felmérésünk kiterjedt a folyóban, a patakokban élő halak diverzitására, abundanciájára. A halászást elektromos halászgéppel és 0,8 cm-es szemböségű húzóhálóval végeztük. A patakokban a zonációkat reprezentáló 100-100 m-es szakaszokat vizsgáltunk. A halászási adatokat 57 helyről gyűjtöttük.

A Bódvából és a folyót tápláló patakokból 36 fajt sikerült eddig kimutatni, amelyek közül 11 faj védett. Százalékos arányukat a Bódvát tápláló patakokban a 2. táblázat, a Bódvában fogott fajokét az 1. táblázat mutatja.

A Bódvát tápláló patakokban a domináns fajok: *Leucisus cephalus, Noemacheilus barbatulus, Salmo trutta m. fario, Alburnus alburnus.* Ezek a patakok jellegzetesen epirhitron, metaritron szint tájba tartoznak. A Sas-, Ragya-, Vecsem-patakban csak a *Noemachilus barbatulus* az egyetlen halfaj ami kimutatható volt.

A Bódva-folyóban, amely az epipotamon szinttájba tartozik, 1987-ben és 1993-ban a fogott fajok százalékos arányában néhány fajnál nagy eltérés van. Az *Alburnoides bipunctatus,* a *Rhodeus sericeus amarus* és a *Leuciscus cephalus* mindkét évben a folyó jellemző fajai. Csökkent a ragadozó életmódot (carnivor) folytató fajok száma, vagy egyáltalán nem kerültek elő 1993-ban. Az omnivor halak százalékos aránya növekedett. Különösen a *Rhodeus sericeus amarus* és a *Gobio kessleri* populációja növekedett meg. Ez utóbbi faj a folyó bizonyos szakaszain kiszorította a *Gobio gobio*-t. 1987-hez képest 6 új fajt fogtunk. Ezek közül a *Sabanejewia aurata* és a *Pseudorasbora parva* megjelenése és gyors felszaporodása érdekes.

A Bódva-folyóban a *Leuciscus cephalus* és a *Chondrostoma nasus* egyedszámának csökkenése mellett megfigyelhető, a két faj kor szerinti megoszlásán belül is, hogy 1987-hez képest 1993-ban a 3 évesnél idősebb százalékos aránya csökkent a populáción belül.

Vizsgáltuk az abundancia alakulását 1987-ben és 1993-ban, értéke 100 méterre eső individuum.

A diverzitást a Shannon-Weaver függvény segítségével számoltuk ki.

The streams from the territory of the Aggtelek National Park and the proposed Cserehát Landscape Protection Area belonging to it flow into the Bódva and Sajó rivers. Some of the smaller streams, e.g. Barakonyi, Réti, Telkes streams become dry in rainless years. In the others there is water for the whole year. These tested waters are: Sas, Ragya, Debrétei, Vecsem, Pasnyak, Jósva, Ménes, Rakaca, Szuha streams and the swamp at Tornanádaska village.

From this territory data are collected since 1984, but in 1987 and 1993 comprehensive tests were begun to depict the changes and the present status of the fauna.

Beside the estimation of the fauna the age distribution of populations and the growth of the individual species were studied. Our investigation covered the diversity and abundance of fishes living in the streams and rivers. Fishing was done by means of electric fishing machine and towing-net having 0,8 cm mesh size. In the streams 100 m sectors were investigated representing the zonation. Fishing data were collected from 57 sites.

From the River Bódva and the streams of it 36 species were detected, 11 of them are protected. Their percentage in the streams and in the river Bódva is shown in Table 1.

Table 1. Species in river Bódva and streams, and their percentage

Species	Bódva		Streams
	% (1987)	% (1993)	%
Abramis brama	-	-	0,7
Alburnoides bipunctatus	32,8	26,2	2,0
Alburnus alburnus	-	5,2	9,4
Aspius aspius	-	-	0,1
Barbus barbus	1,6	1,8	0,3
Barbus meridionalis Petényi	2,6	0,1	1,3
Carassius auratius	3,3	-	1,9
Carassius carassius	0,2	-	0,1
Chondrostoma nasus	8,4	2,1	0,1
Cobitis teania	1,2	2,6	0,3
Cyprinus carpio	-	-	0,1
Esox lucius	1,5	0,1	0,5
Eudontomyzon danfordi	0,2	-	0,3
Gobio albipinnatus	0,2	0,1	0,2
Gobio gobio	9,7	4,0	2,9
Gobio kessleri	0,8	5,2	0,9
Gymnocephalus cernuus	-	0,1	2,6
Lepomis gibbosus	-	-	0,2
Leuciscus cephalus	21,5	11,0	34,4
Leuciscus idus	-	-	0,4
Leuciscus leuciscus	2,0	0,8	0,5
Lota lota	-	0,1	-
Misgurnus fossilis	-	-	0,1
Noemacheilus barbatulus	0,2	3,5	22,5

Species	Bódva		Streams
	% (1987)	% (1993)	%
Oncorhynchus mykiss	0,2	-	3,0
Perca fluviatilis	1,3	-	0,6
Phoxinus phoxinus	-	-	2,8
Pseudorasbora parva	-	0,3	0,5
Rhodeus sericeus amarus	8,5	33,9	4,3
Rutilus rutilus	0,3	0,1	0,2
Sabanejewia aurata	-	2,3	-
Salmo trutta m. fario	0,2	-	4,1
Scardinius erythrophthalmus	0,8	-	0,2
Stizosteidon lucioperca	0,2	-	2,1
Tinca tinca	0,3	0,1	0,2
Vimba vimba	1,1	0,4	0,1
Zingel streber	1,1	0,1	0,1

In the subsidiary streams of River Bódva dominant species are: *Leuciscus cephalus, Noemacheilus barbatulus, Salmo trutta m. fario, Alburnus alburnus.* These streams are at the epirhitron and metarhitron level region. In the streams Sas, Ragya and Vecsem the only detected species is *Noemacheilus barbatulus.*

In the river Bódva being at the epipotamon level region there was considerable difference in the percentage of the species found in 1987 and 1993. The characteristic species of the river were in both cases the *Alburnoides bipunctatus, Rhodeus sericeus amarus* and *Leuciscus cephalus.* Number of the carnivorous species was decreased, some of them was not detected in 1993. Percentage of the omnivorous species was increased. Especially the population of *Rhodeus sericeus amarus* and *Gobio kessleri* was increased. The later superseded *Gobio gobio* at several sectors of the river. Related to 1987 six new species were fished. From these the appearance and rapid breeding of *Sabanejewia aurata* and *Pseudorasbora parva* was rather interesting.

In the river Bódva the population of *Leuciscus cephalus* and *Chondostroma nasus* was decreased, the percentage of the age over 3 years also was decreased in 1993 related to 1987.

The change of abundance was investigated in 1987 and 1993, its value is individuals per 100 metres.

Diversity was calculated by means of Shannon-Weaver function (Table 4).

JÓSVA WITH BÓDVA	26. 08. 1984.		01. 09. 1984.		19. 05. 1987.		20. 06. 1987.		15. 07. 1987.		25. 08. 1989.		16. 10. 1992.	
	50	1,090	68	1,846	62	1,406	19	1,493	26	1,069	27	1,274	17	1,874
JÓSVA WITH POND	28. 02. 1984.		16. 10. 1992.											
	58	0,987	65	0,683										
MÉNES WITH SZÖGLIGET	05. 10. 1986.		28. 04. 1988.		16. 10. 1992									
	52	1,201	34	1,291	92	1,071								
MÉNES WITH POND	16. 10. 1992.													
	63	0,222												
MÉNES WITH JÓSVA	16. 10. 1992.													
	20	1,375												
BÓDVA WITH JÓSVA	26. 08. 1984.		19. 05. 1987.		16. 10. 1992.									
	31	1,504	120	1,096	33	1,567								
BÓDVA WITH KOMJÁTI	26. 08. 1984.													
	23	1,119												
BÓDVA WITH BÓDVA-RÁKÓ	25. 08. 1984.													
	19	1,475												
BÓDVA WITH RAKACA BROOK	25. 08. 1984.		13. 04. 1986.											
	12	1,473	22	1,630										
RAKACA BROOK WITH BÓDVA RIV.	01. 09. 1984.		05. 10. 1986.											
	54	1,869	7	0,796										
RAKACA WITH MESZES	01. 09. 1984.													
	51	1,864												
TELEKES WITH BÓDVA	19. 05. 1987.													
	24	24												
KÉCSŐ	19. 05. 1987.													
	7	0,683												
SZUHA WITH KURITYÁN	09. 11. 1992.													
	342	1,127												
SZUHA WITH SZUHAFŐ	09. 11. 1992.													
	34	1,354												

LEGEND:

FISHING PLACE	DATE	
	ABUNDANCE	DIVERSITY

Table 3. Abundances in 1987 and 1993

Fishing place	1987	1993
Bódva with Hídvégardó	37	323
Pasnyak stream	-	203
Vecsem stream	-	85
Ménes stream with pond	-	64
Ménes stream with quarry	-	32
Ménes stream with Jósva	-	19
Bódva with Bódvarákó	55	56
Jósva with pond	97	118
Bódva with Jósva	145	53
Bódva with Perkupa	49	-
Bódva with Büdöskút	-	132
Rakaca with Rakacaszend	-	31
Rakaca with Bódva	62	206
Bódva with Edelény	-	222
Bódva with Boldva	122	191
Bódva with Sajó	-	96

Table 4. Diversity in 1987 and 1993

Fishing place	1987	1993
Bódva with Hídvégardó	1,192	1,339
Pasnyak stream	-	0,086
Bódva with Bódvaszilas	1,178	-
Ménes stream with pond	-	0,219
Ménes stream with quarry	-	1,223
Ménes stream with Jósva	-	1,371
Bódva with Bódvarákó	1,205	1,561
Bódva with Jósva	-	1,838
Bódva with Perkupa	1,361	-
Bódva with Büdöskút	-	1,526
Rakaca with Rakacaszend	-	1,086
Rakaca with Bódva	2,098	1,831
Bódva with Edelény	-	0,458
Bódva with Boldva	1,868	2,098
Bódva with Sajó	-	1,533

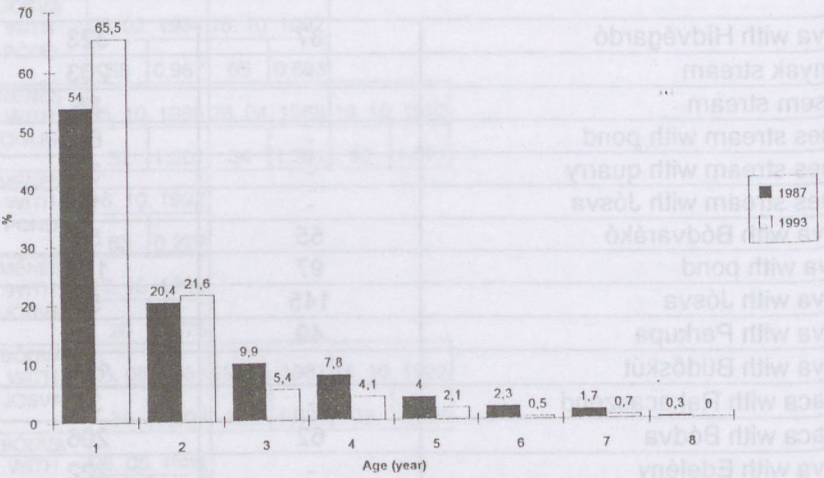


Fig. 1 - Age distribution of *Leuciscus cephalus*

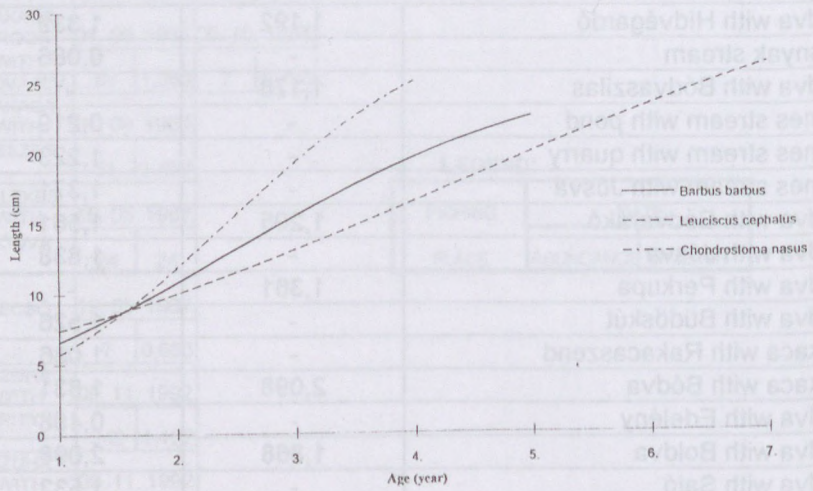


Fig. 2.a. - Increase of the collected species

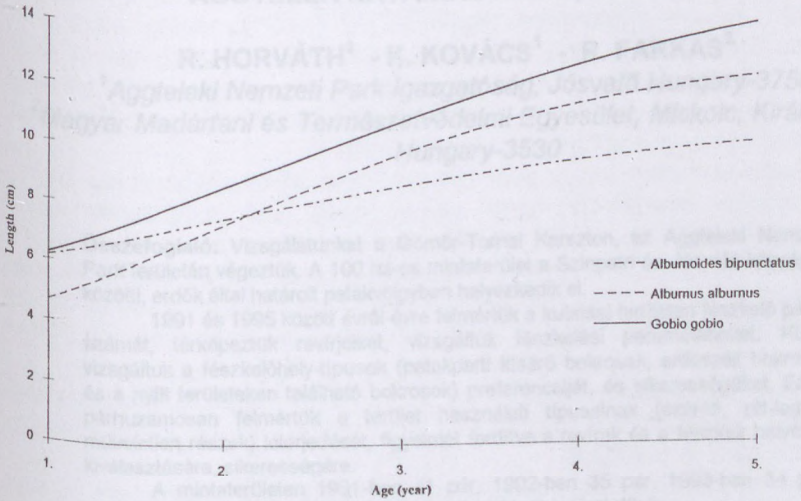


Fig. 2.b. Increase of the collected species

Species	Age (year)						
	1.	2.	3.	4.	5.	6.	7.
Alburnoides bipunctatus	6,14	7,46	8,56	9,39	9,98	-	-
Alburnus alburnus	4,65	7,26	9,65	11,28	12,18	-	-
Barbus barbus	6,59	10,77	15,49	19,61	22,48	-	-
Chondrostoma nasus	5,68	11,81	19,30	25,01	-	-	-
Gobio gobio	6,23	8,52	10,73	12,55	13,86	-	-
Leuciscus cephalus	7,39	9,99	13,07	16,47	19,96	23,26	26,15

Fig. 2.c. Increase of the collected species

RED-BACKED SHRIKE R-BS (*LANIUS COLLURIO*) SCIENTIFIC RESEARCH IN THE AGGTELEK NATIONAL PARK (HUNGARY)

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Összefoglaló: Vizsgálatunkat a Gömör-Tornai Karszton, az Aggteleki Nemzeti Park területén végeztük. A 100 ha-os mintaterület a Szinpetri és Jósvafő községek közötti, erdők által határolt patakvölgyben helyezkedik el.

1991 és 1995 között évről-évre felmértük a kutatási területen fészkelő párok számát, térképeztük revírjeiket, vizsgáltuk fészkelési paramétereiket. Külön vizsgáltuk a fészkelőhely-típusok (patakparti kísérő bokrosok, erdőszéli bokrosok és a nyílt területeken található bokrosok) preferenciáját, és sikerességüket. Ezzel párhuzamosan felmértük a terület használati típusainak (szántó, rét-legelő, műveletlen részek) kiterjedését, figyelmet fordítva a revírek és a fészkek helyének kiválasztására, sikerességére.

A mintaterületen 1991-ben 41 pár, 1992-ben 35 pár, 1993-ban 34 pár, 1994-ben 4o pár és 1995-ben 46 pár R-bS költését regisztráltuk.

A fészkelőhely-típusok vizsgálatánál váltakozó preferencia és sikerességi adatokat kaptunk, azonban a patakparti kísérő társulás kedveltsége volt a legkisebb, mindazok ellenére, hogy általában ez a fészkelőhely biztosította a legnagyobb sikerességet.

A fészkelési sikertelenséget elsősorban a május-június csapadékos időszak, másodsorban a Szajkó (*Garrulus glandarius*) fészekalj-pusztítása okozta. Ezek ellen madaraink második, harmadik sőt esetenként negyedik költési próbálkozással védekeztek, egészen addig, amíg nem jártak sikerrel, vagy "ki nem futottak az időből". A többnapos esők a már kirepült fiókák túlélését (gázolások a közúton, kondició-csökkenés) is veszélyeztették

Until the nineties no noteworthy R-bS research projects have been made in the Carpathian Basin, publication were rather limited to the occasional feeding habits of this species. Only one study dealt with the ecology of the R-bS (Győrfi, 1968) in a more detailed.

In the course of our research we followed the tendency of the breeding birds of R-bS, as the function of the continuously changing land use forms between 1991 and 1995. We have separately analyzed the preferences and successfulness of 3 types of habitats and 3 types of nesting places. We have also attempted to reveal the selection factors influencing the breeding.

Method

We have made our work on the territory of the Aggtelek National Park, in the Jósva-valley. The 100 ha sample area is located in the brook valley surrounded by forests between the villages Szinpetri and Jósvafő. On the above mentioned areas we have surveyed the reviers, nests and

successfulness of the nesting R-bS pairs in 1991, 1992 and 1993 for 8 weeks (June-July). In 1994 our research took only two weeks (June). In 1995 we had the possibility to make a survey of 5 weeks (June). In 1991 and 1992 we have explored the nests of R-bS breeding pairs with systematic investigation, and then we applied only the methods of field wandering and telescope observation. At the places where we did not find the nest of the breeding pair, we established the successfulness of breeding on the basis of the young birds that left the nest.

We have surveyed every year the land use types of the study areas, separating the intensively used plough-lands, the extensively used meadows and pastures, and the uncultivated ruderal areas.

We have distinguished 3 types of nesting places in an empirical way (birds breeding on the trees and in the bushes on the edge of the forest, in the bushes on the bottom of the valley and the R-bS pairs breeding in the accompanying bushes of the brookside.

We have continuously followed the influence of the public road passing through the research area, in particular the running over of young birds by cars, with regard to the R-bS.

We have calculated the meteorological background parameters on the basis of the measurements of the Jósvafő station. Our research project has been made within the framework of the complex nature status survey organized in the territory of the Aggtelek National Park.

Results

We have registered the breed of 41 reviers in 1991, 35 reviers in 1992, 34 reviers in 1993, 40 reviers in 1994 and 46 reviers of R-bS in 1995 on the sample area (Fig. 1).

In the region of the intensively cultivated plough-lands we have noticed the activity of 14 pairs (3 ha/pair) in 1991, later 9 pairs (4.8 ha/pair), 12 pairs (3.7 ha/pair), 15 pairs (2.7 ha/pair) and 15 pairs (2.7 pair/ha). We found the percentage of the successfulness of the known nests in 1991 to be 62%, whereas it was 88% in 1992, 73% in 1993, 53% in 1994 and 60% in 1995 .

In the region of the extensively used meadows, pastures we have observed the activity of 17 (1.2 ha/pair), 15 (2.1 ha/pair), 13 (1.7 ha/pair), 16 (1.0 ha/pair) and 21 pairs (1.1 ha/pair). The percentage of the successfulness of the known nests was 60% in 1991, whereas it was 80% in 1992, 46% in 1993, 31% in 1994 and 47% in 1995.

In the region of the uncultivated ruderal areas covered with dry stalks of weed we have noticed the activity of 10 (3.7 ha/pair), 11 (2.4 ha/pair), 9 (3.8 ha/pair), 9 (4.8 ha/pair) and in 1995 10 pairs (3.5 ha/pair). The percentage of the successfulness of the known nests in 1991 was 64%, and it was 64% in 1992, 89% in 1993, 56% in 1994 and 80% in 1995.

Figure 1.

	Num-ber of rev.	Intensively cultivated plough - land			Extensively used meadows, pastures			Uncultivated ruderal			Precipitation (May - Aug)				
		Area (ha)	*Breed (pair)*	*Succ. (%)*	*Area (ha)*	*Breed (pair)*	*Succ. (%)*	*Area (ha)*	*Breed (pair)*	*Succ (%)*	*May mm*	*Jun mm*	*July mm*	*Aug mm*	*Total mm*
1991	41	42	14	62	21	17	60	37	10	64	85	77	78	83	323
1992	35	43	9	88	31	15	80	26	11	64	14	49	69	9	141
1993	34	44	12	73	22	13	46	34	9	89	56	92	32	34	214
1994	40	40	15	53	16	16	31	43	9	56	98	31	22	84	235
1995	46	41	15	60	23	21	47	35	10	80	52	133	23	103	311

Figure 2.

Year	INTENSYVELY cultivated plough-land		EXTENSIVELY meadows, pastures		UNCULTIVATED ruderal	
	B. pair	Av. ha/pair	B. pair	Av. ha/pair	B. pair	Av. ha/pair
1991	14	3,0	17	1,2	10	3,7
1992	9	4,8	15	2,1	11	2,4
1993	12	3,7	13	1,7	9	3,8
1994	15	2,7	16	1,0	9	4,8
1995	15	2,7	21	1,1	10	3,5

In the course of the examination of nesting places (1991-1992) we have separately evaluated the breed of pairs nesting on the trees and in the bushes on the edge of the forest, in the bushes on the bottom of the valley and in the accompanying bushes of the brookside.

On the research area we have found 45 nests in 1991 (most of them were the 2nd, 3rd and even the 4th attempt), in which 19 hatchings (42%) were successful. On the areas on the edge of forests 16 (36%) attempts were made, and 6 of them (38%) were successful. In the bushes on the bottom of the valley we have noticed 21 (47%) attempts of breeding, and 8 (38%) of them were successful. In the accompanying bushes of the brookside there were 8 (17%) nesting attempts, and 5 (63%) of them were successful. From the 26 unsuccessful nests 12 were destroyed in the stage of construction, 12 after the eggs were laid, and 2 with the young birds inside. The reason of the destruction of the young birds was without exceptions related to summer rainstorms and Jay (Garrulus glandarius) predation.

We have found 61 nests in 1992 (most of them were the 2nd, 3rd and even the 4th attempt), in which 12 hatchings (19 %) were successful. On the areas on the edge of forests 26 (43%) attempts were made, and only 3 of them (12 %) were successful. In the bushes on the bottom of the valley there were 26 (43 %) nests and 6 (23%) of them were successful. In the accompanying bushes of the brookside there were 9 (14%) nesting attempts, and 3 (33%) of them were successful. From the 49 unsuccessful nests 40 were left by the R-bS in the course of the nest construction and 9 nests were destroyed after the eggs had been laid. The destruction of the young birds this year was also due to summer rainstorms and Jay (Garrulus glandarius) predation.

On the public road within the boundaries of the research area we have found 12 birds run over by cars in 1991 and 5 in 1992, which number is, according to our experiences, one third or one fourth of the birds actually killed by vehicles.

Discussion

In each year of the research, grass plots were the most preferred habitats (1.0-2.1 ha/pair). The intensively utilized areas, with the exception of 1992 (4.8 ha/pair) were more preferred (2.7-3.7 ha/pair) than the uncultivated areas, whereas the uncultivated areas were, with the exception of 1992 (2.4 ha/pair) the least preferred (3.5-4.8 ha/pair) (Fig. 2). We attribute the changes of preferences in 1992 and the exceptionally high percentage of success to the low level of precipitation (May-August 141 mm). This is half or two third of the value measured in the other research years (1991-323 mm, 1993-214 mm, 1994-235 mm, 1995-311 mm) (Fig. 1).

After the examination of the types of nesting places we obtained varying results regarding the preferences and successfulness, but the accompanying bushes of the brookside were the least popular, despite of the fact that it was this nesting place that ensured the highest percentage of success.

The unsuccessfulness of nesting was mainly caused jointly by the rainy period between May and June, on the other hand by the destruction of broods by the Jay *(Garrulus glandarius).* Our birds defended themselves against this by attempts of breeding two, three or even four times until the achievement of success, or until they "ran out of time". The rains lasting several days have also threatened the survival of the young birds that have already left the nests (running over on public roads, weakening of condition).

The traffic of vehicles driving on the road and running over the R-bS, in particular the young birds that left the nests has to be mentioned as a significant selection factor. 10-20% of the young birds that left the nest on the nesting area of the Jósva-valley is run over even before starting migration.

Acknowledgement

We want to thank to everybody who helped us in our research. Special thanks to the Aggtelek National Park Directorate, because without its financial and moral support our work could not have been successful, and the OMFB (Budapest) for having supported our attendance at the Symposium.

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SURVEY OF BIRD COMMUNITIES BY REVIER MAPPING IN THE AGGTELEK NATIONAL PARK

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Összefoglaló: Az elmúlt évtizedben számos madárfaj fészkelő állománya jelentős csökkenést mutat. A változások pontos detektálására, a territoriális fajok (pl. énekesmadarak) monitorizálására már 1974-ben javasolta a revírtérképezés alkalmazását az International Bird Census Commitee.
Hazánkban ez a módszer, munkaigényessége miatt sajnos nem terjedt el, noha pontosságának vizsgálata nemcsak külföldön hanem Magyarországon is megtörtént.

Vizsgálatainkat 1993 és 1996 között végeztük a Gömör-Tornai Karszton, az Aggteleki Nemzeti Park területén. A tornanádaskai Alsóhegyen karsztbokorerdő (UTM - DU86D2), a dobódéli Blaskó-völgyben extrazonális bükkös (UTM - DU75D4), a jósvafői Tengerszem oldalon gyertyános-tölgyes (UTM - DU65D2) élőhelyen készítettük felméréseinket.
1993-94-95-96-ban, április-május-június időszakban 9-9 alkalommal, napkeltétől 2-4 órás felmérési időszakban történt az éneklő hímek, fészkelőpárok revírjeinek észlelése. A felmérés során a klasszikus revírtérképezés módszerével, előre kijelölt útvonalat bejárva dolgoztunk.

Az észlelt adatok alapján történő kiértékeléskor territóriumnak tekintettük azokat a területeket, ahol konkrét fészkeléseket észleltünk. Továbbá azokat a területeket, ahol a revírhasználati jelzések (éneklés, revírharc, fészekanyag, kis fiókák stb.), a madarak észlelési időintervallumának legalább 1/3-ra kiterjed.
Azon madarak költőpárjai, melyek csupán részben érintették a területet, csupán 0,5 egységnyi értékkel szerepelnek.

A karsztbokorerdős mintaterületen 1993-ban 34 fajt észleltünk, melyek közül 27 faj, összesen 79 költőpárja fészkelt. 1994-ben 33 fajt észleltünk, melyek közül 27 faj , összesen 96,5 költőpárja fészkelt. 1995-ben 40 fajt észleltünk, melyek közül 27 faj, összesen 82,5 költőpárja fészkelt. 1996-ben 40 fajt észleltünk, melyek közül 25 faj , összesen 77,5 költőpárja fészkelt (1. táblázat).

Az extrazonális bükkös mintaterületen 1993-ban 24 fajt észleltünk, melyek közül 21 faj, összesen 60 költőpárja fészkelt. 1994-ben 30 fajt észleltünk, melyek közül 22 faj , összesen 77 költőpárja fészkelt. 1995-ben 25 fajt észleltünk, melyek közül 17 faj, összesen 51,5 költőpárja fészkelt. 1996-ben 23 fajt észleltünk, melyek közül 18 faj , összesen 67 költőpárja fészkelt (2. táblázat).

A gyertyános-tölgyes mintaterületen 1993-ban 27 fajt észleltünk, melyek közül 22 faj, összesen 66,5 költőpárja fészkelt. 1994-ben 20 fajt észleltünk, melyek közül 19 faj , összesen 61 költőpárja fészkelt. 1995-ben 25 fajt észleltünk, melyek közül 20 faj, összesen 59,5 költőpárja fészkelt. 1996-ben 25 fajt észleltünk, melyek közül 20 faj , összesen 67,5 költőpárja fészkelt (3. táblázat).

Introduction

Populations of several nesting species display a remarkable decline in the last decade. The International Bird Census Commitee (Pinowski-Williamson 1974.) proposed the revier mapping method for the precise detection of these changes as early as in 1974.

Unfortunately this method - demanding much work - did not become widespread in Hungary, although there has been studies to prove its exactness not only abroad (Enemer *et al.*,1976.), but also in Hungary (Moskát 1986.). Despite of these the method was used only in some places and in short term (1-3 years) studies (Moskát 1988, 1990; Füri 1995; Gyurácz 1995.).

Methods

Our studies have been carried out on the area of the Gömör-Torna Karst in the Aggtelek National Park. There were three individual sampling units: Pannonian Karst white oak shrub forests of the Alsóhegy, Tornanádaska (UTM - DU86D2), extrazonal beech stands in the Blaskó Valley, Dobódél (UTM - DU75D4), oak-hornbeam forest near the Tengerszem Pond, Jósvafő (UTM - DU65D2).

The 10 ha large first sampling site at Tornanádaska (4/A) is characterised by a S-SE exposure and also by a mosaic biotope of *Campanulo - Festucetum pallentis* and *Ceraso mahalebeto - Quercetum pubescentis* communities diversified by white oak patches with old (sometimes 80 years) trees.

The second sampling site, Bódvarákó (1/B) was a 86 years old extrazonal beech forest (*Melitti Fagetum*) without othet tree sepcies. It was 10.6 ha large having a N-NW exposure.

The third site (Jósvafő 32/A) can be basicly identified as a 64 years old oak-hornbeam (*Querco petraeae - Carpinetum*) forest, which was 7.8 ha large with a relatively continuous shrub layer in its SW-exposured part, which is not true for the NE one.

Number of singing males and nesting pairs were measured and reviers of the breeding species were mapped each year between 1993 and 1996 (in April, May and June, 9-9 occasions, 2-4 hour sampling periods each) applying the classic revier mapping method, walking all over the formerly defined sampling route.

During data evaluation observations were considered as one territory where breeding was observed or revier-using signs (sing, fight for the revier, nest-material, youngs) were detected at the same site at least for the 1/3 of the sampling period of the given species. Breeding pairs, territory of which has just partly overlapped with the study area were also considered by a 0.5 value.

Results

The number of nesting species and pairs are as follows:
- in the shrub forest biotope: 1993 - altogether 34 species observed, 27 species nesting with 79 pairs; 1994 - 33/27/96,5; 1995 40/27/82,5; 1996 - 40/25/77,5 (Table 1)
- in the extrazonal beech forest: 1993 - altogether 24 species observed, 21 species nesting with 606 pairs; 1994 - 30/22/77; 1995 - 25/17/51,5; 1996 - 23/18/67 (Table 2)
- in the oak-hornbeam biotope: 1993 - altogether 27 species observed, 22 species nesting with 66,5 pairs; 1994 - 20/19/61; 1995 - 25/20/59,5; 1996- 25/20/67,55 (Table 3)

Table 1. Yearly data on the population sizes (breeding pairs) of bird communities in the mosaic-like shrub forest biotope
Alsóhegy (10 ha)

	Species	1993	1994	1995	1996
1.	Phasianus colchicus			0	0
2.	Tetrastes bonasia		0		
3.	Streptopelia turtur	1	3	2	2
4.	Caprimulgus europaeus	1	2	0,5	0
5.	Upupa epops	1	1+3x0,5	2	1
6.	Jynx torquilla	3	3	1+2x0,5	0,5
7.	Dendrocopos major	1		1	1
8.	Lullula arborea	1	1+0,5	1	0,5
9.	Oriolus oriolus	1	1		1
10.	Garrulus glandarius	1	1	1	
11.	Parus major	7	7,5	6	4+3x0,5
12.	Parus caeruleus	2	1	1	0
13.	Parus ater			0	1
14.	Parus palustris	1	2	0,5	0
15.	Parus montanus	0			
16.	Aegithalos caudatus	1	1	2	1
17.	Sitta europaea	0	1	0	0
18.	Certhia familiaris				0
19.	Troglodytes troglodytes				0
20.	Turdus viscivorus			0	
21.	Turdus philomelos	1	1	0	1
22.	Turdus merula	4+0,5	5+2x0,5	4+0,5	5+0,5
23.	Phoenicurus ochruros	0			0
24.	Luscinia megarhynchos	1	0	1	0
25.	Erithacus rubecula	7	10	6	10+0,5
26.	Sylvia atricapilla	5	7	5+0,5	5
27.	Sylvia curruca	4	2+2x0,5	4	4
28.	Sylvia communis			2	
29.	Sylvia borin			0	
30.	Sylvia nisoria	0			
31.	Phylloscopus trochilus	5+0,5	6+0,5	4+0,5	3

	Species	1993	1994	1995	1996
32.	Phylloscopus collybita	9+0,5	5+3x0,5	3	6+0,5
33.	Phylloscopus sibilatrix		0	0	0
34.	Regulus regulus	0		0	0
35.	Muscicapa striata	1	0	0	2
36.	Ficedula hypoleuca		0		0
37.	Prunella modularis				0
38.	Anthus trivialis			0	0
39.	Lanius collurio	0	2	3	2+0,5
40.	Sturnus vulgaris			0	0
41.	Pastor roseus			0	
42.	Coccothraustes coccothraustes	? (0)	1	2	3
43.	Carduelis chloris	3+2x0,5	4	3	2
44.	Carduelis carduelis	0,5	3	3	1
45.	Carduelis cannabina	3	3	5+0,5	4+0,5
46.	Serinus serinus		0	0	
47.	Fringilla coelebs	2	4+0,5	4+0,5	3
48.	Emberiza citrinella	2	3	4+2x0,5	4
49.	Emberiza cia	8	9,5	6+2x0,5	6+0,5
		34/27-79	33/27-96,5	40/27-82,5	40/25-77,5
	Passer montanus		3	1	many

Table 2. Yearly data on the population sizes (breeding pairs) of bird communities in the extrazonal beech forest biotope **Dobódél (10,6 ha)**

	Species	1993	1994	1995	1996
1.	Columba oenas	1	0	0	1
2.	Jynx torquilla		1		
3.	Picus canus	1	0	0	1
4.	Dendrocopos major	1	1	1	3
5.	Dendrocopos minor	0	1		1
6.	Oriolus oriolus		0	0	
7.	Garrulus glandarius	0		0	0
8.	Parus major	6+0,5	6+6x0,5	6+0,5	7+0,5
9.	Parus caeruleus	3	3	3+0,5	6+3x0,5
10.	Parus ater	2+0,5	3+6x0,5	3	4
11.	Parus montanus	1	1 fele P.p		
12.	Parus palustris	2	1	1	0
13.	Sitta europaea	3	3+2x0,5	4	3+0,5
14.	Certhia familiaris		0		0
15.	Troglodytes troglodytes	1	0	1	
16.	Turdus philomelos		0	0	
17.	Turdus merula	1+2x0,5	3	1+2x0,5	3
18.	Erithacus rubecula	7	10	7+2x0,5	6+2x0,5
19.	Sylvia atricapilla	3	3	2	1
20.	Phylloscopus collybita	1		0	
21.	Phylloscopus sibilatrix	3	5+0,5	1+0,5	5

	Species	1993	1994	1995	1996
22.	Muscicapa striata		0	1	1
23.	Ficedula parva	1	1		
24.	Ficedula albicollis	7	8+2x0,5	5+2x0,5	8
25.	Anthus trivialis	0	1	0	0
26.	Sturnus vulgaris		2	2+0,5	2+0,5
27.	Passer montanus		1		
28.	Coccothraustes coccothraustes	6	6+0,5	3	5
29.	Carduelis chloris	1	1	0	0
30.	Carduelis carduelis	0,5	1	1	1
31.	Fringilla coelebs	5+3x0,5	5+2x0,5	4+0,5	5
32.	Emberiza citrinella		0		
		24/21-60	30/22-77	25/17-51,5	23/18-67

Table 3. Yearly data on the population sizes (breeding pairs) of bird communities in the oak-hornbeam forest biotope **Tengerszem-tó (7,8 ha)**

	Species	1993	1994	1995	1996
1.	Picus canus				0
2.	Dendrocopos major	1	2	2	2
3.	Dendrocopos medius	1	1		
4.	Dendrocopos minor	1			
5.	Oriolus oriolus				1
6.	Garrulus glandarius	2		0	1
7.	Parus major	7	8+2x0,5	7+0,5	4
8.	Parus caeruleus	3	6+2x0,5	6+0,5	5+2x0,5
9.	Parus ater	2	1	0	1
10.	Parus palustris	2	1	1	1
11.	Aegithalos caudatus	1		0,5	1
12.	Sitta europaea	3	3	2+2x0,5	2+0,5
13.	Certhia familiaris	2	1	1	2
14.	Troglodytes troglodytes	2	0,5	2x0,5	0
15.	Turdus philomelos	2	1	1	2
16.	Turdus merula	3	4+3x0,5	1+2x0,5	2+0,5
17.	Phoenicurus ochruros	0			
18.	Erithacus rubecula	6	7+3x0,5	5+2x0,5	9+0,5
19.	Sylvia atricapilla	4	2	4+0,5	2+0,5
20.	Sylvia curruca	1	1		0
21.	Phylloscopus collybita	2x0,5	1	3	3+3x0,5
22.	Phylloscopus sibilatrix	6	5	5	7
23.	Muscicapa striata				1
24.	Ficedula albicollis	3	1	2	1+0,5
25.	Ficedula hypoleuca	0			
26.	Motacilla alba			1	
27.	Motacilla cinerea			1	
28.	Sturnus vulgaris			0	
29.	Passer montanus			0	

	Species	1993	1994	1995	1996
30.	Passer domesticus	0			
31.	Coccothraustes coccothraustes	5	5	3	7+3x0,5
32.	Carduelis chloris	0	0	2	0
33.	Carduelis carduelis	0			0
34.	Carduelis cannabina			0	
35.	Fringilla coelebs	7	5+0,5	6+0,5	5+4x0,5
		27/22-66,5	20/19-61	25/20-59,5	25/20-67,5

Table 4. Population data of the studied bird communities at the different sampling sites

Sampling site	1993	1994	1995	1996
Alsóhegy - 10 ha	34/27- 79	33/27- 96,5	40/27- 82,5	40/25- 77,5
Dobódél - 10,6 ha	24/21- 60	30/22- 77	25/17- 51,5	23/18- 67
Tengerszem - 7,8 ha	27/22- 66,5	20/19- 61	25/20- 59,5	25/20- 67,5

Discussion

Data gained are only comparable with themselves in time. Studies carried out on different locations are not comparable neither in the case of biotopes of a similar type and having identical sampler.

It is not reliable to have general conclusions from our dataset. More detailed data processing has no reason because of the short sampling period and the fluctuations in the population sizes (Table 4). The population size of most of the bird species fluctuates around an average and changes are only detectable after a longer period (10 years as a minimum) (Waliczky 1991).

For a more accurate measurement of population changes it would be necessary to carry out precise inventories, monioring studies with the territory mapping method all over the country.

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RESTRICTION OF FORESTRY IN THE MAIN FOREST TYPES OF THE AGGTELEK NATIONAL PARK, BASED ON THE SURVEY OF NESTING BIRD COMMUNITIES

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Összefoglaló: Az Aggteleki Nemzeti Park teljes területének - természetföldrajzi fekvéséből következően - 75,8 %-a erdő.
Noha az erdős területek közel 90%-a állami tulajdonban vannak, s a szövetkezeti, önkormányzati és magántulajdonban levő erdők aránya elenyésző, a védett terület nagyrészén nyereségorientált erdőgazdálkodás folyik. (Az ANP hosszú távú kezelési koncepciója ezt először a természetvédelem igényei szerint működő erdőgazdálkodással váltaná fel, melyet később az erdőgazdálkodási tevékenységek teljes felfüggesztése követne.)
Az Aggteleki Nemzeti Park Igazgatóság mint szakhatóság, a jogszabályok adta kereteken belül tudja az erdőgazdálkodási tevékenységeket térben és időben, valamint erdészeti módszereiben korlátozni, szabályozni.
Az Aggteleki Nemzeti Park területén, különféle módszerekkel (fészek- és revírtérképezések, pontszámlálások, ritka madárfajok állományváltozásának vizsgálata, ornithofaunisztikai adatok stb.), 1986-tól folynak ornithológiai vizsgálatok. Ezen kutatások adatait és tapasztalatait felhasználva kerültek összeállításra, a Karszt legjellemzőbb erdőtipusaiban (bükkösök és elegyes bükkösök, fenyvesek és elegyes fenyvesek, gyertyános-tölgyesek valamint a melegkedvelő- és cseres-tölgyesek) fészkelő madárközösségek fajlistái. Emellett részletezésre kerültek az érintett madárfajok - a területre jellemző - átlagos denzitási, költési- és fészekaljszámbeli, valamint a költési időintervallumra vonatkozó paraméterei.
Bizonyos speciális igényű (fészkelő-, táplálkozó-, élőhely) fajok, különösen a ritka, fokozottan védett madarak, (ragadozómadarak, baglyok, császármadár, fehérhatú fakopáncs) alkalmi, lokális előfordulásúak. Ezekben az esetekben a természetvédelmi szempontból legértékesebb fajok zavartalanságát kell biztosítani, s az érintett területen, akár hosszútávra is, minden erdőgazdálkodás tevékenység felfüggesztése is szükségessé válhat.
A listákat áttekintve, összességében megállapíthatjuk, hogy egyes speciális esetek kivételével (*Corvus corax, Aquila heliaca, Strix uralensis* stb. fészkelése esetén), általában március 15. és július 31. között szükséges a védett területeken zajló erdőgazdálkodási tevékenység időbeli tiltása.
Fenti listák alapján, a terepi ismeretek segítségével tudja az Aggteleki Nemzeti Park Igazgatóság, mint a védett terület természetvédelmi hatósága (az Erdőfelügyelőség szakhatóságaként), térben és időben korlátozni a nyereségorientált erdőgazdálkodót, megakadályozva - többek között - a listákon bemutatott értékek pusztulását.

As a consequence of its geographical situation, 75.8 % of the total area of the Aggtelek National Park is covered by forests:

1. Submontaneous beech (*Melitti - Fagetum*)	1634,9 ha	11,1 %
2. Oak-hornbeam (*Querco petraeae - Carpinetum*)	10154,5 ha	68,6 %
3. Sessile-Turkey oak (*Quercetum petraeae - cerris*)	619,8 ha	4,2 %
4. Linden-ash (*Tilio - Fraxinetum*)	126,0 ha	0,9 %

5. Limestone-gorge forest (*Phyllitidi - Aceretum*)	13,1 ha	0,1 %
6. Thermophilous oak (*Corno - Quercetum*)	1602,9 ha	10,8 %
7. Karstic shrub-forest (*Ceraso - Quercetum pubescentis*)	612,7 ha	4,1 %
8. Alder forest (*Alnetum glutinosae*)	30,0 ha	0,2 %
9. Willow forest (*Salicetum albae - fragilis*)	1,7 ha	0,0(1) %
Total:	14795,6 ha	100,0 %

Although as much as 90 % of the forested areas is state-owned, thus the proportion of other owners (collective farms, municipalities, private owners) is insignificant, it is still the profit oriented forest management which is dominating on protected areas. (By the long term management strategy of the ANP this would be replaced first by a forestry practice, which serves nature conservation purposes, and later even this kind of activity should be given up).

The Aggtelek National Park Directorate can restrict and regulate forestry activity in time, space and methodology as an authority, using relevant legislation tools.

Bird communities of the Aggtelek National Park area are studied since 1986 with various sampling methods (nest, revier and point mapping, measurement of changes in the population size of the different species, ornithofaunistical studies, etc.).

Based on the data and experience of these studies species lists of nesting bird communities of the different biotope types (beech and mixed beech, pure and mixed pine, oak-hornbeam, thermophilous and sessile-Turkey oak forests) have been compiled. (Table 1-5.)

Besides this, for species characteristic of the area parameters of average density, nesting, clutch and breeding period are given in detail. Some species of special environmental demands (nesting, feeding, biotope), especially the rare, strictly protected species (raptors, owls, Hazel Grouse, White-backed Woodpecker) occur accidentally or locally. In these cases it is required to assure imperturbability of the most valuable species and on these areas it could be necessary to give up with all the forestry activities even for the long term.

Overviewing the tables one can state in general that except for some special cases (nesting of *Corvus corax, Aquila heliaca, Strix uralensis*, etc.) it is necessary to prohibit forestry activitiy on protected areas in time, between 15 March and 31 July.

Based on these lists, the Aggtelek National Park Directorate, as an authority responsible for nature conservation (special authorithy for the Forestry Inspectorates), is capable to restrict the profit-oriented forestry activities in time and space, preventing - among others - the destruction of natural values enumerated on the lists.

Table1-5. Data of nesting - protected and strictly protected - bird species occur in the different forest types of Aggtelek National Park

Table 1. Beech and mixed beech forests

Species	Months III. IV. V. VI. VII. VIII.	Theoretical value	No. of breeding/ Av. nestling no.	Density pair/10ha
Buteo buteo		10.000 Ft	1/3	accidental
Accipiter gentilis		10.000 Ft	1/3	accidental
Columba oenas		50.000 Ft	6/2	1-2
Streptopelia turtur		10.000 Ft	2/2	1-3
Strix aluco		10.000 Ft	1/4	accidental
Asio otus		10.000 Ft	1/5	accidental
Jynx torquilla		10.000 Ft	1/9	1-5
Picus viridis		10.000 Ft	1/6	1
Picus canus		50.000 Ft	1/6	1
Dryocopus martius		50.000 Ft	1/5	1
D. minor		10.000 Ft	1/6	1-3
D. major		10.000 Ft	1/5	2-5
D. medius		50.000 Ft	1/5	1-2
T. troglodytes		2.000 Ft	2/7	1-3
Prunella modularis		10.000 Ft	2/5	1-3
E. rubecula		2.000 Ft	2/7	1-15
L. megarhynchos		10.000 Ft	2/5	1-3
Muscicapa striata		2.000 Ft	1/5	1-2
F. albicollis		10.000 Ft	1/6	1-10
Ficedula parva		50.000 Ft	1/6	1-2
Turdus philomelos		2.000 Ft	2/5	2-5
Turdus merula		2.000 Ft	2/5	2-10
Ph. collybita		2.000 Ft	2/6	2-4
Ph. sibilatrix		2.000 Ft	1/6	1-10
Sylvia atricapilla		2.000 Ft	2/5	5-10
Ae. caudatus		2.000 Ft	1/10	1-3
Parus palustris		2.000 Ft	1-(2)/10	2-3
Parus ater		2.000 Ft	2/8	2-8
Parus caeruleus		2.000 Ft	2/12	2-8
Parus montanus		2.000 Ft	2/8	1-3
Parus major		2.000 Ft	2/10	1-15
Sitta europaea		2.000 Ft	2/8	2-3
Certhia familiaris		2.000 Ft	2/6	1-3
Fringilla coelebs		2.000 Ft	2/5	5-10
C. coccothraustes		2.000 Ft	2/5	2-8
Carduelis carduelis		2.000 Ft	2/5	1-8
Carduelis chloris		2.000 Ft	2/5	1-8
Pyrrhula pyrrhula		10.000 Ft	2/5	1-2
Corvus corax		50.000 Ft	1/4	accidental
Aquila pomarina		250.000 Ft	1/1	accidental
Tetrastes bonasia		250.000 Ft	1/9	accidental
D. leucotos		100.000 Ft	1/5	1
Ciconia nigra		250.000 Ft	1/4	accidental
Aquila heliaca		500.000 Ft	1/2	accidental
Strix uralensis		100.000 Ft	1/4	accidental

Table 2. Mixed pine forests

Species	Months III. IV. V. VI. VII. VIII.	Theoretical value	No. of breeding/ Av. nestling no.	Density pair/10ha
Buteo buteo		10.000 Ft	1/3	accidental
Accipiter gentilis		10.000 Ft	1/3	accidental
Accipiter nissus		10.000 Ft	1/5	accidental
Columba oenas		50.000 Ft	6/2	1-2
Streptopelia turtur		10.000 Ft	2/2	1-3
Strix aluco		10.000 Ft	1/4	accidental
Asio otus		10.000 Ft	1/5	accidental
Picus viridis		10.000 Ft	1/6	1
Picus canus		50.000 Ft	1/6	1
Dryocopus martius		50.000 Ft	1/5	1
D. minor		10.000 Ft	1/6	1-3
D. major		10.000 Ft	1/5	2-5
D. medius		50.000 Ft	1/5	1-2
A. trivialis		2.000 Ft	2/5	1-2
T. troglodytes		2.000 Ft	2/7	1-3
Prunella modularis		10.000 Ft	2/5	1-3
E. rubecula		2.000 Ft	2/7	1-15
F. albicollis		10.000 Ft	1/6	1-10
Ficedula parva		50.000 Ft	1/6	1-2
Turdus philomelos		2.000 Ft	2/5	2-5
Turdus viscivorus		10.000 Ft	2/5	1-2
Turdus merula		2.000 Ft	2/5	2-10
Ph. collybita		2.000 Ft	2/6	2-4
Ph. sibilatrix		2.000 Ft	1/6	1-10
Sylvia atricapilla		2.000 Ft	2/5	5-10
Regulus regulus		10.000 Ft	2/10	1-2
Ae. caudatus		2.000 Ft	1/10	1-3
Parus palustris		2.000 Ft	1-(2)/10	2-3
Parus cristatus		10.000 Ft	2/6	2-3
Parus ater		2.000 Ft	2/8	2-8
Parus caeruleus		2.000 Ft	2/12	2-8
Parus montanus		2.000 Ft	2/8	1-3
Parus major		2.000 Ft	2/10	1-15
Sitta europaea		2.000 Ft	2/8	2-3
Certhia familiaris		2.000 Ft	2/6	1-3
Fringilla coelebs		2.000 Ft	2/5	5-10
Emberiza citrinella		2.000 Ft	2/5	2
C. coccothraustes		2.000 Ft	2/5	2-8
Carduelis carduelis		2.000 Ft	2/5	1-8
Carduelis chloris		2.000 Ft	2/5	1-8
Pyrrhula pyrrhula		10.000 Ft	2/5	1-2
Loxia curvirostra		10.000 Ft	2/4	1-2
Corvus corax		50.000 Ft	1/4	accidental
Aquila pomarina		250.000 Ft	1/1	accidental
Tetrastes bonasia		250.000 Ft	1/9	accidental
D. leucotos		100.000 Ft	1/5	1
Ciconia nigra		250.000 Ft	1/4	accidental
Aquila heliaca		500.000 Ft	1/2	accidental
Strix uralensis		100.000 Ft	1/4	accidental

Table 3. Pure pine forests

Species	Months III. IV. V. VI. VII. VIII.	Theoretical value	No. of breeding/ Av. nestling no.	Density pair/10ha
Buteo buteo		10.000 Ft	1/3	accidental
Accipiter gentilis		10.000 Ft	1/3	accidental
Accipiter nissus		10.000 Ft	1/5	accidental
Streptopelia turtur		10.000 Ft	2/2	1-3
Strix aluco		10.000 Ft	1/4	accidental
Asio otus		10.000 Ft	1/5	accidental
Picus canus		50.000 Ft	1/6	1
Dryocopus martius		50.000 Ft	1/5	1
D. minor		10.000 Ft	1/6	1-3
D. major		10.000 Ft	1/5	2-5
D. medius		50.000 Ft	1/5	1-2
T. troglodytes		2.000 Ft	2/7	1-3
Prunella modularis		10.000 Ft	2/5	1-3
E. rubecula		2.000 Ft	2/7	1-15
Turdus philomelos		2.000 Ft	2/5	2-5
Turdus merula		2.000 Ft	2/5	2-10
Ph. collybita		2.000 Ft	2/6	2-4
Ph. sibilatrix		2.000 Ft	1/6	1-10
Sylvia atricapilla		2.000 Ft	2/5	5-10
Regulus regulus		10.000 Ft	2/10	1-2
Ae. caudatus		2.000 Ft	1/10	1-3
Parus palustris		2.000 Ft	1-(2)/10	2-3
Parus cristatus		10.000 Ft	2/6	1-2
Parus ater		2.000 Ft	2/8	2-8
Parus caeruleus		2.000 Ft	2/12	2-8
Parus montanus		2.000 Ft	2/8	1-3
Parus major		2.000 Ft	2/10	1-15
Sitta europaea		2.000 Ft	2/8	2-3
Certhia familiaris		2.000 Ft	2/6	1-3
Fringilla coelebs		2.000 Ft	2/5	5-10
C. coccothraustes		2.000 Ft	2/5	2-8
Carduelis carduelis		2.000 Ft	2/5	1-8
Carduelis chloris		2.000 Ft	2/5	1-8
Pyrrhula pyrrhula		10.000 Ft	2/5	1-2
Loxia curvirostra		10.000 Ft	2/4	1-2
Corvus corax		50.000 Ft	1/4	accidental
Aquila pomarina		250.000 Ft	1/1	accidental
Tetrastes bonasia		250.000 Ft	1/9	accidental
Ciconia nigra		250.000 Ft	1/4	accidental
Aquila heliaca		500.000 Ft	1/2	accidental
Strix uralensis		100.000 Ft	1/4	accidental

Table 4. Oak-hornbeam forests

Species	Months III. IV. V. VI. VII. VIII.	Theoretical value	No. of breeding/ Av. nestling no.	Density pair/10ha
Pernis apivorus		50.000 Ft	1/2	accidental
Buteo buteo		10.000 Ft	1/3	accidental
Accipiter gentilis		10.000 Ft	1/3	accidental
Accipiter nissus		10.000 Ft	1/5	accidental
Columba oenas		50.000 Ft	6/2	1-2
Streptopelia turtur		10.000 Ft	2/2	1-3
Strix aluco		10.000 Ft	1/4	accidental
Asio otus		10.000 Ft	1/5	accidental
Jynx torquilla		10.000 Ft	1/9	1-5
Picus viridis		10.000 Ft	1/6	1
Picus canus		50.000 Ft	1/6	1
Dryocopus martius		50.000 Ft	1/5	1
D. minor		10.000 Ft	1/6	1-3
D. major		10.000 Ft	1/5	2-5
D. medius		50.000 Ft	1/5	1-2
A. trivialis		2.000 Ft	2/5	1-2
T. troglodytes		2.000 Ft	2/7	1-3
Prunella modularis		10.000 Ft	2/5	1-3
E. rubecula		2.000 Ft	2/7	1-15
L. megarhynchos		10.000 Ft	2/5	1-3
Muscicapa striata		2.000 Ft	1/5	1-2
F. albicollis		10.000 Ft	1/6	1-10
Ficedula parva		50.000 Ft	1/6	1-2
Turdus philomelos		2.000 Ft	2/5	2-5
Turdus merula		2.000 Ft	2/5	2-10
Ph. collybita		2.000 Ft	2/6	2-4
Ph. sibilatrix		2.000 Ft	1/6	1-10
Sylvia atricapilla		2.000 Ft	2/5	5-10
Sylvia curruca		2.000 Ft	1/5	2-5
Ae. caudatus		2.000 Ft	1/10	1-3
Parus palustris		2.000 Ft	1-(2)/10	2-3
Parus ater		2.000 Ft	2/8	2-8
Parus caeruleus		2.000 Ft	2/12	2-8
Parus montanus		2.000 Ft	2/8	1-3
Parus major		2.000 Ft	2/10	1-15
Sitta europaea		2.000 Ft	2/8	2-3
Certhia familiaris		2.000 Ft	2/6	1-3
Fringilla coelebs		2.000 Ft	2/5	5-10
Emberiza citrinella		2.000 Ft	2/5	2
C. coccothraustes		2.000 Ft	2/5	2-8
Carduelis carduelis		2.000 Ft	2/5	1-8
Carduelis chloris		2.000 Ft	2/5	1-8
Pyrrhula pyrrhula		10.000 Ft	2/5	1-2
Corvus corax		50.000 Ft	1/4	accidental
Aquila pomarina		250.000 Ft	1/1	accidental
Tetrastes bonasia		250.000 Ft	1/9	accidental
D. leucotos		100.000 Ft	1/5	1
Ciconia nigra		250.000 Ft	1/4	accidental
Aquila heliaca		500.000 Ft	1/2	accidental
Strix uralensis		100.000 Ft	1/4	accidental

Table 5. Thermophilous and sessile-Turkey oak forests

Species	Months III. IV. V. VI. VII. VIII.	Theoretical value	No. of breeding/ Av. nestling no.	Density pair/10ha
Pernis apivorus		50.000 Ft	1/2	accidental
Buteo buteo		10.000 Ft	1/3	accidental
Accipiter gentilis		10.000 Ft	1/3	accidental
Streptopelia turtur		10.000 Ft	2/2	1-3
Strix aluco		10.000 Ft	1/4	accidental
Asio otus		10.000 Ft	1/5	accidental
Upupa epops		50.000 Ft	2/6	1
Jynx torquilla		10.000 Ft	1/9	1-5
Picus viridis		10.000 Ft	1/6	1
Picus canus		50.000 Ft	1/6	1
Dryocopus martius		50.000 Ft	1/5	1
D. minor		10.000 Ft	1/6	1-3
D. major		10.000 Ft	1/5	2-5
D. medius		50.000 Ft	1/5	1-2
A. trivialis		2.000 Ft	2/5	1-2
T. troglodytes		2.000 Ft	2/7	1-3
E. rubecula		2.000 Ft	2/7	1-15
L. megarhynchos		10.000 Ft	2/5	1-3
Muscicapa striata		2.000 Ft	1/5	1-2
F. albicollis		10.000 Ft	1/6	1-10
Turdus philomelos		2.000 Ft	2/5	2-5
Turdus viscivorus		10.000 Ft	2/5	1-2
Turdus merula		2.000 Ft	2/5	2-10
Ph. collybita		2.000 Ft	2/6	2-4
Ph. sibilatrix		2.000 Ft	1/6	1-10
Ph. trochilus		2.000 Ft	1/6	2-5
Sylvia atricapilla		2.000 Ft	2/5	5-10
Sylvia borin		2.000 Ft	2/5	1-2
Sylvia curruca		2.000 Ft	1/5	2-5
Ae. caudatus		2.000 Ft	1/10	1-3
Parus ater		2.000 Ft	2/8	2-8
Parus caeruleus		2.000 Ft	2/12	2-8
Parus major		2.000 Ft	2/10	1-15
Sitta europaea		2.000 Ft	2/8	2-3
Certhia familiaris		2.000 Ft	2/6	1-3
Oriolus oriolus		10.000 Ft	1/4	1-2
Lanius collurio		10.000 Ft	1/5	1-5
Fringilla coelebs		2.000 Ft	2/5	5-10
Emberiza citrinella		2.000 Ft	2/5	2
C. coccothraustes		2.000 Ft	2/5	2-8
Carduelis carduelis		2.000 Ft	2/5	1-8
Carduelis chloris		2.000 Ft	2/5	1-8
Corvus corax		50.000 Ft	1/4	accidental
Aquila pomarina		250.000 Ft	1/1	accidental
Tetrastes bonasia		250.000 Ft	1/9	accidental
D. leucotos		100.000 Ft	1/5	1
Ciconia nigra		250.000 Ft	1/4	accidental
Aquila heliaca		500.000 Ft	1/2	accidental
Strix uralensis		100.000 Ft	1/4	accidental

MONITORING AND CONSERVATION OF HOUSE-DWELLING BAT COLONIES IN THE ADMINISTRATIVE AREA OF AGGTELEKI NATIONAL PARK

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Összefoglaló: Az Aggteleki Nemzeti Park hatósági területén (Észak-Magyarország) 1994-95-ben épületlakó denevérfajok állományainak feltérképezését végeztük egy hatékony védelmi program megalapozásaként. A vizsgálatok során 48 település 60 épülete került felmérésre. A cikk ismerteti 7 bizonyított denevérfaj (*Rhinolophus hipposideros, Rhinolophus ferrumequinum, Myotis blythi, Myotis emarginatus, Myotis dasycneme, Eptesicus serotinus, Plecotus austriacus*) helyzetét és a védelmére és a szaporodó helyek megőrzésére tett kisérletek eredményeit.

Abstract: The paper is about the results of bat-fauna monitoring work done by the authors in buildings on the area of the Aggtelek National Park (North-Hungary) during 1994-95. The research was carried out in 60 buildings of 48 settlements. The paper is about the ocurrence of 7 bat species: *Rhinolophus hipposideros, Rhinolophus ferrumequinum, Myotis blythi, Myotis emarginatus, Myotis dasycneme, Eptesicus serotinus, Plecotus austriacus.* The paper presents the location, composition of species and size of house-dwelling colonies living in the area of ANP. It also describes the endangering factors and actions for protection.

Introduction

The general degradation of nature is a world-wide phenomenon and we have to feel urged to gather the most possible pieces of information. Biomonitoring helps us to work out proper nature conservation strategies, but there is a basic requirement to survey the size of populations and the changes of individuals in number.

Bats are endangered in every respect, their populations have gone through serious changes for the worse for the past decades. It means that human interference have become more and more determining in the direction of natural processes. The occurrence of some species in artificial buildings is particularly high, so these populations are even more affected by anthropogenic influences. During our study we were aiming at examining the factors which result in high endangerment due to special features of the habitats. On the other hand, we have surveyed the size and the species of the populations.

Material and Methods

The project was completed between 1994 and 1995 relying on the monitoring scheme of previous years (ifj. Boldogh 1995, Bihari & Gombkötő 1993). The target area is supervised by th Aggtelek National Park (Fig. 1).

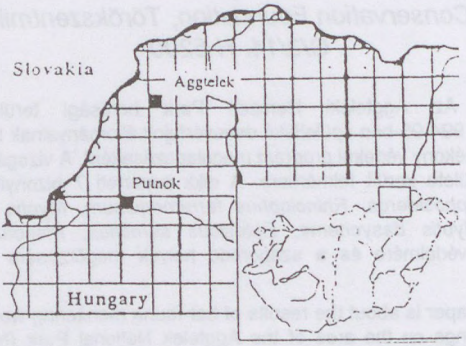


Fig. 1. The research area

The area is rich in surface forms resulting in a diverse meso- and microclimate. The plants and animals of northern slopes and basins show a connection with the Carpatians, whereas southern slopes and basins show the characteristics of the Pannonian region. Most of the villages studied are situated in river valleys, where mostly arable land has replaced the natural vegetation.

The basis of the study was the survey of church buildings at 48 villages (even more than once a year). Besides this, other buildings (manor-houses, gamekeeper's lodges etc.) have been studied, thus altogether 68 buildings have been checked.

The two following aims of the work can be defined:
- the survey of the populations
- habitat maintenance and protection

Results

The survey of the populations

Based on the results of the projects of previous years, the location of the populations of different species have been specified. A special attention has been paid to the definition of different demands of the different species as far as habitat is concerned and to elaborate different protection strategies.

Lesser horseshoe bat (*Rhinolophus hipposideros*)

This is the most frequently found species in the buildings of the area (Fig. 2). The third of the data concerning the presence of bats in buildings in the region authorised by the Aggtelek National Park was about this species. It was found in 17 buildings during the last two years.

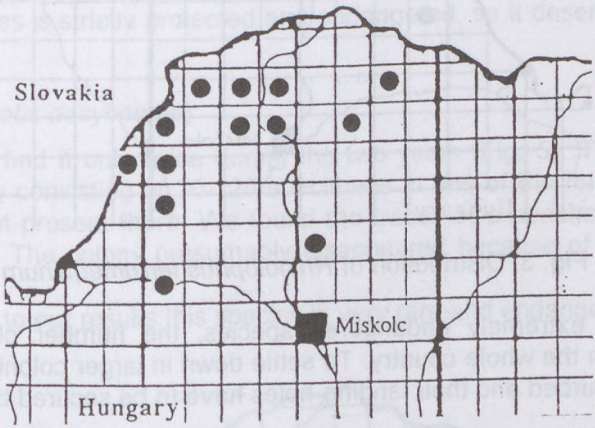


Fig. 2. Distribution of *Rhinolophus hipposideros*

The species had been recorded in four of these buildings during earlier surveys (ifj. Boldogh 1995; Szentgyörgyi *et al.* 1993), and in three of these four it was found again. In four cases, a decrease of the number of individuals was detected, in one case, there was no change, and there are yet another three cases where even increase was recorded, compared to the previous year data. In one of the latest category a population of ten had increased to thirty or forty and in other from eighty to a hundred and twenty. The species lives in small groups, which rarely counts more than ten-fifteen individuals. Besides these smaller populations some larger colonies can find safe breeding sites.

The colonies strictly stick to their residential places. To secure the existing landing-holes is an important task in their protection. Endangered species.

Greater horseshoe bat (*Rhinolophus ferrumequinum*)

It was recorded in surprisingly few, altogether 9 buildings during the survey, and even here only few (1-5) individuals, probably males were found (Fig. 3). They were found in the same building only twice during the study.

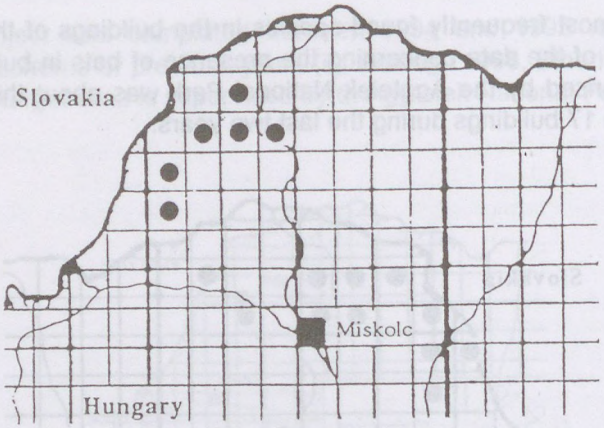


Fig. 3. Distribution of *Rhinolophus ferrumequinum*

It is an extremely endangered species, the number of colonies is decreasing in the whole country. To settle down in larger colonies they need to live undisturbed and their landing-holes have to be secured by all means.

Geoffroy's bat (*Myotis emarginatus*)

Some greater colonies are known in the area. (Fig. 4) A colony of 90 and another of 1.200 individuals were found in 1994 but they vanished by next year for an unknown reason.

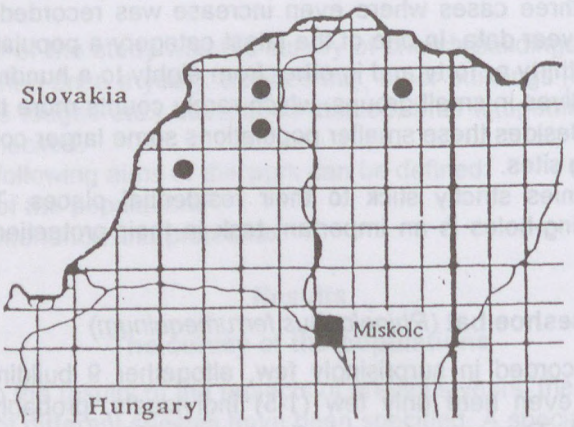


Fig. 4. Distribution of *Myotis emarginatus*

These colonies had been discovered earlier by ifj. Boldogh 1995, Szentgyörgyi *et al.* 1994. In three further habitats populations of 100, 120 and 200 have been found.

In the light of the results of earlier studies the yearly dynamics of the colonies is varied. The unsystematic changes in the number of specimens was experienced in the surroundings of Bükk-mountains as well. Unfortunately we do not know the causes of this drastic decrease.

This species is strictly protected and endangered, so it deserves special attention.

Pond bat (*Myotis dasycneme*)

We could find it only twice during the two years (Fig. 5). There was a nursery colony consisting of 70-120 specimens in one of the habitats. Next year it was not present there. We found the traces of a perished colony in another roost. The colony presumably disappeared because of a barn owl (*Tyto alba*).

According to our results this species is very rare and endangered.

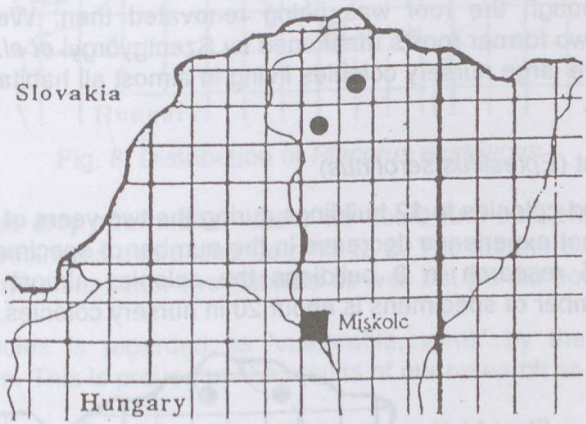


Fig. 5. Distribution of *Myotis dasycneme*

Lesser and greater mouse-eared bat (*Myotis blythi* and *M. myotis*)

We suppose that these two species can be found together, although we did not find mixed colonies in the examined churches. Dead specimens and those we kept in hand were lesser mouse-eared bats (*M. blythi*).

We found them in 9 buildings during the two years, in 5 buildings large colonies (consisting of 60-350 specimens) lived (Fig. 6). There is data of appearance which is absolutely surprising. In case of 2 colonies the number of specimens decreased from 250 to 220 and 200 to 120.

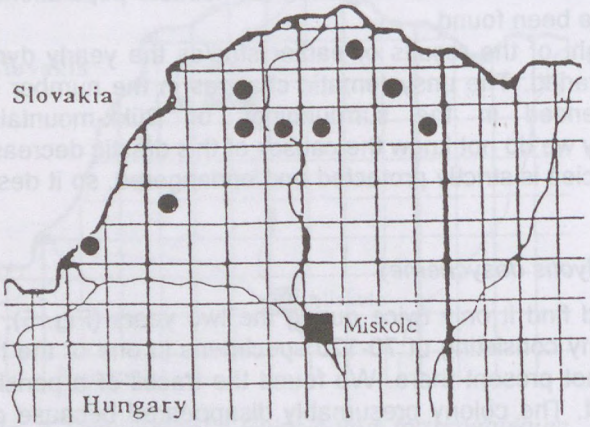


Fig. 6. Distribution of *Myotis blythi* et *myotis*

The number of specimens in another colony doubled (it counted 120 animals), though the roof was being renovated then. We did not find colonies in two former roosts mentioned by Szentgyörgyi *et al.* 1993.

There are large nursery colonies living in almost all habitats, so it is less endangered.

Serotine bat (*Eptesicus serotinus*)

We found colonies in 12 buildings during the two years of research (Fig. 7). We did not experience decrease in the number of specimens. According to the 1995 research in 3 buildings the colonies almost doubled. The average number of specimens is about 20 in nursery colonies.

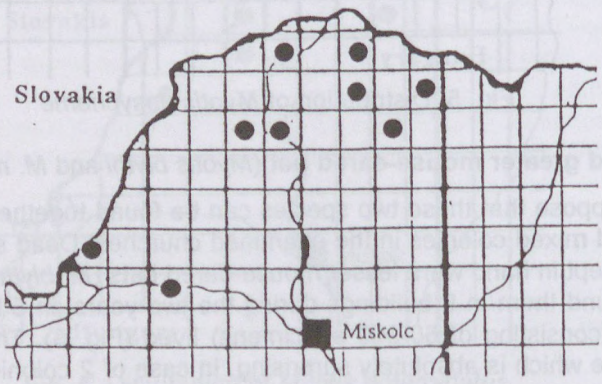


Fig. 7. Distribution of *Eptesicus serotinus*

This species is very flexible so it is not under direct threat. In order to protect it we have to preserve its feeding areas.

Grey long-eared bat (*Plecotus austriacus*)

The species often can be found in buildings but it is very rare in this area (Fig. 8). We have proved its presence only in 5 roosts during the two years. We found only dead specimens in two of the above mentioned habitats.

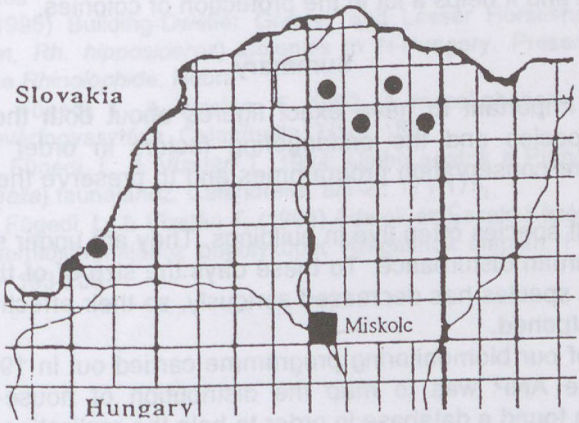


Fig. 8. Distribution of *Plecotus austriacus*

There was only one habitat where we could find bats twice. Then the number of specimens decreased from 15 to 2. The literature (Szentgyörgyi *et al.* 1994) mentions other two habitats as well but we did not find colonies there.

This species is regarded as 'vulnerable, week' by the international categoriyation. This is proved by the results of our research as well.

Maintenance and protection of habitats

The human-made, artificial habitats replace quite a few disappeared natural habitats. The most serious endangering factor is the disappearance of habitats. It is often the result of the closing of landing-holes and attic-windows. The renovations are usually done during their nursing period which means another serious danger.

The suitable attic-windows are essential for the protection and resettling of the colonies. Pigeons also cause serious problems and we can get rid of them by making the attics dark. We clean the attics from the piled guano and this way help to settle the conflict of interests between the nature

conservation authorities and the owners of buildings. We can make these habitats safe for the long term with small repairs, for example by insulating the planks.

It is very surprising that many people are still afraid of bats because of superstitions and misbelieves, that is why we do educational work as well. According to our results the presence of predators exerts influence on the size of colonies but rarely causes their disappearance.

The fact we have up-to-date information about the planned renovations (e.g. the change of roof, tiling) is regarded as one of our most important achievements and it helps a lot in the protection of colonies.

Summary

It is very important to have exact figures about both the colonies of protectable species and the endangering factors in order to carry out effective nature conservation programmes and to preserve the endangered species.

Certain bat species often live in buildings. They are under serious threat because of human disturbance. To these days the size of of the population of most of the species has decreased seriously, so their effective protection cannot be postponed.

The aim of our biomonitoring programme carried out in 1994-95 on the territory of the ANP was to map the distribution of house-dwelling bat species and to found a database in order to help the realisation of protective activities.

The house-dwelling bat species of the area are generally endangered, although there are important and significant nursery colonies in case of some of them. With the help of the proposed methods, the buildings can be maintained and can serve as both artificial roosts and safe habitats.

Acknowledgements

We would like to thank the Aggtelek National Park for having allowed our research. We also have to thank those clerics who let us in churches and buildings and made it possible for us to get the information for our work. We are also grateful to Behavioural Ecology Research Group (VÖCS), Department of Evolutionary Zoology and Human Biology and its leader Prof. Zoltán Varga for having allowed us to use the technical equipment of the department. Part of the costs our work was sponsored by the Pro Renovanda Cultura Hungariae Foundation, Hungarian Bat Conservation Foundation and Regional Environmental Center for Central and Eastern Europe.

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GEOLOGICAL AND SPELEOLOGICAL RESEARCH

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MANAGEMENT PLANS FOR WORLD HERITAGE SITES - APPLICATION OF IUCN GUIDELINES FOR CAVE AND KARST PROTECTION

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Összefoglaló: A világ minden részén találkozhatunk karsztos tájjal, a rá jellemző felszíni és felszín alatti formákkal. A karsztterületek értékét az is mutatja, hogy számos közöttük kiemelt védelmet élvez (pl.Világörökség része).

A karsztos területek és barlangjaik speciális védelmi intézkedéseket igényelnek, melyek szinte minden esetben túl kell, hogy terjednek a védett terület határain. E jelenségek ugyanis nem mentesülnek azoktól a károsító hatásoktól sem, melyek forrása jelentős távolságra eshet a határoktól. Így a hatékony védelem és kezelési intézkedések kidolgozása nemcsak helyi, hanem regionális szinten is kívánatos.

E tanulmány az IUCN által megfogalmazott védelmi és kezelési irányelveket állítja párhuzamba a helyi lehetőségekkel.

Abstract: Karst landforms and associated features such as caves are distributed widely throughout the world. They have many values and many are located in various protected areas including several sites designated on the World Heritage List.

Karst and cave areas require special management considerations often extending well beyond the formal boundaries of protected areas in which the more obvious features fall.

Caves and Karst are amongst the most vulnerable of landforms, and are often subject to degradation as a result of phenomena or events which occur at a considerable distance. Their effective protection and management therefore requires consideration and action at both regional and local levels.

The study compares the application possibilities of IUCN general management Guidelines with regional characteristics.

I. GENERAL IUCN CONSIDERATIONS FOR KARST SYSTEMS

I.1. Introduction: Karst environment and cave systems

- integrity of karst is dependent upon maintenance of hydrological system
- karst is vulnarable to a distinctive set of environmental sensitivities
- many karst areas have been densely populated and heavily impacted for hundreds of years land and groundwater degradation has commonly occured
- caves are in focus due to their mysterius character and beauty. Protection and management of
wider karst environment is important as it underpins the adequate protection of a cave or any other single element of a karst landscape

I.2. The importance of caves and karst

- managing of karst landforms is the part of a strategy to safeguard global geodiversity
- a number of economic, human and scientific values may be present in karst areas (diversity of demands that are in conflict with one another)

I.3. Threats to caves and karst

- proper protection is not just a matter of preserving interesting, beautiful and scientifically interesting natural features, but it has far reching environmental implications generating significant economic impacts. Proper management of karst is an essential element of water resources management
- caves and karst are often subject to degradation as a result of phenomena and events which occur at a considerable distance. Their effective protection and management therefore requires consideration and action at both regional and local levels.

I.4. Options in protection of karst

- Protection of karst features has all too often focused upon caves, and not given adequate consideration to the need for protection and proper management of the total karst area as a land unit.
- The establishment of protected areas is not enough in itself. The management of karst demands specific interdisciplinary expertise and this is in the early stages of development in most countries. Management agencies should recognize the importance of this expertise and take advantage of interagency or international co-operation in order to enhance their own capacity.

I.5. Management at the regional and site level

- Karst management must be holistic in its approach and should aim to maintain the quality and quantity of water and air movement through the subterranean environment as well as the surface.
- In general, karst systems develop over geological timescales which must inevitably include significantly different environments from that of today. Some karst systems will thus be so out of phase with prevailing conditions that they have no capacity to regenerate. Other systems may have some capacity to regenerate but this may entail timescales greater than that of individual human generations. Caves and their contents (speleothems, sediments and bones) may have been formed or emplaced under different climate regimes and may remain unaltered for millennia. These may require specific management attention because of their fragility.

I.6. International Co-operation and liaison

- International cooperation can play a vital role in strenghtening the karst protection, management capacity of land, and in ensuring integrated protection on a world basis.

IUCN GUIDELINES	ACTIONS AND MEASURES TO BE DONE IN AGGTELEK KARST BEING A WORLD HERITAGE SITE
II.	
1.Effective planning for karst regions demands a balanced consideration of economic, scientific and human values, within the local cultural and political context and in a way which is congruent with that context	A detailed development plan for the region has to be prepared considering IUCN aspects.
III.	
2.The integrity of any karst system depends upon an inreactive relationship between land and water. Any interference with this relationship is likely to have undesirable impacts, and should be subjected to thorough environmental assesment.	Impact sources of surrounding area has to be assessed and evaluated.
3. Land managers should identify the total catchment area of any karst lands, and be sensitive to the potential impact of any activities within the catchment, even if not on the karst itself.	All activities in the total catchment area has to be controlled by ANP and SKLPA.
4. Destructive actions in karst, such as quarrying or dam construction, should be located so as to minimize conflicts with other resource values.	Working quarries should be controlled and thier production reduced by contracts.
5. Pollution of groundwater poses special problems in karst and should always be minimized.	Measures should be taken to control stream crossings, car wash, use of chemicals.
6. All other human uses of karst areas should be planned to minimize undesirable impacts, and monitored in order to inform future decision-making.	Continuous cobperation and coordination with local communities (Aggtelek and Jósvafő) should be developed.

7.While recognizing the non-renewable nature of many karst features, particularly within caves, good management demands that damaged features be restored in so far as is practicable.	Restoration and reconstruction of damages (broken dripstones, lamp flora, flood effects) has to be done.
IV.	
8. Governments should ensure that an appropriate selection of karst sites is declared as protected areas under appropriate legistlation.	Law / regulation is needed at least on the level of the National Authority for Nature Conservation
9. High priority in protection should be given to areas or sites having high natural, social or cultural value: possessing a wide range of values within the one site: which have suffered minimal environmental degradation: and/or of a type not already represented in the protected areas system of their country.	Priority should be given to cave entrances and catchment areas of strictly protected caves as parts of World Heritage
10. Where possible, total catchment areas should be included within the protected areas boundary.	Cooperation with SKLPA should be organized.
11. Where such coverage is not possible, consideration should be given to the use of environmental controls or total catchment management agreements under planning or water management legislation to safeguard the quantity and quality of water inputs to the karst system.	Agreements and contracts needed with Watershed management Authorities
12. Land managers should identify karst areas not included within protected areas and give consideration to safeguarding the values of these areas by such means as planning controls, programs of public education, heritage agreements or covenants.	Karst areas not included in ANP area has to be surveyed and mapped.
13. Management agencies should seek to develop their expertise and capacity for karst management and recognize the value of inter-agency or international co-operation.	Cooperation with SKLPA needed.

V.

14. Managers of karst areas should recognize that these landscapes are complex three-dimensional integrated natural systems comprised of rock, water, soil, vegetation and atmosphere elements. Equally management of specific cave sites should recognize this complexity.	Complexity has to be reflected in detailed area management plans.
15. Management in karst should aim to maintain natural flows and cycles of air and water through the landscape in balance with prevailing climatic and biotic regimes. Management in caves should equally aim at the maintenance of natural flows.	Natural flows in the whole catchment area should be mapped and monitored in detail.
16. Managers should recognize that in karst, surface actions may be rapidly translated into impacts underground and elsewhere.	Surface and underground monitoring system should be developed.
17. Pre-eminent amongst karst processes is the cascade of carbon dioxide from low levels in the external atmosphere through greatly enhanced levels in the soil atmosphere to reduced levels in cave passages. Elevated soil carbon dioxide levels depend on plant root respiration, microbiological activity and a health soil invertebrate fauna. This cascade must be maintained for the effective operation of karst solution processes.	Detailed field investigations and experiments should be carried out in cooperation with university researches. Contracts and permissions has to be issued to develop cooperation.
18. The mechanism by which this is achieved is the interchange of air and water between surface and underground environments. Hence the management of quality and quantity of both air and water is the keystone of effective management at regional, local and site specific scales. Development on the surface must take into account the infiltrations pathways of water	Detailed and continuous field measurements should be carried out and coordinated at all three levels regarding the Slovak side as well.
19. Management should aim to maintain the natural transfer rates of fluids, including gases, through the integrated network of cracks, fissures and caves in the karst. The nature of materials introduced must be carefully considered to avoid adverse impacts on air and water quality.	=

20. Soil management must aim to minimize erosive loss and alteration of soil properties such as aeration, aggregate stability, organic matter content and a healthy soil biota.	=
21. Pivotal to the prevention of erosion and maintenance of critical soil properties is the presence of a stable vegetation cover.	=
22. Because of the importance of karst areas as biological refuges, further fragmentation by road construction and similar activities should be avoided. If this is unavoidable, then corridors for animal dispersal should be maintained as a high priority. Within caves both terrestrial and aquatic fauna are best protected by the preservation of air and water quality. Accelerated stream siltation and compaction of sediments by visitors may be detrimental to cave fauna. The infrastructure of tourist caves (paths, steps, lights) should be designed to avoid decomposition and the release of either toxic substances or additional energy sources into the cave environment.	New planning and/or reconstructing of tourist trails (especially Blue Trail) and traffic roads has to be controlled. Survey and mapping of animal migration corridors has to be made. Show caves should have detailed management plans. Detailed investigations should be carried out considering the effects of visitors to the condition of the caves
23. Climate change has occured over geological timescales within which karst systems have evolved. Human intervention has the potential to alter climate in ways that may radically affect natural karst processes. Management prescriptions must be flexible, must recognize this possibility and must maximize the resilience of the system. The effects of high magnitude - low frequency events such as floods, fires and earthquakes must be recognized in management strategies at regional, local and site-specific scales.	A site-specific monitoring system should be established
24. Establishment and maintenance of karst protected areas can contribute to the protection of both the quality and quantity of groundwater resources for human use. Catchment protection is necessary both on the karst and on contributing non-karst areas. Activities within caves may have detrimental effects on regional groundwater quality.	Cooperation and agreement is needed between ANP and local Watershed Management Authority.

25. Catchment boundaries commonly extend beyond the limits of the rock units in which the karst has formed. Definition of the whole karst drainage network depends on planned water tracing experiments and cave mapping. The boundary of this extended catchment can fluctuate dramatically according to weather conditions. Fossil cave passages can be reactivated following heavy rain.	Detailed catchment mapping and monitoring system has to be established especially in Baradla, Béke and Kossuth caves.
26. More than in any other landscape, a total catchment management regime must be adopted in karst areas. Activities undertaken at specific sites may have wider ramifications in the catchment due to the ease of transfer of materials in karst.	A total catchment management plan for Gömör-Torna Karst has to be established
27. Recognizing that the extraction of rocks, soil, vegetation and water will clearly interrupt the processes that produce and maintain karst, such uses must be carefully planned and executed to minimize environmental impact. Extractive industries may be incompatible with the preservation of natural and cultural heritage	Environmental effects should be strictly limited and/or stopped if any damage (material or aesthetic) for the World Heritage Site can be assessed.
28. Imposed fire regimes on karst should, as far as is practicable, mimic those occurring naturally if the aim of management is sustainable land use.	Fires caused by the public has to be controlled and use/damage of fires should be made clear for them.
29. Human visiting of caves and karst may be irreversibly damaging particularly when cumulative over time. Management planning should recognize this fact and seek to minimize visitor impacts and maximize environmental protection.	Receiving capacity of caves has to be assessed. Showcaves are necessary victims considering protection as visit for caves are oriented to them.
VI.	
30. International, regional and national organizations concerned with aspects of karst protection and management should recognize the importance of international co-operation and do what they can to disseminate expertise and share expertise.	Close cooperation with Slovak Karst Landscape Protection Area is needed.
31. The documentation of cave and karst protection/ management policies should be encouraged, and such policies made widely available to other management authorities.	Cave and surface management plans should correspond with each other.

32. A database should be prepared listing cave and karst areas included within protected areas, but also identifying major unprotected areas which deserve recognition. Karst values of existing and potential World Heritage sites should be similarly recorded.

Existing Cave cadaster has to be completed with karst area cadasters. Unified evaluation categories of karstic World Heritage sites should be established.

THE EVOLUTION OF THE GEOLOGICAL STRUCTURE OF THE AGGTELEK-RUDABÁNYA MOUNTAINS

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Összefoglaló: Az Aggteleki Nemzeti Park területére eső Aggtelek-Rudabányai-hegység földtani felépítését és szerkezetfejlődését tekintve Magyarország egyik legbonyolultabb területe. Geológiai értelemben - határon túli folytatásával, a Szlovák Karszttal együtt (összefoglaló földtani nevük: Déli Gömöridák) - az Észak-nyugati-Kárpátok legbelső tagja.

Alaphegységi, döntően triász kőzetei három nagy csoportba sorolhatók, melyek egyúttal három egymás fölötti szerkezeti egységbe is tartoznak. Közülük a legalsót, az "autochton"-t szendrői- és upponyi-hegységi típusú paleozóos kőzetek, valamint a feltehetően rájuk települő triász korú Tornai-sorozat kőzetei (pl. az Esztramoson) építik fel. Ezek a Tethys kréta előtti D-i kontinentális szegélyét képviselik, és alacsony fokú (epimetamorf) átalakuláson estek át. A középső szerkezeti egység, a Mellétei-takaró többnyire csak fúrásokból ismert. A Tornakápolnai-, Mellétei- és Bódvarákói-sorozatok kőzetei építik fel, melyek magát, az itt a középső-triásztól a középső-késő-juráig meglévő óceáni Tethyst képviselik. Az átalakultság foka nagyon alacsony (anchimetamorf). A felső szerkezeti egység a felszínen legelterjedtebb, nem metamorf, aljzatától elszakított Szilicei-takaró(rendszer). Magyarországon a triász (és alárendelten jura) kőzetekből álló Bódvai- és Szőlősardói- (a Rudabányai-hegységben), valamint Aggteleki-sorozatok (az Aggteleki-hegységben) képviselik. E sorozatok, eredeti aljzatukkal, a gömör-szepesi-érchegységi paleozoikummal együtt a Tethys kréta előtti É-i kontinentális szegélyén foglaltak helyet. A Szilicei-takaró(rendszer) evaporitos bázisrétegeiben a Tornakápolnai-sorozat tektonikusan belegyúrt bázisos magmatitjai is megtalálhatók. A harmadkori fedő felső-oligocén-alsó-miocén, pannon és negyedkori képződményekből áll.

A szerkezetfejlődésben 4 fő fázis különíthető el: 1. A középső-triászban kezdődő riftesedés, melynek nyomán kialakult a fent említett 3 fő ősföldrajzi terület; 2. A jura közepétől a kréta elejéig tartó szubdukciós, kollíziós és takaróképződési folyamatok, melyek a 3 egymás fölött található szerkezeti egységet alakították ki; 3. A valószínűleg a kréta közepére tehető gyűrődési fázis, a hegységre oly jellemző, D-i irányultságú feltolódásokkal és az alsó-hegyi-derenki öv kisebb szirtjeivel (ilyen pl. a Szád-vár és maga az Alsó-hegy is); 4. A Darnó-zóna késő-oligocéntől a miocén közepéig tartó balos vízszintes eltolódásai, melyek nyomán az addig az Aggteleki-hegységtől D-re elhelyezkedő Rudabányai-hegység három részletben, néhány 10 km-rel ÉK felé, jelenlegi helyére vonszolódott.

A területet azóta már csak blokktektonikai mozgások érték. A hegység legújabb kiemelkedése, mely a pliocén végétől kezdődött, és több ciklusban azóta is tart, már a Kárpátok általános kiemelkedésének előterében játszódott le. A már előzőleg is karsztosodott mészkőfennsíkokban kialakultak a nagy barlangrendszerek, amiben a Kárpátok felől lezúduló kavicsanyag játszhatta a legaktívabb szerepet.

Being the innermost member of the NW Carpathians, the Aggtelek-Rudabánya Mts., as part of the Southern Gemerides, is one of the most complex regions of Hungary both by its geological build-up and structural development.

Its basement is formed mostly by Triassic rocks ranged into three major groups responding three tectonic units in superposition. The lower of them is the "autochton" with a Paleozoic basement of the Szendrő and Uppony Mts. and the Triassic Torna series (e.g. on the Esztramos), lying probably upon it. The "autochton" represents the pre-Cretaceous Southern continental margin of the Tethys and recently is of low grade metamorphism. The middle structural unit is the Meliata nappe built up by the Tornakápolna, Meliata and Bódvarákó series (known mostly from boreholes), representing the oceanic Tethys itself, having existed from the Middle Triassic up to the Middle-Late Jurassic. The metamorphism is of very low grade. The upper structural unit is the non-metamorphic, detached Silica nappe consisting of (in Hungary) the Triassic and subordinately Jurassic Bódva, Szőlősardó (in the Rudabánya Mts.) and Aggtelek series (in the Aggtelek Mts.), forming most of the surface outcrops. They, with their original basement, the Paleozoic of the Gemer-Spiš Metalliferous Mts., represent the pre-Cretaceous Northern continental margin of the Tethys. The basal, evaporitic layers of the Silica nappe contain the tectonically reworked blocks of the Tornakápolna series, too. The Tertiary cover is represented by Upper Oligocene-Lower Miocene, Pannonian and Quarternary beds.

Four major stages can be distinguished in the structural evolution:

1. The Middle Triassic rifting, having created the three major paleogeographic units mentioned above.
2. The Middle Jurassic to Early Cretaceous subduction, collision and overthrust processes, having formed the three major tectonic units in superposition.
3. The probably Middle Cretaceous folding process, having also created the thrusts of southern vergence, characteristic for the mountains, and the small klipps of the Alsó-hegy-Derenk belt, too.
4. The Late Oligocene to Middle Miocene sinistral movements of the Darnó-zone that removed the Rudabánya Mts., having situated until that time to the S from the Aggtelek Mts., in three segments with a few 10 kilometres to the NE, to its recent place.

Since then only brick-tectonic movements can be shown. The newest uplift of the mountains started at the end of the Pliocene, and took place in the foreground of the general emergence of the Carpathians. In the previously karstified large limestone bodies (mostly of the Aggtelek series) the mass pebble material coming from the Carpathians played the dominant role in developing the huge cave systems.

KARST DRAINAGE SYSTEMS ESTABLISHED BY WATER TRACING METHODS IN AGGTELEK NATIONAL PARK

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Összefoglaló: Az ANP területét magába foglaló Észak-borsodi-Karszton az első nyomjelzéses vizsgálatot a Baradla-barlang kutatásakor a 30-as években végezték el. Az első jelentős vizsgálatsorozatra az 50-es évek elején került sor, amikor a karsztvidék D-i része nagyobb víznyelőinek felszínalatti hidrológiai kapcsolatát kívánták tisztázni. A rendszeres vizsgálatok az Alsó-hegyi karsztterületen folytatódtak előbb barlangkutatók, majd a VITUKI szakembereinek résztvételével a 60-70-es években, majd a MÁFI kutatói végeztek még ismeretlen rendszerekre vonatkozó vizsgálatokat 1984 után. Napjainkig 105 kísérletről van legalább említés szintű írásos anyag. Ennek ellenére még számos tisztázatlan terület vár megismerésre, és jónéhány vizsgálat megismétlésére van szükség a bizonytalan adatok miatt.

Az Aggtelek-Rudabányai-hegyvidék földtani felépítésében szerepet játszó kőzetek közül legidősebb a perm - alsó-triász evaporitos összlet, melynek üledékei vízzáró tulajdonságúak. Felszínen Bódvaszilas és Derenk között fordul elő vékony pásztában, valamint Perkupa környékén. Felszín alatt gyakorlatilag mindenütt a felette ismert, zömmel karsztosodó kőzetek feküjét képezi. Az alsó-triász kampili rétegek alsó részét homokköves-márgás rétegek képviselik, felfelé a mésztartalom a lemezes mészkő sorozatban egyre inkább nő. A legfelső rétegsor általában már közepesen-jól karsztosodó középső-felső-triász mészkő, melynek vastagsága helyenként az 1000 métert is meghaladja.

A terület legnagyobb rendszere, Baradla-barlang főága és oldalágainak víznyelőiben eltűnő vízfolyások a jelzések alapján két alsó rendszerben jutnak a Jósva-forrás csoportba. Az aggteleki bejárattól a Vörös-tói oldalágig a víznyelők a Jósva langyos vizű Medence-forrásába vezetik a vizet. míg a Vörös-tói oldalágtól az Óriás-termi víznyelőig a víznyelőkben elnyelődő víz a Rövid Alsó-barlangba jut. A Jósva-Medence-forrása egy vizsgálat szerint a szlovákiai Kecső (Kecovo) alatt a Kecső-völgyben elnyelődő vízzel is közvetlen hidrológiai kapcsolatban áll.

Az 50-es évek elején nyomjelzésekkel sikerült megállapítani számos egyéb, önálló vízrendszerek létét, a kimutatást néhol sikeres barlangfeltárás követte: Béke-, Szabadság- és Dancza-barlang. Eddig csak a Teresztenyei-forrás rendszere áll ellen a feltáró munkának.

Szőlősardótól K-re 2 kisebb rendszert mutattak ki a Túrós-töbrök és a Bedela-kút, valamint a Szén-völgy és a Sárkány-kút között.

A Jósva-völgytől É-ra levő karsztfennsíkon a Kossuth-barlang vizét felszínre vezető Nagy-Tohonya-forrásnak eddig hat felszíni víznyelőponttal való kapcsolatát mutatták ki, így ez a legjobban ismert felszín alatti vízrendszer. A Vass Imre-barlangnak a Szlovákiai Milada-barlanggal valószínűsített árvizi bifurkációja igazolásra vár.

A Kopolya-forrásnak a Háló-réti víznyelővel és a Kopolya-zsombollyal való kapcsolatát igazolták egyértelmi'en.

Számos hidrológiai összefüggést mutattak ki a Bába-völgy - Acskó-rét térségében. Öt kis méretű rendszer mellett három nagyot sikerült kimutatni: Csörgő-, Vecsem- és a szlovákiai Köszörű-forrásokkal kapcsolatban álló víznyelők esetében. Az Alsó-hegy zsombolyaiban végzett vizsgálatok a néhol igen lassú - karsztvíznívón történő áramlást mutattak ki elsősorban.

A Rudabányai-hegység számos víznyelőjében eltűnővízfolyásokat még nem vizsgálták, míg a Telekes-völgyi víznyelő nyomjelzései eredménytelenek maradtak.

The first water tracing in the karst areas of Aggtelek-Rudabánya Mountains including also Aggtelek National Park was carried out in the thirties in Baradla Cave. The first major test series took place at the beginning of the fifties, in order to establish the spring connections of the large sinks at the southern part of the region. In the sixties and the seventies systematical researches were continued at the Alsó-hegy area by cavers and the specialists of the Water Resources Research Center; and after 1984 the Hungarian Geological Survey carried out some tracings at further unknown systems. Up to now altogether 105 experiments have been reported, still there are several areas to be investigated, and many tests should be repeated because of uncertain data.

From among the rock formations building up the Aggtelek-Rudabánya Mountains, the oldest one is an impermeable Permian-Lower Triassic evaporitic complex, with outcrops around Perkupa as well as between Bódvaszilas and Derenk in form of narrow strips. The younger, mostly karstifiable formations are generally underlain by this complex. The higher parts of the Lower Triassic are characterised by upwards increasing carbonate contents within a sandstone - marl - platy limestone sequence. The uppermost formations are moderate to well karstifiable Middle and Upper Triassic limestones, the thickness of which is more than 1000 m in some places.

On the evidence of water tracing experiments, the underground streams sinking in the passages of Baradla Cave (the largest system of the region) emerge in Jósva spring group via two lower systems. The cave sinks between Aggtelek entrance and Vörös-tó Branch drain to the lukewarm Medence Spring; while the water from the sinks between Vörös-tó Branch and Óriás-terem get to the Short Lower Cave feeding Táró Spring. On the basis of one tracing, Medence Spring is in connection with the waters sinking in the Slovakian part of Kecsô Valley, too.

The presence of several independent karst drainage systems were established by water tracing in the fifties, which were followed by successful cave explorations in some cases (Béke Cave, Szabadság Cave, Danca Cave). The system of Teresztenye Spring still withstands the attacks of explorers.

In the southeastern part of the region two minor systems were only established eastward from Szőlősardó (from Túrós dolines to Bedela-kút Well, and from Szén Valley to Sárkány-kút Well). The streams disappearing in the many sinks of Szalonna area have not been traced yet; while the tracings carried out in Telekes Valley Sink have had no result.

In the central part of the region the best studied underground system is that of Kossuth Cave feeding Nagy-Tohonya Spring; its connection to six surficial sinks have already been established on the karst plateau northward from Jósva Valley. The probable flood bifurcation of Vass Imre Cave with Milada Cave (Slovakia) should be confirmed. From among the surface connections of Kopolya Spring, Háló-rét Sink and Kopolya Shaftcave have been identified.

In the northeastern part of the region several hydrological connections have been detected in the area of Bába and Acskó Valleys. Besides of five minor systems, three larger ones have been established in the case of the sinks draining to Csörgő Spring, Vecsem Spring and Köszörű Spring (Slovakia). The tracing experiments carried out in the potholes of Alsó-hegy Plateau revealed mostly very slow flows at the karst water table.

RELATION BETWEEN MORPHOLOGY AND ROCK-OUTCROPPING ON SOME PLATEAUS NEAR JÓSVAFŐ (NE HUNGARY)

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Összefoglaló: A terület földtani térképein a lépték és feltehetőleg a szerzők szemlélete miatt a fedett területek általában nincsenek elválasztva a kibúvásoktól. A szerző a Jósvafőtől ÉK-re eső területen, amelyet uralkodóan a Wettersteini Formáció épít fel, 1992-94-folyamán 5000-es térképezést végzett, melynek során jelölte a feltártság fokát, a geomorfológiai alakzatok típusát és feltüntette a negyedidőszaki képződményeket is.

Nagyon sok fedett terület van, változatos domborzati helyzetben, a kibúvások között. A völgytalp helyenként széles, mivel a völgy idősebb töbröt metsz, vagy feltöltött töbröket fűz fel. A kibúvások változatos, ill. a kiterjedtebbek egyes részei eltérő módon vannak feltárva: 1. sziklás, 2. padok, rétegfejek, tömbök, tuskók lépten-nyomon, 3. ugyanezek fedett szakaszokkal, 4. törmeléklejtő, 5. sűrű törmelék, heverő tömbök, 6. gyér törmelék, 7. különlegességek (pl. kőzettörmelék csak kidőlt fák gyökerében). Ugyanazon töbör lejtői változó mértékben és módon vannak feltárva. Alig fordul elő, hogy egy töbör lejtői teljes mértékben feltáródtak.

Két fő típusa van a dolináknak. 1. Óraüveg alakú, nagyjából szimmetrikus alak, melynek mélysége átmérőjéhez képest csekély. 2. Többé-kevésbé tölcséralakú, oldalnézetben aszimmetrikus forma, lapos feneke enyhén lejt a dolinalejtő legmeredekebb része felé. Mindkét típusnak altípusai vannak, amelyek a fejlődés szakaszait jelentik. Az 1. típus első altípusa kerek vagy ovális, enyhén homorú fedett térség, míg egy lejtőkkel közrefogott kis síkság a 2. típus utolsó stádiumát jelzi.

A morfológiai sorozat igazolja, hogy a töbrök vertikális karsztosodással (nem pedig beomlással) képződtek. Az első típusba tartozó töbrök a mélyülő szakaszban vannak, a második típusba soroltak pedig a feltöltődés szakaszait mutatják.

Összetett alakzatok jelzik a karsztosodás egyenlőtlen intenzitását.

Introduction

The geological maps relating to the area investigated (Balogh 1948, 1964, Grill *et al.* 1985, Less 1993) do not mark off the covered fields lying among outcrops from the exposures because of their scale and maybe of their authors' attitude.

In the course of 1992-1994 the author surveyed an area NE of Jósvafő on scale 1:5000 on behalf of the Aggtelek National Park Directorate. This area is built up mainly of the Wetterstein Formation. The main goal of the work was to survey the terrain where karstic forms are common within the area mentioned (Fig. 1). While surveying the author marked the grade of outcropping, the type of the landforms and mapped the Quaternary rocks, too.

Outcropping of the Wetterstein Formation

The outcrops (or parts of large exposures) vary in grade of outcropping as follows:

1. rocky,
2. beds, blocks, boulders at every step,
3. beds etc. interrupted by soil-covered parts,
4. scree,
5. dense debris, lying blocks,
6. scattered rock debris,
7. others (e. g. detritus exposed only by roots of falled trees or by wild-hogs).

Original outcropping has changed on the formerly cultivated fields because people had carried off the stones making stockpiles of them.

There are a lot of covered fields among the outcrops in various morphological positions. On the low-lying plateau extending over Tohonya to Kuriszlán (280-290 m a.s.l.) outcrops on the doline slopes (Figs. 2-4) or on the sides of the valleys that cut the plateau (Figs. 2-4) can be found in the first place. Outcropping of the bedrock on the rim and slopes of a doline vary from "full coverage" to "rocky". Doline with completely exposed slopes is unique (e.g. doline No. 305, Fig. 5).

A well outcropped place on the low-lying plateau can be seen at the 305 m isoline that reflects probably a tectonic line (Fig. 3). The high-level plateaus (430-450 m a.s.l. and in higher positions) are better outcropped but a few of them are rather covered (e.g. S and E of the doline No. 304, Fig. 5).

Wetterstein Limestone and Dolomite are usually uncovered on the steep slopes of the valleys. The moderate slopes and the ridges are outcropped in different ways but covered on many places as well. Mountain-tops are rocky or cropped out nearly continuously (e.g. Kopasz-tető, András-galya; Fig. 4), or they are almost covered (e.g. Kerek-Gárdony-tető; Fig. 6).

Thick brown, brownish yellow and, predominantly, red soil play a role as cover. In some places the bedrock is covered by Quaternary red clay (e.g. NW of the doline No. 275, Fig. 3 and SW of the doline No. 325, Fig. 5).

Some traits of the valleys

Two vast-bottom valleys cross the low-lying plateau. There are two places along them where an amphiteatrum-like widening can be seen. They may be remains of slopes of an older doline cut by the valleys. (SE of Tohonya spring and at the place No. 276 in the Lófej Valley, Fig. 2). The lower section of the Tohonya Valley crosses a form bordered with rocky walls on the NW and SW that is perhaps remain of a polje of tectonic origin (No. 194, Fig. 4).

The bottom of a steeply inclined valley is flat and broad in some places. The shape of these places is oval or nearly round with almost flat bottom reflecting their origin as filled older dolines (forms Nos. 197, 199, 202, Fig. 7; 313, Fig. 8). When water flows in the valley it spreads over the bottom of these forms or cuts a narrow, shallow bed into the sediment (SE of 197, Fig. 7). It happens that water-course leaves its original line (at the form 202, Fig. 7).

The gullies falling into the Tohonya Valley and into the Lófej Valley have deposited a lot of tali. Lófej Valley itself flows into the other through a wide but very low alluvial fan (Fig. 2). There are tali also in dolines (No. 188, Fig. 4; No. 212, doline W of No. 222, Fig. 6). At the NE corner of doline No. 151 (Fig. 3) an earthflow can be observed that has two fronts reflecting reiterated solifluction.

Dolines

There are two main morphotypes of dolines in the area:

1. Watch-glass-shaped, roughly symmetric form with a depth small as compared to the diameter.
2. More or less funnel-shaped form, assymmetric in profile, with a flat bottom shelving towards the steepest part of the doline-slope.

Both types have subtypes showing the theoretical development stages (Fig. 1).

The first stage of type 1. is a round or oval, flat or slightly hollow, covered field (e.g. NW of the doline No. 149, Fig. 4, at the places 209, KG, Fig. 6). These forms often join to more developed dolines as No. 324 (Fig. 8), one at doline No. 231 (Fig. 6) or another one on the large, shelving slope of the doline No. 331 (Fig. 3).

Characteristic type 1. dolines are in a great number N of Hegytető but also on the delineated parts (e.g. No. 168, Fig. 3; Nos. 314-315, Fig. 5; Nos. 212, 222, Fig. 6). The next step of the development is represented by type 1. dolines with rather flat bottom and with off-centred deep end (e.g. Nos. 166, 332, Fig. 3; No. 149, Fig. 4; No. 203, Fig. 7; Nos. 311-313, Fig. 8). Outside the area there are deep dolines with very small flat centres. They show where the development of the type 1. dolines tends.

When the karstic cavities under a doline had silted up the sediment and the eroded soil could not percolate but deposited on the bottom and therefore a type 2. doline formed (e.g. Nos. 151, 164-165, 331, 333, Fig. 3; No. 188, Fig. 4; Nos. 299-302, 304, 326, Fig. 5; SSW of No. 212, No. 231, WSW and NNW of No. 231, W of No. 222, Fig. 6). The doline-slope(s) in the main transport direction(s) became shelving and covered. Couloirs on the steep slopes, in turn, carry mainly water, not sediment, except some cases mentioned above. Where a rocky part of doline-slope crops out just at the flat bottom a mature stage of filling up can be registered (e.g. No. 167,

Fig. 3; north part of 197, Fig. 7). A level plain amongst slopes shows the last stage of type 2 (e.g. 275, perhaps place No. 334, Fig.3).

The observed morphological series justifies that the dolines have generally been developed by vertical karstification (not by collapse). The dolines divided into type 1. are in the progressive (sinking) phase and those of type 2. show different stages of filling up. Complex forms reflect the inequality of karstification (e.g. No. 302, Fig. 5; No. 231, Fig. 6). Swallets – as signs of extreme inequality – formed when karstification had opened a well-drained point of the bedrock where both debris and fine sediment could be let through. Sometimes swallets get plugged and water finds another way to leave (see doline No. 191, Fig. 4).

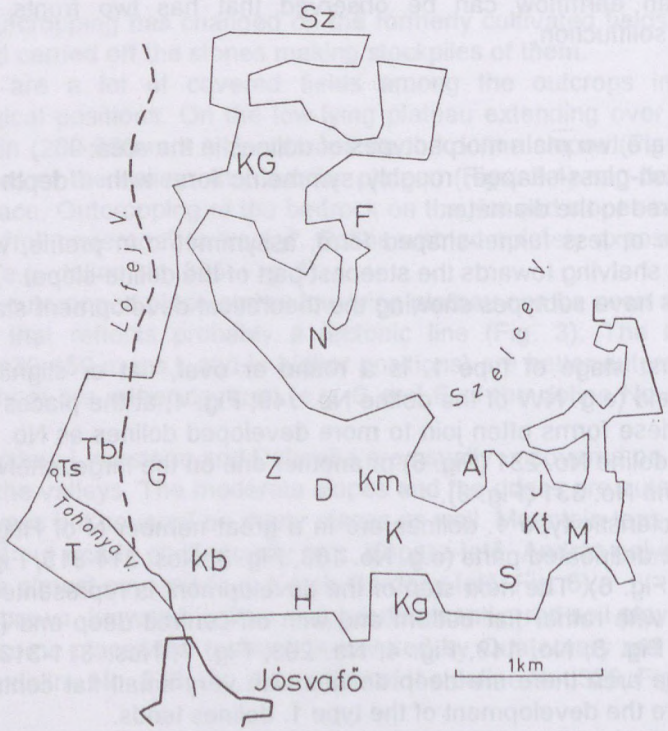


Fig. 1. Contour of the investigated area. Legend: A = András-galya (hill), D = Ducsmány (field), F = Fertős-tető (plateau), G = Gerge-bérc (plateau), H = Hegytető (plateau), J = Juhász-lápa (plateau among hills), K = Kuriszlán (field), Kb = Köves-bérc (plateau), Kg = Kis-Galya (hill), KG = Kerek-Gárdony-tető (hill), Km = Kismező (field), Kt = Kopasz-tető (hill), L = Lipinye (group of hills), M = Morvai-lápa (plateau among hills), N = Nagy-szod-völgy (valley), S = Szőlő-tető (hill), Sz = Százholdas (forest), Tohonya (plateau), Tb = Tohonya-bérc (plateau), Ts = Tohonya spring.

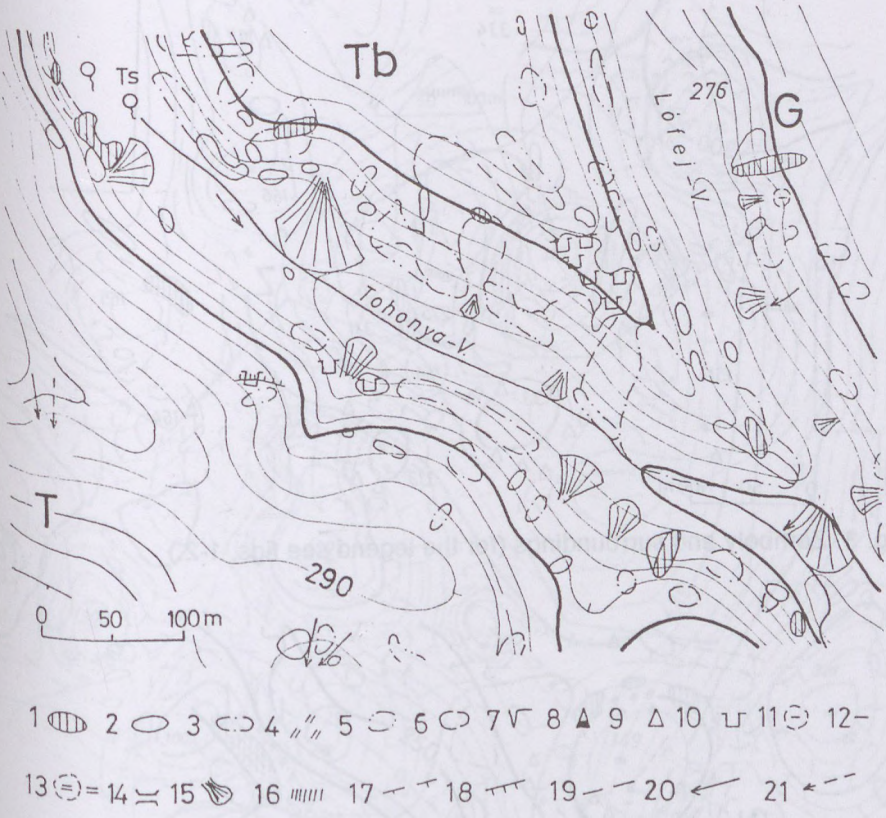


Fig. 2. Tohonya, Tohonya-bérc (for explanations see Fig. 1.). Legend: 1 to 7. Degrees of the outcropping (for explanations see the text) 8. Single rock, small tower rock 9. Single block 10. Abandoned quarry 11. Slightly hollow field 12. Deep end of a doline 13. Flat field, flat sole of a doline 14. Small guiche (pass of earth, stone-gate) 15. Talus, alluvial fan 16. Bench 17. Vertical wall rock (fault plane) 18. Steep wall rock (fault trace) 19. Cart-way 20. Gully bed, shallow couloir 21. Line of water-flow

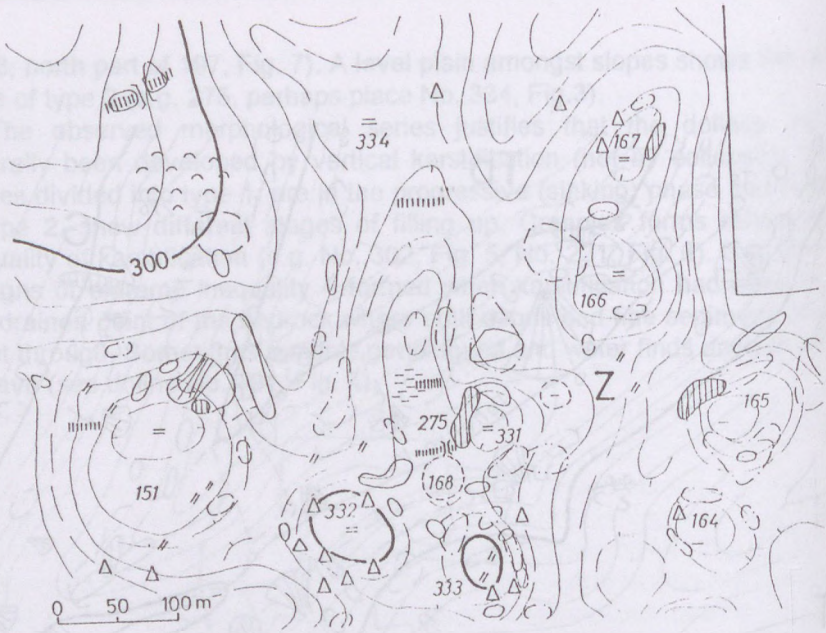


Fig. 3. Zomboly and surroundings (for the legend see figs. 1-2.)

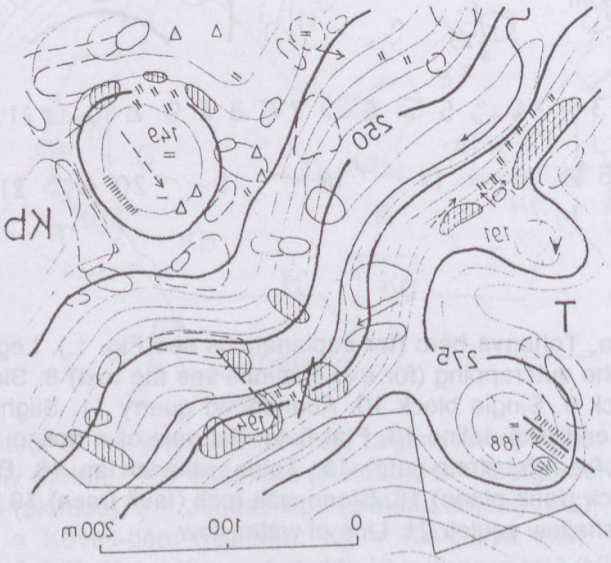


Fig. 4. Kövesbérc (for the legend see figs. 1-2.)



Fig. 5. Juhász-lápa, Morvai-lápa and surroundings (for the legend see figs. 1-2.)

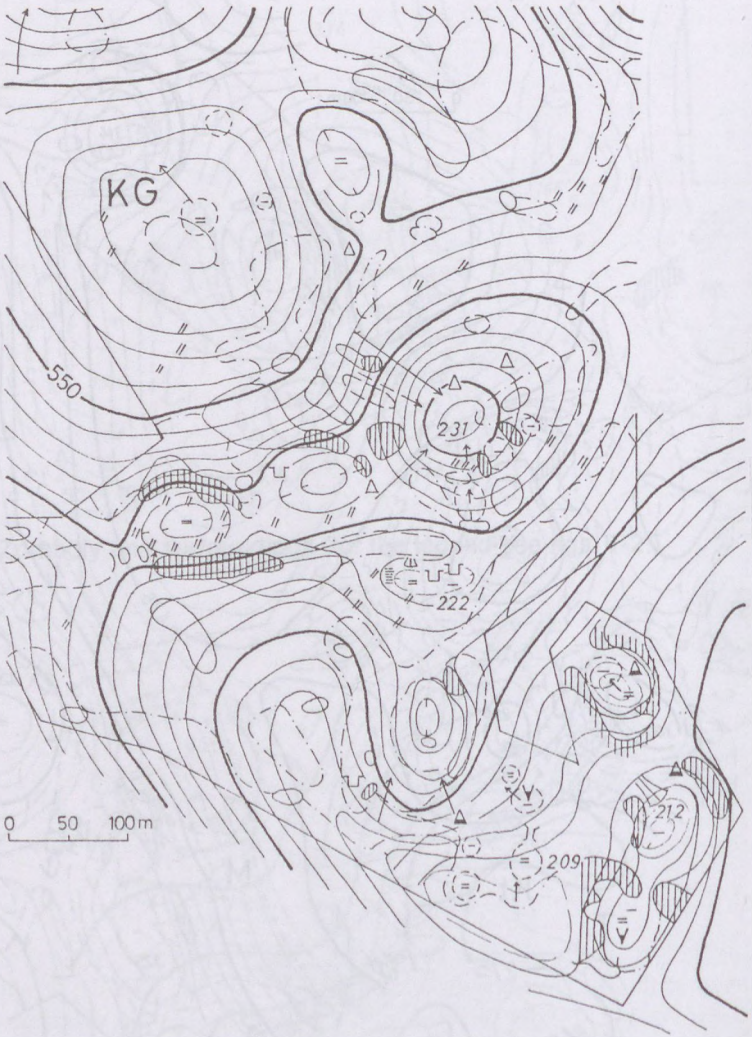


Fig. 6. Kerek-Gárdony-tető and surroundings (for the legend see figs. 1-2.)

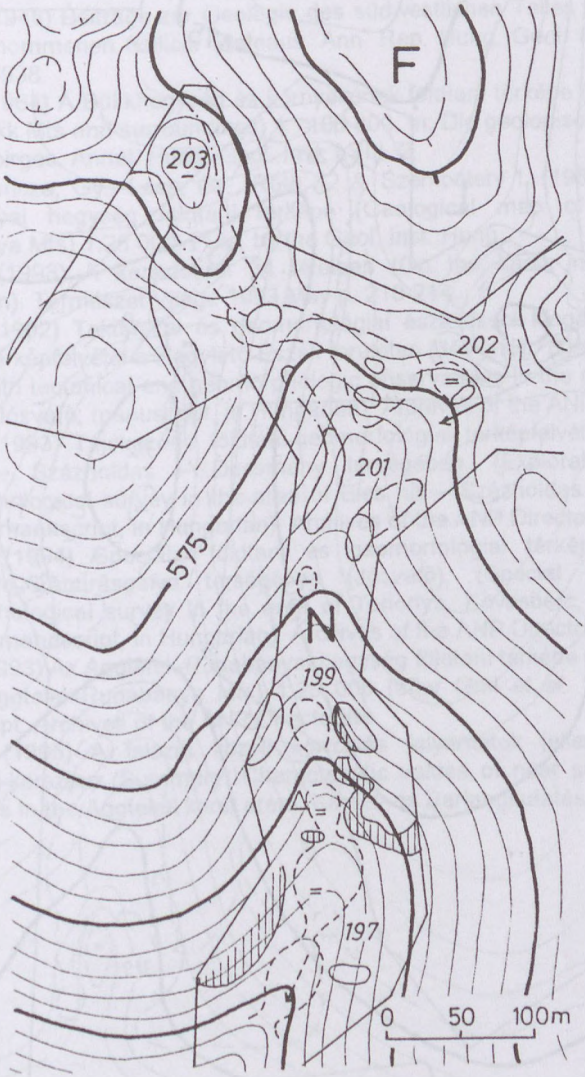


Fig. 7. Nagy-Szod Valley (for the legend see figs. 1-2.)



Fig. 8. Lipinye (for the legend see figs. 1-2.)

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GEOLOGY OF THE STUDY-PATHS OF THE AGGTELEK NATIONAL PARK

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Összefoglaló: Az Aggteleki Karszt területét nagyrészt a triász időszak folyamán képződött kőzetek építik fel, ezek tulajdonságai szabják meg ennek a tájnak az arculatát, ezeknek köszönhetőek a világhírű barlangok és a többi karsztjelenség. Ezek a kőzet-együttesek (a lithosztratigrafiai formációk), valamint földtani alapszelvényként szolgáló feltárásaik hazánkban csak itt fordulnak elő.

Tudományos kutatásuk során számos új rétegtani egység került leírásra, bemutatásukban fontos szerepet töltenek be a védett felszíni és felszínalatti geológiai alapszelvények, a földtani tanösvények, melyek szerves részei a földtani természetvédelemnek.

Mindezek természetvédelmi kezelésben vannak, helyzetükből fakadóan vezetővel (Baradla bg.), ill. anélkül látogathatók (a felszínen vezető tanösvények, jelzett alapszelvény feltárások). Az út mentén elhelyezett táblák magyarázó szövegei, vagy kirándulásvezető használatával tájékozódhatunk.

E tanulmány bemutatásával a változatos és érdekes, valamint szakmailag is ismert földtani értékekből ízelítőt kívánunk nyújtani, (kiegészítve a tanösvények térségét is érintő földtani anyagvizsgálatok: kőzetvékonycsiszolat, mikromineralógia, vegyelemzés, infravörös spektroszkópia eredményeivel), hogy felhasználhassuk a földtani természetvédelmi oktatáshoz, környezeti neveléshez, tudományos ismeretterjesztéshez.

The bulk of the Aggtelek National Park area is made up of Triassic rocks, the physical properties of which played a decisive role in the formations of the world-famous caves and other karstforms, and in the general geomorphological evolution of the area.

In Hungary, the Aggtelek area is the only one, where this very particular rock suite is exposed and can be studied on the surface. Therefore all the measured reference sections of the Aggtelek Triassic (on the surface and underground) are located within the premises of the National Park.

Key sections and other geological features along the study-paths together form an integral part of the conservation and presentation of geological phenomena in the Park.

Places of geological interest are marked by posters both in the Baradla Cave (Fig. 1) and on the study-paths (Figs. 2, 3). Underground sites can be visited only with a guide, surface features (study-paths and key sections) are accessible individually by using the local maps.

The younger rocks most characteristic of the area are red clays. According to latest investigations (e.g. infrared spectroscopy) of samples collected in the vicinity of the study-paths they can be divided into three major groups (Fig. 4). They are different both by their micropetrography and microsedimentology. The differences clearly show the polygenetic origin of

the red clays. They differ from each other not only by their Si/Al ratio but also by the "degree of orderliness" of the kaolinite crystals and features of sedimentation. Infrared-spectroscopic study of kaolinite-"ordering" proved to be the best method to distinguish samples belonging to different groups.

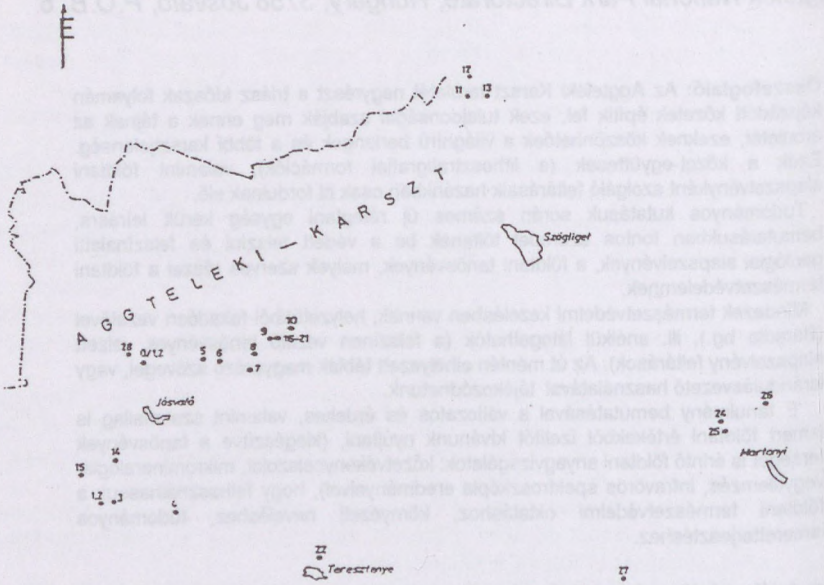


Fig. 4. Sampling map

ANP	Mo	II-Mo	II	Kao	Q	Kfp	Pl	Goe	He	An	am
o/1	24	9	20	10	10	6	4	10		1	6
1	11	22	16	8	25		4		8	1	5
3	24	16		39	4			4	6	1	6
11	5	11	28	13	22	4	4		8		5
14	17	10	12	20	23	2	3		7	1	5

o-14: code of sample
Mo: montmorillonite, II-Mo: illite-montmorillonite, II: illite, Kao: kaolinite, Q: quartz, Kfp: K-feldspar, Pl: plagioclase feldspar, Goe: goethite, He: haematite, An: anatase, am: amorf.

Table 1. X-ray diffraction of red clays

Table 2.

MICROMINERALOGY OF RED CLAYS — table 2

ANP sample code	1:% pce 2:size/mm 3:habit	quartz	carbonate	haem. limonite	recent biodetr.	mica	sandstone	bauxitomorph	+ compo-nen.	rest out of 100g
• 0/1	1 2 3	20 0,1-1,0 1..3	70 0,1-2,0 1..2	5 0,1-0,4	2 C	1		2 globular	1 garnet	10,5 %
• 1	1 2 3	40 0,3-0,6 1..3		25 0,2-0,6 1-3 □	25	1 0,1-0,3 1	1 1,0-2,0 2..3	5 0,1-0,4 glob.	3 garn., ilmenit. feldsp., rutil, zirc.	1,4
• 3	1 2 3	50 0,3-0,6 1..3		25 0,2-3,0	18	1		5 0,2-2,0 glob.	2 ilm.,garn. tourm., pyrite. syderite	1,95
• 11	1 2 3	80 0,2-0,6 1..3		5 0,2-0,6 1..3 □	10	+	+		5 garnet, ilmenit	1,2
• 14	1 2 3	70 0,06-0,4 1..3		20 0,1-0,8 0,..3 □		+	+	5 glob.	5 pyrite syderite magnetitz ircon	1,8
4	1 2 3	80 0,06-0,2 1..3		5 0,2-0,6 1..3	10	+	2 1,0-2,0 2..3		3 ilm.,pyr. tourm. almand.	0,95
5	1 2 3	80 0,06-1,0 1.3 □		10 0,2-0,8 1..3 □	5	mus-covit	2 1,0-2,0 2..3	1-1 globul.	3 ilmen, garnet	1,1
10	1 2 3	40 0,06-0,2 1..3		8 0,1-0,6 1..2	50	+			2 ilmen. Syderite	2,0
12	1 2 3	20 0,06-0,4 1..3		8 0,2-0,8 1..3 □	70	+	+red	1-1 red glob.	2 zirkon tourm. ilm. garn.	1,8
16	1 2 3	85 0,2-0,6 1..3		10 0,2-0,8 1..3 □	C	+	1		4 chert. pyr.garn.	3,2
22/2	1 2 3	60 0,2-0,6		15 0,2-0,8	20	+ chlorite			5 ilm. pyrit garnet	2,7
23	1 2 3	60 0,1-0,2 1,0-2,0	10 1,0-5,01 0..1	5 0,2-0,8 1..3 □	20	+			5 chert ilmenit garnet	8,0 (1-1 shale detr,)
26	1 2 3	40 0,1-0,4 1,0-2,0	50 1,0-3,0	2 0,2-0,8	3 C	+	+		5 ilmenit garnet	4,2

(• X-ray too), r: recent 3: 1...5 roundness, □ : euhedral, C: carbonaceous plants

code of sample	CaO	MgO	Calcite calculated	Dolomite calculated	$FeCO_3$
1	53,8	0,3	94,9	1,4	0,12
2	55,7	0,2	98,7	0,9	0,04
3	49,1	3,52	78,7	16,2	
4	49,3	4,0	77,8	18,4	
5	46,9	2,9	76,3	13,3	
6	38,5	12,6	37,2	58,0	
7	41,0	4,3	62,1	19,9	
8	53,5	0,2	94,7	0,9	0,04
16	52,8	1,3	90,8	6,0	
17	54,8	0,5	96,3	2,3	
18	54,6	0,6	95,8	2,8	
19 (1-19. sample st-path of To-Ku)	54,5	0,5	95,8	2,3	
Baradla cave Fault Hall	54,0	0,6	94,7	2,8	

Table 3. Chemical Analyses

Red clays always contain also some hematite, goethite and a lot of loess-derived quartz, as well as little clasts of reddish-violet sandstone eroded from Lower Triassic rocks of the wider surroundings. In a few samples collected near Gergés-lápa, Borókás-töbör and Vörös-tó some textural elements, similar to those known from bauxitic rocks were also identified.

The three major groups of the Aggtelek red clay are the followings:

Group A: Clays recording an oxidizing depositional environment, containing globular bauxitomorphous grains and very few quartz-silt. They represent the early stage of pedogenic alteration but contain abundant fine redeposited debris of a more mature, older soil. They are often criss-crossed by a dense network of desiccation cracks.

Group B: Clays, likewise formed under oxidizing conditions, contain abundant silt-size quartz (loess) and textural elements, minerals and colloidal ironhydroxide precipitates (films along grain boundaries and invoids) that point to a seasonal climate.

Group C: Clays of less thoroughly oxidizing facies. They are often laminated and mottled pointing to deposition in a continuously wet environment.

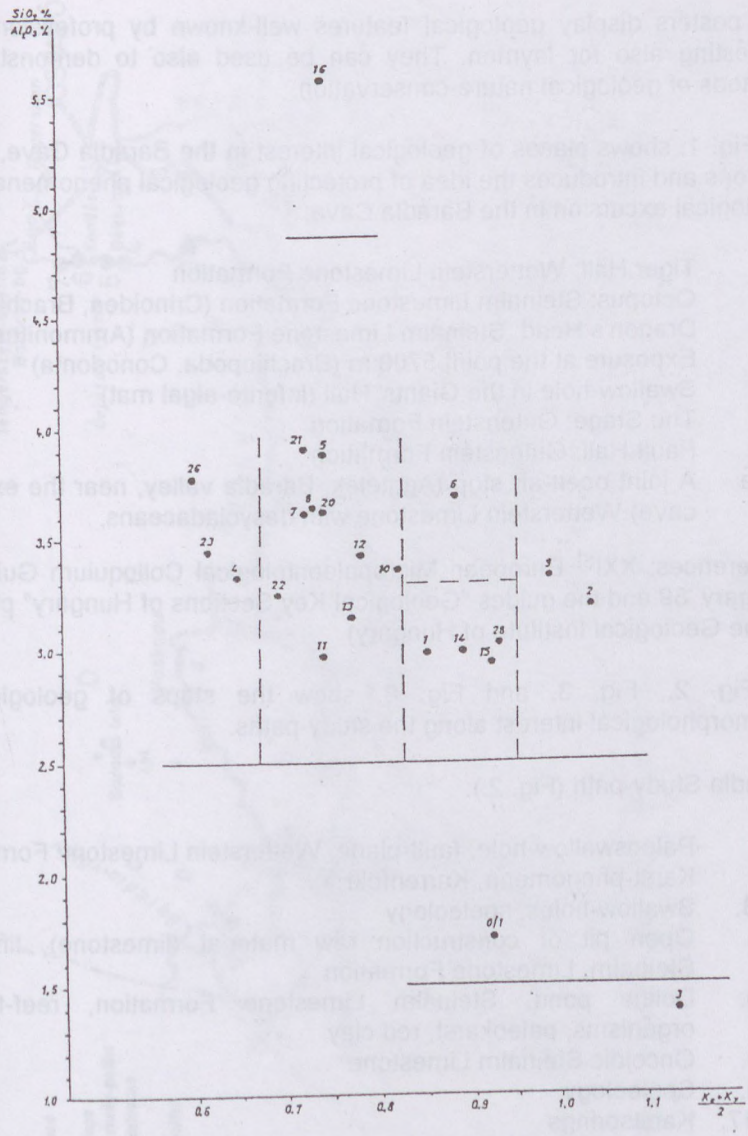


Table 4. Degree of orderliness of Kaolinite Crystals taken as a function of Al/Si ratio

The posters display geological features well-known by professionals and interesting also for laymen. They can be used also to demonstrate the methods of geological nature-conservation.

Fig. 1. shows places of geological interest in the Baradla Cave, the key sections and introduces the idea of protecting geological phenomena. Geological excursion in the Baradla Cave:

1. Tiger Hall: Wetterstein Limestone Formation
2. Octopus: Steinalm Limestone Formation (Crinoidea, Brachiopoda)
3. Dragon's Head: Steinalm Limestone Formation (Ammonites)
4. Exposure at the point 5700 m (Brachiopoda, Conodonta)
5. Swallow-hole in the Giants' Hall (loferite-algal mat)
6. The Stage: Gutenstein Fomation
7. Fault Hall: Gutenstein Formation

1/a A joint open-air stop (Aggtelek, Baradla valley, near the exit of the cave):Wetterstein Limestone with dasycladaceans.

(References: XXIst European Micropaleontological Colloquium Guidebook, Hungary '89 and the guides "Geological Key Sections of Hungary" published by the Geological Institute of Hungary)

Fig. 2., Fig. 3. and Fig. 6. show the stops of geological and geomorphological interest along the study-paths.

Baradla Study-path (Fig. 2.):

2. Paleoswallow-hole, fault-plane, Wetterstein Limestone Formation
6. Karst-phenomena, Karrenfeld
7-8. Swallow-holes, speleology
9. Open pit of construction raw material (limestone), lime-kiln, Steinalm, Limestone Formation
13. Doline pond, Steinalm Limestone Formation, reef-forming organisms, paleokarst, red clay
14. Oncoidic Steinalm Limestone
15. Speleology
16-17. Karstsprings

Orientation: posters placed along the tourist-path, set up by the National Authority for Nature Conservation and by the Geological Institute of Hungary.

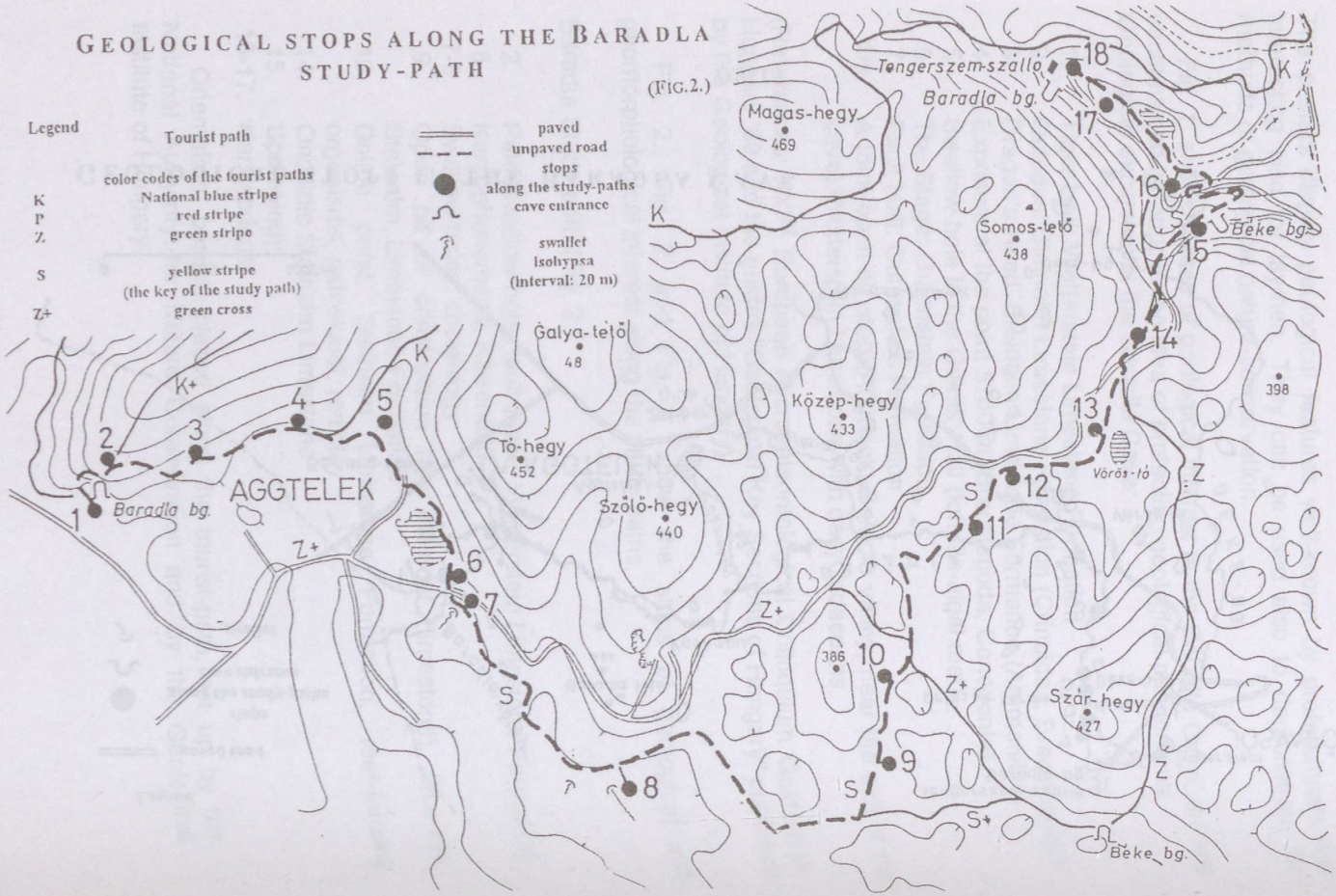


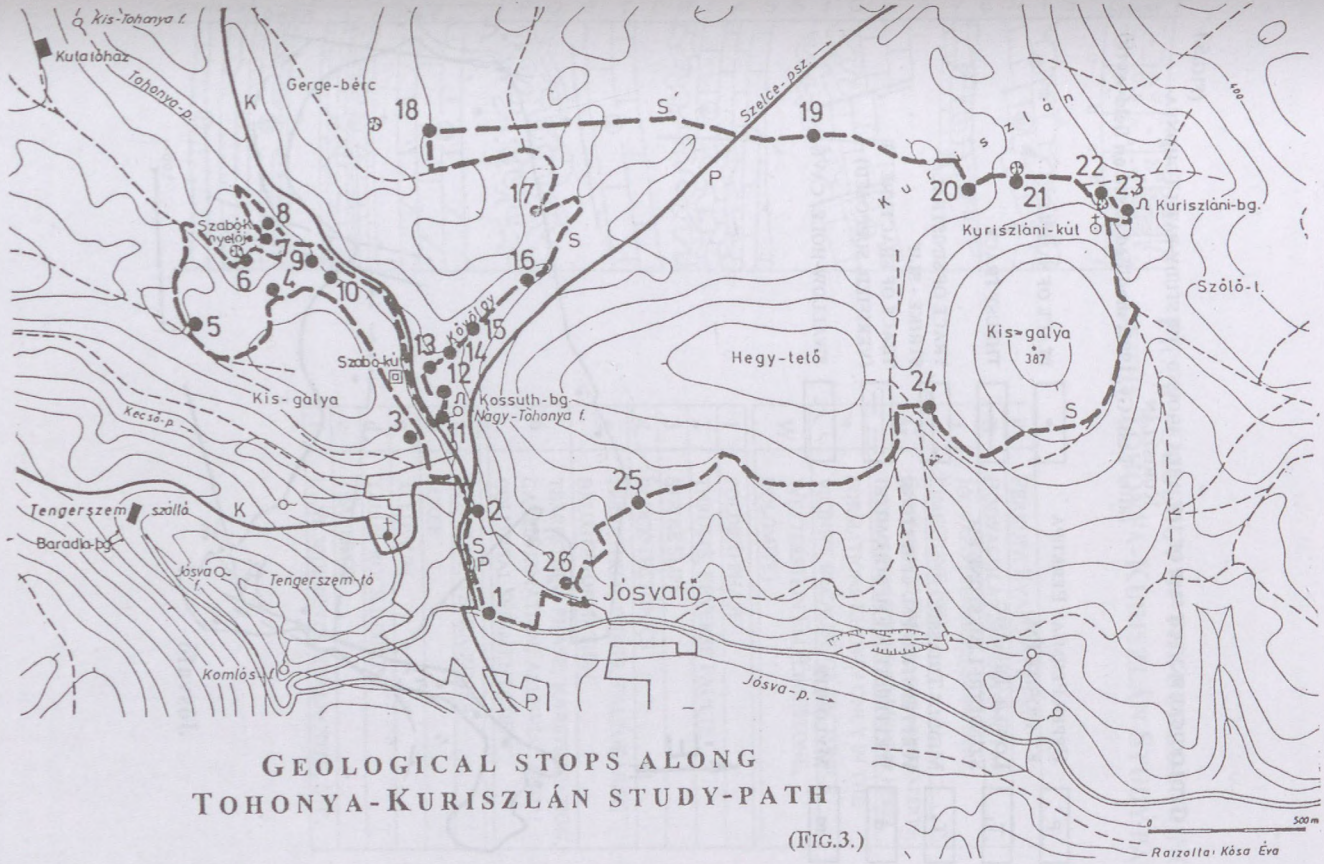
GEOLOGICAL STOPS IN THE BARADLA CAVE

(FIG. 1.)

GEOLOGICAL STOPS ALONG THE BARADLA STUDY-PATH

(FIG.2.)





GEOLOGICAL STOPS ALONG
TOHONYA-KURISZLÁN STUDY-PATH

(FIG.3.)

(FIG.5.)

GEOLOGICAL SKETCH MAP OF THE AREA AROUND THE STUDY-PATH TOHONYA-KURISZLÁN
(after Less, Gy. 1992, modified based on field-work)

P — UPPER PERMIAN PERKUPA EVAPORITE FM

T_1 — LOWER TRIASSIC SZINPETRI LIMESTONE FM

T_2 — MIDDLE TRIASSIC WETTERSTEIN FM. LIMESTONE

d — WETTERSTEIN FM. DOLOMITE

m — MYLONITE

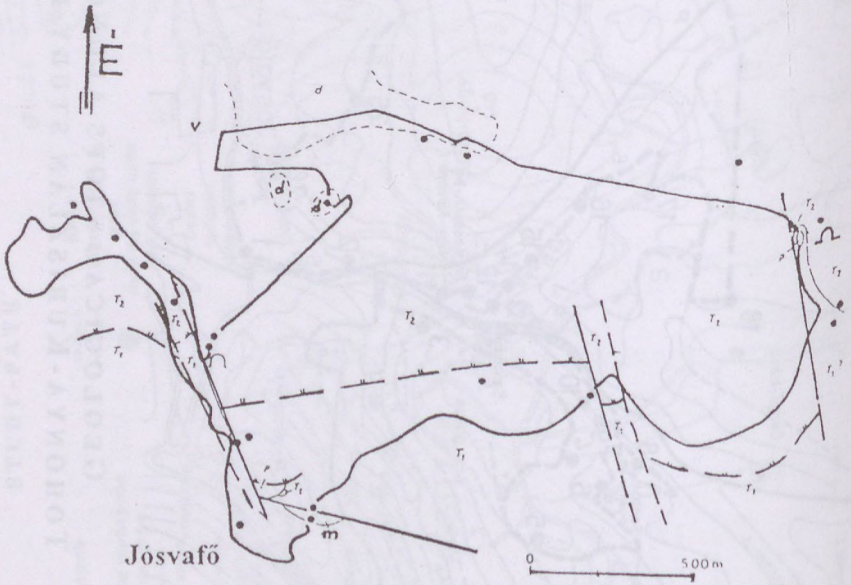
PLACE OF SAMPLING

THRUST TRACE

TRACE OF SINISTRAL STRIKE - SLIP

TRACE OF FRACTURE (VERIFIED. SUPPOSED)

SWALLOW-HOLE, CAVE



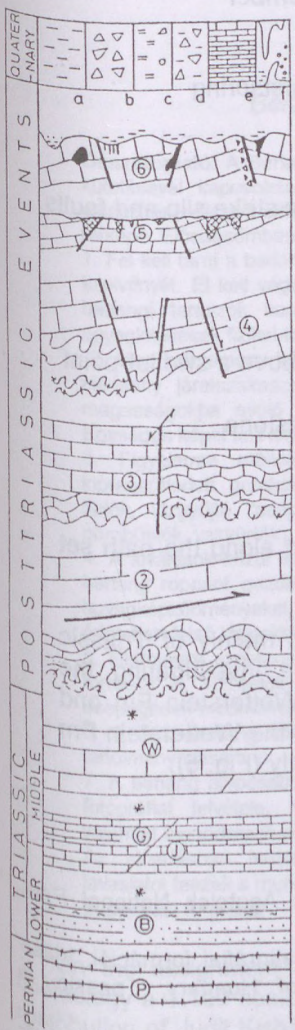


FIG. 6. GEOLOGY OF THE SURROUNDINGS OF THE TOHONYA-KURISZLÁN STUDY-PATH

P	PERKUPA EVAPORITE FM
B	BÓDVASZILAS SANDSTONE FM
J	JÓSVAFŐ MEMBER (SZINPETRI LIMESTONE FM)
G	GUTENSTEIN FM. (AS FOR SOME EXPERTS, THERE ARE ONLY JÓSVAFŐ MEMBER HERE)
*	FORMATIONS KNOWN ONLY IN THE VICINITY BECAUSE OF TECTONICS
W	WETTERSTEIN FM (LIMESTONE, DOLOMITE)

1	FOLDING PHASE
2	THRUSTS, REVERSE FAULTS
3	STRIKE SLIPS
4	BLOCK TECTONICS
5	TERRESTRIAL PHASE, PALEOKARST, BAUXITE FORMATION
6	TERRESTRIAL PHASE, KARSTIFICATION, CAVE FORMATION, ALLUVIAL AND COLLUVIAL SEDIMENTATION

a	RED CLAY, TERRA ROSSA
b	SCREE
c	ALLUVIUM
d	TALUS, ROCK DEBRIS
e	TRAVERTIN
f	CAVE SEDIMENTS, STALACTITE, ETC.

Tohonya-Kuriszlán Study-path (Figs. 3, 6):

2. Fold tectonics
3. Szinpetri Limestone Formation, Jósvafő Member
4-5. Dolines
6. Doline with swallow-hole
7. Wetterstein Limestone Formation, paleo-karstspring
8. Travertin
9-10. Tectonic phenomena
11. Karstified fissure cave (Kossuth Cave)
12. A rock of Wetterstein Limestone, traces of a strike slip and faults
13. Small cave
14. Epigenetic valley, channel-knock-point
16. Hanging valley
17. Dolomitplateau
18-21. Dolines of different types, collapse of soil above a swallet-point
22. Shaft cave
23. Karstcave in thick-bedded Wetterstein Limestone
26. Mylonite (shear-breccia)

Orientation: a guidebook and posters 1 to 26 placed along the path set up by the Aggtelek National Park Directorate.

The study-path leads through a terrain built up mainly of Triassic limestones, dolomites and their transitions. While investigating the boundary of these rocks within the terrain of the Wetterstein Fm and also the line and character of the boundary between the Wetterstein Fm and the Jósvafő Member could be drawn more exactly (Fig. 5).

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A REVIEW AND EVALUATION OF THE SPELEOLOGICAL VALUES OF THE BÉKE CAVE AIMING AT A COMPREHENSIVE SCIENTIFIC RESEARCH PROGRAM

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Összefoglaló: A Barlangtani Intézet megbízására összeállítottam a Béke-barlang kutatásával kapcsolatos tudományos kérdések palettáját. A kutatási program elkészítésének aktualitását az adta, hogy elkészült a barlang 1:100 méretarányú térképe. Előadásomban a kiemelkedően érdekes problémákat ismeretem.

1. Fel kell tárni a barlang tektonikai szerkezetét és el kell készíteni teljes geológiai szelvényét. El kell végezni a Komlós-patak medrének kavicskitöltés-vizsgálatát, a barlangi teraszok korának és térbeli helyzetének azonosítását, valamint az agyagkitöltések fizikai-kémiai elemzését.
2. Meg kell ismerni barlangi meanderek, szifonok és a teljesen cseppkőmentes, alacsony járatszakaszok kialakulásának törvényszerűségeit és a beláthatatlan magasságokba nyúló kürtők térbeli szerkezetét ill. barlanggenetikai szerepét. Egységes képet kell kialakítani a barlang színlőrendszereiről.
3. Figyelemre méltóak a Béke-barlang különleges kisformái: a szálkőből kipreparálódott gombasziklák, tarajok, kőoszlopok; a kőzetfelszínbe bemélyedő öblök, vízgyűjtő "csápok", csatornák; a mennyezeti oldásformák (főtekarrok, gömbüstök, vakkürtők), valamint a "lábas sziklák" és hullámkagylók.
4. A kiválások közül legsürgetőbb a mésztufagátak kialakulásának kutatása és a barlang roppant gazdag cseppkőállományának értékelése. Meg kell említeni az agyagképződményeket is, mert nagy gazdagságban fordulnak elő a szinte teljesen érintetlen felső járatokban.
5. Hidrológiai szempontból a földalatti tórendszer vízháztartásának és a barlangi források ill. víznyelők rendszerének megismerése, valamint az agresszív vizű csepegések eredetének és kémiai összetételének vizsgálata ajánlott.
6. A Béke-barlang kitűnően alkalmas a "hagyományos" szpeleológiai kérdések tanulmányozására is.
7. A barlang alaposabb dokumentációja érdekében elkészítendő teljes, tematikus fotográfiai felvétele, egyes járatszakaszainak igen részletes szelvényezése, valamint meanderező járatainak térmodellje.

Az előadásban ismertetem a kutatási feladatok megoldásának ütemtervét, javaslatot teszek a munkálatok szervezési kérdéseire és eredményeinek lehetséges publikálási formáira.

On the assignment and with the financial assistance of the Institute of Speleology a 1:100 scale map of the Béke Cave has been completed with the contribution of Judit Kisbán, M Sc. Mining engineer. In the course of the survey such details of the cave were revealed to the author that had not been commonly known formerly. The complex research of these details would present the speleological attractions of the Béke Cave in a focus, their research would significantly improve the knowledge of the Aggtelek caves. The experienced facts were recorded in a report of 93 pages. This report reviews the unique speleological values of the Béke Cave, the scientific problems conserning particular phenomena and also suggests a schedule and pattern of organization

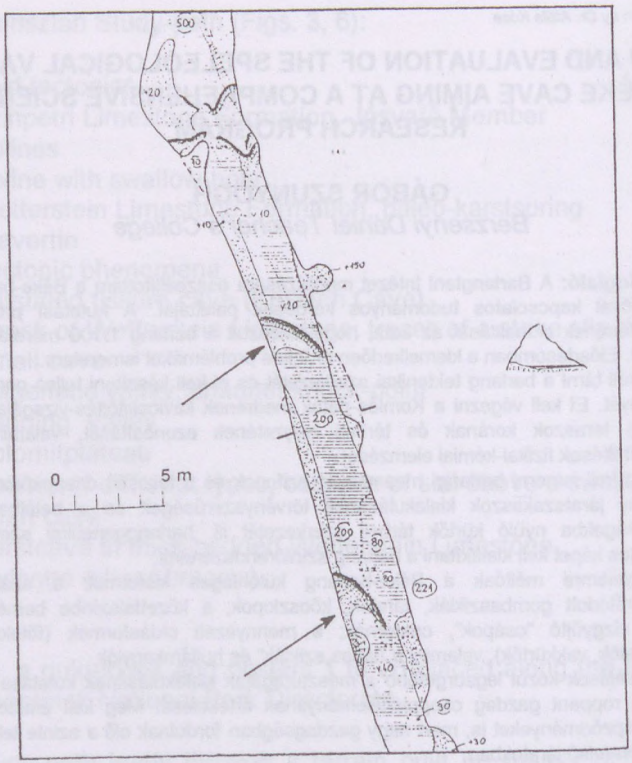


Fig. 1. Spur-like rimstone dams

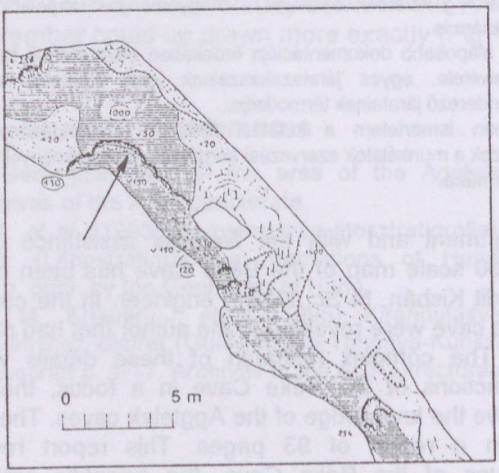


Fig. 2. Longitudinal (asymmetric) rimstone dam

for the research. This paper spotlights - without aiming at completeness - some of the speleological peculiarities of the Béke Cave.

Rimstone Dums

The most spectacular formations are the rimstone dams or gours that dam up the water of the Komlós Stream. These gours create the unique chain of that haven't been met in any other Hungarian caves. Four hundred and thirty six of these dams developed in the Main Passage.

References usually figure that the development of the gours takes place parallel to the process of damming up the water. On the other hand there are rimstone dams in the Béke Cave that do not close off the stream completely only reach in from one side of the passage as „spurs" (Fig. 1).

Regarding the morphology of these gours they are not destroyed remnants of once complete dams, thus their mere existence makes the review of rimstone dam development necessary.

It's another unique character of the rimstone dams that they are asymmetric attached to the passage wall at one side at right angle at one side curving back upstream at the middle of the stream-bed to run (in many cases) almost parallel with the passage axis to reach the other bank (Fig. 2). To ascertain the nature of this asymmetric development would surely show the genetics of rimstone dams in a different focus.

The spatial distribution, the shape and rate of growth of the gours also raise interesting questions.

A different group of gours is not located in the stream-bed but it is „suspended" (e. g. the „ Big Tufa Dam"). Their structure is different from that of the dams: they are mostly rounded, arrayed of one another like pillows, their surface is covered by minute calcite rimmed pools of 1-2 cm2 surface. They never span the stream-bed but lean onto the sides (Fig. 3). Some underground spring is always detectable above these gours, so it is not the Komlós Stream responsible for their making but the water of its tributaries.

While gours that function as dams in effect occur almost exclusively in the Béke Cave, suspended gours occur in other caves of the Aggtelek Karst as well. Most widely known of these letter are the „Sultan's Sofa" in the Baradla Cave and the „Pearl River" of the Szabadság Cave.

Cave Meanders

A considerable part of the passages in the Béke cave, summing up to several hundred meters consists of series of meanders. These meanders - like bends differ from „common" meanders that they show the most important character of meandering the changes of position. This special process can be traced in the cave as meanders developed earlier, at higher positions of the base level haven't been destroyed, but remained as upper passages or asymmetric counterparts. Bends belonging to different levels are placed at shifted positions (Fig. 4).

The occurrence of the cave meanders is strange, since according to the generally accepted (classic geomorphological) theory of Cholnoky meanders can occur only in middle (approaching full maturity) and lower (mature) course river

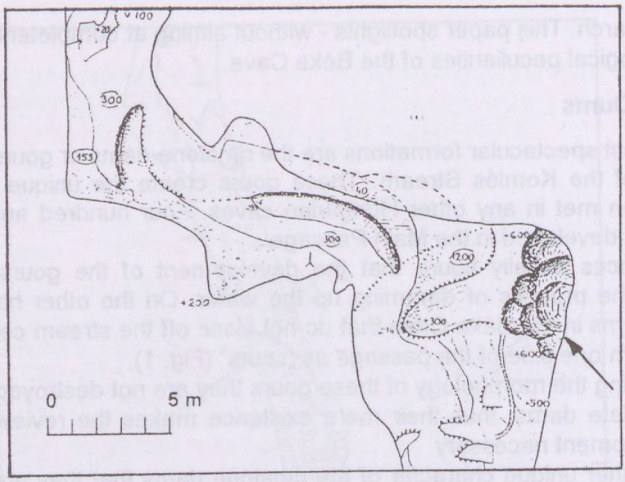


Fig. 3. Typical suspended gour in the lower section of the Main Passage

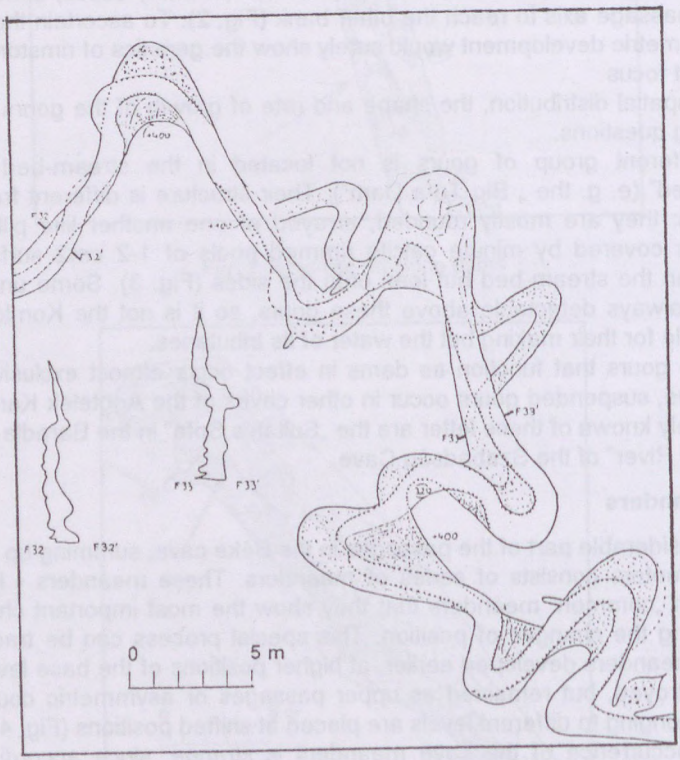


Fig. 4. Meandering passage in the Discovery Branch

sections. Water courses of upper course (immature) character (like caves) do not meander. The question arises: whether cave passage meandering is due to the asymmetric erosion effect of the gravel load or some hitherto unknown effect of corrosion. (Well developed meanders occur elsewhere in the Aggtelek Karst in caves believed to be of corrosion origin, but they are scarce in the typically erosion-cave Baradla.).

Studying the structure of meandering cave passages the process of the making of the cave can be traced almost year by year from the original tectonic fissure through the straight juvenile conduits to the wide, overgrown, self destroying big round meander-bends.

Problems of geographic, hydrographic and karst morphology nature concerning the principles of making, qualitative and quantitative characters of the meanders shall be investigated.

'Rock mushrooms', Crest and Bedrock-Columns

Beside stalactites and rimstone dams characteristic minor features are the various shapes sculpted from the original bedrock and still being part of it.

One group of these is made up of 'rock mushrooms' rising on the cave floor to heights of 30-60 cm. The horizontal section of their stems is generally streamlined in the direction of the Komlós Stream (Fig. 5).

Another group of this kind of formations is the crest-like shapes sculpted from the passage walls. Their profile is usually rather slender resembling blades of knives (Hara-kiri Rock) . In many cases the blades are 'pierced' or are connected to the bedrock at numerous points ('eared rocks').

Finally columns of rock occur in the cave connecting floor and roof with living rock that somehow evaded destruction (Fig.6).

The investigation of these formations (beyond their morphological description) shall be focused to the question: by what kinds of geological or hydrological coincidences have they evaded cavity development, what principles characterize their development.

Rocking and „Leggy" Rocks

Rocks may be located in the stream-bed (fallen earlier) that do not lie on the floor by a full surface but are balanced on points („legs"). It is strange that the Komlós stream did not go round the rocks (it could have, there is enough room around in the muddy fill of the bottom) but keeping the original route cut a way under the obstacles.

These formations occur quite frequently but only a few people know them as fall out of the normal range of view (can be noticed only from under). Their study is justified by the fact that the occurrence of such formations has not been hitherto mentioned in professional references.

Hydrogeography of the pond system of the Komlós Stream

The unique image of the Béke Cave is due to its underground system of 123 ponds. As to its hydrogeography the progress of a flood wave is one of the arising intriguing questions. The Main Passage of the Béke Cave is nothing but a

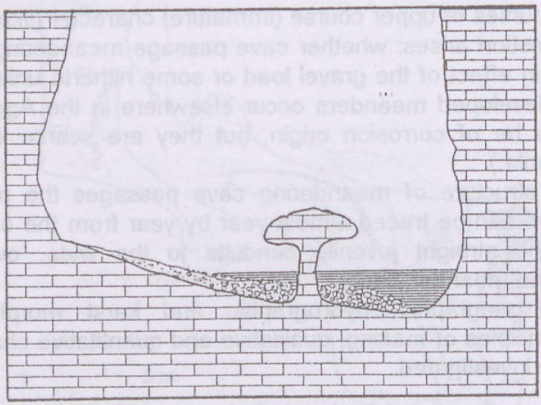


Fig. 5. The structure of "mushroom" rocks

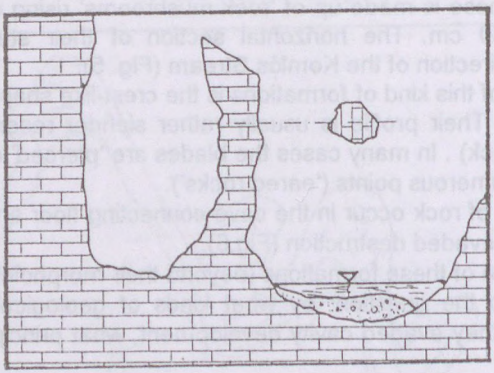


Fig. 6. Ideal section of bedrock columns

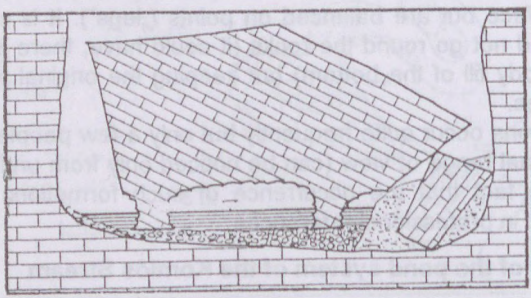


Fig. 7. Ideal section of leggy rocks

cascade-system, a string of ponds and cataracts. The cataract-theory (beside much else) deals with the problems of the progress of flood waves through lake systems (rate of progress, extensions, discharge, parameters of flood crests etc.), question that haven't ever been asked in cave environments to the author's knowledge.

The water balanced of the pond-system poses another problem. According to recent observations after a period of about one year without significant runoff the pools dry up to the "Swimming Pool Syphon". By what way the water vanishes remains a question. One possibility is evaporation but there is little chance to it because of the big volume of the ponds and because of high humidity. There is more chance to percolation, but that seems too slow - the system doesn't receive any recharge for months at a time and the pools steadily reach up to their rims. It is perceptible that the rimstone dams are slightly permeable or that the lowering karst water table is followed by the percolation of the pond- water through the secondary porosity of the rock. The study of these enigmas would be interesting.

The chemical composition and its changes of the pond- and spring-waters is a question to be answered. The growth of the rimstone dams points at calcium carbonate saturated waters, while small bays and niches in the pool-bed indicate aggressive waters. These virtual controversies can be dissolved only by wide range water analysis.

A further group of questions concern the sediment transportation of the Komlós Stream. It is strange that the stream-bed is not filled by everywhere. The upstream end of the Main Passage is almost devoid of gravel, but downstream relatively coarse gravel covering the bottom becomes widespread. Further downstream the average grain size of the sediment decreases until it becomes almost fine sand at the lower end of the main passage. It seems to be strange that in the course of only a few kilometres the grains suffer such a decrease of size. It seems to be more credible that a selection of grain size occurs, big size grains settle upstream of the rimstone dams and the water transports only fine grained load further. In this event the ponds behind the dams should fill up but the considerable depth of the ponds seem to contradict this. Silting of the ponds can't be observed either. Answers to these questions could promote the evolution of theories on erosion type cave development (by presently accepted theories the bed load the stream of the Main Passage plays a decisive role in the development of the Béke Cave). On the other hand these answers could promote the solution of the sedimentation problems of artificial boating lakes in caves.

Documentary Activities

The subject of the documentation of a full image of the Béke Cave shall consist of the systematic interpretation of all significant objects. It is extremely important to prepare a systematic photographic documentation with special focus on the interpretation of the hitherto mostly neglected pond system and connected formations on the Jósvafő side of the Rope Ladder Syphon. It is suggested to prepare scale 1:1 maps and sections of some special parts of the cave for special purposes as well as the making of a 3D model.

The Scope of Research Subjects in the Béke Cave

Quite obviously the size of this paper does not permit to describe all questions in detail but it permits to list those general subjects that would meet wider interest.

Geological problems: the petrographic tectonic structure of the cave, the structure of the gravel fill of the stream-bed, the age and spatial distribution of cave terraces, the spatial distribution and physico-chemical composition of clay fills.

Special major formations: syphons, low passages, 'polished' sections of passages void of sinter formations, cave-ins, avens reaching high up to obscure heights, meanders, terraces and terrace systems, passages divided by rock bridges or false bottoms.

Special minor formations: sculpted (positive) and dissolved (negative) rock formations, ceiling solution forms, rocking and 'leggy' rocks, scalloping.

Cave concretions: rimstone dams and 'hanging' gours, stalactites and other mineral concretions, mud forms.

Hydrological questions: aggressive (sources of intensive dissolution at present) water inflows, cave springs and swallets, the water balance of the underground pool system, the hierarchic system of karst water reservoires and conduits, the chemical composition of the infiltrating karst water.

Physical questions: cave acoustics, radon-, air current- and air exchange studies.

Biological questions: preparation of the compremensive flora and fauna map, bat counting, study of vertebrate occurrences and domains.

Documentation: preparation of systematic photographic documentation, the preparation of cm accuracy sections, the making of 3D models of some special parts of the cave.

Some Likely Variations of the Organization of the Research Works

The volume of suggested and abundant research subjects (not really detailed in this paper) can not be worked out but with a multidisciplinary action team, the activity of such a team needs to be coordinated. This coordination could be the task either of the Institute of Speleology , the Aggtelek National Park, or the Hungarian Speleological Society (MKBT). The team members could be experts of the MKBT, interested students of universities and colleges. A significant part of the listed tasks can be accomplished with some smaller teams within several months or years at the most. That is, the duration of work (2-4 years) does not exceed the normal stretch of higher education within which students can be counted on.

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THE MENDING OF MAN MADE DESTRUCTION IN THE BÉKE CAVE AND WAYS OF THE RESTORATION OF THE ORIGINAL CONDITIONS

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Összefoglaló: Az elmúlt évtizedek során a Béke-barlangban több olyan műszaki beavatkozás történt, amely bizonyos járatszakaszok eredeti arculatát jelentősen megváltoztatta, és a barlangot, mint természeti értéket károsította. Előadásomban e károsodások felmérésének eredményeiről, és az eredeti állapot rekonstrukciójához szükséges intézkedések terveiről kívánok beszámolni, mely munkát a Barlangtani Intézet megbízásából 1994-95 években végeztem.

Az első jelentős átalakítás a Mesterséges-főbejárat kiépítésekor történt: a vágathajtás során felszabadult meddőkőzetet a Fő-ágban szétteregették, illetve egy, a bejárat alatt elhelyezkedő domb kialakítására használták. Emiatt a Komlós-patak eredeti áramlási rendszere megváltozott, és a Bejárati-teremben ill. környékén nagyfokú agyagfelhalmozódás indult meg. Mivel az elagyagosodás folyamata ma már gyakorlatilag visszafordíthatatlan, ezért a kulturált áthaladás érdekében a szóban forgó területet célszerű egy acélszerkezetű járóosztállyal áthidalni.

A második komolyabb beavatkozás a jósvafői szanatórium kiépítéséhez kapcsolható. A vágathajtáshoz szükséges geodéziai munkálatok érdekében a Komlós-patak tufagátjain vízszintsüllyesztő átvágásokat végeztek, a mély vizű tavak felett pedig fából hidakat építettek. Roncsaik ma szerteszét hevernek a Fő-ág mentén. Az eredeti állapot visszaállítása érdekében összesen 37 gátat kell "restaurálni" és kb. 1 m^3-nyi korhadt fagerendát kell kihordani.

A barlang képződményeinek védelme szükségessé teszi, hogy a látogatók ruhája lehetőleg tiszta maradjon. Ezért a sáros-agyagos szakaszok átjárását kapaszkodó kötelek és létrák elhelyezésével ill. csúszásgátló lépések kialakításával kell megkönnyíteni.

Ugyanilyen okok miatt járatbővítést kell végrehajtani az Óriás-termet a szanatóriummal összekötő sárszifonban és az azt követő kisebb agyagos teremben. Keresztmetszetük jelenleg csak négykézlábas közlekedést tesz lehetővé, ezért átjárásuk során a látogatók ruházata fölöslegesen besározódik.

Életveszélyes omlást a Béke-barlangban egyedül a Felfedező-ági bejárat és a Disznó-fürdő között találunk. A többi omlás csupán rendszeres felülvizsgálatot igényel.

More than one technical interventions happened during the recent decades that have substantially changed the original image of some sections of the cave passages thus harming the natural asset, the cave. The author reports about the results of the survey of these damages done in contract with the Speleological Institute in 1994-1995 and about the necessary measures to be taken for the reconstruction of the original conditions.

1. The first significant changes were made by the construction of the man made Main Entrance: the tailing of the tunneling operation was partly dumped and spread in the Main Passage partly dumped under the entrance creating a mound. Caused by this dumping the course of the Komlós Stream has changed

and a big accumulation of mud was resulted in the vicinity of the Entry Room. As for the mud accumulation is now a practically irreversible process, the civilised way of the passage of the section in subject would be the construction of a steel walkway.

The most simple structure to span the scene would be two longitudinally placed steel profiles with iron mesh walk to let muddy floods pass and with hand rails to avoid potential accidents (Fig. 1).

Only the slippery and dangerous mud-slopes of the mound filling the Entry Room serve as an acces to the stream level of the Main Passage, flights of the steel steps shall be fitted at both end of the bridge (Fig. 2).

Resulted by some reshaping works in the entry section of the upper part of the Main Passage a muddy pond formed that never dries up. This pond cannot be drained, consequently it also should be spanned by a steel bridge (Fig. 3 and 4).

2. The second serious intervention is connected to the artificial entrance at Jósvafő. The surveying operations that were necessary for the construction of the entrance adit clefts were cut into the rimstone dams to lower the water level. The cuts were made relatively gently, only narrow clefts were sawed thus these formations maintained their former shapes. The rimstone dams couldn't have grown ever since of course, as the Komlós Stream does not tumble from their rims any more. The original luster, the pink hue of the dams have been gradually lost and the surfaces have started to be smeared by mud.

The clefts into the rimstone dams shall be fitted by brass meshes shaped locally to the particular cleft and fixed by screws, the space behind the mesh filled concrete made with locally acquired gravel and sand. During reconstruction the stream-water shall be drained through pipes at the bottom of the fillings that can be sealed by wooden plugs later. The last phase of the operation would be to cover the brass mesh by a roughened cement layer to promote rimstone growth. (Fig. 5)

The number of cut and to be restored rimstone dams is 37, the total dam surface to be restored is 8 m^2, the volume of the concrete to be placed would be 2 m^3.

3. Out of the place materials significantly blemish the original state of the cave. These materials were carried in partly to make wooden bridges to cross deeper pools during the survey, partly they are the litter of cave trips: garbage and carbide dumps.

The removal of garbage is a simple task, it shall be carried out in backpacks. The ruins of the scaffolding is a more difficult task. The punk wood has been impregnated by calcium carbonate, the average piece weighing more than a 100 kg. Their removal seems practicable chopped to pieces of 30-40 cm on backpack frames.

The accumulation of litter is extreme in the Main Passage. A total of 35 m length of wooden beams of 15 cm diameter, 1.5-2.0 m in individual length as well as 16 m of total length of 2" wooden planks are scattered in the passages.

4. At the same time with the reconstruction other measures shall be taken to

protect the cave. The protection of the cave's totally mud free formations, the surfaces of the white rimstone dams and the polished wall surfaces demands that the coveralls of the visitors stay clean. For this purpose the muddy-murky sections of the cave shall be equipped with grip-ropes and ladders as well slip-proof steps thus providing easier and cleaner passage.

5. The reconstruction of the vicinity of the Big Room shall be specially dealt with. Some man made changes made decades ago have remained incomplete. The „ Mud Syphon" connecting the Big Room with the spaces used by the sanitarium was enlarged only just to be passable. No one cared about the muddy conditions and the dangerous muddy slopes of the Big Room. Thus trips cannot enter the cave from the Jósvafő entrance at human conditions and trips started at the man made Main Entrance end in the unpleasant „ mud bath".
The described problem can be solved by the construction of steps, the installation of grip-ropes and ladders as well as by the construction of a 22 m long masonry lined tunnel replacing the Mud Syphon (Fig. 6). At the bottom of the tunnel a sump shall be constructed and the collected water pumped to the surface at intervals.
Because of the law ceiling in the passage between the Mud Shyphon and the Sanitarium Room one can climb the slippery and worn stairs in a stooped posture thus this passage shall be deepened and new steps shall be constructed.
A total of 150 m of grip ropes, a total of 1.5-2.0 m tall ladders shall be installed. 25 m of passage floor shall be deepened and 45 m^2 of floor shall be cleaned of blast debris. Tunnel enlargement requires the removal of further 30 m^3 of rock.

6. Man made interventions made it necessary to check the stability of the cave system. The occurrence of sections hazardous to cave in not extensive but hazardous locations shall be checked periodically.
Direct danger occurs presently in a 60 m long section between the Discovery Branch entrance and the Hog Bath because the bedrock here is composed of loose small grained debris. The passage has caved in at more than one locations and the same can be expected at any time. The discovery Branch entrance being sealed at the Hog Bath shall be banned as well.
The so called „ Cracking Cave In" shall be reexamined because as it has been well known this mound of debris stirred at the time of the exploration . Warnings shall be placed along the safe route because wandering among the blocks in the rubble may cause the displacement of unstable rocks.
Unsafe conditions were generated by blasts meant to enlarge the entry squeeze of the Rum Shyphon : one of the rock pillars of the gate cracked. A buttress made of the blast produced debris can secure the damaged pillar (Fig. 7).

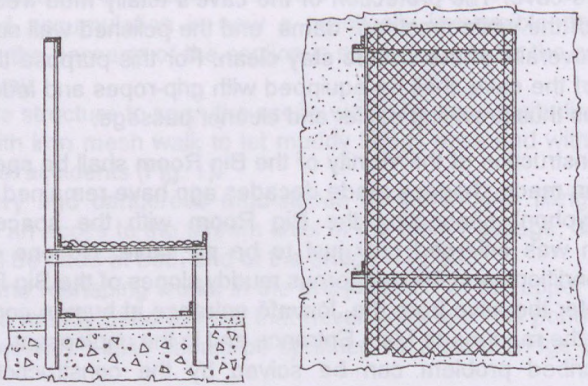


Fig. 1. Sketch of the steel bridge in the Entry Room

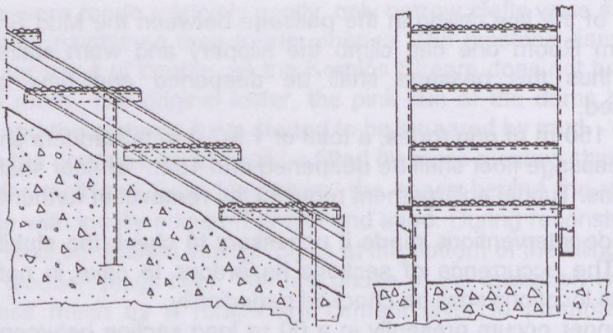


Fig. 2. Sketch of the stairs leading to the level of the Komlós stream from the Entry Room

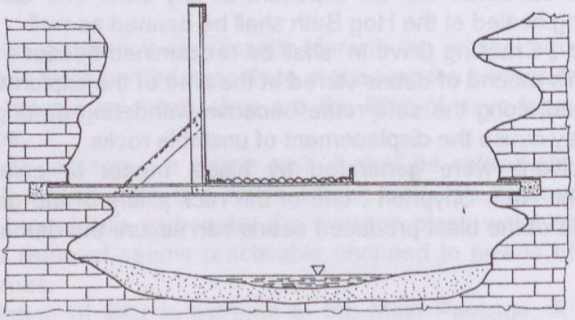


Fig. 3. Sketch of the bridge spanning the muddy lake at the upper section of the Main Passage

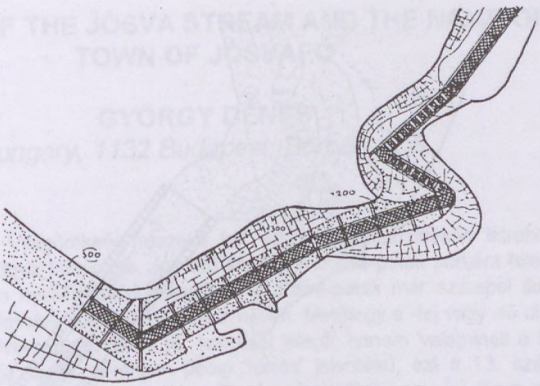


Fig. 4. The suggested position of the bridge to be raised in the upper section of the Main Passage

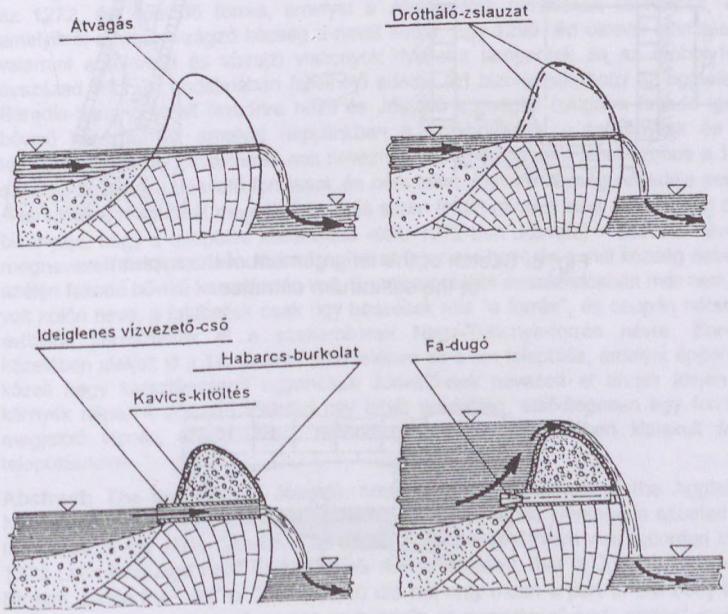


Fig. 5. Scheme of the reconstruction of the clefted rimstone dams

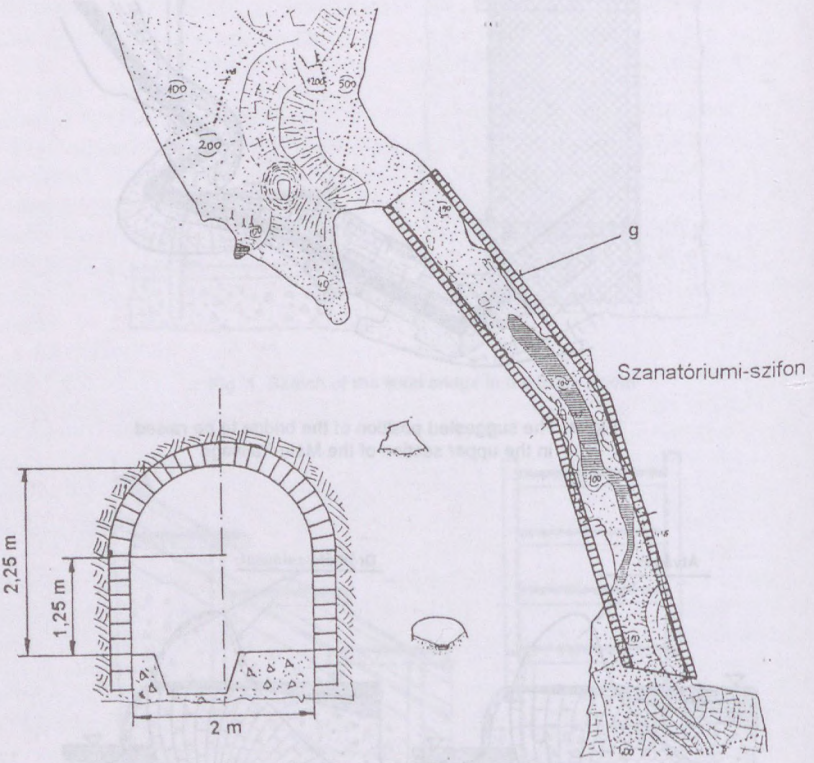


Fig. 6. Sketch of the enlargement of the syphon at the sanitaruim entrance

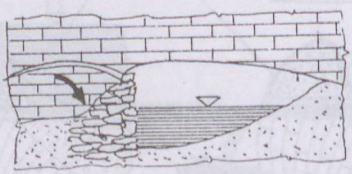


Fig. 7. Design of the buttress at the entry pillar of the Rum Syphon

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THE SOURCE OF THE JÓSVA STREAM AND THE NAME OF THE TOWN OF JÓSVAFŐ

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Összefoglaló: A Világörökség részévé lett Aggteleki-karsztvidéken létrehozott Nemzeti Parknak egyik központja, Jósvafő község a Jósva-patak partjára települt. Egy 1272. évi latin nyelvű királyi oklevélben a Jósva-patak már szerepel *fluvius Ilsuafey*, vagyis 'Jósvafej~Jósvafő folyócska' néven. Minthogy a -fej vagy -fő utótag a régi magyar nyelvben nemcsak a 'fej' testrészt jelenti, hanem 'valaminek a felső vége, kiindulópontja' is, víznevekben pedig 'forrás' jelentésű, ezt a 13. századi víznevet ma így mondhatnánk: 'a Jósva-forrás vízfolyása' vagy 'a Jósva-patak forrásának vízfolyása'. A Jósvafő földrajzi név eredetileg tehát egy forrást megjelölő víznév, amely így önmagában azt jelenti 'Jósva-forrás' vagy 'a Jósva-patak forrása'. Közelében a 13. században nem is volt lakott település, csak utóbb, a 14. század első felében alakult ki az a kis falu, amelyet ugyanezen névvel megjelölve Jósvafő-nek neveztek, nyilván azért, mert az ilyen nevű forrás mellé települt. De Jósvafő község környezetében számos karsztforrás fakad, és kérdés, hogy közülük melyik az 1272. évi Jósvafő forrás, amelyet a Jósva-patak forrásának tekintettek, és amelyikről a ma is virágzó község a nevét kapta. Egy 1295. évi oklevél elemzése, valamint a földrajzi és vízrajzi viszonyok nyujtotta támpontok és az utóbbi két évszázad földrajzi irodalmában fellelhető adatok azt bizonyítják, hogy az aggteleki Baradla-barlang vizeit felszínre hozó és Jósvafő községtől nyugatra fakadó igen bővizű karsztforrás, amelyet napjainkban a szakirodalom, a tankönyvek és a térképek egyaránt Jósva-forrás-nak neveznek, semmiképp sem lehet azonos a 13. századi Jósvafej ~ Jósvafő forrással, és nem lehet Jósvafő község névadója sem. A tanulmány megírását megelőző kutatás során feltárt minden adat és adottság azt bizonyítja, hogy a település kialakulása előtt, 1272-ben Jósvafej ~ Jósvafő néven megnevezett forrás a Kossuth-barlang vizeit felszínre hozó és a mai község északi szélén fakadó bővizű karsztforrás volt. Ennek az utóbbi évszázadokban már nem is volt külön neve, a falubeliek csak úgy beszéltek róla "a forrás", és csupán néhány évtizede keresztelték el a szakemberek Nagy-Tohonya-forrás névre. Ennek közelében alakult ki a 14. század első felében az a kis település, amelyet éppen a közeli nagy karsztforrásról ugyancsak Jósvafő-nek nevezett el annak idején a környék népe. A Jósvafő földrajzi név tehát eredetileg, elsődlegesen egy forrást megjelölő víznév, amely utóbb, másodlagosan lett a közelében kialakult falu településneve.

Abstract: The township of Jósvafő, one of the headquarters of the Aggtelek National Park in the Aggtelek Karst, now part of the World Heritage is situated at the banks of the Jósva Stream. The name of the Jósva Stream was recorded in a 1272 Latin language royal document as *fluvius Ilsuafey*, that is Jósvafej~Jósvafő Stream. Since the "-fej" or "-fő" (-head) did not only mean a part of the body but also carried a meaning of „upper end, origin of something" and „spring" in old Hungarian hydrographic names. The 13th century hydrographic name could be said now: the stream of the Jósva Spring or the watercourse of the spring of the Jósva Stream. The geographic name Jósvafő was originally the name of a spring that means Jósva Spring or the Spring of the Jósva Stream. There was no settlement in the vicinity of the spring in the 13th century, a small community

developed only later, in the 14th century. This hamlet was named the same as the spring, Jósvafő, obviously because it was built at a spring having the same name. On the other hand numerous karstic springs occur in the vicinity of the township of Jósvafő and the question has been raised which one of these was mentioned in the 1272 document, which one was considered as the source of the Jósva Stream, the one that is the name giver of the community. The analysis of a 1295 document, geographical and hydrographical evidences as well as references in the geographical literature of the last two centuries confirm that the resurgence of the waters of the Baradla Cave, the karstic spring of very abundant discharge west of the township of Jósvafő that is consequently referred to as Jósva Spring can be anything but the Jósvafej~Jósvafő Spring mentioned in the 13 century document, consequently it can not be the original name giver of the township of Jósvafő. All data and evidences that turned up in the course of the research that preceded the writing of this paper proved that the spring that was named Jósvafej~Jósvafő before the community came into being was nothing else but the spring of abundant discharge at the north municipal limit of the present community and that is the resurgence of the Kossuth Cave waters. This spring did no have a name in recent centuries, it was referred to by locals as „the spring" and has been labelled as Greater Tohonya Spring by professionals only for several decades. The hamlet developing in the 14th century was referred to by the population of the vicinity the same as to the spring Jósvafő. The geographic name Jósvafő was originally a hydrographic name indicating a spring and that became secondarily the name of the community developing nearby.

The Jósva Stream is a virtual axis of the Aggtelek National Park that was recently excepted to be part of the World Heritage. The Jósva Stream conducts the drainage of a major part of the karst area to the recipient Bódva River. The township of Jósvafő, that is the residence of the national park headquarters, is the scene of the confluence of waters emerging from various karstic springs to this small river. These are the waters of the Tohonya Spring fed by the Vass Imre Cave. This is joined by the water of the intermittent Lófej Spring by a valley that is usually dry at its lower section. The waters of the big Kossuth Cave spring join at a lower section followed by the Kecső Stream that carries the water of the Kecső and Babot Springs. At a lower section the stream emerging from the big discharge resurgence of the Aggtelek Baradla Cave join and the get together is completed by the small rivulet emerging from the Kajta Spring. The waters emerging from numerous karstic springs merge within the municipality borders of the township of Jósvafő (in free translation „Jósva Head"). As for which spring can be regarded as the „head", the resource of the Jósva Stream, different ages held different opinions.

The names of a part of the streams and springs in the Jósvafő vicinity were mentioned in two Latin language documents written in the 13th century. They are mentioned in the documents specifying the boundaries of the estate of Teresztenye in 1272 and that of the estate of Noak in 1295.

The names of the Kajta and Jósva Streams are recorded in the 1272 document (Zichy 1871), the letter as *fluvius Ilsuafey*. Since the "-fej" or "-fő" (-head) carried a meaning of „spring" too in old Hungarian hydrographic names (Benkő 1967), the Latin name can be translated as the „stream of

the Jósva Spring". Consequently the geographic name Jósva-fő certainly existed in the 13th century as the name of a spring, when the community of Jósvafő did not show a single trace yet. The town of Jósvafő formulated in the first half of the 1300-s on the banks of the Jósva Stream (Kiss 1988) consisting of some huts and maybe a mansion at the beginning named after the spring by the people of the vicinity. Consequently the Jósva-fej ~ Jósva-fő hydrological name is earlier than the Jósvafő municipal name. The question remains which of the numerous springs was the one that was considered the „head", the point of origin of the Jósva Stream in the 13th century. The one that gave the name to the small settlement formulated in the next century.

The analysis of the 1295 document (Fejér 1829) provides a good approach to the solution of the riddle. It can be assumed from the description of the estate boundary that the big discharge resurgence of the Baradla Cave System and its water spreading in the lower section of the spring-valley was named Sár (Mud). The boundary then crossed the Kecső vize (Water of Kecső) watercourse, that is the Kecső Stream now at Northeast, then beyond a hill it got to the Jósva-patak (Jósva Stream) watercourse. Then it followed the course of the Jósva Stream until the confluence of the formerly crossed Kecső Stream. The boundary further followed the Jósva Stream to where now the houses of the township stand, but at that time there was still no trace of the settlement. The boundary departed the line of the Jósva Stream further on and curved to Southeast. It is clear from the quoted description that the watercourse flowing from the north to the south was considered the Jósva Stream that received the Kecső Stream and it was called Jósva down- and upstream of the confluence. Again the question remains which of the springs was the one that was considered the „head of the Jósva".

One thing can be considered to be a fact anyway, that the group of big resurgences that discharge the waters of the Baradla Cave System - that is unanimously named Jósva-forrás (Jósva Spring) by professional writers, school textbooks and map makers - is not the historic Jósva Spring. As it has been proved from the 1295 document, the name of this spring-watercourse system was Sár (Mud) in the 13th century. The Sár was addressed by experts of the 19th century - certainly out of professional considerations - the Resurgence of the Baradla or the stream flowing from the Aggtelek cave (Dénes 1979) only to be named Jósva-forrás (Jósva Spring) again by experts in the beginning of the 20th century. The reason may had been that none of the other springs discharging to the Jósva Stream bore that name any more and it was decided that this one, the biggest of all should have the historic name. At the same time - the author was convinced during his fact finding meetings with local people - there were senior people yet in 1970 who called the stream flowing from the Vass Imre and Kossuth Caves Jósva, even upstream of the confluence with the

Kecső Stream. Where can then the spring be located that was really considered the Head of the Jósva Stream by local people in the 13th century and then named the new settlement Jósvafő in the 14th century?

A head or point of origin of the small Jósva Stream rushing from the north could be considered one of the springs upstream of the Kecső confluence: the big resurgence of the Kossuth Cave, or the source of the minor stream arriving there, the Tohonya Spring that is the resurgence of the waters of the Vass Imre Cave. Or the intermittent Lófej Spring further to the north.

Several authors identified the Lófej Spring as the source of the Jósva Stream just because this spring is the most distant one to the north (Dénes 1979). But this spring discharge water only intermittently, its discharge is small and its water usually disappears in the limestone bed of the downstream valley after a few hundred meters. Medieval people who named the features of the landscape would hardly consider a spring whose discharge hardly ever reaches the bed of the Jósva Stream the origin of that particular stream. It can also hardly believed that the inhabitants of the new community would name their town after such a distant spring.

The Tohonya Spring at the foot of the Tohonya Hill is a steady spring of modest discharge from the Vass Imre Cave, but the spring has ever been named Tohonya (tardy, sluggish) together with the small rivulet, the Tohonya Stream. Thus no one would ever have considered the sluggish system the source of the Jósva Stream. The spring is also quite far from Jósvafő, the township could hardly be its namesake.

Contemplating all the above it can be interpreted that only such a spring could be mentioned by the 1272 document, only such a spring could have been regarded the head of the Jósva Stream ever since the Medieval, that correspondingly to the 1295 document has been feeding the watercourse flowing from the north and that has been discharging steadily and abundantly, so that it could have really been regarded as the origin of the Jósva Stream. Last but not least the name „Jósva Spring" could stick with the hamlet being born at the beginning of the 14th century only if its houses were built close to the namesake spring. Summarising all these the only spring that remains for investigation can be the closest big discharge spring upstream the Jósva Stream from the Kecső confluence.

Only the resurgence of the Kossuth Cave corresponds to all these conditions. It rises north of the Kecső confluence at the immediate proximity of the township, its abundantly flowing water surged up in a wide-spreading spring-lake before its bed was trained. The lake majestically spread in the valley and barred the track of further going to the north on the left bank ever since ancient times not leaving a trace of doubt that IT is the source, the upper end, the origin of the Jósva Stream. With no doubt this spring was the 13th century Jósva-fej or Jósva-fő (Jósva-head) and the core of the ancient town was built just below this spring. The big spring was accepted as THE

spring (Jakucs 1952) of the township for centuries, later the spring lost its name, it has become „the spring". It was only some decades ago in the second half of the 20th century that professionals named the spring - by not a very resourceful choice of the name - Nagy-Tohonya-forrás (Greater Tohonya Spring), just because it merges with the stream discharged by the upstream Tohonya Spring.

The study of the springs of the Jósva Stream this way led to the knowledge of the historic beginnings of the township of Jósvafő, to the solution of the riddle of the origin and etymology of its name.

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THE ROLE OF KARSTIC SPRINGS IN THE DEVELOPMENT OF INDUSTRIES IN JÓSVAFŐ

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Összefoglaló: A térség meghatározó jelentőségű karsztforrásai Jósvafő határában fakadnak. A korai középkorban már felismerték ezek jelentőségét. Energiájukat az érczúzástól a kovácsoláson át a gabonaőrlésig hasznosították. A század első felében még villamos energiát is termeltek a Jósva-forrás vizével, közvilágítást is kiépítve a településen, majd később a barlangban. A XIX-XX. század új energiaforrásai fokozatosan háttérbe szorították a helyi vízienergia hasznosítását, olyan mértékben, hogy ezek az ipari emlékek is megsemmisültek. Maradványaik felkutatása, konzerválása, bemutatása, tárgyi emlékeink közkinccsé tétele a mai kor feladata.

Abstract: The karstic springs of decisive importance in the vicinity of Jósvafő rise in the outskirts of the township. The importance of these springs was recognised as early as in the Middle Ages. The energy of the springs has ever been utilised from ore crushing to milling grains. Even electricity was generated in the first half of the 20th century by the water of the Jósva Spring thus creating public lighting in Jósvafő and later in the Baradla Cave. The new sources of energy developing in the 19th and 20th centuries made local generation of electricity obsolete so much so that even the remains of this industry have vanished. The search, conservation, exhibition of said remains and to make them accessible to the public is the responsibility of our days.

Out of the 21 springs of major discharge in the Aggtelek Karst 7 rise in the immediate vicinity of the township of Jósvafő. The author does not intend to discuss the hydrological and hydrogeological properties of these springs, only their discharges are what count in the respects of this paper.

The table shows the properties of said 7 springs and the totals and averages of all 21 springs (MAUCHA 1986).

No.	Name of spring	Average discharge m^3/day	max. m^3/day	min. m^3/day	Fluctuation of flow Q_{ave}/Q_{min}	Flow of 80% average duration	Elevation above sea level (m)
1	Jósva	16,591	618,000	5,616	3	10,900	218
2	Big Tohonya	10,682	209,000	1,987	5	3,614	217
3	Komlós	1,224	39,500	17	72	233	220
4	Szabó Well	580	4,600	156	4	*326	219
5	Babot Well	1,580	6,600	717	2	*1,498	254
6	Small Tohonya	1,694	37,411	101	17	263	268
7	Lófej	523	21,600	9	58	56	423
8	Total of 21 springs	49,707	1,358,581	8603	-	-	-

* estimated data

Studying the table one can come to the following main consequences:

- The 66% of the total discharge of the studied 21 springs rise in 7 springs in the immediate vicinity of Jósvafő,
- the Jósva spring beats all other springs with its highest discharge and with the duration of this discharge,
- the township is situated at an elevation of 209 m a.s.l. and the big springs rise within 10 m of relative difference of elevation with good conditions of drainage.

Taking into account that people who settled in this location since the early Middle Ages haven't ever had any other but hydraulic energy released by the springs, consequently the energy consuming „processing industries" took root here.

The Relation of Jósvafő and the Waters

From the results of the archives research of Dr. György Dénes (DÉNES 1979) it is known that the royal deed of gift of Teresztenye dated in 1272 and the sales contract prepared by the authority in the town of Eger in 1295 mention the small river already, the former as *fluvius Ilsuafey*, the letter as *fluvius Ilsua*. According to etymological research the Ilsua > Jósva geographical name hints at the marshy nature of the Jósva Valley and the -fej or -fő (head) extension means the spring with no doubt.

A verdict document dated October 24, 1399 under the rule of King Sigismund contains the first detailed description about Jósvafő (archives of the age of Sigismund, section F).

„...and last on the property of Ilswafw twenty inhabited- and two abandoned serf parcels, ploughland of three ploughs*, dog rose bush of three ploughs, a towerless church, a **two wheeled mill** that is driven from above, one of these wheels belongs to said Steven and his sons, an **abandoned mill** and a **mill commonly called the forge**..." (*1 plough ≅ 70 ha).

Based on the description in the document Lajos Marjalaki Kiss identified the location of this „mill commonly called the forge" and organised by the Historic Committee of Metallurgy, headed by Gyula Nováki and Dr. Gábor Vastagh excavations began in the autumn of 1964 in the outskirts of Jósvafő on the Huta (Forge) Meadow and in the Almás Gorge.

It was learned that the forge at the letter location was driven by undershot paddlewheels. The bigger wheel drove the hammer of the forge, the smaller one drove the bellows of the iron smelter „pig furnace" (Fig. 1).

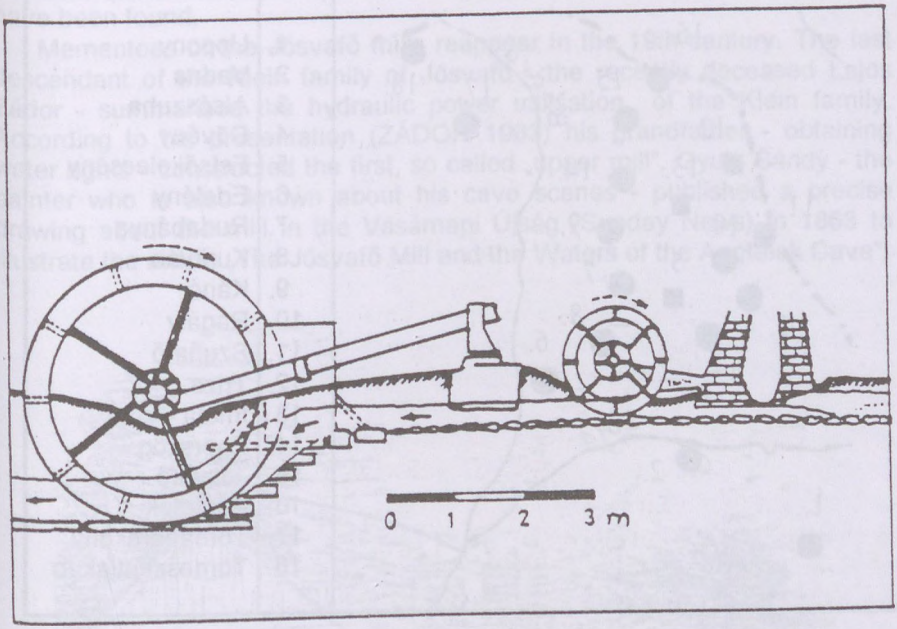
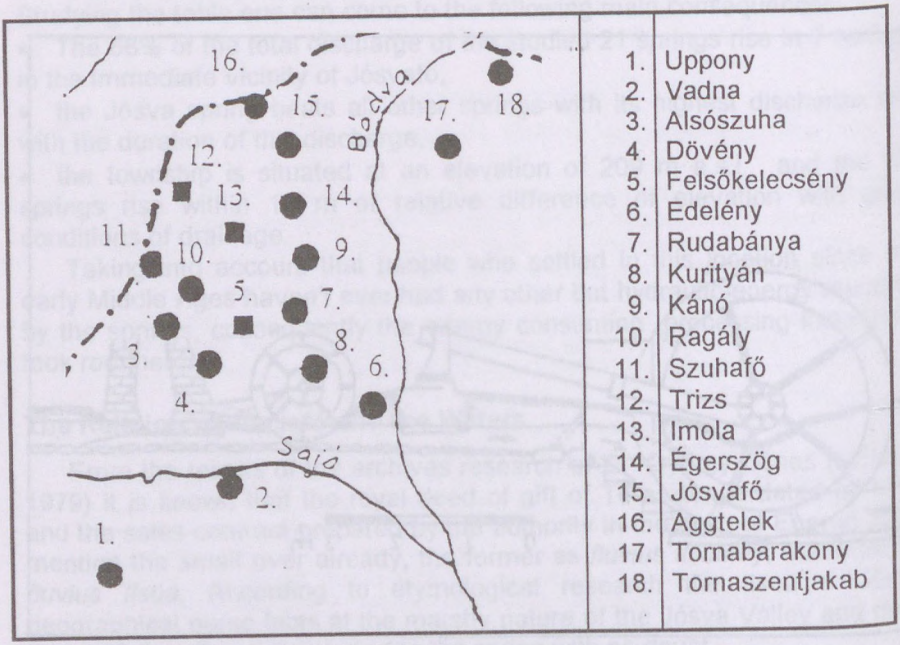


Fig. 1. The likely arrangement of the Almás Gorge forge after Dr. Gábor Vastagh

It wasn't possible to reconstruct the smelter itself from the excavated fragments of the furnace, but from the analysis of the uncovered large quantity of iron-slag it could be learned without any doubt, that the forge processed high barite content iron ore from the Rudabánya mine. Studying the properties and composition of the slags it was decided that the forge in Jósvafő was a so called intermediate type, a transition between 10-12th century furnaces (Rennofen) and the later shaft furnaces (Stockofen) (VASTAGH 1986).

According to Gusztáv Heckenast hydraulic energy was applied in metallurgy since after 1320, latest since the beginning of the 1340s. The technology spread quickly and probably became general around 1380 (HECKENAST 1980).



● Iron-slag finds ■ Imola type furnaces

Fig. 2. shows the locations of slag finds and furnaces (HECKENAST-NOVÁKI-VASTAGH-ZOLTAY 1968)

From the 15th century hardly any hints can be found on metallurgy in the region. This may have been caused by the gradual devastation of forests and the consequent permanent migration as well as the inadequacy of the watercourses necessary for technology dependent on hydraulic energy. Tax records from the times of the Turkish occupation mention some communities in the region that paid their tax by „iron rails", but in this historic period iron metallurgy in Borsod and South Gömör was gradually replaced by the quickly developing metallurgy of the region that is called today Slovak „Erzgebirge" (Slovenské Rudohorie).

Grain Grinding in Water Mills

The emergence of water mills had a great effect on the development of medieval societies. While two persons were able to produce 4.5 to 7 kg of flour in an hour, a water mill produced 150 kg in the same period of time. The first water mills were constructed at the end of the 11th century. Their performance was 0.5-1.0 HP (0.73549 kW). The verdict document of 1399 mentioned working and idle mills in Jósvafő.

No other records dated in the Middle Ages or in the subsequent centuries about, or physical remains of industries utilising hydraulic energy have been found.

Mementoes of the Jósvafő mills reappear in the 19th century. The last descendant of the Klein family of Jósvafő - the recently deceased Lajos Zádor - summarised the hydraulic power utilisation of the Klein family. According to his presentation (ZÁDOR 1983) his grandfather - obtaining water rights - constructed the first, so called „upper mill". Gyula Sándy - the painter who is also known about his cave scenes - published a precise drawing about the mill in the Vasárnapi Újság (Sunday News) in 1863 to illustrate the article „The Jósvafő Mill and the Waters of the Aggtelek Cave".

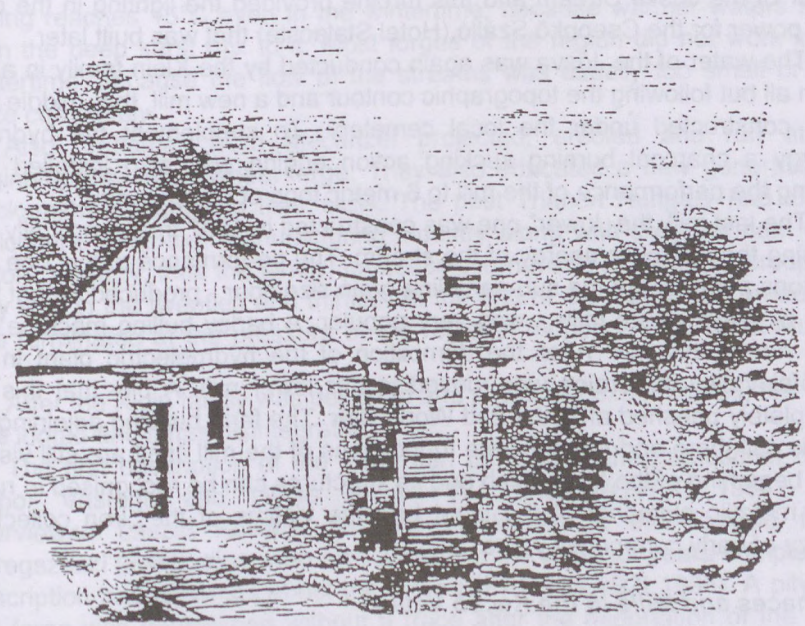


Fig. 3. The Jósvafő Water Mill; after the drawing of Gyula Sándy; Sunday News 1863

Dr. Endre Dudich presents a picture with „the former mill that used to be powered by the Jósva Stream" - photographed by Károly Lendvay.

The mill is shown on the picture with the conduct ditch and a crumbling side building. The valley was called at that time the „Törőfej(Braking-head) Valley" after the hemp-dressing and steeping activity practiced there.

The abandoned mill was reconstructed as the „Baradla" tourist hostel in 1933 (POLGÁRDY 1941) where even Hungary's Regent, Miklós Horthy had

a lunch on the occasion of his visit to celebrate the opening of the first cave section equipped by electric lights - powered by the cave's own hydroelectric turbine.

At the lower end of the Törőfej Valley the Klein family established a so called „light plant" conducting the water from the mill to the turbine by an open ditch. The generator they mounted supplied electricity only to buildings owned by the family, than from 1917 they supplied light to houses in the town as well. The fee for the light was 3-4 eggs per lightbulb/month or some labour. A threshing-machine was also powered by the plant.

Simultaneously with the damming of the Lake Tengerszem (freely translated: „Mountain Lake") a new turbine was installed on the dammed water of the Jósva Stream and this turbine provided the lighting in the cave and power for the Cseppkő Szálló (Hotel Stalactite) that was built later.

The water of the Jósva was again conducted by the Klein family in a dug ditch all but following the topographic contour and a new mill, the „middle mill" was constructed under the local cemetery. To supplement the hydraulic energy a charcoal burning sucking action engine was also installed thus raising the performance of the mill to 6 metric tons of flour per day.

The last mill, the „lower" one was constructed in 1902 thus practically fully utilising the hydraulic energy of the stream. The performance of this one was 2.5 tons per day, but the sub-semolina grain size flour - produced at that time only by large steam mills - was very popular. A barley hulling machine was also run in this mill. After the demolition of the hydroelectric plant in the Törőfej Valley its turbine was moved to this lower mill. A pity that this mill completely perished after the 2nd World War. The farm building adjoining the mill is still there and the concrete foundations of the mill itself are still visible. The beginning of the lower ditch and its structures can be recognised in ruins. The metallic elements of the plant became victims of the „iron collecting" frenzy of early communist years.

Furnaces and Mills in the Kecső Valley

Another characteristic scene of hydraulic energy utilisation was the Kecső Valley (SZABLYÁR 1994). The traces of the ditch supplying water to a hemp-dresser and its water wheel can be seen right at the edge of the town. This part of the valley was called Törőkert (Breaking Garden).

In front of the big discharge resurgence of the valley, the Babot Well, the barely recognisable remnants of a building can be seen indicating the scene of a forge that used to be there. The forge that worked with two hammers and a grinding wheel powered by three water wheels was seen by blacksmith Mihály Szedlák of Mecenzéf (now Medzev in Slovakia) in 1923, but according to his verbal report it was in ruins in 1925. A note, the record of a

conversation of the technical historian Gyula Kiszely with Mihály Szedlák saved the plan of this forge.

No physical evidence was left after the captation of the Babot Spring and the construction of the waterworks but senior locals say that the spring-water drove a mill as well.

Hoe-forge and Distillery in the Tohonya Valley

The next scene of hydraulic power usage was the Tohonya Valley where the Klein family had craftsmen from Mecenzéf construct a forge to manufacture hoes in 1920-21. The choice of location was probably partly based on the recognition that the water-temperature of the Big Tohonya Spring reaches 15°C even in the wintertime, because warmer waters rising from the deep karst mix to it. Most forges of the region did not work in the wintertime, because the flow of the streams was usually too small or they froze completely.

Also craftsmen from Mecenzéf projected, erected and run at the beginning this three wheel forge. They also educated a new generation of blacksmiths transmitting their skills. The post Trianon Hungary had lost its agricultural hand-tool manufacturing industry along with sixty per cent of its historic territory, thus the family, processing iron made in Diósgyőr prospered very well in the twenties and thirties. At the end of the thirties the production was terminated at the pressure of the regional monopoly, the Rima-Murány Inc.

After the Klein family was deported and physically exterminated, the forge was looted and it has disintegrated.

The first description of the forge can be read in the manuscript of Dr. Gábor Vastagh and Gyula Nováki (VASTAGH-NOVÁKI 1964), who interviewed László Kovács, formerly blacksmith in the Jósvafő forge. Beregszászi (Bak) Lajos, who also worked in the forge for years completed a description and drawings about the forge (BEREGSZÁSZI 1995). A pity that the forge was demolished without a trace after the deportation of the Klein family, on its location a house was built. The water conducting ditches disappeared without a trace during the drainage of the foreground of the Big Tohonya Spring. Chance only preserved a large wooden beam from the vanished forge to be exhibited in the local museum soon.

A distillery was run at the beginning of the 20th century that used the spring-water for cooling.

Most of the traces of the industry - that applied hydraulic energy in Jósvafő - have vanished. The few that remained must be immediately rescued, protected.

It would serve a good purpose to reconstruct the last Hungarian hoe-forge to raise a memorial to one of the cradles of Hungarian iron metallurgy.

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APPENDIX

THE LICHENFLORA OF AGGTELEK NATIONAL PARK AND BIOSPHERE RESERVE (1997)

Compiled by ERIKA TÓTH
Aggtelek National Park Directorate, Hungary, 3758 Jósvafő P.O.B. 6.

Az Aggteleki Nemzeti Park és Bioszféra Rezervátum zuzmóflórája (1997) Boros Ádám, Fóriss Ferenc, Hazslinszky Frigyes, Lőkös László, Szatala Ödön és Tóth Erika munkái és gyűjtései alapján készült.

The list of lichens (1997) of Aggtelek National Park and Biosphere Reserve is based on the lichenological works and collections of Ádám Boros, Ferenc Fóriss, Frigyes Hazslinszky, László Lőkös, Ödön Szatala and Erika Tóth.
The species marked by * need further revision.

Acarospora macrospora (Hepp) Massal.
Acrocordia conoidea (Fr.) Körber
Acrocordia gemmata (Ach.) Massal.
Amandinea punctata (Hoffm.) Coppins & Scheideg.
Anaptychia ciliaris (L.) Körber
Anisomeridium biforme (Borrer) R. C. Harris
Arthonia dispersa (Schrader) Nyl.
Arthonia galactites (DC) Dufour
Arthonia punctiformis Ach.
Arthonia radiata (Pers.) Ach.
Arthopyrenia fraxini Massal.
Arthopyrenia lapponia Anzi
Arthopyrenia punctiformis (Pers.) Massal.
Arthothelium ruanum (Massal.) Körber
Aspicilia calcarea (L.) Mudd
**Aspicilia candida* (Anzi) Hue
**Aspicilia cheresina* (Müll. Arg.) Hue var. *microspora* (Arnold) Clauz. & Roux
Aspicilia contorta (Hoffm.) Krempelh.
Aspicilia moenium (Vainio) Thor & Timdal (*Aspicilia excavata*)
**Aspicilia farinosa* (Flörke) Arnold
Bacidia arceutina (Ach.) Arnold
Bacidia bagliettoana (Massal. & De Not.) Jatta
**Bacidia egenula* (Nyl.) Arnold
Bacidia fraxinea Lönnr.
Bacidia globulosa (Flörke) Haf. & Wirth (*Catillaria globulosa*)
**Bacidia laurocerasi* (Delise ex Duby) Zahlbr.
Bacidia polychroa (Th.Fr.) Körber

Bacidia rubella (Hoffm.) Massal.
Bacidia subincompta (Nyl.) Arn.
Baeomyces rufus (Hudson) Rebent.
**Bagliettoa limbroides* Massal.
Bryoria fuscescens (Gyeln.) Brodo et Hawksw.
Buellia disciformis (Fr.) Mudd
Buellia epipolia (Ach.) Mong.
Buellia venusta (Körber) Lettau
Caloplaca alociza (Massal.) Migula
Caloplaca cerina (Ehrh. ex Hedwig) Th.Fr.
Caloplaca chalybaea (Fr.) Müll. Arg.
Caloplaca cirrochroa (Ach.) Th.Fr.
Caloplaca coronata (Krempelh. ex Körber) J. Steiner
Caloplaca decipiens (Arnold) Blomb. et Forss.
Caloplaca dolomiticola (Hue) Zahlbr. (*C. velana, C. placidia*)
Caloplaca flavorubescens (Huds.) J. R.
Caloplaca flavovirescens (Wulfen) Dalla Torre et Sarnth.
Caloplaca holocarpa (Hoffm. ex Ach.) Wade
Caloplaca lactea (Massal.) Zahlbr.
Caloplaca obliterans (Nyl.) Blomb. et Forssell
Caloplaca ochracea (Schaer.) Flagey
Caloplaca steropea (Ach.) Poetsch
Caloplaca variabilis (Pers.) Müll. Arg.
**Caloplaca vitellinula* auct. medieur (non (Nyl.) H. Olivier)
Caloplaca xantholita (Nyl.) Jatta
Candelariella aurella (Hoffm.) Zahlbr.
Candelariella xanthostigma (Ach.) Lettau
Catapyrenium rufescens (Ach.) Breuss
Catillaria lenticularis (Ach.) Th.Fr.
Catillaria minuta (Massal.) Lettau
Cetraria chlorophylla (Willd.) Vainio
Cetraria islandica (L.) Ach.
Cladonia coniocraea (Flörke) Spreng.
Cladonia digitata (L.) Hoffm.
Cladonia fimbriata (L.) Fr.
Cladonia macilenta Hoffm.
Cladonia magyarica Vain.
Cladonia parasitica (Hoffm.) Hoffm.
Cladonia pyxidata (L.) Hoffm.
Cladonia pyxidata (L.) Hoffm. ssp. *chlorophaea* (Flörke ex. Sommerf.) Wirth
Cladonia rangiformis Hoffm.
Cladonia rei Schaer.
Cladonia squamosa (Scop.) Hoffm.

Cladonia subulata (L.) Weber ex F. H. Wigg.
Cladonia symphycarpa (Flörke) Fr..
Clauzadea chondrodes (Massal.) Clauz. et Roux
Clauzadea monticola (Schaer.) Hafellner et Bellem.
Collema auriforme (With.) Coppins et Laundon
Collema crispum (Huds.) Weber ex Wigg.
Collema cristatum (L.) Weber ex Wigg.
Collema flaccidum (Ach.) Ach.
Collema limosum (Ach.) Ach.
Collema multipartitum Sm.
Collema polycarpon Hoffm.
Collema tenax (Sw.) Ach. em. Degel.
Collema undulatum Laurer ex Flotow
Dermatocarpon bachmannii Anders
Dermatocarpon miniatum (L.) Mann
**Dermatocarpon subcrustosum* (Nyl.) Zahlbr.
Diploschistes muscorum (Scop.) R. Sant.
Evernia prunastri (L.) Ach.
Graphis scripta (L.) Ach.
Gyalecta jenensis (Batsch) Zahlbr.
Hypocenomyce scalaris (Ach. ex Lilj.) Choisy
Hypogymnia physodes (L.) Nyl.
Hypogymnia tubulosa (Schaer.) Hav.
Lecania cyrtella (Ach.) Th..Fr
Lecania erysibe (Ach.) Mudd.
Lecanora albella (Pers.) Ach.
Lecanora albescens (Hoffm.) Branth. et Rostrup
Lecanora allophana Nyl.
Lecanora argentata (Ach.) Malme
Lecanora carpinea (L.) Vain.
Lecanora conizaeoides Nyl. ex Crombie
Lecanora crenulata Hooker
Lecanora dispersa (Pers.) Sommerf.
Lecanora expallens Ach.
Lecanora glabrata (Ach.) Malme
**Lecanora hungarica* Szat.
Lecanora intumescens (Rebent.) Rabenh.
Lecanora pallida (Schreb.) Rabenh.
**Lecanora meridionalis* H. Magn.
Lecanora muralis (Schreb.) Rabenh.
Lecanora pulicaris (Pers.) Ach.
Lecanora rugosella Zahlbr.
Lecanora saligna (Schrad.) Zahlbr.

Lecanora subrugosa Nyl.
Lecanora symmicta (Ach.) Ach.
Lecidea lurida (Ach.) DC.
Lecidea sarcogynoides Körber
Lecidella carpathica Körber
Lecidella elaeochroma (Ach.) Choisy
Lecidella stigmatea (Ach.) Hertel et Leuck
Lepraria incana (L.) Ach.
Leptogium corniculatum (Hoffm.) Minks
Leptogium gelatinosum (With.) Laundon
Leptogium lichenoides (L.) Zahlbr.
Leptogium plicatile (Ach.) Leight.
Leptorhaphis epidermidis (Ach.) Th.Fr.
Leptorhaphis tremulae Körber
Lobothallia radiosa (Hoffm.) Hafellner
Melanelia elegantula (Zahlbr.) Ess.
Melanelia exasperata (De Not.) Essl.
Melanelia exasperatula (Nyl.) Essl.
Melanelia fuliginosa (Fr. ex Duby) Essl. in Egan
Melanelia glabra (Schaer.) Essl. (*Parmelia glabra* (Schaer.) Nyl.)
Melanelia glabratula (Lamy) Essl.
Melanelia subargentifera (Nyl.) Essl.
Melanelia subaurifera (Nyl.) Essl.
Mycobilimbia sabuletorum (Schreb.) Hafellner
Opegrapha atra Pers.
Opegrapha calcarea Sm.
Opegrapha rufescens Pers.
Opegrapha varia Pers.
Parmelia verruculifera (Nyl.) (*Neofuscelia verruculifera*)
Parmelia caperata (L.) Ach.
Parmelia conspersa (Ehrh. ex Ach.) Ach.
Parmelia glabra (Schaer.) Nyl.
Parmelia quercina (Willd.) Vainio
Parmelia saxatilis (L.) Ach.
Parmelia subrudecta Nyl. (*Punctelia subrudecta* (Nyl.) Krog)
Parmelia sulcata Taylor
Parmelia tiliacea (Hoffm.) Hale
Parmeliopsis ambigua (Wulf.) Nyl.
Peltigera canina (L.) Willd.
Peltigera didactyla (With.) Laundon
Peltigera horizontalis (Huds.) Baumg.
Peltigera praetextata (Flörke ex Sommerf.) Zopf.
Peltigera rufescens (Weiss) Humb.

Pertusaria albescens (Huds.) M. Choisy et Werner
Pertusaria amara (Ach.) Nyl.
Pertusaria leioplaca DC.
Pertusaria pertusa (Weigel) Tuck.
Petractis clausa (Hoffm.) Krempehl.
**Phaeophyscia cernohorskyi* (Nádv.) Essl.
Phaeophyscia ciliata (Hoffm.) Moberg
Phaeophyscia orbicularis (Neck.) Moberg
Phaeophyscia sciastra (Ach.) Moberg
Phlyctis agelaea (Ach.) Flotow
Phlyctis argena (Spreng.) Flotow
Phylliscum demangeonii (Moug. et Mont.) Nyl.
Physcia adscendens (Fr.) Oliv.
Physcia aipolia (Ehrh. ex Humb.) Fürnr.
Physcia caesia (Hoffm.) Fürnr.
Physcia dubia (Hoffm.) Lettau
Physcia stellaris (L.) Nyl.
Physcia tenella (Scop.) DC.
Physconia detersa (Nyl.) Poelt
Physconia distorta (With.) Laundon
Physconia entheroxantha (Nyl.) Poelt
Physconia grisea (Lam.) Poelt
Placocarpus schaereri (Fr.) Breuss
Placynthiella icmalea (Ach.)
Placynthium lismorense (Nyl. ex Crombie) Vainio
Placynthium nigrum (Huds.) Gray
Platismatia glauca (L.) W. Culb. et C.Culb
Polyblastia albida Arnold
Protoblastenia incrustans (DC.) J. Steiner
Protoblastenia rupestris (Scop.) J. Steiner
Pseudevernia furfuracea (L.) Zopf.
Pseudevernia furfuracea (L.) Zopf. var. *ceratea* (Ach.) Hawksw.
Psora decipiens (Hedwig) Hoffm.
Psorotichia schaereri (Massal.) Arnold
Pyrenula nitida (Weigel) Ach.
Ramalina calicaris (L.) Fr.
Ramalina farinacea (L.) Ach.
Ramalina fastigiata (Pers.) Ach.
Ramalina fraxinea (L.) Ach.
Ramalina pollinaria (Westr.) Ach.
Rinodina bischoffii (Hepp) Massal.
Rinodina calcarea (Arnold) Arnold
Rinodina confragosa (Ach.) Körber

Rinodinella controversa (Massal.) Mayrh. et Poelt
Sarcogyne regularis Körber
Scoliciosporum chlorococcum (Graewe ex Stenham.) Vezda
Scoliciosporum umbrinum (Ach.) Arn.
Staurothele caesia (Arnold) Arnold
Strangospora pinicola (Massal.) Körber
Synalissa symphorea (Ach.) Nyl.
Thelocarpon laureri (Flotow) Nyl.
Thyrea confusa Henssen
**Toninia athallina* (Hepp) Timdal
Toninia candida (Weber) Th.Fr.
Toninia sedifolia (Scop.) Timdal (*Toninia coeruleonigricans*)
Toninia toniniana (Massal.) Zahlbr.
Usnea hirta (L.) Weber ex Wigg.
Usnea subfloridana Stirt.
Verrucaria aethiobola Wahlenb.
Verrucaria coerulea DC.
Verrucaria foveolata (Flörke) Massal.
Verrucaria fuscella (Turner) Winch.
**Verrucaria glaucellodes* Hepp
Verrucaria hochstetteri Fr.
Verrucaria hydrela Ach.
**Verrucaria inaequata* Servít
**Verrucaria interrupta* (Arnold) J. Steiner
Verrucaria lecideiodes (Massal.) Trev.
Verrucaria macrostomata Dufour ex DC.
Verrucaria marmorea (Scop.) Arnold
**Verrucaria minuta* (Hepp) Zsch.
Verrucaria muralis Ach.
Verrucaria nigrescens Pers.
**Verrucaria subconcentrica* J. Steiner
Vulpicida pinastri (Scop.) Mattson et Lai
Xanthoria fallax (Hepp) Arnold
Xanthoria parietina (L.) Th.Fr.

RESULTS OF BRYOLOGICAL RESEARCH IN AGGTELEK NATIONAL PARK IN THE FRAME OF COMPLEX ECOLOGICAL STATE ASSESSMENT

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Jelen munka bemutatja az Aggteleki Nemzeti Park területén, 1994-ben és a korábi esztendőkben végzett bryológiai kutatómunka eredményeit.
A terület bryoflorájának feltérképezését, tudományos igényű gyűjtését Boros Ádám kezdte el (első herbáriumi adata 1929-ből való), majd folytatta azt több mint harminc éven keresztül. Később csatlakoztak hozzá olyan kiváló bryológusok mint Vajda László, Pócs Tamás és Orbán Sándor, kiknek bryoflorisztikai adatai alapján kerültek kijelölésre a mintavételi területeink.

Introduction

This work contains the description of the bryological research of the year 1994 and is based on the results obtained in the previous years. The floristical exploration of this region, the data gathering and classification were initiated by Ádám Boros (first data obtained in 1929). During the next 30 years he continued working in the area and later other well-known bryologists, such as László Vajda, Tamás Pócs and Sándor Orbán, were joined in his research. Their publications helped us choose the mapping of the sample areas.

After going over 20.000 herbal capsules belonging to Eszterházy Károly Teachers Training College and the Hungarian Natural History Museum we have given a list containing all published and unpublished data of bryophyte species occurring in the area of Aggtelek National Park. This is the first special list which contains a potential floristical series of data for a national park in Hungary.

Naturally, the number of the bryophyte species that we collected and identified is only a fragment of the entire collection gathered by bryologists (see above). Seven places were chosen with defence ecological parameters where we predicted the apperance of rare species.

The sample places were: Lófej Valley, Patkós Valley, Szádvár Hill, Ménes Valley, Haragistya, Kecsô Valley and Kavicshát.

Results

1. Patkós Valley

On north-facing slopes of Patkós Valley there are common species like *Homalia trichomanoides* and on tree trunks *Metzgeria conjugata, Radula complanata*. In humid habitats there occurs *Brachythecium rutabulum, Chyloscyphus pallescens* var. *fragilis, Plagiothecium denticulatum*. Along springs there is *Cratoneuron filicinum* var *fallax, Brachithecium rivulare, Marchantia polymorpha*. On dry limestones, *Tortella tortuosa, Encalyptra streptocarpa, Schistidium apocarpum* are exposed to the sunshine. A rare species we have found here is *Lophocolea cuspidata*.

Species which are characterising this sample area:

Fissidens taxifolius Hedw.
Metzgeria conjugata Lindenb.
Brachytecium rivulare [Bruch.] Br.eur.
Radula complanata [L.] Dum.
Plagiomnium undulatum [Hedw.] Kop.
Cratoneuron filicinum [L. ap. Hedw.] Roth. var. *fallax* Brid.
Homalia trichomanoides [Hedw.] B.S.G.
Marchantia polymorpha L. emend Burgeff.
Lophocolea cuspidata [Nees.] Limpr.
Amblistegium subtilis [Hedw.] Crum.
Platydictia confervoides [Brid.] Crum.

2. Szádvár Hill

On north-facing slopes of Szádvár hill, typical species are *Anomodon viticulosus, Anomodon attenuatus* and *Porella plathyphylla*. On the western side of Szádvár there is a valley where the othervise not too common species: *Dicranum scoparium Tetraphis pellucida* can also be found. *Pellia endiviifolia, Conocephalum conicum and Marchantia polymorpha* are present on stones among springs. Rare species are : *Fissidens minutulus, Anomodon rugelii.*

Species which are characterising this samle area:

Radula complanata [L.] Dum.
Tortula ruralis [Hedw.] Gaertn. et al.
Fissidens minutulus Sull.
Neckera crispa Hedw.
Neckera complanata [Hedw.] Hueb.
Neckera webbiana [Mont.] Schimp
Porella platyphylla [Torrey et Nees.] Lindenb.

Brchythecium rutabulum [Hedw.] B.S.G.
Dicranum scoparium Hedw.
Tortula calcioles W. Kramer
Tetraphis pellucida Hedw.
Pellia endiviifolia [Dicks.] Lindb.
Conocephalum conicum [L.] Dum

3. Ménes Valley

New elements in the Ménes Valley are *Rhodobryum ontariense* which also occurs in Telekes Valley and *Fontinalis antypiretica*, which was found in springs.

Species which are characterising this sample area:

Rhodobryum ontariense [Kindb.] Kindb.
Plagiomnium undulatum [Hedw.] Kop.
Plagiomnium cuspidatum [Hedw.] Kop.
Plagiomnium rostratum [Schrad.] Kop.
Homalia trichomanoides [Hedw.] B.S.G.
Plagiochila porelloides [Torrey et Nees.] Lindenb.
Radula complanata [L.] Dum.
Fissidens crassipes Wils.
Fissidens taxifolius Hedw.
Pellia endiviifolia [Dicks.] Dum.
Frullania dilatata [L.] Dum.
Plagiothecium denticulatum [Hedw.] B.S.G.
Anomodon attenuatus [Hedw.] Huben.
Anomodon rugelii [C.Mull.] Keissl.
Pseudoscleropodium purum [Hedw.] Fleisch.
Schiostidium apocarpum [Hedw.] B.S.G.
Pseudoleskeella nervosa [Brid.] Nyh.
Fissidens minutulus Sull.
Neckera complanata [Hedw.] Hueb.
Brachythecium rutabulum [Hedw.] B.S.G.

4. Haragistya

On the exposed swards in Haragistya we can find xerophyte bryophyte species like *Tortella tortuosa* and *Grimmia pulvinata*. *Ptilidium pulcherrimum* which lives on tree trunks is relatively rare species here.

Species which are characterising this sample area:
Ptilidium pulcherrimum [G.Web.] Vainio
Tortella tortuosa [Hedw.] Limpr.

Climacium dendroides Web. et Mohr.
Hylocomium splendens [Hedw.] B.S.G.
Pleurozium schreberi [Brid.] Mitt.

5. Kecső Valley

Kecsô Valley and Babot Fountain were the next collecting place. According to bibliographical and herbal data, *Porella arboris vitae* var. *Killarniensis* should be found in this valley as well as in Börzsöny but we could not locate it in the Kecsô Valley.

Species which are characterising this sample area:
Neckera webbiana [Mont.] Schimp.
Neckera complanata [Hedw.] Hueb.
Metzgeria conjugata Lindb.
Plagiochila porelloides [Torrey et Nees.] Lindenb.
Homalia trichomanoides [Hedw.] B.S.G.
Plagiomnium cuspidatum [Hedw.] Kop.
Lophocolea heterophylla [Schrad.] Dum.
Plagiothecium denticulatum [Hedw.] B.S.G.
Amblistegium serprns [Hedw.] B.S.G.
Orthotrichum obtusifolium Schrad.

6. "Kavicshát"

One of the very interesting places with many species was in Kavicshát near Aggtelek. The acidity of the soil give optimal substrat for many rare species like *Fossomria wondraczekii, Ephemerum serratum, Riccia glauca, Scapania mucronata* and *Atrichum angustatum.* Other rare species are *Fissidens bryoides, Pottia intermedia, Pleuridium subulatum.*

Species which are characterising this sample area:
Fissidens taxifolius Hedw.
Plagiochila porelloides [Torrey et Nees.] Lindeneb.
Pottia trucata [Hedw.] Fuernr.
Fossombronia wondraczekii [Corda] Dum.
Ephemerum serratum [Hedw.] Hampe
Riccia glauca L.
Scapania mucronata Buch
Jungermannia hyalina Lyell in Hook
Hypnum cupressiforme Hedw.
Astomum crispum [Hedw.] Hampe
Pleuridium subulatum [Hedw.] Rabenh.
Fissidens bryoides Hedw.
Scleropodium purum [Hedw.] Limpr.

Pohlia nutans [Hedw.] Lindb.
Plagiomnium ellipticum [Brid] Kop.
Leskeella nervosa [Brid.] Loeske

7. Lófej Valley

Species which are characterizing this sample area
Porella plathyphylla (L.) Pfeiff
Neckera complanata (Hedw.)
Plagiomniun ellipticum (Brid.) Kop.
Plagiomnium cuspidatum (Hedw.) Kop.
Plagiochila porelloides (Torrey et Nees.) Lindenb.
Radula complanata (L.) Dum.
Metzgeria conjugata Lindb.
Lophocolea minor Nees
Neckera besseri (Lob.) Jur.
Anomodon rugelii (C Mull.) Keissl.
Brachythecium rivulare B.S.G.
Cratoneuron filicinum var fallax (Brid.) Roth
Neckera webbiana (Mitt.) Schimp
Barbilophozia barbata (Schmid. ex Schreb.) Loeske
Cololejeunea Rossettiana (Mass.) Schiffn.
Lophocolea cuspidata (Nees) Limpr.
Lejeunea cavifolia [Ehrh.] Lindb.
Frullania tamarisci [L.] Dum.

Summary

In summary we can say that during the data research we identified several rare species: from acid damp soil the circumpolar *Fossombronia wondraczekii*, the submediterranean Atlantic *Riccia glauca*, which has not previously been described in this area, Europien mediterranean *Ephemerum serratum*, and the Euro-Asien mediterranean *Astomum crispum. Tetraphis pellucida, Lejeunea cavifolia, Cololejeunea Rossettiana, Ptilidium pulcherrimum* and *Atrichum angustatum*, which are otherwise regarded as rare in Hungary are quite common in the area of Aggtelek National Park.

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LIST OF VASCULAR PLANTS OF AGGTELEK NATIONAL PARK AND BIOSPHERE RESERVE (1997)

Compiled by
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A lista az 1992-94 között lezajlott Komplex Ökológiai Állapotfelmérés botanikai kutatási eredményein, valamint az Aggteleki Nemzeti Park munkatársainak adatain alapul.

The results of the botanical survey and research in the frame of the Complex Ecological Status Survey (1992-94) and the data of the specialized staff of the Aggtelek National Park were used as the basis of the list.

PTERIDOPHYTA

SPHENOPSIDA

Equisetaceae
Equisetum arvense L.
Equisetum hyemale L.
Equisetum sylvaticum L.

PTEROPSIDA

Pteridaceae
Pteridium aquilinum (L.) Kuhn

Thelypteridaceae
Thelypteris palustris Schott

Aspleniaceae
Asplenium ruta-muraria L.
Asplenium trichomanes L.
Asplenium viride Huds.
Ceterach javorkaeanum (Vida) Soó
Phyllitis scolopendrium (L.) Newman

Athyriaceae
Athyrium filix-femina (L.) Roth
Cystopteris fragilis (L.) Bernh.

Aspidiaceae
Polystichum lonchitis (L.) Roth
Dryopteris carthusiana (Vill.) H.P. Fuchs
Dryopteris filix-mas (L.) Schott

Polypodiaceae
Polypodium vulgare L.

SPERMATOPHYTA
GYMNOSPERMATOPHYTA
CONIFEROPSIDA

Pineaceae
Larix decidua Mill.
Picea abies (L.) Karsten
Pinus nigra Arnold
Pinus sylvestris L.
Pseudotsuga menziesii (Mirbel) Franco

Cupressaceae
Juniperus communis L.

ANGIOSPERNATOPHYTA
DICOTYLEDONOPSIDA

Berberidaceae
Berberis vulgaris L.

Ranunculaceae
Isopyrum thalictroides L.
Actea spicata L.
Caltha palustris L.
Aconitum anthora L.
Aconitum variegatum subsp. *gracile* (Rchb.) Gáy
Aconitum vulparia Rchb.
Consolida regalis S.F. Gray
Anemone nemorosa L.
Anemone ranunculoides L.
Anemone sylvestris L.
Pulsatilla grandis Wender
Pulsatilla grandis f. pseudoslavica Soó
Clematis recta L.
Clematis vitalba L.
Adonis aestivalis L.
Adonis vernalis L.
Ficaria verna Huds.
Ranunculus acris L.
Ranunculus auricomus L.
Ranunculus bulbosus L.
Ranunculus cassubicus L.

Ranunculus flammula L.
Ranunculus lanuginosus L.
Ranunculus polyanthemos L.
Ranunculus repens L.
Thalictrum flavum L.
Thalictrum foetidum L.
Thalictrum lucidum L.
Thalictrum minus L.

Aristolochiaceae
Asarum europaeum L.
Aristolochia clematitis L.

Rosaceae
Spiraea media Fr. Schm.
Cotoneaster intergerrimus Medik.
Cotoneaster niger Fr.
Pyrus pyraster Burgsd.
Malus sylvestris (L.) Mill.
Sorbus aria (L.) Cr.
Sorbus aucuparia L.
Sorbus domestica L.
Sorbus torminalis (L.) Cr.
Crataegus monogyna Jacq.
Crataegus oxyacantha L.
Rubus caesius L.
Rubus fruticosus L.
Rubus idaeus L.
Fragaria vesca L.
Fragaria viridis Duch.
Potentilla alba L.
Potentilla anserina L.
Potentilla arenaria Borkh.
Potentilla argentea L.
Potentilla collina Wibel
Potentilla erecta (L.) Räuschel
Potentilla heptaphylla L.
Potentilla inclinata Vill.
Potentilla recta L.
Potentilla reptans L.
Potentilla rupestris L.
Waldsteinia geoides Willd.
Geum urbanum L.
Filipendula ulmaria (L.) Maxim.

Filipendula vulgaris Mönch
Agrimonia eupatoria L.
Sanguisorba minor Scop.
Sanguisorba officinalis L.
Alchemilla acutiloba Opiz
Alchemilla gracilis Opiz
Alchemilla monticola Opiz
Rosa canina L.
Rosa gallica L.
Rosa pendulina L.
Rosa spinosissima L.
Rosa tomentosa Sm.
Cerasus avium (L.) Mönch
Cerasus fruticosa Pall.
Cerasus mahaleb (L.) Mill.
Prunus spinosa L.

Crassulaceae
Sedum acre L.
Sedum album L.
Sedum maximum (L.) Hoffm.
Sedum sexangulare L.
Sempervivum marmoreum Gris.
Jovibarba hirta (L.) Opiz

Grossulariaceae
Ribes rubrum L.
Ribes uva-crispa L.

Saxifragaceae
Chrysosplenium alternifolium L.
Saxifraga bulbifera L.
Saxifraga paniculata Mill.
Saxifraga tridactilites L.

Fabaceae
Genista germanica L.
Genista pilosa L.
Genista sagittale (L.) P. Gibbs
Genista tinctoria L.
Genista tinctoria subsp. *elatior* (Koch) Simk.
Chamaecytisus albus (Hacq.) Rothm.
Chamaecytisus austriacus (L.) Link
Chamaecytisus ciliatus (Wahlb.) Rothm.
Chamaecytisus hirsutus (L.) Link

Chamaecytisus hirsutus subsp. *leucotrichus* (Schur) A. et D. Löve
Lembotropis nigricans (L.) Gris.
Cytisus procumbens (W. et K.) Spreng.
Chamaecytisus ratisbonensis (Schaeffer) Rothm.
Ononis arvensis L.
Medicago falcata L.
Medicago lupulina L.
Medicago minima (L.) L.
Medicago x varia Martyn
Melilotus officinalis (L.) Pall.
Trifolium alpestre L.
Trifolium aureum Poll.
Trifolium campestre Schreb.
Trifolium diffusum Ehrh.
Trifolium dubium Sibth.
Trifolium incarnatum L.
Trifolium medium L.
Trifolium montanum L.
Trifolium ochroleucon Huds.
Trifolium pannonicum Jacq.
Trifolium patens Schreb.
Trifolium pratense L.
Trifolium repens L.
Trifolium rubens L.
Anthyllis vulneraria L.
Dorycnium germanicum (Gremli) Rikli
Dorycnium herbaceum Vill.
Lotus corniculatus L.
Amorpha fruticosa L.
Robinia pseudo-acacia L.
Astragalus austriacus Jacq.
Astragalus glycyphyllus L.
Astragalus onobrychis L.
Astragalus vesicarius subsp. *albidus* (W. et K.) Br.-Bl.
Coronilla varia L.
Hippocrepis comosa L.
Onobrychis arenaria (Kit.) Ser.
Onobrychis viciifolia Scop.
Vicia angustifolia L.
Vicia angustifolia subsp. *segetalis* (Thuill.) Arc.
Vicia cassubica L.
Vicia hirsuta (L.) S.F. Gray
Vicia lathyroides L.

Vicia pannonica Cr.
Vicia sepium L.
Vicia tenuifolia Roth
Vicia tetrasperma (L.) Schreb.
Lathyrus hirsutus L.
Lathyrus latifolius L.
Lathyrus niger (L.) Bernh.
Lathyrus nissolia L.
Lathyrus pannonicus (Jacq.) Garcke
Lathyrus pisiformis L.
Lathyrus pratensis L.
Lathyrus tuberosus L.
Lathyrus vernus (L.) Bernh.

Thymelaeaceae
Daphne mesereum L.

Lythraceae
Lythrum hyssopifolia L.
Lythrum salicaria L.

Onagraceae
Epilobium hirsutum L.
Epilobium parviflorum Schreb.
Chamaenerion angustifolium (L.) Scop.
Circaea lutetiana L.

Rutaceae
Dictamnus albus L.

Simaroubaceae
Ailanthus altissima (Mill.) Swingle

Polygalaceae
Polygala amara L.
Polygala comosa Schkuhr
Polygala major Jacq.
Polygala vulgaris L.

Aceraceae
Acer campestre L.
Acer platanoides L.
Acer pseudo-platanus L.
Acer tataricum L.

Balsaminaceae
Impatiens glandulifera Royle

Impatiens parviflora DC
Impatiens noli-tangere L.

Celastraceae
Euonymus verrucosa Scop.
Euonymus europaea L.

Staphyleaceae
Staphylea pinnata L.

Rhamnaceae
Rhamnus catharticus L.
Frangula alnus Mill.

Araliaceae
Hedera helix L.

Cornaceae
Cornus mas L.
Cornus sanguinea L.

Umbelliferae
Sanicula europaea L.
Astrantia major L.
Eryngium campestre L.
Chaerophyllum aromaticum L.
Chaerophyllum temulum L.
Anthriscus nitida (Wahlenb.) Garcke
Anthriscus sylvestris (L.) Hoffm.
Torilis japonica (Houtt.) DC.
Orlaya grandiflora (L.) Hoffm.
Bifora radians M.B.
Bupleurum affine Sadler
Bupleurum falcatum L.
Bupleurum longifolium L.
Trinia glauca (L.) Dum.
Falcaria vulgaris Bernh.
Pimpinella major (L.) Huds.
Pimpinella saxifraga L.
Aegopodium podagraria L.
Sium latifolium L.
Berula erecta (Huds.) Coville
Seseli annuum L.
Seseli osseum Cr.
Libanotis pyrenaica (L.) Bourg.
Aethusa cynapium L.

Aethusa cynapium subsp. *agrestis* (Wallr.) Dost.
Silaum peucedanoides (M.B.) Kozo-Poljanski
Cnidium dubium (Schkuhr) Thell.
Selinum carvifolia (L.) L.
Angelica sylvestris L.
Peucedanum alsaticum L.
Peucedanum carvifolia Vill.
Peucedanum cervaria (L.) Lap.
Peucedanum palustre (L.) Mönch
Pastinaca sativa L.
Heracleum sphondylium L.
Daucus carota L.
Laser trilobum (L.) Borkh.
Laserpitium latifolium L.

Rubiaceae
Asperula cynanchica L.
Asperula tinctoria L.
Sherardia arvensis L.
Cruciata glabra (L.) Ehrend.
Cruciata pedemontana (Bell.) Ehrend.
Galium album Mill.
Galium aparine L.
Galium boreale L.
Galium glaucum L.
Galium mollugo L.
Galium odoratum (L.) Scop.
Galium palustre L.
Galium schultesii Vest.
Galium tricornutum Dandy
Galium uliginosum L.
Galium verum L.

Caprifoliaceae
Sambucus ebulus L.
Sambucus nigra L.
Sambucus racemosa L.
Viburnum lantana L.
Viburnum opulus L.
Lonicera xylosteum L.

Valerianaceae
Valeriana officinalis L.

Dipsacaceae
Dipsacus laciniatus L.
Scabiosa ochroleuca L.
Knautia arvensis (L.) Coult.
Succisa pratensis Mönch
Succisella inflexa (Kluk) Beck

Adoxaceae
Adoxa moschatellina L.

Tiliaceae
Tilia cordata Mill.
Tilia platyphyllos Scop.

Malvaceae
Hibiscus trionum L.
Malva sylvestris L.
Malva neglecta Wallr.
Lavathera thuringiaca L.

Linaceae
Linum austriacum L.
Linum catharticum L.
Linum flavum L.
Linum hirsutum L.
Linum tenuifolium L.

Oxalidaceae
Oxalis acetosella L.
Oxalis dillenii Jacq.

Geraniaceae
Erodium cicutarium (L.) L' Hérit
Geranium palustre L.
Geranium pusillum Burm. f.
Geranium pyrenaicum Burm. f.
Geranium robertianum L.
Geranium rotundifolium L.
Geranium sanguineum L.

Euphorbiaceae
Euphorbia amygdaloides L.
Euphorbia angulata Jacq.
Euphorbia cyparyssias L.
Euphorbia exigua L.
Euphorbia falcata L.

Euphorbia helioscopia L.
Euphorbia epithymoides L.
Euphorbia salicifolia Host.
Euphorbia virgata W. et K.
Mercurialis perennis L.

Oleaceae
Fraxinus excelsior L.
Fraxinus ornus L.
Ligustrum vulgare L.

Gentianaceae
Centaurium erythraea Rafn.
Centaurium pulchellum (Sw.) Druce
Gentiana cruciata L.
Gentiana pneumonanthe L.
Gentianella ciliata (L.) Borkh.
Gentianella livonica (Eschsch.) Soó

Asclepiadaceae
Vincetoxicum hirundinaria Medik.

Apocynaceae
Vinca herbacea W. et K.
Vinca minor L.

Convolvulaceae
Convolvulus arvensis L.
Cuscuta trifolii Bab.
Calystegia sepium (L.) R. Br.

Boraginaceae
Cynoglossum officinale L.
Lappula heteracantha (Ledeb.) Borb.
Lappula squarrosa (Retz.) Dum.
Symphytum tuberosum subsp. *angustifolium* (Kern.) Nym.
Symphytum officinale L.
Anchusa barrelieri (All.) Vitm.
Nonea pulla (L.) Lam. et DC
Pulmonaria angustifolia L.
Pulmonaria mollis Wulf.
Pulmonaria obscura Dum.
Pulmonaria officinalis L.
Myosotis arvensis (L.) Hill
Myosotis palustris (L.) Nath.
Myosotis sylvatica (Ehrh.) Hoffm.

Lithospermum officinale L.
Lithospermum purpureo-coeruleum L.
Cerinthe minor L.
Onosma tornense Jáv.
Onosma visianii Clem.
Echium italicum L.
Echium russicum J.F. Gmel.
Echium vulgare L.

Verbenaceae
Verbena officinalis L.

Labiatae
Ajuga genevensis L.
Ajuga reptans L.
Scutellaria galericulata L.
Sideritis montana L.
Nepeta cataria L.
Dracocephalum austriacum L.
Glechoma hederacea L.
Melittis carpatica Klokov (*syn.:Melittis grandiflora* Sm)
Prunella grandiflora (L.) Scholler
Prunella laciniata (L.) Nath.
Prunella vulgaris L.
Mentha aquatica L.
Mentha longifolia (L.) Nath.
Galeobdolon luteum Huds.
Galeopsis pubescens Bess.
Phlomis tuberosa L.
Betonica officinalis L.
Lamium amplexicaule L.
Lamium maculatum (L.) L.
Teucrium botrys L.
Teucrium chamaedrys L.
Teucrium montanum L.
Salvia glutinosa L.
Salvia pratensis L.
Salvia verticillata L.
Stachys annua (L.) L.
Stachys germanica L.
Stachys recta L.
Stachys silvatica L.
Acinos arvensis (Lam.) Dandy
Clinopodium vulgare L.

Calamintha mentifolia subsp. *sylvatica* (Bromf.) Menitskij
Thymus pannonicus All.
Thymus praecox Opiz
Thymus pulegoides L.
Origanum vulgare L.
Lycopus europaeus L.

Solanaceae
Atropa belladonna L.
Solanum dulcamara L.
Solanum luteum Mill.
Scopolia carniolica Jacq.

Scrophulariaceae
Verbascum austriacum Schott
Verbascum lychnitis L.
Verbascum phlomoides L.
Verbascum phoeniceum L.
Veronica arvensis L.
Veronica austriaca L.
Veronica teucrium L.
Veronica beccabunga L.
Veronica chamaedrys subsp. *vindobonensis* M. Fischer
Veronica hederifolia L.
Veronica officinalis L.
Veronica praecox All.
Veronica prostrata L.
Veronica spicata (Host) Nym.
Linaria angustissima (Lois.) Re
Linaria genistifolia (L.) Mill.
Linaria vulgaris Mill.
Schrophularia nodosa L.
Scrophularia umbrosa Dum.
Kickxia elatine (L.) Dum
Kickxia spuria (L.) Dum
Digitalis grandiflora Mill.
Gratiola officinalis L.
Euphrasia rostkoviana Hayne
Euphrasia stricta D. Wolf
Euphrasia tatarica Fisch.
Melampyrum arvense L.
Melampyrum cristatum L.
Melampyrum nemorosum L.
Melampyrum pratense L.

Lathraea squamaria L.
Rhinanthus minor L.
Rhinanthus rumelicus Vel.
Rhinanthus wagneri Deg.

Globulariaceae
Globularia punctata Lap.

Orobanchaceae
Orobanche caryophyllacea Sm.

Plantaginaceae
Plantago lanceolata L.
Plantago media L.

Papaveraceae
Papaver dubium L.
Papaver rhoeas L.
Chelidonium majus L.
Corydalis cava (L.) Schw.
Corydalis solida (L.) Clairv.
Fumaria vaillantii Lois.

Cruciferae
Diplotaxis muralis (L.) DC.
Sinapis alba L.
Raphanus raphinastrum L.
Thlaspi arvense L.
Thlaspi jankae Kern.
Thlaspi perfoliatum L.
Isatis tinctoria L.
Capsella bursa-pastoris (L.) Medik.
Alyssum alyssoides (L.) L.
Alyssum montanum L.
Alyssum montanum subsp. *brymii* (Dost.) Soó
Lunaria rediviva L.
Berteroa incana (L.) DC.
Barbarea vulgaris R. Br.
Cardamine amara L.
Cardamine impatiens L.
Cardamine pratensis L.
Cardaminopsis arenosa (L.) Hay
Dentaria bulbifera L.
Dentaria gladulosa W et K.
Arabidopsis thaliana (L.) Heynh.

Arabis hirsuta (L.) Scop.
Arabis auriculata Lam.
Arabis turrita L.
Erysimum cheiranthoides L.
Erysimum odoratum Ehrh.
Turritis glabra L.
Alliaria petiolata (M.B.) Cavara et Grande
Sisymbrium strictissimum L.

Resedaceae
Reseda inodora Rchb.
Reseda lutea L.

Cistaceae
Helianthemum canum (L.) Baumg.
Helianthemum nummularium (L.) Mill.
Helianthemum ovatum (Viv.) Dun.

Violaceae
Viola ambigua W. et K.
Viola arvensis subsp. *arvensis* Murr.
Viola canina L.
Viola elatior Fr.
Viola mirabilis L.
Viola riviniana Rchb.
Viola stagnina Kit.
Viola sylvestris Lam.
Viola tricolor subsp. *subalpina* Gaud.

Guttiferae
Hypericum hirsutum L.
Hypericum montanum L.
Hypericum perforatum L.
Hypericum tetrapterum Fr.

Cucurbitaceae
Bryonia alba L.
Echinocystis lobata (Michx.) Torr.

Campanulaceae
Campanula bononiensis L.
Campanula cervicaria L.
Campanula glomerata L.
Campanula patula L.
Campanula persicifolia L.
Campanula rapunculoides L.

Campanula rapunculus L.
Campanula rotundifolia L.
Campanula sibirica L.
Campanula sibirica subsp. *divergentiformis* (Jáv.) Dom.
Campanula trachelium L.
Asyneuma canescens (W. et K.) G. et Sch.
Adenophora lilifolia (L.) Bess.
Phyteuma orbiculare L.

Compositae
Eupatorium cannabium L.
Solidago gigantea subsp. *serotina (Ait.) McNeill*
Solidago virga-aurea L.
Aster amellus L.
Aster linosyris (L.) Bernh.
Stenactis annua (L.) Nees
Erigeron acris L.
Erigeron acris subsp. *macrophyllus (Herb.) Soó*
Erigeron annua (L.) Nees
Antennaria dioica (L.) Gaertn.
Gnaphalium sylvaticum L.
Filago arvensis Lam.
Inula britannica L.
Inula ensifolia L.
Inula germanica L.
Inula helenium L.
Inula hirta L.
Inula salicina L.
Helianthus decapetalus L.
Bidens tripartita L.
Anthemis tinctoria L.
Achillea collina J. Becker
Achillea millefolium L.
Achillea nobilis subsp. *neilreichii (Kern.) vel.*
Achillea pannonica scheele
Achillea ptarmica L.
Matricaria discoidea DC.
Matricaria maritima subsp. *inodora (L.) Soó*
Galinsoga parviflora Cav.
Chrysanthemum corymbosum L.
Chrysanthemum leucanthemum Pers.
Artemisia campestris L.
Artemisia vulgaris L.

Taraxacum laevigatum (Willd.) DC.
Taraxacum officinale Weber
Taraxacum serotinum (W. et K.) Poir
Tragopogon dubius Scop.
Tragopogon floccosus W. et K.
Tragopogon orientalis L.
Tussilago farfara L.
Petasites albus (L.) Gaertn.
Petasites hibridus (L.) G.M. Sch.
Scorzonera hispanica L.
Scorzonera purpurea L.
Senecio integrifolius (L.) Clairv.
Senecio jacobaea L.
Serratula tinctoria L.
Echinops sphaerocephalus L.
Carlina acaulis L.
Carlina vulgaris L.
Arctium lappa L.
Arctium tomentosum Mill.
Jurinea mollis (L.) Rchb.
Jurinea mollis subsp. *macrocalathia* (C. Koch) Soó
Carduus collinus W. et K.
Carduus crispus L.
Carduus nutans subsp. *macrolepis* (Peterm.) Kazmi
Onopordum acanthium L.
Cirsium arvense (L.) Scop.
Cirsium canum (L.) All.
Cirsium eriophorum (L.) Scop.
Cirsium oleraceum (L.) Scop.
Cirsium palustre (L.) Scop.
Cirsium pannonicum (L.f.) Link
Cirsium rivulare (Jacq) All.
Cirsium vulgare (Savi) Ten.
Crupina vulgaris Pers.
Centaurea cyanus L.
Centaurea jacea L.
Centaurea macroptilon Borb.
Centaurea micranthos S. G. Gmel.
Centaurea macroptilon subsp. *oxylepis* (W. et Gr.) Soó
Centaurea pannonica (Heuff.) Simk.
Centaurea pseudophrygia C.A. Mey.
Centaurea rhenana Bor.
Centaurea sadleriana Janka

Centaurea scabiosa L.
Centaurea spinulosa Roch.
Centaurea triumfettii All.
Centaurea triumfettii subsp. *aligera* (Gugl.) Dostál
Cichorium intibus L.
Lactuca perennis L.
Lactuca quercina L.
Lactuca saligna L.
Lactuca serriola L.
Lapsana communis L.
Leontodon autumnalis L.
Leontodon hispidus L.
Leontodon incanus (L.) Schrank
Hypochoeris maculata L.
Picris hieracioides L.
Chondrylla juncea L.
Mycelis muralis (L.) Dum.
Sonchus arvensis L.
Crepis pannonica (Jacq.) C. Koch
Prenanthes purpurea L.
Hieracium bauhinii Schult. ex Bess
Hieracium caespitosum Dum.
Hieracium cymosum L.
Hieracium lachenalii C.C. Gmel.
Hieracium laevigatum Willd.
Hieracium pilosella L.
Hieracium praecurrens Vukot.
Hieracium racemosum W. et K.
Hieracium sylvaticum (L.) Grufbg.
Hieracium umbellatum L.
Hieracium wiesbaurianum Uechtr.
Hieracium x bifurcum M.B.

Pyrolaceae
Pyrola rotundifolia L.
Monotropa hypopitys L.

Ericaceae
Calluna vulgaris (L.) Hull.

Loranthaceae
Viscum album L.

Santalaceae
Thesium linophyllum L.

Caryophyllaceae
Cucubalus baccifer L.
Agrostemma githago L.
Silene longiflora Ehrh..
Silene nemoralis W. et K.
Silene nutans L.
Silene otites (L.) Wibel
Silene vulgaris (Mönch) Garcke
Lychnis flos-cuculi L.
Petrorhagia prolifera (L.) Ball et Heyw.
Dianthus armeria L.
Dianthus carthusianorum L.
Dianthus carthusianorum subsp. *saxigenus* (Schur) Jáv.
Dianthus deltoides L.
Dianthus plumarius subsp. *preacox* (Kit.)Dom.
Dianthus pontederae Kern.
Saponaria officinalis L.
Myosoton aquaticum (L.)Mönch
Stellaria graminea L.
Stellaria holostea L.
Cerastium brachypetalum Desp.
Cerastium pumilum Curt.
Cerastium silvaticum W. et k.
Cerastium fontanum subsp. *triviale* (Link) Jalas
Holosteum umbellatum L.
Minuartia fastigiata (Sm.) Rchb.
Minuartia setacea (Thuill.) Hay.
Arenaria procera subsp. *glabra* (Williams) Holub
Arenaria serpillifolia L.
Moehringia trinervia (L.) Clairv.
Spergula arvensis L.

Chenopodiaceae
Polycnemum verrucosum Láng
Chenopodium album L.
Chenopodium hybridum L.
Chenopodium polyspermum L.
Atriplex rosea L.

Amaranthaceae
Amaranthus retroflexus L.

Primulaceae
Primula veris L.

Lysimachia nummularia L.
Lysimachia vulgaris L.
Anagallis arvensis L.

Polygonaceae
Polygonum aviculare L.
Polygonum hidropiper L.
Polygonum mite Schrank
Rumex acetosa L.
Rumex aquaticus L.
Rumex obtusifolius L.
Rumex sanguineus L.
Fallopia dumetorum (L.) Holub.
Fallopia convolvulus (L.) A. Löve

Cannabaceae
Humulus lupulus L.
Cannabis sativa L.

Urticaceae
Urtica dioica L.
Urtica urens L.
Parietaria officinalis L.

Ulmaceae
Ulmus procera Salisb.
Ulmus glabra Huds.

Betulaceae
Corylus avellana L.
Betula pendula Roth
Betula pubescens Ehrh.
Carpinus betulus L.
Alnus glutinosa (L.) Gaertn.

Fagaceae
Fagus sylvatica L.
Quercus cerris L.
Quercus petraea (Mattuschka) Lieblein
Quercus pubescens Willd.
Quercus robur L.
Quercus rubra L.
Quercus virgiliana Ten.

Salicaceae
Salix aurita L.

Salix caprea L.
Salix cinerea L.
Salix rosmarinifolia L.
Salix triandra L.
Salix viminalis L.
Populus tremula L.

MONOCOTYLEDONOPSIDA

Alismataceae
Alysma plantago-aquatica L.

Butomaceae
Butomus umbellatus L.

Liliaceae
Colchicum autumnale L.
Anthericum ramosum L.
Gagea lutea (L.) Ker-Gawl.
Allium flavum L.
Allium montanum F.W. Schmidt
Allium scorodophrasum L.
Allium spaerocephalum L.
Allium ursinum L.
Allium vineale L.
Fritillaria meleagris L.
Lilium martagon L.
Erythronium dens-canis L.
Asparagus officinalis L.
Muscari bothrioides (L.) Mill.
Muscari comosum (L.) Mill.
Muscari teniuflorum Tausch
Ornithogalum pyramidale L.
Scilla sp. - Scilla bifolia agg.
Majanthemum bifolium L.
Polygonatum latifolium (Jacq.) Desf.
Polygonatum multiflorum (L.) All.
Polygonatum odoratum (Mill.) Druce
Polygonatum verticillatum (L.) All.
Convallaria majalis L.
Paris quadrifolia L.

Amaryllidaceae
Galanthus nivalis L.

Iridaceae
Iris graminea L.
Iris pseudacorus L.
Iris pumila L.
Iris sibirica L.
Iris variegata L.

Juncaceae
Juncus bufonius L.
Juncus effusus L.
Juncus inflexus L.
Luzula luzuloides (Lam.) Dandy
Luzula campestris (L.) Lam. et DC.
Luzula forsteri (Sm.) DC.

Orchidaceae
Anacamptis pyramidalis (L.) Rchb.
Cephalantera damasonium (Mill.) Druce
Cephalantera longifolia (Huds.) Fritsch
Cephalantera rubra (L.) Rich.
Corallorhiza trifida Châtelain
Dactylorhiza incarnata (L.) Soó
Dactylorhiza majalis (L.) Soó
Epipactis atrorubens (Hoffm.) Bess.
Epipactis helleborine Cr.
Epipactis microphylla (Ehrh.) Sw.
Epipactis palustris (Mill.) Cr.
Epipactis purpurata Sm.
Gymnadenia conopsea (L.) R.Br.
Neottia nidus-avis (L.) Rich.
Orchis laxiflora subsp. *palustris* (Jacq.) Bonnier et Layens
Orchis morio L.
Orchis purpurea Huds.
Orchis tridentata Scop.
Orchis ustulata L.
Platanthera bifolia (L.) Rich.

Cyperaceae
Eriophorum latifolium Hoppe
Eleocharis acicularis (L.) R. et Sch.
Eleocharis carniolica Koch
Scirpus sylvaticus L.
Carex acutiformis Ehrh.
Carex appropinquata Schumacher

Carex brevicollis DC.
Carex brizoides L.
Carex buekii Wimm.
Carex caryophyllea Latour.
Carex digitata L.
Carex distans L.
Carex elata All.
Carex elongata L.
Carex flava L.
Carex gracilis Curt.
Carex hirta L.
Carex humilis Leyss.
Carex lepidocarpa Tausch
Carex leporina L.
Carex liparicarpos Gaud
Carex michelii Host.
Carex montana L.
Carex nigra (L.) Reichard
Carex pairaei F. Schultz
Carex pallescens L.
Carex pilosa Scop.
Carex remota Jusl.
Carex riparia Curt.
Carex silvatica Huds.
Carex tomentosa L.
Carex vesicaria L.
Carex vulpina L.

Gramineae
Agropyron caninum (L.) P.B.
Agropyron intermedium Host.
Agropyron pectinatum (M.B.) R. et Sch.
Agropyron repens (L.) P.B.
Agrostis canina L.
Agrostis capillaris L.
Agrostis stolonofera L.
Aira elegantissima Schur
Alopecurus pratensis L.
Anthoxanthum odoratum L.
Avena sativa L.
Botriochloa ischaemum (L.) Keng
Brachypodium pinnatum (L.) P.B.
Brachypodium sylvaticum (Huds.) R. et Sch.

Briza media L.
Bromus benekenii (Lange) Trimen
Bromus erectus Huds.
Bromus inermis Leyss.
Bromus mollis L.
Bromus ramosus Huds.
Calamagrostis arundinacea (L.) roth
Calamagrostis epigeios (L.) Roth
Cleistogenes serotina (L.) Keng
Cynosorus cristatus L.
Dactylis glomerata L.
Dactylis polygama Horvátovszky
Danthonia alpina Vest.
Deschampsia caespitosa (L.) P. B.
Digitaria sanguinalis (L.) Scop.
Hordelymus hispidus (L.) Jessen
Festuca arundinacea Schreb.
Festuca gigantea (L.) Vill.
Festuca heterophylla Lam.
Festuca ovina L.
Festuca pallens Host
Festuca pratensis Huds
Festuca pseudovina Hack.
Festuca rubra L.
Festuca rupicola Heuff.
Festuca valesiaca Schleich.
Arrhenaterum elatius (L.) J. et C. Presl
Glyceria fluitans (L.) R. Br.
Glyceria maxima (Hartm.) Holmberg
Helictotrichon compressum (Heuff.) Henrard
Helictotrichon pubescens (Huds.) Pilger
Helictotrichon pratense (L.) Bess.
Holcus lanatus L.
Holcus mollis L.
Koeleria cristata (L.) Pers.
Koeleria pyramidata (Lam.) P.B.
Lolium temulentum L.
Melica ciliata L.
Melica nutans L.
Melica picta C. Koch
Melica uniflora Retz.
Milium effusum L.
Molinia arundinacea (Schrank) Domin

Nardus stricta L.
Phleum phleoides (L.) Karsten
Poa angustifolia L.
Poa badensis Haenke
Poa compressa L.
Poa nemoralis L.
Poa pannonica subsp. *scabra* (Kit.) Soó
Poa pratensis L.
Poa angustifolia L.
Poa trivialis L.
Sesleria heufleriana Schur
Setaria pumila (Poir.) R. et Sch.
Setaria viridis (L.) P.B.
Sieglingia decumbens (L.) Bernh.
Stipa capillata L.
Stipa joannis Celak.
Stipa pulcherrima C. Koch
Stipa tirsa Stev.
Trisetum flavescens (L.) P. B.
Phalaroides arundinacea (L.) Rauschert

PROTECTED INVERTEBRATE SPECIES OF AGGTELEK NATIONAL PARK AND BIOSPHERE RESERVE (1997)

Compiled by **ZOLTÁN VARGA**
Kossuth Lajos University, Dept. of Evolutionary Zoology and Human Biology, Debrecen, Egyetem tér 1. H-4010

Mollusca
Helix pomatia
Bielzia coerulescens
Sadleriana pannonica

Odonata
Calopteryx (Agrion) virgo
Coenagrion ornatum
Onychogomphus forcipatus
Stylurus flavipes
Gomphus vulgatissimus
Ophiogomphus cecilia
Cordulegaster bidentatus
Anaciaeshna isosceles
Aeshna mixta
Orthetrum brunneum

Mantodea
Mantis religiosa

Orthoptera
Poecilimon fussi
Isophya modestior stysi
Isophya brevipennis
Tettigonia caudata
Pholidoptera transsylvanica
Saga pedo
Gampsocleis glabra
Paracaloptenus caloptenoides
Stenobothrus eurasius
Arcyptera fusca

Planipennia
Libelluloides macaronius
Mantispa styriaca

Coleoptera
Calosoma sycophanta
Carabus coriaceus
Carabus intricatus

Carabus nemoralis
Carabus hortensis
Carabus convexus
Carabus violaceus
Carabus glabratus
Carabus cancellatus
Carabus granulatus
Carabus scabriusculus
Carabus ullrichi
Carabus scheidleri
Carabus obsoletus
Carabus scheidleri
Carabus zawadszkyi
Cychrus rostratus
Duvalius hungaricus
Anthaxia hungarica
Capnodis tenebrionis
Meloe autumnalis
Lucanus cervus
Dorcus parallelepipedus
Sinodendron cylindricum
Copris lunaris
Bolbelasmus unicornis
Potosia hungarica
Potosia aeruginosa
Oryctes nasicornis
Acanthocinus aedilis
Megopis scabricornis
Rosalia alpina
Cerambyx cerdo
Trichoferus pallidus
Akimerus schaefferi
Purpuricenus kaehleri

Trichoptera
Drusus trifidus

Lepidoptera
Korscheltellus fusconebulosus
Algedonia luctualis
Spialia sertorius
Zerynthia polyxena
Papilio machaon
Iphiclides podalirius
Parnassius mnemosyne
Pieris (Artogeia) bryoniae

Pieris (Artogeia) mannii
Colias myrmidone
Satyrium w-album
Lycaena (Thersamonia) dispar
Lycaena (Loweia) alciphron
Lycaena (Palaeochrysophanus) hippothoe
Cupido sebrus
Maculinea alcon xerophila (curiosa)
Maculinea teleius
Maculinea arion
Maculinea ligurica
Aricia artaxerxes issekutzi
Aricia (Eumedonia) eumedon
Polyommatus (Agrodiaetus) admetus
Euphydryas (Hypodryas) maturna
Melitaea telona kovacsi
Boloria (Clossiana) euphrosyne
Boloria (Clossiana) selene
Brenthis ino
Argyronome laodice
Pandoriana pandora
Vanessa atalanta
Nymphalis polychloros
Inachis io
Euvanessa antiopa
Neptis rivularis
Neptis sappho
Limenitis (Ladoga) camilla
Limenitis populi
Apatura iris
Apatura ilia
Lopinga achine
Chazara briseis pannonica
Endromis versicolora
Saturnia pyri
Lemonia taraxaci
Lemonia dumi
Proserpinus proserpina
Hemaris fuciformis
Hemaris tityus
Hydria (Rheumaptera) undulata
Larentia clavaria
Euphya scripturata
Schistostege decussata
Arichanna melanaria

Boarmia viertlii
Peribatodes umbraria matrensis
Ennomos quercarius
Charissa (Gnophos) pullata
Furcula bicuspis
Leucodonta bicoloria
Notodonta torva
Pheosia gnoma
Phalera bucephaloides
Ocnogyna parasita
Pericallia matronula
Coscinia cribrum punctifera
Paidia rica
Panchrysia deaurata
Catocala fraxini
Periphanes delphinii
Cucullia campanulae
Cucullia xeranthemi
Cucullia gnaphalii
Asteroscopus syriacus decipulae
Oria musculosa
Phragmatiphila nexa
Staurophora celsia
Photedes captiuncula delattini
Amphipoea lucens
Apamea sicula (=syriaca) tallosi
Apamea platinea
Chersotis fimbriola baloghi
Parexarnis fugax
Dichagyris candelisequa
Dichagyris musiva
Euxoa decora
Euxoa birivia
Euxoa hastifera
Euxoa distinguenda

Hymenoptera
Ichneumon disparis
Protichneumon pisorius
Rhyssa persuasoria

LIST OF VERTEBRATE SPECIES OF AGGTELEK NATIONAL PARK AND BIOSPHERE RESERVE (1997)

Compiled by **RÓBERT HORVÁTH**
Aggtelek National Park Directorate, Hungary, 3758 Jósvafő P.O.B. 6.

Cyclostomata
Eudontomyzon danfordi

Pisces
Salmo trutta m. fario
Salmo gairdneri
Esox lucius
Rutilus rutilus
Rutilus pigus virgo
Scardinius erythrophthalmus
Leuciscus leuciscus
Leuciscus cephalus
Leuciscus idus
Phoxinus phoxinus
Aspius aspius
Leucaspius delineatus
Alburnus alburnus
Abramis brama
Abramis balleri
Vimba vimba
Tinca tinca
Chondrostoma nasus
Barbus barbus
Barbus meridionalis petényi
Gobio gobio
Gobio albipunctatus
Gobio uranoscopus
Gobio kessleri
Pseudorasbora parva
Rhodeus sericeus amarus
Carassius carassius
Carassius auratus
Cyprinus carpio
Nemachilus barbatulus
Misgurnus fossilis
Cobitis taenia
Sabanejewia aurata

Lota lota
Lepomis gibbosus
Perca fluviatilis
Gymnocephalus cernuus
Gymnocephalus schraetzer
Stizostedion lucioperca
Zingel streber

Amphibia
Salamandra salamandra
Triturus cristatus
Triturus vulgaris
Bombina bombina
Bombina variegata
Bufo bufo
Bufo viridis
Hyla arborea
Rana temporaria
Rana dalmatina
Rana ridibunda
Rana lessonae
Rana esculenta

Reptilia
Lacerta viridis
Lacerta agilis
Podarcis muralis
Ablepharus kitaibelii
Anguis fragilis
Elaphe longissima
Coronella austriaca
Natrix natrix
Natrix tesellata

Aves (x - breeding species 1980-)
x *Podiceps ruficollis*
Ardea cinerea
Egretta alba
Egretta garzetta
Nycticorax nycticorax
x *Ixobrychus minutus*
x *Ciconia ciconia*
x *Ciconia nigra*
Anser anser

Anser fabalis
x *Anas platyrhynchos*
x *Anas querquedula*
Anas crecca
Aythya ferina
x *Aythya fuligula*
x *Pernis apivorus*
Milvus migrans
x *Accipiter gentilis*
x *Accipiter nissus*
x *Buteo buteo*
Buteo lagopus
Aquila chrysaetos
x *Aquila heliaca*
x *Aquila pomarina*
Haliaetus albicilla
Circus cyaneus
Circus pygargus
Circus aeruginosus
x *Circaetus gallicus*
Pandion haliaetus
x *Falco cherrug*
Falco peregrinus
x *Falco subbuteo*
Falco columbarius
x *Falco tinnunculus*
x *Tetrastes bonasia*
x *Perdix perdix*
x *Coturnix coturnix*
x *Phasianus colchicus*
Grus grus
Rallus aquaticus
x *Crex crex*
x *Gallinula chloropus*
x *Fulica atra*
x *Vanellus vanellus*
x *Charadrius dubius*
Tringa nebularia
Tringa ochropus
x *Tringa hypoleuca*
Gallinago gallinago
Scolopax rusticola
Larus ridibundus

Sterna hirundo
x *Columba oenas*
x *Columba palumbus*
x *Streptopelia turtur*
x *Streptopelia decaocto*
x *Cuculus canorus*
Tyto alba
Otus scops
Bubo bubo
x *Athene noctua*
x *Strix aluco*
x *Strix uralensis*
x *Asio otus*
Glaucidium passerinum
x *Caprimulgus europaeus*
Apus apus
x *Alcedo atthis*
Merops apiaster
Coracias garrulus
x *Upupa epops*
x *Jynx torquilla*
x *Picus viridis*
x *Picus canus*
x *Dryocopus martius*
x *Dendrocopos major*
x *Dendrocopos syriacus*
x *Dendrocopos medius*
x *Dendrocopos leucotos*
x *Dendrocopos minor*
x *Galerida cristata*
x *Lullula arborea*
x *Alauda arvensis*
x *Hirundo rustica*
x *Delichon urbica*
Riparia riparia
x *Oriolus oriolus*
x *Corvus corax*
x *Corvus cornix*
Corvus frugilegus
Coloeus monedula
x *Pica pica*
Nucifraga caryocatactes
x *Garrulus glandarius*

x *Parus major*
x *Parus caeruleus*
x *Parus ater*
x *Parus cristatus*
x *Parus palustris*
x *Parus montanus*
x *Aegithalos caudatus*
x *Remiz pendulinus*
x *Sitta europaea*
x *Certhia familiaris*
x *Cinclus cinclus*
x *Troglodytes troglodytes*
x *Turdus viscivorus*
Turdus pilaris
x *Turdus philomelos*
Turdus iliacus
x *Turdus torquatus*
x *Turdus merula*
Monticola saxatilis
x *Oenanthe oenanthe*
x *Saxicola torquata*
x *Saxicola rubetra*
x *Phoenicurus phoenicurus*
x *Phoenicurus ochruros*
x *Luscinia megarhynchos*
Luscinia luscinia
x *Erithacus rubecula*
x *Locustella naevia*
x *Locustella fluviatilis*
Locustella luscinioides
x *Acrocephalus arundinaceus*
x *Acrocephalus scirpaceus*
x *Acrocephalus palustris*
x *Acrocephalus schoenobaenus*
x *Hippolais icterina*
x *Sylvia atricapilla*
x *Sylvia nisoria*
x *Sylvia borin*
x *Sylvia communis*
x *Sylvia curruca*
x *Phylloscopus trochilus*
x *Phylloscopus collybita*
x *Phylloscopus sibilatrix*

x *Regulus regulus*
Regulus ignicapillus
x *Muscicapa striata*
Ficedula hypoleuca
x *Ficedula albicollis*
x *Ficedula parva*
x *Prunella modularis*
x *Anthus trivialis*
x *Motacilla alba*
x *Motacilla cinerea*
x *Motacilla flava*
Bambycilla garrulus
Lanis excubitor
x *Lanius minor*
x *Lanius senator*
x *Lanius collurio*
x *Sturnus vulgaris*
x *Passer montanus*
x *Passer domesticus*
x *Coccothraustes coccothraustes*
x *Carduelis chloris*
x *Carduelis carduelis*
Carduelis spinus
x *Carduelis cannabina*
x *Serinus serinus*
x *Pyrrhula pyrrhula*
Carpodacus erythrinus
x *Loxia curvirostra*
x *Fringilla coelebs*
Fringilla montifringilla
x *Emberiza citrinella*
x *Emberiza calandra*
x *Emberiza cia*
x *Emberiza schoeniclus*
Plectrophenax nivalis

Mammalia
Erinaceus concolor
Talpa europaea
Sorex minutus
Sorex araneus
Neomys fodiens
Neomys anomalus

Crocidura leucodon
Crocidura suaveolens
Rhinolophus euryale
Rhinolophus ferrumequinum
Rhinolophus hipposideros
Plecotus austriacus
Plecotus auritus
Myotis nattereri
Myotis bechsteini
Myotis emarginatus
Myotis mystacinus
Myotis daubentoni
Myotis dasycneme
Eptesicus serotinum
Pipistrellus pipistrellus
Nyctalus noctula
Nyctalus leisleri
Lepus europaeus
Sciurus vulgaris
Citellus citellus
Dryomys nitedula
Eliomys quercinus
Glis glis
Muscardinus avellanarius
Rattus norvegicus
Rattus rattus
Micromys minutus
Mus musculus
Apodemus agrarius
Apodemus microps
Apodemus sylvaticus
Apodemus flavicollis
Cricetus cricetus
Ondatra zibethica
Arvicola terrestris
Clethrionomys glareolus
Microtus arvalis
Ursus arctos
Felis lynx
Felis silvestris
Canis lupus
Vulpes vulpes
Lutra lutra

Meles meles
Martes martes
Martes foina
Mustella erminea
Mustella nivalis
Mustella putorius
Sus scrofa
Capreolus capreolus
Cervus elaphus
Ovis musimon

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