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A kezdet évei. Pócs Tamás, a vegetációkutató

Fekete G.
MTA Ökológiai és Botanikai Kutatóintézete
`h6868fek@helka.iif.hu`

Immár több mint ötvenéves baráti ismeretség fűz Pócs Tamáshoz. Kezdetét rögtön az egyetemi évekkel veszi. Az eleinte még Andreánszky Gábor, majd Soó Rezső professzorok vezette, Múzeum körúti Növényrendszertani és Növényföldrajzi Tanszék oktatóinak egyénisége, tudása inspiratív és kellemes befogadó közeget, menedéket jelentett. Itt ismerkedtünk össze a növényismeret, illetve botanika, paleobotanika iránt lelkesedő, felettünk meg alattunk járó évfolyamok hallgatóival. Az alsóbb évfolyamok hallgatói között az első pillanattól kitűnt nagyfokú fajismeretével Pócs Tamás. Respektusunk még csak nőtt, amikor a speciális növényszociológiai kollégiumot tartó vendégprofesszor, Zólyomi Bálint kezében megpillantottunk egy kiadványt — a Növényföldrajzi Térképezési Tanfolyam jegyzetét —, amelyen a résztvevők névsorában az akkori nagyok mellett megtaláltuk — az egyedüli középiskolás — Pócs Tamás nevét. Neve már 1950-ben nem volt ismeretlen a vezető botanikusok előtt, hiszen Tamás rendszeresen bejárt a Növénytárba mint akadémiai ösztöndíjas hallgató, ott nemegyszer felkereste Jávorka Sándort, aki örömmel segített gyűjtött kritikus növényei meghatározásában.

Első dolgozataink közel azonos időpontban jelentek meg, már csak ezért is jól emlékszem a körülményekre. Ő még javában egyetemi hallgató ekkor. Tanulmányának címe: A rákoskeresztúri Akadémiai Erdő vegetációja. Benne Budapest határán, az egykor változatosságáról nevezetes Rákos-vidék pusztai növényzetének utolsó hírmondóiról ad számot. A maradványfoltokból rekonstruálta az eredeti növényzetet. Tőle tudjuk: a nyárfaligetekben, irtásokban, akácosokban a területen megbúvó erdei fajok félreérthetetlenül jelzik, hogy az eredeti erdő a gyöngyvirágos tölgyes volt. Megfigyeli és leírja azt az átalakulási folyamatot, ahogyan az eredeti homoki gyepek a felnövekvő akác alatt átalakulnak, és ruderális elemekkel telítődve a homokra tipikus akácos aljnövényzetté fejlődnek. Legfontosabb talán mégis az, hogy a fajgazdag homokpusztai gyepek mellett zártabb homoki gyepeket is talál és ír le, Festucetum strictae konszociáció néven.

Mai ismereteink szerint a Festuca wagneri gyepjéről van szó. Felismeri ennek a gyepnek sztyeppréti vonásait, és néhány homoki sztyeppfaj alapján a Festucetum sulcatae-t helyettesítő társulásként írja le. (Megjegyezzük, hogy a következő évtizedekben elhúzódó vita folyt arról, hogy a Duna—Tisza köze záródó Festuca wagneri gyepjei vajon még a homokpusztagyepek szélső helyzetű, a sztyepprétek felé mutató képviselői, avagy már — mint Pócs is vélte — valóban a homoki sztyepprétekhez sorolhatóak. A kérdés a primér szukcesszió megítélése szempontjából érdekes. Nagyobb anyagon végzett újabb vizsgálatok az előbbi véleményt támasztják alá. A sztyepprét-bélyegek észrevétele, a gyep elkülönítése, első leírása azonban mindenképpen Pócs Tamás érdeme.)

Az Alma Mater, egyben Tamás első munkahelye a Magyar Nemzeti Múzeum—Országos Természettudományi Múzeum Növénytára volt. Zólyomi Bálint, mesterünk meghívását Ő is örömmel fogadta el, és itt, a Vajdahunyadvár gyönyörű épületében, eszményi körülmények között teltek el a kezdeti évek. Tamást nagy szeretettel fogadták az idősebb, nagynevű kollégák: Jávorka Sándor, Csapody Vera, Újhelyi József és persze mi, nála kicsit idősebb fiatalok is. Az első perctől fogva szaktekintélynek számított — ezt különösen Vera néni hangoztatta gyakran — nagy és biztos növényismerete okán. Közben terepszezonban folyt a fiatalok „kiképzése", a kemény munka, ami voltaképpen már jóval korábban, még hallgató korunkban megkezdődött. Bekapcsolódtunk ugyanis a Bükk hegység növénytársulástani-erdőtipológiai térképezésébe. A bükki térképező „brigádnak" tagjai voltak a vezető Zólyomi Bálint mellett még Jakucs Pál, Baráth Zoltán, Horánszky András. És a legfiatalabbak: Pócs Tamás, Fekete Gábor, Vida Gábor. Egy életre szólóan megtanultuk azt, hogy mi a kollektív munka. Eközben — az ötvenes évek elején-közepén — alakult ki többünknek is egyszerre a szünoptikus vegetációszemlélet, ami kiterjedt a térképezendő egységek azonosítására, meghatározására, elhatárolási kérdésekre, a cönológiai felvételezésnél alkalmazott becslésre stb. Minderre a Bükk hegység változatos, közel természetes vegetációja jól elkülönülő társulásaival igen alkalmas volt. (A bükki térképezésről, annak intenzitásáról, módszertanáról, hozadékáról egy külön cikkben — a Botanikai Közlemények hasábjain — korábban beszámoltunk.) Tény, hogy a napi munka nemcsak a fejünket, de a lábunkat is erősen megterhelte; esténként kifáradva és hatalmas étvággyal tértünk haza. Az ebédet és vacsorát sokszor egyszerre fogyasztottuk el. Tamás teljesítménye itt is figyelemre méltó volt. A bükki élményekről — most nem a terepélményekre gondolok — éppen Tamás kötött egybe egy csokrot elhunyt szegény barátunk, Jakucs Pálról szóló megemlékezése kapcsán. Még így is maradt néhány érintetlen téma. Persze, nehezen lehet például papírra vetni, hogy milyen frenetikus következménye volt a vacsorával fogyasztott, kukoricából készült, pancsolt italnak... Minthogy a tisztességes, szőlőből készült bor akkoriban még hiánycikk volt.

Nemcsak a terepmunka volt közös, együtt végeztük az 1 : 10 000 léptékű térképek, a több füzetet kitevő jegyzőkönyvek kiértékelését-feldolgozását is. Ide kívánkozik egy igen jellemző, maradandó epizód 1953-ból vagy 1954-ből. A bükki brigád vezetője, Zólyomi Bálint elhatározta, hogy a térképezés addigi tapasztalatait, eredményeit botanikusoknak és erdészeknek egyaránt szóló tanulmányban megírjuk. A szövegezés — a Növénytárban — ugyancsak keservesen, akadozva folyt, olykor az éjszakába is nyúlóan. Tamás nehezen bírta az éjszakázást, és bizony néha elszundított. A munkában az erdőtársulások zonalitási viszonyainak bemutatásához érve kiderült, hogy jegyzőkönyvi adataink hiányosak, kisszámúak. (Mindaddig Zólyomit követve a cönológiai felvételek kapcsán rögzített adatokra szorítkoztunk.) Dilemmánk Tamás fülébe juthatott, aki félálmában megmozdult és álmosan megszólalt: „Vegyétek elő az elkészült tízezres térképlapokat. Azokon foltról-foltra haladva, és a szintvonalakat figyelve leolvasható minden szükséges adat, ami a zonalitást kifejező expozíciós diagramokhoz szükséges. Ráadásul így sokkal nagyobb számú adathoz juttok, mint az eddigi módszerrel." Dörmögte ezt, aztán folytatta az alvást. Mondani sem kell: a javaslat telitalálat volt, és pofonegyszerű. Azóta is ez a legmegbízhatóbb módja a zonalitási viszonyok megismerésének. (Amúgy az elkészült tanulmányért, annak cönológiai eredményeiért illetve az erdőgazdálkodás tudományos megalapozásáért Zólyomi Kossuth-díjban részesült.)

Tamás már nagyon készült arra, hogy a Nyugat-Dunántúlon — amelyhez gyermekkori élmények is fűzték — végez majd vegetációfeltárást. Emlékszem, hogy egy alkalommal a bükki terepmunka során, falatozás közben rajongva kezdett el egy beszámolót szőcei élményeiről. A munkafegyelemre — de még sokkal inkább a csapat vezetőjének, Zólyominak erélyére — jellemző: a beszámolót leállította. „Most a Bükkben vagyunk, az itteni munkára összpontosítunk" — volt az indoklás. Az olykor túlzott fegyelem ellenére persze a szerzett tapasztalatok formájában bőséges útravalót kaptunk, amit aztán „inaséveink" letelte után hasznosíthattunk. Tamás is nekifogott az Őrség növényzete feldolgozásának, remek kis munkacsapat élén. De erről később beszélünk.

Zsúfolt programjaink, nagy ambícióink, a kis közösségek összetartó ereje mind-mind hozzájárultak ahhoz, hogy a kegyetlen ötvenes évek gyötrelmeit elviseljük. Persze, közben azért mi, botanikusok is évekre elszigetelődtünk a világtól, nemcsak a karanténban tartott lakosság. Még a szomszédos „baráti" országok látogatásától is el voltunk tiltva. Tamás az első adandó alkalmat megragadta Erdély meglátogatására. Erre 1955-ben kerülhetett sor. Azokban az években jobbára csak a rokoni látogatás volt lehetséges. Ebben az évben jónéhányunknak megszaporodtak a rokonai. Tamás szerezte be őket. A „rokoni" meghívások rendben meg is érkeztek. Így leltem magam is egy életre szólóan egy jó barátra, Gergely János kolozsvári botanikus személyében. A következő évben, 1956 nyarán aztán egy népes magyar botanikus csapat indult útnak Erdélybe. A cél egyrészt az volt, hogy az előző évben a Pareng-hegységben már elkezdett gyűjtő- és felvételező munkát folytassák, illetve, hogy Erdély szépséges alhavasi- havasi tájait meglátogatva flóraismeretük, vegetációszemléletük bővüljön. A résztvevők az akkor feltörő tettrekész fiatalok köréből verbuválódtak. Pócs Tamás mellett Pócsné Gelencsér Ilona, Vida Gábor, Juhász-Nagy Pál, Skoflek István, Komlódi Magda, Kovács Éva, Fekete Gábor, Jakucs Pál, Varga István, Borhidi Attila, Simon Tibor, Simon Tiborné jelentik a teljes kört, a felsoroltak persze nem feltétlenül voltak jelen minden kiránduláson. Noha már 47 éve annak, ma is élénken emlékszem azokra a felejthetetlen túrákra, amit egy nagyobb csoporttal a Csíki-havasokban és a Fogarasi-havasokban tettünk. Tamás felkészült vezetőnek bizonyult, akár geológiáról, akár flóraismeretről, akár pedig az útvonal ismeretéről, megtervezéséről, elszállásolásunkról volt szó. A közös kirándulásokon túl az erdélyi „nyitásnak" persze egyéb hozadéka is volt. Megindult a Pareng flórájának rendszeres kutatása, számos feltűnő újdonsággal (pl. az Aubrietia croatica mint Romániára új faj kimutatásával). Az eredményeket Tamás több, részben társszerzőkkel közös dolgozatban tette közzé. De más hegységekben is elkezdődtek a növénytársulás-tani célú terepmunkák, és ezekből szép dolgozatok is születtek. (Borhidi Attila pl. a keleti-kárpátoki Csalhó vegetációtípusairól és a szubalpin sziklahasadék-gyepekről: az újonnan leírt Gypsophylion petraeae társulásairól, aztán a Keleti- és Déli-Kárpátok lúcosainak cönológiájáról készített tanulmányt, Vida Gábor parengi munkájára alapozva a Transsilvanicum bükköseiről adott áttekintést. Mi pedig, Jakucs Pállal és Gergely Jánossal karöltve sorban Moldva, Dobrudzsa száraz tölgyeseit és az Al-Duna vidékének páratlanul érdekes erdőit kerestük fel és felvételeztük.)

A kezdeti évek nagy alkotása a Vegetationsstudien im Őrség című könyv, munkatársaival: Domokos-Nagy Évával, Pócsné Gelencsér Ilonával és Vida Gáboral közösen írt mű. Még egyetemista, amikor elkészült (1955), de csak 1958-ban jelent meg a Zólyomi Bálint szerkesztette Magyar tájak növénytakarója kiadványsorozat második tagjaként. Ezek az indító kötetek (az első Simon Tiboré volt, és az Észak-Alföld erdőiről szólt) azért is fontosak voltak, mert meghatározták a sorozat következő tagjainak a „fazonját". Ezért is érdemes néhány mozzanatra kitérnünk. A munkacsoport a felvételezésnél a szokásosnál nagyobb figyelmet szentelt a térbeli szintezettségnek. Cönológiai felfogásukban támaszkodnak a Knapp-tól bevezetett „főasszociáció" fogalmára. A társulás alatti egységek, szubasszociációk lehettek akár geográfiai, akár ökológiai tagolás eredményei. Tamás ismeri és komolyan veszi a Zürich—Montpellier iskola hagyományait. Ez pl. abban mutatkozik meg, hogy még a felvételezés megkezdése előtt gondot fordít a minimiárea meghatározására (már a rákoskeresztúri erdőben folytatott terepmunka során is így járt el). Újítás, hogy — Vida Gábor javaslatára — bevezetik az állománytömeg fogalmát, különösen, mert azt tapasztalták, hogy ez az érték a szukcessziósoron belül progresszív irányban nő. Az erdő- és réttípusokat térképezték, a térkép alapszínei a természetes-természetközeli társulásokat fejezik ki (ott, ahol csak az megállapítható volt), a színre ráültetett jelek pedig azt, amely az eredetit felváltotta. Az Epilobietum, az erdőirtás-vegetáció pl. lehetséges, hogy egy alapszínre van ráültetve 8ott, ahol az eredeti társulás, pl. a Dicrano-Pinetum még felismerhető), máshol, felismerhetetlenség esetén hiányzik az alapszín. A munkán amúgy erősen látszik annak a koncepciónak a hatása, ami a bükki térképezésnél körvonalazódott. Az erdőtípusok értékelésénél alaposan konzultáltak erdészeti kutatókkal, ennek eredménye pl., hogy sorra megadják: mely társulásba mely fafajok (akár idegen fafajok is) bevitele lehet sikeres és gazdaságos, persze úgy, hogy emellett a természetes erdőszerkezet nem sérül meg alapvetően. A bemutatott, leírt társulások sora egyértelműsítette, hogy a Nyugat-Dunántúl hazánkban eddig alig ismert vegetációt rejteget. Pócsék monográfiája szolgáltatta később a biztos hivatkozási, tervezési alapot, napjainkban is, amikor az Őrség Nemzeti Park létrejött.

Az eltelt hosszú idő alatt, különösen az utóbbi évtizedben megváltozott az emberi befolyás megítélése a természetes vegetációra, nem utolsósorban mert a kutatók tudatos nyomozással újabb és újabb történeti adatok birtokába jutnak. Többen úgy vélik, hogy az egykori tájhasználat, az erdőkiélés erősen megváltoztatta a nyugat-dunántúli erdők mai képét, erősebben, mint azt hittük. Újabban néhány fiatal erdész-botanikus kolléga vitatja az erdeifenyő egyes állományainak őshonosságát. Bárhogy is legyen, ez nem befolyásolja a könyv alapvető megállapításainak helytállóságát.

Az erdész-botanikusokkal bővült csapat: Pócs Tamás, P. Gelencsér Ilona, Szodfridt István, Tallós Pál és Vida Gábor később, 1955 és 1958 között a Vend-vidéken dolgozott. Szakonyfalu és környékének megjelent vegetációtérképe szép, professzionális mű. Értékét növeli, hogy alaptérképükön a jelentősebb fa- és cserjefajok elterjedését valamint a tőzegmoha-lelőhelyeket is feltüntetik.

Közben eredményeit 1953 óta rendszeresen ismerteti a Botanikai Szakosztály előadó ülésein. Húszéves ekkor, a Szakosztály talán legfiatalabb tagja. Korai közismertségéhez ez is hozzájárul, ne feledjük, hogy a Botanikai Szakosztály az ötvenes-hatvanas években a botanikai közélet első számú fóruma, hiszen akkor más szakosztályok még nem léteztek. Az üléseken pedig az előadóterem nemegyszer zsúfolt.

Tereptapasztalatai, széles irodalmi ismeretei, a Zólyomi-iskolára jellemző fejlett összehasonlító vegetációszemlélete — és még néhány év — kellettek ahhoz, hogy a nyugat-dunántúli terepmunkákat abbahagyva egy másik fontos szintézist vessen papírra. Ennek magva az a gondolat volt, hogy a Keleti Alpok magyarországi előtere, amely dealpin-óceánikus, délen pedig szubmediterrán klímahatás alatt áll, a szubboreális kevert erdőzóna egy darabjának ad helyet. Részletezve: itt két olyan erdőtársulás is zonális, amelyek annak a tűlevelű-lombelegyes zónának tagja, amely Berlintől kelet felé, Lengyelországon keresztül az Uralig húzódik. A keletalpesi peremterületeknek ez az erdőzónája a fő elterjedési területétől mára elszakadt: a posztglaciális vegetációfejlődés során válhatott izolálttá. Pócs Tamás érezte-tudta felismerésének jelentőségét. Hogy biztos legyen a dolgában, felkereste a szóban forgó erdőket összefüggő elterjedési területükön, Lengyelországban, sőt, hogy a róluk szóló irodalmakba is belemélyedhessen, lengyelül is megtanult! Amúgy Tamásnak a jelenség és az okok elemézében segítségére voltak még flóraelterjedési adatok, klímastatisztikák. Jellemezte a tárgyalt zónától délre húzódó illír bükkös zónát: a Vicio oroboidi-Fagetumot, ill. elterjedési területét és a többi szomszédos zónát is. Végül pedig felvázolta a Nyugat-Dunántúl sematikus vegetációtérképét. E nélkül hiányos volna tudásunk az ország vegetációjának alapvonásairól és persze Zólyomi áttekintő másfél milliós vegetációtérképe sem lenne teljes.

Mindazt a sok újat, amit a tűlevelű erdőkről megtudott-megállapított, kandidátusi értekezésében foglalta össze, 1966-ban. Ekkor, a hatvanas évek második felében már megjelent egyfajta igény arra, hogy eredményeinket statisztikai módszerekkel is megerősítsük. Cönológiai táblázatok összehasonlítására a Ramsay-módszerhez jutott el, és fejlesztette azt tovább (ez tulajdonképpen a Sorensen-féle képlet továbbfejlesztése olyan irányban, hogy tekintettel van az állandósági és a dominanciaviszonyokra is, a közös fajoknál pedig figyelembe veszi a két helyen való előfordulást). Az értekezést olvasva teljesedett ki a kép előttünk a fenyvesek valódi szerepéről az ország nyugati felében, hiszen például kijelölte a bakonyperemi-kisalföldi homoki erdei fenyvesek helyét is, és ekkor kaptunk képet a fragmentális jellegű bazofil erdeifenyvesekről is.

Az erdészekkel, erdész kutatókkal való kapcsolat a hatvanas években erős, sok esetben baráti volt. Ez nagyon megkönnyítette a közös kutatásokat, olyan problémák megoldását, amelyek a két tudomány határán merültek fel. Egy fontos terület volt akkoriban az erdőtipológia. Már korábban világossá vált, hogy az erdőtípusok meghatározását a hasonló ökológiai igényű növények együttes előfordulására lehet alapozni. Ilyen rendszer azonban nem volt kidolgozva. Ezért a kutatók egy csapata kiművelte a hazai erdőkben élő növények ökológiai fajcsoportjait. A csapatban Csapody István, Horánszky

András, Simon Tibor, Szodfridt István, Tallós Pál mellett Tamásnak is fontos feladat jutott.

A flóra ugyanúgy érdekelte, mint a vegetáció. Nagyszámú új florisztikai adatot gyűjt össze az Őrségben, a Vend-vidéken. Károlyi Árpáddal közösen megindítja a teljes nyugat-dunántúli flóra enumerációját. A flóramű több részletben meg is jelent, 1965 és 1972 között. Érdeklődése idővel túlnyúlott a hazai, sőt az európai-eurázsiai mérsékelt égövi flórán. Megcsillan előtte a lehetőség: felkeresheti, megismerheti a gazdag távol-keleti flórát. Emlékszem arra az időszakra, amikor beköltözik a Növénytár Flora Generalis termébe, és ott hónapokig ismerkedik a Távol-kelet trópusi-szubtrópusi fajaival, családjaival. Közben tökéletesíti francia nyelvtudását, konzultációkat folytat Andreánszky Gábor professzorral, aki, ha nem is a recens, de a fosszilis szubtrópusi flórák jó ismerője. Az sem téríti el tervétől, hogy a tár főnöke, Zólyomi Bálint kifejti: magyar geobotanikus elsődleges feladata, hogy a jelenlegi hazai flóra és vegetáció keleti rokonságának, párhuzamainak kérdését kutassa, ehhez pedig nem szükséges a trópusok ismerete. De Tamás tántoríthatatlan, és el is éri, hogy 1963-ban kiutazhasson Észak-Vietnamba (Vietnami Demokratikus Köztársaság), és ott eredményes gyűjtő- és kutatóutakon vesz részt. Vietnami kapcsolatai máig fennmaradtak.

1976-ban opponensként működhettem közre az eljáráson, ahol Tamás akadémiai doktori értekezését védte meg. Ez volt hosszas afrikai munkásságának — amelyről Orbán Sándor e kötetben sokkal részletesebben számol be — egyik hozadéka. Az értekezés Tanzániában, az Uluguru- hegységben végzett komplex vegetációtanulmányait ismerteti. Ezen a címen flórarokonsági, flóratöréneti, bioklimatikai eredményeit, a vegetációövek jellemzését ötvözi konkrét ökológiai méréssorozatok értékelésével. Az epifiton mohákban gazdag erdőt és cserjeerdőt, egészen sajátos vízháztartásukat állítja középpontba. Megméri az epifitonok biomasszáját, intercepcióját és kimutatja, hogy az intercepció mértéke arányos azzal a csapadékmennyiséggel, amely már nem járul hozzá hatékonyan az edényes növények alkotta vegetáció fenntartásához. Vizsgálja az epifill flórát is. Elkészíti az Északi Uluguru-hegység potenciális vegetációtérképét, és ennek gyakorlati szerepet szán, mivel segítségével a terület mezőgazdasági rajonizációja végezhető el, és megadható a termesztésre javasolt növények köre. A disszertáció novumai egyébként egy sor addigra megjelent, nemzetközi folyóiratokban közölt tanulmányra alapozódtak.

Nem hittem volna, hogy érdeklődési területeink még találkozni fognak. Pedig így történt. A löszvegetációról van szó, amelyet vácrátóti kutatók is intenzíven vizsgáltak és most is vizsgálnak. Tamás 1996-tól kezdte kutatni a löszfalakon élő moha- és zuzmófajokat, azok taxonómiáját, florisztikai, növényföldrajzi és ökológiai viszonyait. Kiderült, hogy e növénytársulások létüket nagymértékben az extrazonalitásnak köszönhetik, és sivatagi jellegű együtteseket alkotnak. Tamás eredményei jó összhangban vannak eddigi tudásunkkal, bővítik azt, pl. mert megerősítik a löszfalperemeken, gerinceken kialakult Agropyro—Kochietum társulásról, félsivatagi jellegéről korábban kialakított nézetet.

Kivételes tudását az Magyar Tudományos Akadémia is felismerte és elismerte azzal, hogy 1995-ben levelező, majd 2002-ben rendes taggá választotta. A Biológiai Tudományok Osztályának megbecsült tagja. Itt természetesen olyan feladatok is hárulnak rá (akárcsak a botanika, ökológia más képviselőire), mint a szakma hatásos, eredményes képviselete. Ebbe a tudománypolitikai körbe sorolható a Botanikai Bizottság elnöki tisztsége is, amit szintén betöltött már. Működésének igazi területe azonban a terep. Nem is sok ideje annak, hogy élvezhettük akadémiai székfolgaló előadását sivatagi-félsivatagi, kéregszerű bevonatot képező kriptogám közösségekről. Már önmagában impozáns az a szívósság, ami eljuttatta, hajtotta különböző kontinensek száraz zónáinak felkeresésére. Világossá vált fajismereti, ökológiai tudásában gyökerező nagy szintetizáló képessége, lényeglátása. Személyes működésével is tanúsítja, hogy az összehasonlító vegetációtan lehetőségei nem merültek ki.

Kedves Tamás, születésnapodra kívánom, hogy töretlenül teljesíthessed tudományos céljaidat.

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Pócs Tamás, a trópusi botanikus

Orbán S.
Eszterházy Károly Főiskola Növénytani Tanszék, 3301 Eger, Pf. 43.
`orban@ektf.hu`

Pócs Tamás professzort több mint 30 éve ismerem, még kezdő mohász időszakomban találkoztam vele először, mikor a Növénytárban dolgoztam. Akkorra ő már nemzetközileg is elismert briológusnak számított, és minthogy korábban ő is a Növénytárban dolgozott, sokat hallottam róla.

Izgalommal vártam első találkozásunkat és meglepett az, hogy személyesen keresett meg növénytári szobámban, és rendkívül barátságosan viselkedett. Rögtön azzal kezdte, hogy talált nekem egy mohacsaládot, a *Calymperaceae*-t, melynek Afrikában sok faja van, és senki sem foglalkozik a feldolgozásával. Akkor még nem gondoltam, de ő valószínűleg már tudta, hogy több mint húsz év múlva ez lesz akadémiai disszertációm témája. Nem sokkal megismerkedésünk után tettünk egy közös kirándulást a Tarna-vidékre, ahol egy kis tőzegmohás lápfoltot találtunk egy vízzel áztatott útbevágásban, több ritka májmohafaj kíséretében, s az ott gyűjtött anyag meghatározása után megszületett első közös publikációnk, melyben más kutatókkal együtt társszerzők voltunk.

Nem sokkal ezután azzal keresett meg, hogy az egri Növénytani Tanszéken megüresedik egy adjunktusi állás, és szeretné, ha ezt én tölteném be, hiszen ez erősítené a tanszék kriptogámkutatását. Ettől kezdve ismeretségünk barátsággá változott, és számos közös kutatásban és gyűjtőexpedíción vettünk részt mind hazai-európai mind trópusi területeken. 1976-tól kisebb-nagyobb megszakításokkal közel 20 évig vezetője volt a Növénytani Tanszéknek, s miután utódjának nevelgetett az évek során, 1994-ben nekem adta át a tanszékvezetést. Közös munkánk során mindig lenyűgözött munkabírása, szorgalma és kitartása, a megálmodott célok elérése — gondolok itt például a 208 ezer példányos egri mohagyűjtemény megalapítására, a hazánkban egyedülálló mohairodalom-könyvtár és különlenyomat-gyűjtemény létrehozására, a kétszáznál több publikáció megírására, a kriptogámbotanikai kutatócsoport kifejlesztésére.

Mindenkivel nagyon készséges, és munkájában megbízható partner, aki ígéretét időre teljesíteni tudja, ezért rendkívül nagy trópusi botanikai ismeretségi köre van, amellyel napi munkakapcsolatban áll. Ma is nap mint nap határoz, publikációt ír, bírálatot és korrektúrát készít, 40-50 levelet ír elektronikusan küldve, és szervezi következő expedícióját. A nap 24 órájából legtöbbször 16-ot munkával tölt. Az expedíciókra alaposan felkészül, minden irodalmat, térképet, útikönyvet áttanulmányoz, a közlekedés lehetséges módjairól és útvonalairól tájékozódik, kijelöli a gyűjtési helyeket, felveszi a kapcsolatot olyan személyekkel, akik a terepmunkák során segítségükre lehetnek.

Régi vágya és álma volt eljutni a trópusi területekre botanikai kutatási céllal. Ez 1963-ban sikerült először, amikor 2 hónapot töltött Vietnamban és egy életre eljegyezte magát a trópusi mohák kutatásával. Két évre rá újabb 5 hónapot töltött gyűjtőmunkával és lenyűgözte a trópusi területek fajgazdagsága. Számos új mohafajt fedezett fel és tanulmányozta Észak-Vietnam flóraelemeit, a növényzet összetételét és ökológiáját.

1969-ben versenypályázaton nyert el egy oktatói állást az éppen megalakult tanzániai agráregyetemre, Morogoro városában, a gyönyörű, őserdővel borított Uluguru-hegység lábánál, ahová felesége nemrég született kisfiával néhány hónap után követte. A trópusi éghajlatot hamar megszokták, és beilleszkedtek a varázslatos afrikai életbe.

A hétköznapokat kemény munkával töltötte „Senior Lecturer"-ként, mivel a mezőgazdasági növénytan oktatása keretében számos teendővel látták el az egyetemen, de a csodálatos táj és élővilág, a melegszívű emberek és a hétvégeken tett kirándulások és gyűjtőutak nagyon gazdagon kárpótolták. Rendszeresen fogadtak külföldi kutatókat, akikkel együtt végeztek botanikai megfigyeléseket, gyűjtéseket. Sorra járták a vadállatokkal teli nemzeti parkokat és életre szóló élményük volt a Kilimandzsáró megmászása, melyet feleségével csináltak végig, aki talán az első európai nő volt, aki feljutott a Kibo csúcsára. Négy évet töltöttek el Tanzániában, 1971-ben Bence fiukkal gyarapodott a család, majd 1973-ban települtek haza Egerbe.

Afrikában sikerült elegendő anyagot összegyűjtenie a tudományok doktora fokozat elnyeréséhez, elkészítette a „Komplex vegetációtanulmányok Kelet-Afrikában" című értekezését, melyet 1977-ben védett meg.

Világviszonylatban elsőnek vizsgálta a trópusi esőerdők epifiton biomasszája és csapadékfelfogó képessége közötti összefüggést, melynek eredményei ma is legtöbbet idézett publikációi közé tartoznak. Ennek summázott eredménye, hogy sikerült kimutatni kvantitatív módszerekkel, hogy a fán lakó epifiton bevonatnövényzet (moha, zuzmó, páfrány, egyéb növények) biomasszája elérheti az ilyen vegetációtípusban a hektáronkénti 14 tonnát is, amely szárazanyaga négyszeresének megfelelő 50 000 liter vizet képes egyetlen eső alatt megkötni és környezetének fokozatosan átadni. Ez jóval több, mint az egész lombozat által megkötött vízmennyiség (6000 liter). Ehhez járul még a felhőzónában a rendszeres ködcsapadékból visszatartott víz. Nagyon jelentős az epifitonok humuszképzése és felhalmozása is (aerial humusz), mely vizsgálatai szerint elérheti a hektáronkénti 1-2 mázsát. Azóta a vizsgálatokat valamennyi trópusi földrészen megismételték, és hasonló intercepciós eredményekhez jutottak. Ennek a ténynek abban van óriási gyakorlati jelentősége, hogy elsősorban ennek a virágtalan növényekből álló epifiton vegetációnak az érdeme a trópusi vízválasztó hegységek felhőzónájában, hogy a csapadék szabályozva és egész évre elosztva jut a vízgyűjtő hálózatba, a száraz évszak alatt is folyamatos a patakok, folyók vízellátása, a hegységnél tízszer nagyobb területen biztosítva a folyamatos ivó- és öntözővíz-, valamint az energiaellátást. Ezenkívül hat a lokálklímára és enyhíti a szélsőségeket. Egyúttal megvédi a saját és a környező területek talaját a fokozott eróziótól, a földcsuszamlásoktól és az esős évszak alatti árvizektől, a száraz évszak alatt pedig az aszálytól és éhínségektől, amelyek bizony rendszeresen sújtják azokat a területeket, ahol a hegyi erdőtakarót elpusztították (pl. Etiópia, Nepál).

Két cikksorozata is indul ebben az időben, melyek máig is tartanak: az egyik az East African Bryophytes, a másik a New or little known epiphyllous liverworts. Az elsőből 18, a másodikból 9, a szakmában nagyon keresett és számon tartott publikáció jelent meg, mert ezek sok, a tudományra nézve új faj leírását tartalmazzák.

1976-ban újra Afrikában jár és részt vesz a Magyar Televízió Kilimandzsáró című filmjének készítésében. Nagy szüksége volt a stábnak Pócs tanár úrra, hiszen ekkorra már a hegység valamennyi hegymászóútvonalát ismerte.

1978-ban a Magyar Tudományos Akadémia Botanikai Kutatóintézetébe hívták Vácrátótra. A Botanikus Kert vezetését bízták rá, de ez trópusi kutatásaiban nem akadályozta. Innen három gyűjtőexpedíciót tett Kubába, amelyen több ezer mohapéldányt gyűjtött, és a szerpentin alapkőzetű területeken számos újdonságot talált. Ezekkel a felfedezésekkel hozzájárult ahhoz, hogy a karibi szigeteket és a környező területeket ma a mohaevolúció „forró pontjának" a dél-amerikai mohaflóra kialakulásának egyik evolúciós centrumának tartják.

Közben svéd kezdeményezésre visszajárt Tanzániába, ahol az Usambara-hegység esőerdeit kutatták, és egy svéd—magyar Integrált Usambara Esőerdőprogram megvalósításán fáradoztak.

1985-ben a tanzániai agráregyetemen alakult erdészeti fakultáson elnyert egy professzori állást, így norvég alkalmazásban újra Afrikában élt családjával, mely kislányávl gazdagodott az 1975-ös esztendőben. Ez az időszak 1990-ig tartott, és az oktatási tevékenység mellett gyűjtőutakat szervezett, illetve a NORAD cég megbízásából konzulensként a trópusi esőerdők ökológiai és biodiverzitási felméréseit végezte Északkelet-Tanzániában.

Eredményeit annyira elismerés övezte, hogy 1992-ben a Norvég Tudományos Akadémia külső tagja lett.

Ez az öt év a magyar trópusi botanikusok számára nagyon sok eredményt hozott, mivel Pócs professzor szívesen látott házában érdeklődő kutatókat, nemcsak briológusokat, botanikusokat, hanem zoológusokat, ökológusokat, fanerogám taxonómusokat. Mondhatjuk azt is, rendszeres volt a vendégjárás és a rendszerváltozást követő szabad utazási lehetőségek megnyitották az utat Afrika felé is. Minden érdeklődő kutatónak biztosított szállás- és étkezési lehetőséget, érdeklődésének megfelelő gyűjtő- és kutatóutakat szervezett, a szállítást saját Toyota terepjárójukkal gyakran felesége végezte. A cikk szerzőjének is megadatott az a lehetőség, hogy egy hónapra Pócs professzor vendége, gyűjtőtársa és expedíciós útitársa lehetett Tanzániában, így a terepen tanulmányozhatta az akkorra már általa herbáriumi példányokról jól ismert kelet afrikai Calymperaceae fajokat. Azonban nemcsak a magyar kutatókat fogadta nagy barátsággal, hanem az ismert európai briológusok szinte mind megfordultak nála, és ezek gyűjtési eredményeiből is sokszorozódott trópusi publikációinak száma.

1990-ben a Kilimandzsáró lábánál, Moshiban laktak, ahol felesége internátusi nevelőtanári állást töltött be a nemzetközi gimnáziumban, ebben az időszakban a Ngorongoro kráter és a Serengeti rezervátum területén végzett megbízásos konzervációbiológiai kutatásokat. Hazatérésük után még egy évet Vácrátóton töltöttek, de már látszott, hogy visszatérnek Egerbe, hiszen egy 1990-es itthoni szabadságuk idején magánházat vásároltak Felsőtárkányban.

1991-ben visszatért az egri főiskolára, amely akkorára az Eszterházy Károly Tanárképző Főiskola nevet vette fel. A Növénytani Tanszék új épületbe került, és ezzel lehetővé vált önálló mohaherbárium kialakítása, így Vácrátóton tartott trópusi mohagyűjteménye Egerbe került és a korábban megvásárolt anyagokkal együtt létrejött Közép-Európa egyik legnagyobb mohaherbáriuma.

Tanította is a trópusi botanikát, hiszen az ELTE-n „Trópusi ökológia", a gödöllői agráregyetemen a „Trópusi termesztett növények botanikája" című tárgyat oktatta több éven keresztül. Több egyetemen a doktori képzésben is részt vállalt. 1995-ben az MTA levelező tagja lett, majd 1996-ban habilitált, és rá egy évre itthon is egyetemi tanári kinevezést kapott.

Külföldi trópusi botanikus kollégáival együtt néhány évvel ezelőtt rájött arra, hogy utódokat kellene nevelni azokon a területeken, ahol a kutatások folynak, hogy legyen helyi specialista is, aki helyismerettel, helyi fajismerettel és botanikai ismeretekkel rendelkezik. Elindultak tehát mintegy tíz évvel ezelőtt különböző egyetemeken trópusi briológiai kurzusok a helyi specialisták képzésére. Először Helsinkiben indult meg az európai uniós briológiai kurzus, mely három egymást követő évben folytatódott, majd Mérida (Venezuela) és a Nairobi (Kenya) egyetemeken folyt egy-egy kurzus.

Nemcsak külföldön, hanem saját környezetében is törekedett arra, hogy utánpótlást neveljen a trópusi botanika, briológia számára. Visszatérve Egerbe, az ott oktató kollégákat vonta be az expedíciós munkába, akik közül többen már egy-egy mohacsoport specialistái voltak. Figyelme ebben az időben Kelet-Afrika és az indiai-óceáni szigetvilág florisztikai, növényföldrajzi rokonságának kutatására irányult. Akadémiai pályázati támogatás felhasználásával megszervezett az utóbbi tíz évben öt nagyobb kutatási expedíciót, melynek célja Madagaszkár, a Seychelles-szigetek, Comoro-szigetek, Réunion, Mauritius és Rogriguez-szigetek mohaflórájának feltárása. A tanszék mohaherbáriuma ezen expedíciók nyomán több ezer példánnyal gazdagodott és számos a tudományra nézve új fajt sikerült felfedezni.

2001-ben a Magyar Tudományos Akadémia rendes tagjává választották, és ebben komoly szerepet játszott az, hogy világszerte elismert trópusi botanikai kutatómunkát végzett.

Jelenleg a főiskolán működő MTA Bryológiai Kutatócsoportot vezeti, melynek fő profilja a trópusi kriptogám növények kutatása, de ezen kívül munkatársaival együtt kutatja a hazai löszfalak és az ausztráliai szubtrópusi sivatagok virágtalan növényeinek ökológiai, növényföldrajzi és rendszertani vizsgálatát. A löszfalak kutatásában Közép-Európa löszterületeit, Ausztráliában pedig az utóbbi három évben több ezer kilométeres utazással tárta fel a jellegzetes brioflórát.

Meg kell jegyeznünk, hogy közben a trópusokról sem feledkezett meg, hiszen kétszer felkereste Venezuelát, ahol a trópusi briológiai kurzus kapcsán sokat gyűjtött, és sikerült a különleges élővilággal rendelkező Roraima hegyet megmásznia és az elmúlt télen is tartott egy sikeres trópusibriológia-tanfolyamot Nairobiban.

Az ausztráliai megfigyelések és a löszfalak kutatása vitte közel a kryptobiotikus kéreg tanulmányozásához, mely az egész föld száraz és nedves zónájában napjainkban is jelen van, és a benne élő baktériumok, algák, mohák, gombák és zuzmók a földtörténet kezdetétől szerepet játszottak a szárazföld meghódításában és az oxigén mennyiségének növekedésében a földi légkörben. Ennek új szemléletű felfedezésével újabb kutatási téma perspektívája nyílt meg Pócs professzor előtt, s ezért vállalta, hogy akadémiai székfoglalójában ennek az új irányvonalnak a kutatási lehetőségeiről beszél, mintegy megújítva eddigi kutatásainak szellemiségét és eredményeit. E kéreg tanulmányozása céljából az utóbbi két évben kétszer járt afrikai sivatagi szubtrópusi területen Tunéziában, és igen sok érdekes dolgot figyelt meg és sok újdonságot talált a gyűjtések során.

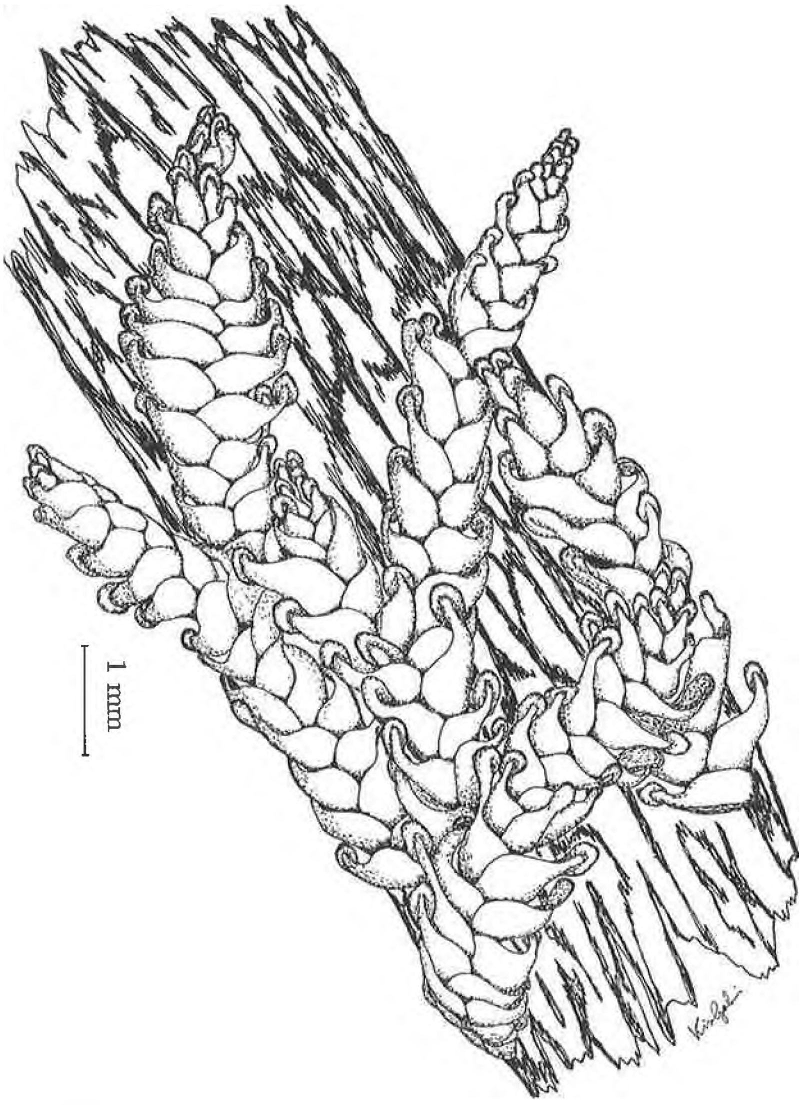
Tudományos publikációinak száma 265, idézettsége 2000 körül van, 20 nemzetközi kongresszuson illetve konferencián tartott előadást. Az általa leírt, tudományra nézve új taxonok száma: 10 virágos növény, 113 moha- és 1 csigafaj. A más specialisták számára gyűjtött anyagából leírtak 12 új virágosnövény-, 65 moha-, 32 zuzmó-, 6 csiga-, 43 rovar- és 118 atkataxont, melyek közül számos faj, valamint a Pocsia Vězda (zuzmó), Pocsiella Bizot (moha), Pocsia Mahunka, Pocsoppia Mahunka (atka) tudományra nézve új nemzetségek az ő nevét viselik. Sok publikációja jelent meg ebben a főiskolai folyóiratban, és ez hozzájárult ahhoz, hogy a nemzetközi elismerést kivívják tudományos közleményeink.

Oktató- és tudományos tevékenysége elismeréseképpen 10 magas kitüntetésben és díjban részesült, melyek közül kiemelkedő a Szent-Györgyi Albert-díj (1996), a Pro Natura Díj (2001) és a Szilárd Leó Professzori Ösztöndíj (2003).

A tudományos közéletben is aktív szerepet vállal, így 7 nemzetközi és 7 hazai tudományos társaságban vannak különböző funkciói. Ezek közül az International Association of Bryologist egyik alapító tagja és egy ideig (1981—87) alelnöke volt. A Magyar Biológiai Társaság elnökeként 1991-től 1994-ig, az MTA Botanikai Bizottság elnökeként 1993-tól 1996-ig működött. A XVI. Nemzetközi Botanikai Kongresszus (1999, St. Louis, USA) egyik tiszteletbeli alelnökévé választotta. Három hazai és két külföldi tudományos folyóirat szerkesztőbizottságának tagja, illetve rovatvezetője. A Pro Renovanda Cultura Hungariae és a Bolyai-ösztöndíj alapítványok biológiai kuratóriumának tagja.

Pócs professzor urat a gondviselés jó egészséggel áldotta meg, ma is elsők között van, amikor egy komoly megpróbáltatást jelentő trópusi hegyre fel kell jutni. Szellemi erejét a folyamatos kutatómunka tartja jó kondícióban. Szeretetre méltó kolléga, barát, segítőkész ember, szívós munkatárs, elismert kutató, okos tanácsadó, kellemes társasági ember. Teljes „Ember" a maga valóságában. Azt kívánom neki magam és a hozzá közel álló kollektíva nevében, hogy még sokáig élvezhessük ezeket a kiváló emberi tulajdonságait, és ehhez kívánunk további jó egészséget 70. születésnapján.

Tamás és Sanyi



Colura saroltae **Pócs**, 1987. J. Bryol. 14: 497
Tanzania, Kilimanjaro Mts.
Coll.: T. Pócs, E. Fráter, G. Kósa 87173/K (EGR)

Acta Acad. Paed. Agriensis, Sectio Biologiae **XXIV** *(2003) 19–21*

Malakológiai útravaló Pócs Tamástól

Varga A.
Mátra Múzeum, Gyöngyös

Rendkívül érdekes a sors, és talán a véletlen, ami meghatározhatja valakinek az életútját, munkásságának alakulását. Pócs Tamással való ismeretségem közel negyven évre nyúlik vissza. Néhány kiragadott epizóddal, nagyon is szubjektíven, szeretném felvillantani ezt a négy évtizedet. Ezek az aprócska események talán megférnek szerényen meghúzódva a nagy dolgok mellett. Én úgy érzem, számomra mégis sokat jelentettek, és nagyban hatottak életpályám alakulására, amiért mindig nagyon hálás leszek. Gyakran a felidézett történetek egyes szám első személyben mesélődnek, de minden esetben Pócs Tamás értékes és hasznos útravalóival zárulnak, amire ha sikerült ráéreznünk és megfogadnunk, életünk során csak a hasznunkra válhatott.

Pontosan a hónapra és a napra már nem emlékszem, de 1963-ban történt — negyedikes gimnazista voltam —, amikor az egyik napilap hírrovatában az alábbiakat olvastam: Dr. Pócs Tamás tudományos kutató hazatért vietnami gyűjtőútjáról. Több ezer herbáriumi tétellel, sok ezer rovarral és csigával gyarapította a Természettudományi Múzeum gyűjteményét. Ez az aprócska híradás ma is ott lapul valahol régi papírjaim, jegyzeteim között. 1964-ben, amikor az Egri Tanárképző Főiskola nappali tagozatára felvételiztem, a Növénytani Tanszék egyik ajtaján megpillantottam: Dr. Pócs Tamás, tanszékvezető. Többször elsétáltam az ajtó előtt, hátha megláthatom a kutatót, aki megjárta a trópusokat, és ott gyűjthetett. Ezek a legkorábbi emlékeim, akkor még nem is mertem gondolni, mennyi segítséget fogok kapni tőle az elkövetkező évek során.

Mint vidéki gimnazistát, minden érdekelt, ami az élő vagy az élettelen természettel kapcsolatos. Kőzeteken, ásványokon és fosszíliákon kívül rovarokat és csigaházakat gyűjtöttem. A főiskolai évek mintegy vízválasztóként a puhatestűek vizsgálata felé irányították figyelmemet. Az az érdekes, talán én lehettem az egyetlen hallgató, aki a növénytani tanszéken zoológiával foglalkozhatott. Itt figyelt fel az érdeklődési területemre Pócs Tamás. Elmondta, Ő is tanulmányozta korábban a csigákat. Néhány nap múlva már kezemben tarthattam megjelent dolgozatait (Agócsy, P. & Pócs, T. (1960): Data to the Mollusk fauna of Hungary. Annls Hist.-Nat. Mus. Natn. Hung. 52: 437—

445.; Agócsy, P. & Pócs, T. (1961): *Alopia soosiana* n. sp. (Mollusca, Gastropoda). Annls Hist.-Nat. Mus. Natn. Hung. 53: 533—536.; Pócs, T. & Károlyi, Á. (1961): The occurence of the *Helicigona* (*Campylea*) *illyrica* Stabile in Hungary (Mollusca, Gastropoda). Annls Hist.-Nat. Mus. Natn. Hung. 53: 531—532.).

Ezt követően felgyorsultak az események. Egy-két mondatos információi mindig valami újra irányították figyelmemet. Egy alkalommal említette: Szarvaskő É-i oldalán, a Saxifraga aizonos sziklagyepeiben egy ritka orsócsigát, *Balea perversa*-t gyűjtött. Útmutatásai alapján tizennégyszer kerestem fel és vizsgáltam át minden lehetséges pontot. Az utolsó alkalom meghozta az eredményt: végre megtaláltam a faj egy népes populációját a csúcsi rész D-i oldalán. Megtanított a kitartó és az odafigyelő gyűjtés metodikájára.

Hatalmas ismeretanyagával a legváratlanabb helyzetekben is meg tudta diákjait lepni. 1966-ban a Mecsekben voltunk terepgyakorlaton. A Jakabhegyen egy nagytermetű fekete-sárga színezetű szitakötőt fogtam. Tamás ezt meglátva azonnal elmondta róla a legfontosabbakat: ez egy *Cordulegaster* faj, ami elég ritka Magyarországon. (Évekkel később tudtam meg, szitakötőkkel is foglalkozott.)

Élénken emlékszem a következő esetre. Ez egy másik terepgyakorlaton történt, az Alacsony Tátrának azon a részén, ahol az őskőzet és a mészkő találkozik. Megálltunk egy rövid ebédszünetre. Az étel elfogyasztása után nekem megmaradt a kenyér sarka, amit szépen egy szikla mellé letettem, milyen jó lesz a rovaroknak. Indulás előtt Tamás végignézte a területet, meglátta és felvette a kenyeret, megállított minket, majd így szólt: tanuljuk meg, a hegyek között soha ne dobjuk el az ételt, mert nem tudhatjuk nem kerülünk-e olyan helyzetbe, hogy szükség lehet rá. Több mint harminc év telt el, de akkor ezt a leckét jól megtanultam, és mind a mai napig meg is tartottam.

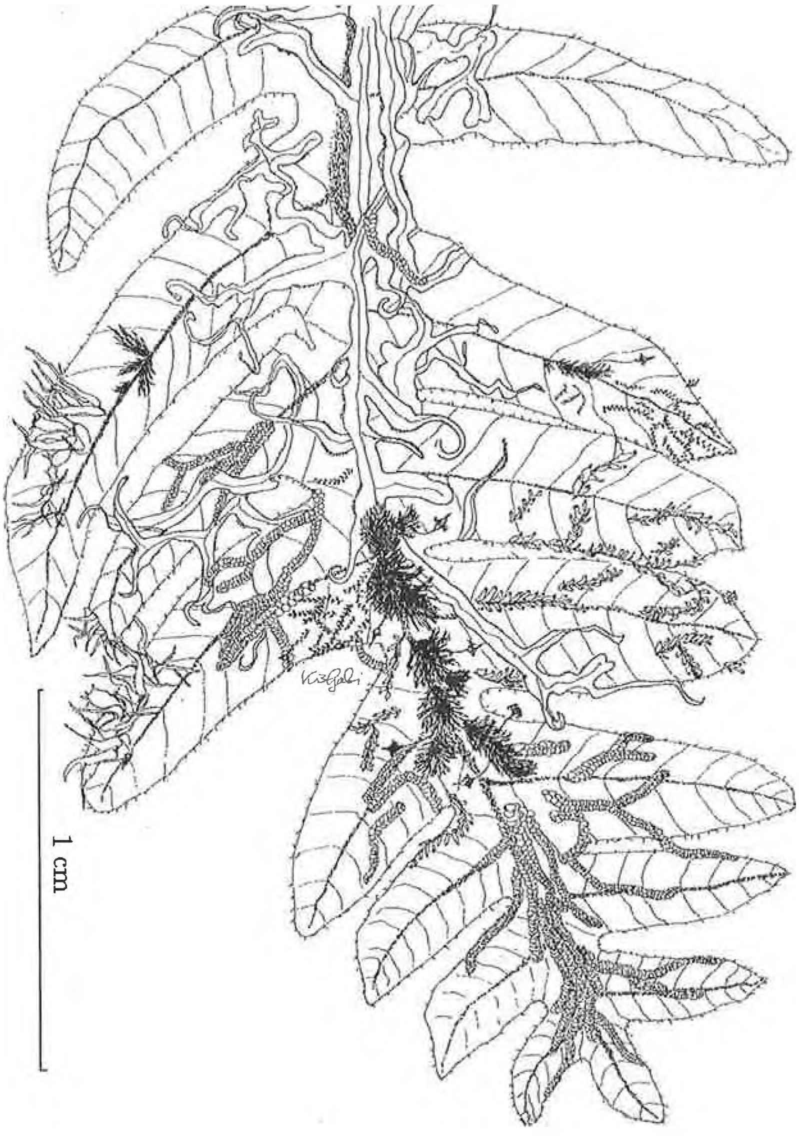
Mint diákok egy alkalommal segédkeztünk irodájának átrendezésében. A munka befejezése után megkínált minket egy különlegességgel, vietnami zöld teával, amit 1963-as útjáról hozott haza. Ez 1965 körül lehetett. Elmondta, ez egy nem mindennapi ital, amit Vietnamban keserűen fogyasztanak. Kóstolgatva szorongattuk a poharat. Valami miatt el kellett hagynia a szobát. Cimmer Sarolta (évek múlva a felesége) volt közöttünk a legbátrabb: ez olyan erős és keserű, nem lehet meginni felkiáltással a maradékot kiöntötte. Mi azonnal, nagy egyetértéssel, követtük a példáját. Amikor visszajött az irodájába, finom volt, mondogattuk. Hosszú időnek kellett eltelnie, hogy most az igazságra fény derülhessen.

Hogy lettem „csigász”, hogyan ismerkedtem meg a MTM kutatóival, ezt is Tamásnak köszönhetem. Ő a korábbi években együtt dolgozott dr. Agócsy Pállal, a malakológiai gyűjtemény vezetőjével, s megbeszélte vele, vegyen a védőszárnyai alá. Így indult az ismeretségem az állattári kutatókkal, s ha nem is közvetlenül, de Tamás segített hozzá, hogy megismerkedjek Pintér Lászlóval, Közép-Európa egyik legnagyobb nevű malakológusával, akivel így egy életre szóló baráti és szakmai kapcsolatba kerülhettem.

Hogyan történt a tanár-diák viszony átalakulása. 1968 nyarán találkozót beszéltünk meg Brassóban, a Fekete templom mellett, déli 12 órára. Szekeres Miklós barátommal mi a Bucsecsből jöttünk, ahol a Déli-Kárpátok endemikus csigái, az Alopiák után kutattunk. Tamás elővett egy kis üveg italt: „most már kollegák lettünk", és felajánlotta, tegezzük. Még aznap elindultunk a Fogarasi-havasok felé, ahol néhány nap múlva addigi életem legnagyobb kalandja esett meg velem. Javaslatára a Bilea menedékházhoz egy kevéssé járt úton, a Kis-Árpás-völgyön keresztül kívántunk feljutni. Útközben buzgón kerestünk egy apró termetű mohát, ami kicsiny talajüregekben él, és fluoreszkál. Este a szállásunkon Tamás kiemelte, a nap legnagyobb eredménye ennek a mohának a megtalálása volt. Mint megtaláló, büszke voltam magamra, pedig rám illhetett a közmondás: „vaktyúk is talál szemet". A rossz időjárás miatt utunkat meg kellett szakítani, egy elhagyott erdészlakban húztuk meg magunkat. Kétnapos eső után végre délután neki tudtunk vágni a gerinc megmászásának. Minden könnyen és simán ment, de közvetlenül a Negoj csúcsa előtt egy függőlegesnek tűnő, omladozó falon kellett felmásznunk. Tamás ment előre mindenféle sziklamászó kellék nélkül, nagy küszködéssel és még nagyobb félelemmel mi is feljutottunk neki köszönhetően a sziklafalon. Közben az egyik hátizsák minden tartalmával lezuhant, és eltűnt a szemünk elől. Mire elértük a Negoj csúcsát ránk esteledett. Egy szikla takarásában húzódtunk meg, tanácsára hajnalig ébresztgettük egymást, nehogy valaki elaludjon, mert bizony nagyon hideg volt. Itt tanultam meg: vészhelyzetben ismerhetjük meg igazán egymást, és természetesen saját magunkat is.

Eddig tartottak a tágabb értelemben vett diákéveim emlékképei. Később, amikor egy-egy külföldi útjáról hazatért, mindig hozott magával csigákat. Ezek között voltak érdekességek, ritkaságok, és elég gyakran a tudományra nézve új fajok is. Ezek közül néhány — nagyrabecsülésünk jeléül — az ő nevét viseli: *Phaedusa pocsi*: Szekeres 1969, *Dioryx pocsi*: Varga 1972, *Maizania* (*Maizania*) *pocsi*: Varga 1976.

Kedves Tamás, a távoli emléknyomok útravalóinak felidézése után fogadj el tőlem egy apró ajándékot, amit 70. születésnapodra szeretnék átnyújtani: egy új csigafaj Vietnamból, az *Elma pocsi* n. sp.



Epiphyllous bryophytes
Réunion
Coll.: G. Kis 9618 (EGR)

Acta Acad. Paed. Agriensis, Sectio Biologiae **XXIV** *(2003) 23–28*

First Record of the Tropical Asian-Pacific Genus Powellia (Racopilaceae, Bryopsida) for the East African Islands: P. pócsii Zanten spec. nov. and P. elliptica (Ren.) Zanten comb. nov.

Zanten, B. O. van
Department of Plant Biology, University of Groningen
Kerklaan 30, NL 9751 NN, Haren, Netherlands
`bovzanten@wish.net`

Abstract. *Powellia pócsii* Zanten is described from Madagascar and *Racopilum ellipticum* Ren., also from Madagascar, is transferred to the genus *Powellia* as *P. elliptica* (Ren.) Zanten. A discussion on their origin is presented.

Introduction

The family of the *Racopilaceae* is characterized by its dorsi-ventrally flattened, dimorphous leaves and its abundant rhizoid growth from the abaxial side of leaf insertion on ventral side of the stems. The dorsal leaves are usually smaller than the lateral leaves and differently shaped.

There are two genera, *viz.*: *Racopilum* P. Beauv. and *Powellia* Mitt. The genus *Racopilum* is widely distributed in the tropics and temperate regions of the Southern Hemisphere and comprises ca. 35 species, which number will almost certainly be reduced when studied monographically, especial the African taxa. The genus *Powellia* was up till the present paper restricted to the southern Pacific, North Queensland and the Malesian region and comprises 6 species (including the two Madagascan species).

The most important differences between the two genera are in the sporophyte. *Powellia* has an erect, not furrowed capsule when dry and a papillose exostome that may be striate at base only and the endostome lacks cilia. The leaves are unbordered or bordered by elongate cells. The leaf rib is excurrent or ending in or below apex. *Racopilum* has usually an inclined, furrowed capsule, striate exostome and a normally well-developed endostome. The leaf rib is nearly always excurrent. The species of *Powellia* are usually smaller than those of *Racopilum* and the lateral leaves are undulate, at least at their base, which is not the case in *Racopilum*. For further differences see Zanten (1970).

Acknowledgements: I thank the curator of herb. P for the loan of the type of *Racopilum ellipticum* and the curator of herb. MO for the loan of

several unidentified species of *Racopilum* from the Malagasy Region which turned out to belong to *Powellia.*

Powellia pócsii Zanten spec. nov. Fig.1 A,B

Latin description. Planta gracilis, caespites eius densi, laete virides, caulibus repentibus, irregulariter pinnatim ramosis, ventraliter dense tomentosis, foliis lateralibus late ovato-ellipticis, obtusis, leviter undulatis, marginibus integris, in aristam brevissimam, 40 μm longam productis, cellulis laminalibus hexagonis, 10–14 μm longis et 6–10 μm latis, parietibus orassiusculis, (sub)lavibus. Folia stipulaeformia late ovata, apice acuminata, basi cordata, integerrima, costa in aristam brevem (60–80 μm longam) producta.

Seta 9–10 mm longa. Theca erecta, elongata-elliptica sine operculo 1.5 mm longa, sicca non plicata. Peristomium duplex: dentes exostomii cca. 420 μm longi, lineari-lanceolsalis endostomii membranacea cca. 100–120 μm alta, processis 120 μm longis, sine ciliis. Operculum leviter oblique rostratum, rostro 0.5 mm longo. Sporae minute papillosae. Calyptra non vidi.

Slender plants in dense, green mats; stems creeping, irregularly pinnately branched, ventrally densely tomentose. Lateral leaves ovate-elliptic, 0.8–1.0 mm long, somewhat undulate when dry, rib excurrent in a short point of ca. 40 μm length, margins entire, lamina cells hexagonal, 10–14 μm long and 6–10 μm wide, firm-walled, smooth or nearly so. Dorsal leaves (without arista) smaller, 0.4–0.5 mm long, broadly ovate, acuminate with cordate base, entire, rib excurrent in a mucro of 60–80 μm length.

Perichaetial leaves ovate, gradually acuminate, hardly narrowed at base, entire, rib excurrent in a short mucro, areolation lax. Seta 9–10 mm long, brownish, turned clock-wise in upper part and anti-clockwise further down. Capsule erect, elongate elliptic, ca. 1.5 mm long, without furrows when dry, exothecium cells irregularly quadrate-hexagonal, ca. 50 μm long and 20–30 μm wide, walls slightly incrassate. Annulus consisting of one row of separating cells. Lid with a slightly oblique or nearly straight, ca. 0.5 mm long rostrum. Peristome double, exostome teeth pale, ca. 420 μm long and 30 μm wide at base, with indistinct median line, papillose, at base striate-papillose, endostome on a ca 100–120 μm high papillose basal membrane, processes ca. 120 μm long, papillose, perforated, irregular, cilia absent. Spores 14–16 μm, minutely papillose.

Madagascar, route de Farafangana, Vangarindrano, foret de basse altitude, sur tronc, J. Bosser 17.769, 12-1963, holotype: MO, iso: GRO; Madagascar, Toliara, 25 m, epiphytic, G. McPherson et al.14150F, 17-10-1989: MO; ibid. 14150D, on stump: MO; ibid. 14228A, 20 m, on trunk: GRO, MO; Mauritius, Robillard 2580, 1881: GRO, MO.

This species is vegetatively very near to *Racopilum ellipticum* Ren., a Madagascan species, described by Renauld (1898) which is transferred to the genus *Powellia* in this paper. Both species share the small size, the broadly ovate, cordate dorsal leaves, and the somewhat undulate lateral leaves. The excurrent part of the nerve of the lateral and dorsal leaves, however, is much shorter in *P. pócsii* (40 μm in lateral and 60–80 μm in dorsal leaves) than in *P. elliptica* (200 μm in lateral and 160–280 μm in dorsal leaves). The areolation tends to be slightly more irregular in *P. pócsii* and the lamina cells are somewhat smaller (10–14 μm in its longest diam.) than in *P. elliptica* (13–15 μm). The sporophytes of the two species could not be compared because that of *P. elliptica* is unknown.

The specimen from Mauritius deviates by the presence of flagelliferous branches with small, caducous leaves. This may be an independent taxon, but for the time being I prefer to treat this specimen as belonging to *P. pócsii*. Similar flagelliferous branches do occur also in *Powellia parvula* from New Guinea. In the genus *Racopilum* flagelliferous branches are quite common in *R. tomentosum* and *R. intermedium*, both American species and, but more rarely, also in *R. cuspidigerum* from tropical Asia, Pacific region and Australia.

The species is dedicated to Tamás Pócs because of his many important contributions to the bryophyte flora of East Africa and the East African Islands.

Phytogeographical discussion

The occurrence of two members of the genus *Powellia* (*P. pócsii* and *P. elliptica*) in the East African Islands is a remarkable range extension of this genus that was, up to the present paper, restricted to the southern Pacific, northern Queensland and the Malesian region, westwards up to Sumatra and the Malay Peninsula. I consider New Guinea as being the evolution centre of the genus because all 4 Asian-Pacific species (of which two are endemic) do occur there. The range extension of this genus to the East African Islands is by no means an isolated phenomenon. Pócs (1976 and 1992) enumerates 14 Malesian-Pacific species (mosses as well as liverworts) that penetrate into Madagascar, but not further into continental Africa. Of the 114 epiphyllous bryophytes known from Madagascar 6 are tropical Asian in distribution and do not penetrate further into continental Africa (Pócs 1997). Pócs et al. (2002) report 5 bryophyte species (out of 167) from the Réserve Spéciale de Manongarivo, Madagascar with a tropical Asian distribution reaching Africa only in the Malagasy Region. O'Shea (2003) mentions another Malesian moss (*Clastobryophylum bogoricum*) penetrating, via Sri Lanka, into Madagascar and Seychelles.

As to the origin of the two African *Powellia* species there are in my view two options:

1. The genus *Powellia* is of Gondwanian origin and its ancient stock (probably a *Racopilum cuspidigerum*-like species) could, after the break-up of the continent, evolve in tropical Africa into *P. pócsii* and *P. elliptica* and in tropical Asia-Oceania into the 4 other species of the genus. In this case we have to assume that the genus is biphyletic and did not survive in America, continental Africa and Australia and New Zealand. The occurrence of *P. integrum* and *P. involutifolia* in northern Queensland may be the result of later introductions.

2. The genus evolved in the eastern part of the Malesian region (probably New Guinea) and one of the species reached in ancient times, via long-range wind dispersal, the East African Islands and evolved there into *P. pócsii* and *P. elliptica.* During the Jurassic or early Cretaceous there existed probably a subcontinent close to the North and East of Madagascar (see Pócs 1997) of which the Comores, Mascarenes and Seychelles are the remnants. In this view it is interesting to note that in Mauritius (Mascarenes) an aberrant flagelliferous form of *P. pócsii* occurs which may be the result of an independent evolution after the submerging of most of the subcontinent.

The characteristics in which *Powellia* deviate from *Racopilum* are probably derived. During the supposed evolution the sporophytes became upright and smooth going along with a reduction of the peristome. This phenomenon is also known in other genera, e.g. in the *Racopilum cuspidigerum*-complex (Koponen & Norris 1986). In the gametophyte the excurrent part of the nerve became shorter during evolution.

Personally I favour the second option.

Powellia elliptica (Ren.) Zanten comb. nov. Fig.1 C

Basionym: *Racopilum ellipticum* Ren. — Prodr. Fl. Bryol. Madag.: 268 (1898).

Type: Madagascar, entre Fianarantsoa et Mananjary, Besson 1880; holo: P-Card.

Although the sporophyte of this species is unknown I came to the conclusion that it most likely belongs to the genus *Powellia* because of its small size, somewhat undulate leaves and, most important, its resemblance to *P. pócsii* Zanten, the new species which certainly is a *Powellia* because of its erect, smooth capsule, papillose exostome and reduced endostome.

Distribution: Endemic to Madagascar, only known from the type collection.

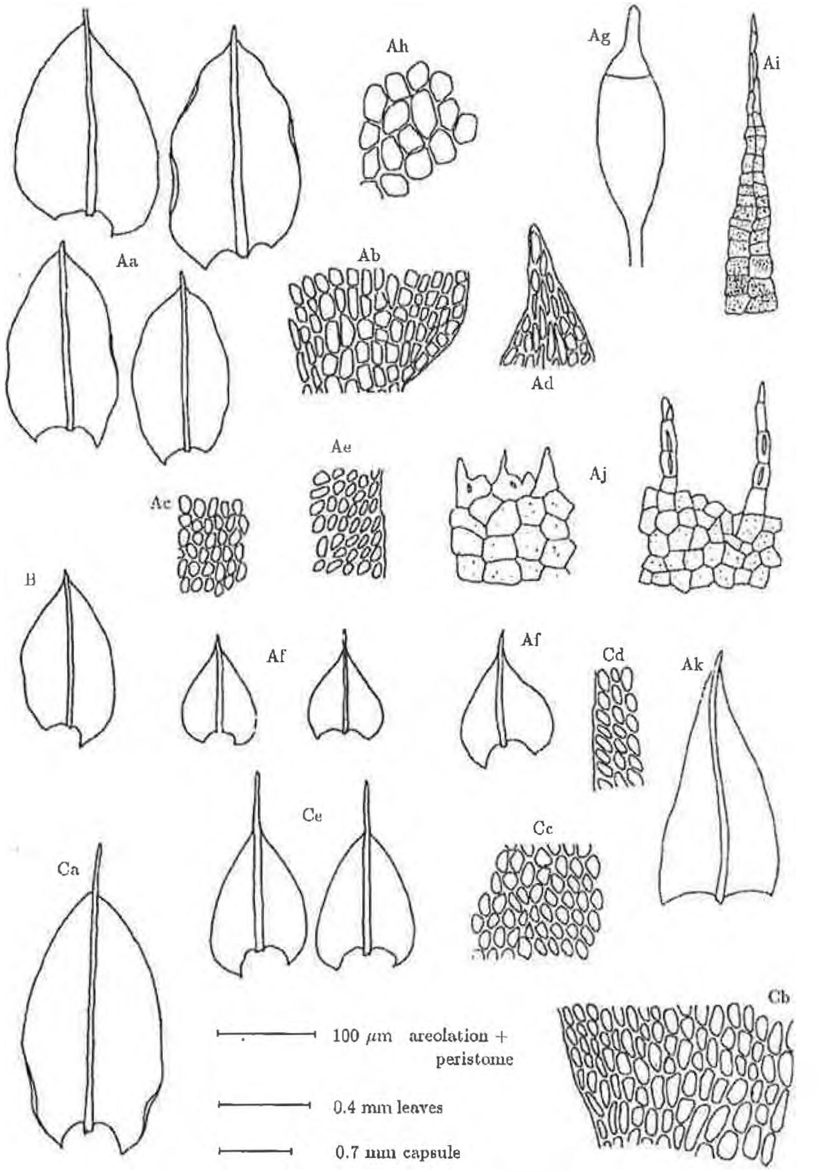


Fig.1 *Powellia pócsii* Zanten spec. nov.

(A) *Powellia pócsii* (from type), (Aa) lateral leaves, (Ab) basal leaf cells, (Ac) areolation in midleaf, (Ad) leaf apex, (Ae) leaf margin near apex, (Af) dorsal leaves, (Ag) capsule, (Ah) exothecial cells, (Ai) exostome tooth, (Aj) endostome, (Ak) perichaetial leaf. **(B)** *Powellia pócsii* (from Robillard 2580), leaf of flagelliferous branch. **(C)** *Powellia elliptica* (from type), (Ca) lateral leaf, (Cb) basal leaf cells, (Cc) areolation in midleaf, (Cd) leaf margin near apex, (Ce) dorsal leaves.

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Notes on Philonotis (Musci, Bartramiaceae), 5. P. caespitosa and P. falcata in South Africa, and Status of P. afrocapillaris

Koponen, T.
Finnish–Chinese Botanical Foundation
Mailantie 109, FIN-08800 Kirkniemi, Finland
`timo.koponen@helsinki.fi`

Abstract. *Philonotis caespitosa* Wils. ex Milde is recorded for the first time for Africa. *P. caespitosa* of the section *Philonotis* was previously known as a holarctic circumpolar species. *P. afro-capillaris* Dix. ex Sim is synonymized with *P. comosa* (Broth.) Griffin & W. R. Buck. These taxa are illustrated and their taxonomy and nomenclature discussed. A revised key to South African *Philonotis* is provided, and the distribution of *P. falcata* (W. J. Hook.) Mitt. is mapped.

Introduction

To complete study of the distribution of *Philonotis falcata* (Hook.) Mitt. (Koponen 1996a), the African specimens so named in the Botanical Museum of the University of Helsinki (H) underwent revision. The collections contained correctly identified specimens, but also included specimens of two other species of *Philonotis*. One of these is *P. caespitosa* Milde, but the other species remained unidentified.

This study continues the revision of *Philonotis* which began by study of southeast Asiatic and Pacific species of *Philonotis* Brid. (Koponen & Norris 1996, Koponen1998, Koponen & Virtanen 1998, Virtanen & Koponen 1998, Koponen 1999).

Revised key to *Philonotis* in South Africa

This key is based on Magill's (1987) keys of South African *Bartramidula* and *Philonotis*, to which some sectional characters are added (see Koponen 1996a, 1996b).

1. Leaves bordered by 4–8 rows of narrow, elongated, incrassate cells; leaf cells smooth .... *P. vagans*

1. Leaves unbordered, or indistinctly bordered by rectangular cells; leaf cells papillate, mamillate or prorate .... **2.**

2. Leaf cell papilla central on cell; plants with glaucois bloom .... **3.** *P. scabrifolia*

2. Leaf cell papilla distal or proximal on cell; plants yellowish green to brownish .... **3.**

3. Leaf cell mammilla or papilla at proximal cell end; proximal leaf border crenulate or double-crenulate (perpendicular crenulae formed by two adjoining border cells), teeth only on distal leaf directed towards apex .... **3.** *P. caespitosa*

3. Leaf cell mammilla or papilla at distal cell end, or on both cell ends; leaf border serrulate-serrate by projecting cell corners directed towards apex .... **4.**

4. Leaf cells mammillose or papillose at distal cell end .... **5.**

4. In basal areolation, mammilla at proximal cell end and in distal areolation at distal cell end .... **8.**

5. Leaves falcate and keeled, distinctly in 5 rows .... *P. falcata*

5. Leaves straight, not in rows .... **6.**

6. Both leaf borders recurved to revolute; leaf cells distinctly papillose .... **3.** *P. africana*

6. Leaf borders plane or slightly recurved; leaf cells smooth or slightly mammillose or prorate .... **7.**

7. Leaf cells + lax, rectangular to oblong-hexagonal; costa generally ending below apex .... *P. hastata*

7. Leaf cells regularly narrow-rectangular, generally incrassate; costa short-excurrent .... *P. dregeana*

8. Leaves narrowly lanceolate; apex acuminate to subulate; perichaetial leaves strongly differentiated, long-linear; capsule wall warty; spore surface warty .... *P. comosa*

8. Leaves narrowly lanceolate to ovate-acuminate, acuminate; perichaetial leaves ovate to short-oblong, acuminate .... *P. globosa*

Philonotis section *Philonotis*

Characteristics of the section *Philonotis* are leaf cells with mammilla or papilla at the proximal cell end or central on the cell; the proximal leaf border crenulate or double-crenulate (perpendicular crenulae formed by two adjoining border cells), and the leaf margin teeth only on the distal leaf directed towards the apex; leaves secund or straight, rarely in five rows.

***Philonotis caespitosa* Wils. ex Milde** (Fig. 1)

Bryol. Silesiaca 241. 1869. — *P. caespitosa* Lorenz, Bryol. Notizb. 90. 1865, *nom. nud.* — *P. fontana* var. *caespitosa* (Milde) Limpr., Krypt. Fl. Schlesien 1: 116. 1875. — *P. fontana subsp. caespitosa* (Milde) Dix., Stud. Handb. Brit. Moss. 294. 1896. — Types (not seen): **Schlesien**. Hasenau vor Obernigk, 30.VIII. 1862 *J. Milde*, in June with fruits; bei Strehlen, *Hilse*. **Mark**. Grünewald, *Solms, Bolle*. **Preussen**. Tilsit, *Heidenreich*. **Baden**. Oberbaden, VI. *Sickenb.*

The African specimens of *Philonotis caespitosa* are rather similar to the plants of the northern hemisphere populations. Most of the specimens represent sterile shoots, which are slender and with erect-spreading distant leaves. The slightly secund leaves are 0.3–0.5 × 0.8–1.3 mm and often maintain their bright green color in dried specimens. The leaves have a plane border and taper gradually from a narrow ovate base to an acuminate apex with excurrent costa. The lamina is rather translucent, since the mamillae or papillae of the cells are not very pronounced, and since the laminal cells are rather wide, 10–15 × 20–45 μm at the basal leaf, and 5–10 × 20–40 μm at the distal leaf. Leaf margin is entire at base, the double crenulate serrations are around mid-leaf, and the margin in the upper third of the leaf is serrate or serrulate. Female plants and sporophytes were not among the material studied, but two specimens (van *Rooy 2991, 3700*) have male stems. The leaves on these are concave, imbricate, and erect, and a little broader and shorter than the leaves from sterile shoots. The perigonial leaves are acute, which resembles the plants from northern populations.

Philonotis caespitosa can be separated from the other South African species of *Philonotis* by the sectional characters, the papillae or mammillae being proximal on laminal cells. The second leaf character, the double crenulate basal leaf, is not as pronounced as in the larger species of the section, such as *P. fontana* (Hedw.) Brid. or *P. seriata* Mitt., but double crenulate teeth were present on every leaf studied. In the earlier bryological literature (Limpricht 1895, Loeske 1905, Rancken 1914, Brotherus 1923, Jensen 1939) the character double crenulate or “double mammillate” leaf margin served as a diagnostic character of the species related to *Philonotis fontana*, but later this character was forgotten. In the species of the other sections, the basal leaf is entire or crenulate to serrulate. The other species of the section *Philonotis* recorded for northern and central Africa are *P. fontana* and *P. tomentella* Mol. (O’Shea 1995).

Descriptions and illustrations: Rancken 1914: 21 (fig. 2); Brotherus 1923: 358 (fig. 63: C–D); Lawton 1971: pl. 115 (figs. 10, 11); Andersen et al. 1976: 225 (fig. 74.5); Smith 1978: 460 (fig. 222: 14–17); Crum & Anderson 1981: 655 (fig. 311: A–C, as Philonotis fontana var. caespitosa); Nyholm 1998: 262 (fig. 221).

In "Index Muscorum" (Wijk et al. 1967), the authority of *Philonotis caespitosa* is credited to Jur. *Verh. Zool. Bot. Ges. Wien* 11: 234. 1862. In that volume, *P. caespitosa* is not mentioned at all, and much later in Juratzka's posthumous flora (1882) it was dealt with at the varietal level.

According to many authors such as Jaeger (1876–1879) and Paris (1894–1898), the name is based on W. Wilson's label name in "Musc. brit. No. 287," which I have not seen, or on "*Bartr. caespitosa* Wils. Ms" (Juratzka 1882, Crum & Anderson 1981). Therefore, before the times of the present Code, the name was credited to Wilson, but Milde was mentioned in the nomenclature by such authors as Jaeger & Sauerbeck (1876–1879), Limpricht (1895), Jensen (1939), Brotherus (1923), and Podpěra (1954). The mistake in "Index Muscorum" was later copied by many recent floras ands checklists, the one exception being Smith's (1978) flora. It may be added that W. Wilson's specimen "Musc. brit. No. 287" does not belong to the syntypes of *P. caespitosa*, since Milde (1869) did not cite it in the protologue.

South African specimens studied:

Cape. Witteberg Mountains, Jouberts Pass, 8 km E of Lady Grey, alpine heath grassland. on soil over basalt, 1,950 m, *van Rooy 2698*; 9 km on Jouberts Pass turnoff from Barkley East–Lady Grey road, wooded rock outcrops on the farm Clobert, alpine heath grassland, on mud over rock, 1,850 m, 1986 *van Rooy 2788* (H). **Lesotho.** Sani River banks 7 km from Sani Top along road to Mokhotlong, alpine heath grassland, in bog, 2,775 m, 1987 *van Rooy 3460* (H). Sani Flats, 2 km from Border Post Mokhotlong, disturbed alpine heath grassland, on soil of river bank, among grass, 2,850 m, *van Rooy 3700* (H); 3 km from Oxbow Lodge to Butha Buthe, alpine heath grassland, in basalt crevice, 2,550 m, 1987 *van Rooy 2867* (H), in bog, 2,550 m, *van Rooy 2842* (H); Mahlasela Hill (West), 10 km from New Oxbow Lodge to Mokhotlong, basalt outcrops, alpine heath grassland, on wet soil in open, 3,100 m, 1987 *van Rooy 2991* (H); Sani Top, along Upper Sani Valley, N of Border Post, alpine heath grassland, in rock overhang, 2,860 m, 1987 *van Rooy 3528* (H). **Natal.** Natal Drakensberg, Sani Top, along basalt cliffs below escarpment, east of Border Post, alpine heath grassland, on wet rock, 2,800 m, 1987 *van Rooy 3653* (H), along escarpment SE of Border Post, alpine heath grassland, on rock ledge in gully, 2,900 m, 1987 *van Rooy 3602* (H), on rock, under water drip, *van Rooy 3583* (H).

Philonotis section *Philonotula* (B. S. G.) A. Jaeger

Plants small to medium-sized, inhabiting moist to mesic habitats in temperate to tropical areas. Proximal leaf border entire, crenulate or serrulate; all leaf cells often narrow and mammillose or papillose to the leaf base; single papilla or more pronounced mammilla/papilla at the distal end of the leaf cell.The capsule horizontal or inclined, ellipsoid or gibboid; peristome complete.

Philonotis falcata (W. J. Hook.) Mitt.

J. Linn. Soc. Bot. Suppl. 1: 62. 1859. — *Bartramia falcata* W. J. Hooker, Trans. Linn. Soc. London 9: 317. 27 f. 4. 1808. — *P. fontana* var. *falcata* (W. J. Hook.) Brid., Bryol. Univ. 2: 21. 1827. — Type: Nepal, coll. Dr. *Buchanan* (Herb. Hooker, Dr. Smith 1808. No. H/2359, ex herb. Kew, BM, holotype!; ex herb. Dawson Turner, ex herb. Hook., BM, isotype!).

Bartramia afrofontana Müll. Hal., Hedwigia 38: 93. 1899. — *Philonotis afrofontana* (Müll. Hal.) Paris, Ind. Bryol. Suppl. 264, 1900. — Synonymized by Magill (1987).

Philonotis falcata was known as *P. afrofontana* from South Africa (Brotherus 1924, Sim 1926), Malawi (Bartram 1953) and Zambia (Phiri & Ochyra 1985), until Magill (1987) discovered the synonymy. Since then it has been recorded for Zimbabwe (Best 1990) and Rwanda and Zaire (Ochyra 1993). Hodgetts et al. (1999) found it to be locally quite common in Lesotho.

Philonotis falcata can be separated from other South African *Philonotis* by the keeled leaves in five rows. This is best seen in the innovation leaves. The microscopic characters are the entire leaf base margin and the basal leaf cells which are regularly rectangular and twice as broad as the distal leaf cells. The basal leaf lamina thus looks more translucent or paler than the basal leaf of species such as *P. africana*, which has much denser areolation.

The African specimens of *Philonotis falcata* studied so far do not differ from the Asiatic plants. The variation in the African population, however, is not as wide as in the Asiatic ones. The leaf shape of African plants is always similar, from an ovate base tapering to a short acute apex with costa ending at the apex (var. *carinata* (Mitt.) Ochi, 1962), while plants with long acuminate leaf apexes with excurrent costa are common in Asiatic plants (*var. falcata*).

Descriptions and illustrations: Brotherus 1924: 466 (fig. 408); Bartram 1939: Pl. 12 (fig. 204); Ochi 1962: PL 4 (as *P. falcata* var. *falcata*), PL 5 (as *P. falcata* var. *carinata*); Gangulee 1974: 1111 (Fig. 539); Noguchi 1989:

569 (fig. 252); Magill 1987: 428 (fig. 123: 6-9); Koponen 1996a: 115, (fig. 1); Kürschner & Ochyra 1999: 272, (fig. 2).

South African specimens studied:

South Africa. Rydal Mt., *H. A. Wager 86* (H-BR); Orange River Colony, 1908 *G. Bailrie 143* H-BR). **Cape.** Cap de Bonne Esperance, *Mac Owen* (H-BR, ex herb. J. Cardot); 9 km on Jouberts Pass turnoff from Barkly East–Lady Grey road, wooded rock outcrops on the farm Clobert, alpine heath grassland, 1,850 m, 1986 *van Rooy 2780* (H), 8 km east of Lady Grey, alpine grassland, on soil over basalt, 1,950 m, 1986 *van Rooy 2698* (H). **Lesotho.** Sehlabathebe National Park, hills around sandstone outcrops just E of Lodge, moist grassland, on rock, 7,900 ft., 1977 *Magill 4341* (H); Sengu River crossing, between Mokhotlong and Tlokoeng, along river banks and small box canyon, on soil over rock, 2,050 m, 1987 *van Rooy 3203* (H); Lekokoaneng, sandstone cliffs along road between Maseru and Teyateyaneng, grassland with cultivation, on sandstone, 1,600 m, 1987 *van Rooy 2831* (H); Khubelu River crossing between Tlokoeng and Mapholaneng, cliffs along river banks, grassland with cultivation, on soil among grass, 2,000 m, 1987 *van Rooy 3244* (H); Oxbow Lodge, moist stream bank in heathland, 8,500 ft, 1982 *Deall & Killick 73a* (H). **Natal.** Newcastle, Farm Pietsrust 18 km N of Newcastle, on rocks, 1978 *Fourie 12700* (H); Cathedral Peak Forest Station, Upper Indumeni Forest, *Podocarpus* montane forest, on rock, 1978 *Magill 5692* (H); Natal Drakensberg, Bushmens nek, Ngwangwane River W of Border Post, sandstone outcrops in grassland, water seepage over cliff, 1,650 m, 1984 *van Rooy 1474* (H); Natal Midlands, Mtwalume Falls, 3 km from Highflats on road to Umzinto, on cliffs at top of falls, on wet cliff, 900 m, 1982 *van Rooy 1036* (H). **Orange Free State.** The farm Olievenrand near the Elandsberg between Zastron and Wesselsdale, wooded mountain slopes, on sandstone cliff at waterfall, 1,500 m, 1986 *van Rooy 2452* (H). **Transvaal.** Van Reenen, *H. A. Wager 264* (H-BR); Lydenburg, *1892 F. Wilms 2420* H-BR); Pretoria, Silverton Ridge, 1928 *Kresfelder 1116* (H).

Philonotis section *Bartramidula* (Bruch & Schimper) Mitt.

Plants small; inhabiting ephemeral habitats in temperate to tropical areas; basal leaf cells wide and mammillose; upper leaf cells narrower, papillose. In the basal areolation more pronounced mammilla or papilla at the proximal end of leaf cell, in the distal areolation pronounced mammila or papilla mostly at the distal cell end; capsule erect, globose or ellipsoid; peristome reduced or lacking.

Magill (1987) accepted the genus *Bartramidula* B. S. G., which has been separated from *Philonotis* on the basis of the capsules being mostly erect and globose to elliptic and the reduced peristome, while *Philonotis* has an inclined, gibbose capsule, and the peristome is complete. Griffin & Buck (1989) came to the conclusion that the gametophytes of *Bartramidula* are in all major respects indistinguishable from those of *Philonotis*, and that the patterning of papillosity seen in leaves of *Batramidula* does not represent a major departure from that found in *Philonotis*. Griffin & Buck 1989) also discussed the capsule characters of *Bartramidula* and described the great variety existing, and they synonymized the genera.

On the basis of my studies carried out on *Philonotis*, it seems very likely that *Bartramidula* is polyphyletic, meaning that the erect, globose to elliptic capsule with reduced peristome has evolved several times. However, since I have not yet studied all the species of *Philonotis* and *Bartramidula*, I treat *Bartramidula* at the sectional level as a working hypothesis.

Philonotis comosa (Broth.) Griffin & W. R. Buck (Fig. 1)

Bryologist 92: 376. 1989. — *Bartramidula comosa* Broth., Nat. Pflanzenfam. 1(3): 644. 1904. — *Bartramia comosa* Hampe & Müll. Hal., Bot. Zeit. 17: 221. 1859, *hom. illeg.*, non Mitten, Fl. Tasman. 2: 195. 1859. — Type: South Africa. Cape, Houteniqua, Montagne Pass, *Breutel* (BM, not seen; a probable syntype in H!).

Philonotis afro-capillaris Dix. ex Sim, Bryol. Afr. 309. 1926, syn. nov. — Isotype: Cape. Wilderness, George, IV.1924 *Miss A. Taylor* sub Sim 10153 (PRE).

Descriptions and illustrations: Brotherus 1924: 459 (fig. 402: H–Q, as *Bartramidula comosa*); Sim 1926: 304 (as *Bartramidula comosa*), 310 (as *Philonotis afrocapillaris*); Magill 1987 (fig. 121: 1–14, as *Bartramidula comosa*).

Sim (1926) described *Philonotis afrocapillaris* based on a single specimen. H. N. Dixon had confirmed the new species: "I know nothing like it, except some forms of our European *P. capillaris*." Magill (1987) studied the type and described it as "an unusual specimen with narrowly lanceolate leaves." He synonymized it with *P. dregeana* (Müll. Hal.) A. Jaeger, thinking that "the elongated stems and distant leaves indicate environmentally induced modification of this specimen". The discovery of one differing specimen among the specimens named as *P. falcata*, and Sim's (1926) illustration of *P. afrocapillaris* leads me to think that it might provide the name for the specimen that I was unable to identify. The type of *P. afrocapillaris*, however, showed to be *P. comosa*.

Two South African species of the *Philonotis* section *Bartramidula*, *Philonotis comosa* and *P. globosa* (Müll. Hal.) Griffin & W. R. Buck, can be distinguished on the basis of the characters in the key. Magill (1987) found that the sterile specimens of *P. globosa* are practically indistinguishable from *P. dregeana*. However, the difference in the mammilosity of basal leaf areolation separates these species.

Discussion

Pócs (1976, 1992) has paid special attention to the correlation between tropical African and Asian bryofloras, excluding pantropical taxa occurring also in South America. Pócs (1992) recorded a total of 178 bryophytes, 70 liverworts, and 108 mosses that have an Afro-Asian bicontinental distribution area. He grouped this set of species into distribution pattern types on the basis of the distribution of the species in tropical Africa, Asia, and Australasia. He recognized 31 distribution patterns. The bryophytes which are widely distributed in Africa and Asia, a total of 32 species, make up the most common pattern group. Pócs (1992) included *Philonotis falcata* in the distribution pattern group of species widely distributed in Asia, but in Africa limited to South Africa. Only four other species showed this distribution pattern. The recent finds of *P. falcata* enlarge its African range (Fig. 2). Accordingly, its total range more closely resembles the ranges of 17 other species, such as *Plagiochasma appendiculatum* Lehm. & Lindenb., *Enthostodon wichurae* M. Fleisch., *Fissidens atroviridis* Besch., and *Garckea comosa* (Dozy & Molk.) Wijk & Marg., which Pócs (1992) included within the distribution pattern group of species widely distributed in Asia, but in Africa restricted to East Africa. However, since a modern world monograph of *Philonotis* awaits its compiler, I only can predict that some other Afro-Asian bicontinental taxa may be hiding within the numerous species of *Philonotis* described from tropical Africa. For instance, a preliminary comparison of Asian *P. thwaitesii* Mitt. and *P. africana* (Müll. Hal.) Paris showed them to be closely related, if not identical.

Philonotis caespitosa has been variously accepted. The best specialists on European *Philonotis*, G. Dismier (1856–1942) and L. Loeske (1865–1935), did not hesitate in giving it species status (Loeske 1905, 1906, Dismier 1908). It is worthwhile is to note that Loeske's (1905) problem was not to separate *P. caespitosa* from *P. fontana* and its relatives, but from *P. marchica* (Hedw.) Brid., which belongs to a different section of *Philonotis*, section *Philonotula*. In Europe, the recent floras accept *P. caespitosa* at the specific level (Andersen et al. 1976, Smith 1978, Frey et al. 1995, Nyholm 1998). In North America, Lawton (1971) accepted it at the specific level, while Crum & Anderson (1981) treated it as a variety of *Philonotis fontana*, as did Ignatov & Afonina (1992) in their check-list of the former Soviet

Union. On the basis of the literature, it has a wide range in Europe, North America (Dismier 1910, Lawton 1971) and Siberia (Nyholm 1998).

Several theories can be offered to explain the presence of *Philonotis caespitosa* in South Africa. First, some bipolar disjunctions of holarctic circumpolar bryophytes are known from South Africa, such as *Saelania glaucescens* (Hedw.) Broth. (Schofield 1974), *Abietinella abietina* (Hedw.) M. Fleisch., and *Bryoerythrophyllum recurvirostrum* (Hedw.) Chen (Magill 1981). Second, it may have intermediate stations in central African mountains not yet detected, or the specimens lie unidentified or are under other names in herbaria. Third, its introduction to South Africa by human activities is not out of the question. Many European bryophytes are known to be human introductions into New Zealand (Schofield 1974) and Australia (Streimann 1998), and the same is possible in South Africa with a longer colonization history than they have.

The key provided gives five other species. Of them, *P. africana, P. dregeana* (Müll. Hal.) A. Jaeger, and *P. hastata* (Duby) Wijk & Marg. belong to the section *Philonotula. P. africana* has denser leaf cell areolation than the other South African species of the section, which with the distinct papillosity of leaf cells makes the leaves obscure. These characters and its reflexed leaf margin separates it from other species of *Philonotis* in South Africa. According to Magill (1987), *P. dregeana* differs from *P. hastata* by having regularly narrow-rectangular laminal cells (rectangular to weakly oblong-hexagonal in *P. hastata*), narrower leaves, and costa short excurrent (ending below the apex or occasionally percurrent in *P. hastata*). The latter character depends on the age or maturity of the plant. Leaves from young stems and from innovations are often obtuse, and the costa is weak. The leaves on mature stems below the gametangia in Asiatic plants commonly have percurrent costa, and leaves with excurrent costa are not rare.

Philonotis scabrifolia (Hook. F. & Wils.) Braithw. belongs to the section *Catenularia* (Müll. Hal.) Paris, and *Philonotis vagans* (Hook. f. & Wils.) Mitt. belongs to the section Pseudo-Mniobryum Broth. They can be distinguisbed by the characters in the key.

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Illustrations

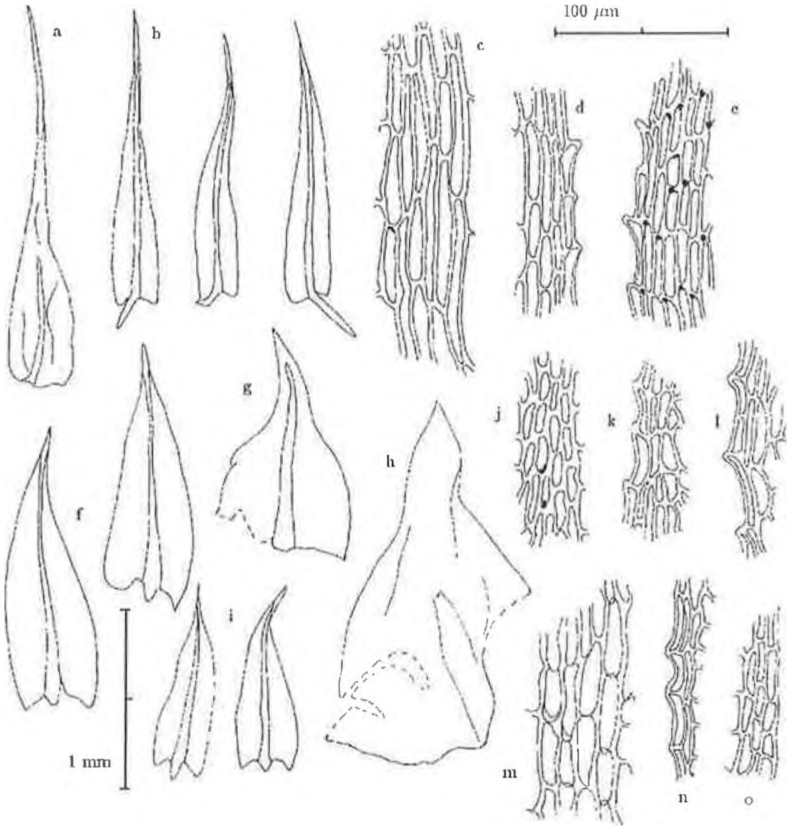

Fig. 1. *Philonotis comosa* (Broth.) Griffin & W. R. Buck. (a–e, from the type of *P. afrocapillaris* Sim, PRE). a: Perichaetial leaf. b: stem leaves. c: basal leaf cells. d: leaf border near leaf base. e: leaf border and leaf cells near apex. — *Philonotis caespitosa* Wils. ex Milde (f–h, j, l, m from van *Rooy 3700*, in H; i, k, n, o from van *Rooy 3653*, in H). — f, i: stem leaves. g: inner perogonoial leaf. h: outer perigonial leaf. j: leaf cells near apex. k: leaf border near apex. l, n: leaf border at midleaf. m: leaf cells near base. o: border near base. — "1 mm" scale for the leaf shapes, and "100 μm" scale for the cellular details.

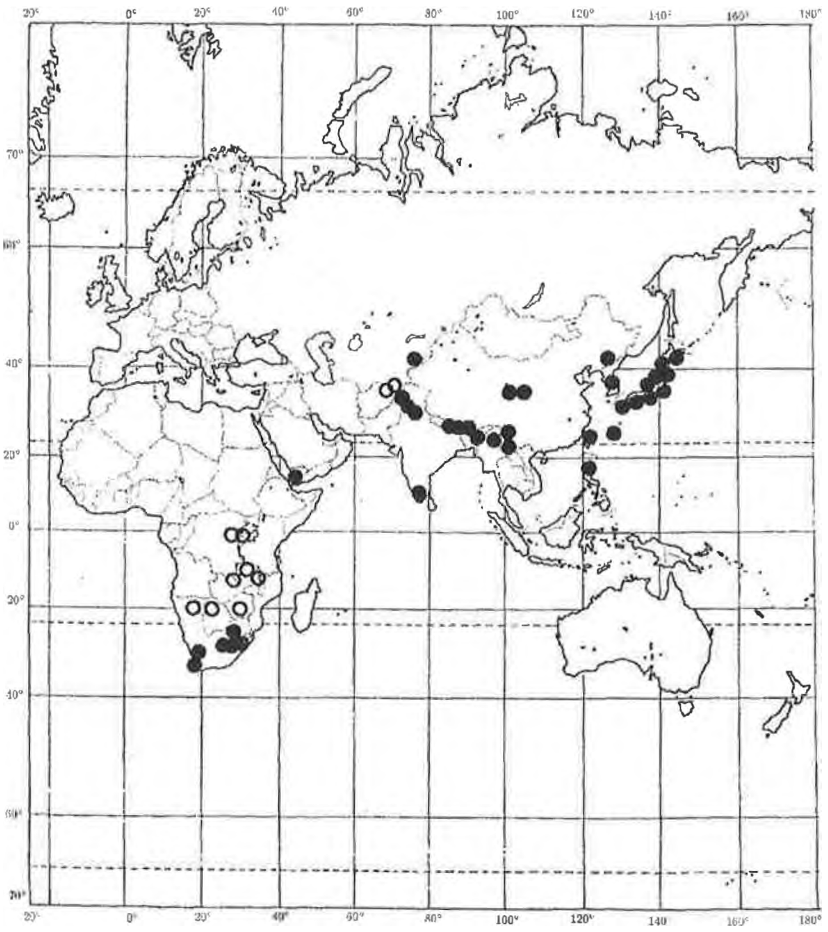

Fig. 2. Distribution of *Philonotis falcata* (W. J. Hook.) Mitt. Solid circles = specimens observed (H). Open circles = literature reports.

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A revision of Pilotrichella (Lembophyllaceae: Musci)

Allen, B. & Magill, R. E.
Missouri Botanical Garden
P.O. Box 299, St. Louis, MO 63166-0299, U.S.A.

Abstract. Pilotrichella (C. Müll.) Besch. is a predominently epiphytic genus of six species found in Hawaii, the Neotropics and Africa: *P. cuspidans, P. flexilis, P. mascarenica, P. mauiensis, P. reesei, sp. nov.* and *P. vermiformis, sp. nov.* The sporophytic features of *Pilotrichella* are uniform throughout the genus. Gametophytic features of the genus that show significant variation include:1. relative plant size; 2. branch bud shape; 3. leaf shape; 4. leaf margin stance; 5. extent of alar cell differentiation; 6. leaf apex shape; and 7. spore size. The section *Orthostichella* differs from *Pilotrichella*, in often having primary stolons as well as stipitate stems, smaller plants with spirally ranked leaves having sparsely developed alar cells and short double costae. The exostome teeth in *Orthostichella* are smooth to papillose while those of *Pilotrichella* are striate at base. *Orthostichella* is here considered distinct from *Pilotrichella* at the generic level. *Pilotrichella* is placed in the Lembophyllaceae rather than the Meteoriaceae on the basis of its absolutely ecostate leaves and green, yellowish red or brown coloration. Within the Lembophyllaceae *Pilotrichella* appears isolated by virtue of its lack of a stem central strand, absolutely ecostate leaves, and more reduced peristome. *Pilotrichella quitensis* is transferred to the genus *Pleurozium* (as *Pleurozium quitense, comb. nov.*). *Camptochaete arbuscula* is reported from Hawaii, and *Weymouthia mollis* is reported from Tahiti and the Falkland Islands.

Pilotrichella (C. Müll.) Besch. is a genus of predominantly epiphytic, frequently pendulous mosses of tropical and subtropical American-African distribution. Hedwig (1801) described the oldest species now placed in *Pilotrichella* (as *Leskea flexilis* Sw.*ex* Hedw.), but the species generally accepted in the genus were first brought together by Müller (1850) under *Neckera* Hedw. sect. *Pseudopilotrichum.* C. Müll. subsections *Orthostichella* C. Müll. and *Pilotrichella* C. Müll.

Bescherelle (1872) elevated Müller's subsect. *Pilotrichella* to generic rank. The newly established *Pilotrichella* was broadly conceived and included four sections: *Orthostichella* (C. Müll.) Besch., *Eupilotrichella* (C.

Müll.) Besch., *Papillaria* (C. Müll.) Besch., and *Meteoridium* (C. Müll.) Besch. *Papillaria* had previously been removed from this group by Lorentz (1864). Jaeger & Sauerbeck (1877) refined *Pilotrichella* by dividing it into two unranked groupings: *Eupilotrichella* (including Bescherelle's sect. *Meteoridium*) and *Orthostichella.* Section *Meteoridium* was removed from *Pilotrichella* by Brotherus (1906) who also positioned the genus (with sections *Orthostichella* and *Eupilotrichella*) in the tribe Meteorieae. This placement of *Pilotrichella* was followed by Fleischer (1908) who assigned the genus to the Meteoriaceae (tribe Pilotrichelleae). The association of *Pilotrichella* with the Meteoriaceae has been generally accepted (see e.g., Brotherus 1925, Bartram 1949, Florschütz 1964, Walther 1983, Vitt 1984, Spessard-Schueth 1994, Churchill & Linares 1995, Duarte-Bello 1997, Magill & van Rooy 1998, Gradstein et al. 2001).

The Meteoriaceae are usually placed in the Leucodontales (Fleischer 1908, Brotherus 1925, Walther 1983, Vitt 1984). The family, however, was transferred to the Hypnales by Buck (1994) and placed near the Brachytheciaceae in part because its exostome teeth are often horizontally striate at base and it lacks stolon-like primary stems that are tightly adherent to the substrate as well as greatly reduced stolon leaves. Buck (1994, 1994a) also reconsidered *Pilotrichella* and its systematic placement. As a result *Orthostichella* C. Mull. was resurrected as a genus (as *Pseudopilotrichum* (C. Müll.) Buck & Allen) and both genera along with *Weymouthia* Broth. and *Squamidium* (C. Müll.) Broth. transferred to the Lembophyllaceae.

There are a number of tropical and subtropical pleurocarpous genera that grow pendulous in predominately epiphytic habitats. These genera present classification problems because they appear to represent several phylogenetic lines as judged by their very different peristomial forms, but they exhibit considerable convergence in their gametophytic features. *Pilotrichella* is one of these problematic genera. It is difficult to decide if it belongs in the Meteoriaceae or Lembophyllaceae because its reduced peristome shows affinities to both families and it is hard to determine whether its gametophytic features are indicative of propinquity of descent or convergence. This situation is further complicated because the Meteoriaceae and Lembophyllaceae are so similar (e.g., compare the family descriptions of the Lembophyllaceae and Meteoriaceae in Buck & Goffinet 2000).

The leaves and stems of most genera placed in the Meteoriaceae often have parts that are intensely black. This odd feature is usually only noticed in passing, but it is so distinctive that when present one can immediately assign unknown specimens to the Meteoriaceae. Genera placed in the Lembophyllaceae can be green, yellowish red or brown, but they never exhibit this intense, at times shiny, black color. Furthermore, all of the genera now placed in the Meteoriaceae that can produce this intense black coloration also have single costae. On the basis of these two features it appears that Squamidium should be returned to the Meteoriaceae. *Pilotrichella, Orthostichella,* and *Weymouthia* which are ecostate or have short double costae and a green, yellowish red or brown coloration seem properly placed in the Lembophyllaceae. Within the Lembophyllaceae *Pilotrichella* appears isolated by virtue of its lack of a stem central strand, absolutely ecostate leaves, and more reduced peristome.

As noted above *Orthostichella* is generally considered a section of *Pilotrichella,* but Müller (1879) used the name at the generic level as did Buck (1994, 1994a). *Orthostichella* differs significantly from *Pilotrichella* in its smaller plant size, and in often having primary stolons as well as stipitate stems. It also differs from *Pilotrichella* in having spirally ranked leaves with sparsely developed alar cells, and often its leaves have short double costae. Sporophytically *Orthostichella* differs from *Pilotrichella* in having shorter setae and smooth to papillose exostome teeth. Additionally the presence of large spores (to 64 μm) in *Pilotrichella* distinguishes the two taxa. For these reasons *Orthostichella* is here considered distinct from *Pilotrichella* at the generic level.

Pilotrichella is stable in most of its features. Its stolons, stems, and branches are identical in structure. It lacks a stem central strand, and its axillary hairs are usually reddish throughout. When the reddish coloration in the axillary hairs is weakly expressed it is the upper rather than the basal cells that remain colored. The stem and branch leaves of *Pilotrichella* are monomorphic, strongly concave, variously ovate in shape, and always lack a costa. Its entire to serrulate leaf margins are generally broadly incurved, and its linear-flexuose leaf cells are often strongly porose. The alar cells in *Pilotrichella* are well-developed, and occur as excavate groups of enlarged, reddish yellow, subquadrate to rectangular, porose cells. Gametophytic features of *Pilotrichella* that show significant variation include: 1. relative plant size; 2. branch bud shape; 3. leaf shape; 4. leaf margin stance; 5. extent of alar cell differentiation; 6. leaf apex shape; and 7. spore size.

The sporophytes of *Pilotrichella* are uniform throughout the genus. The setae are elongate and variously papillose roughened. The genus has ovoid to short-cylindrical capsules, long-rostrate opercula, and hairy, cucullate calyptrae. The *Pilotrichella* peristome is diplolepideous and reduced with yellowish white exostomes and endostomes that are nearly the same length as the exostome teeth. The more or less linear exostome teeth are lightly horizontally striate on the dorsal (outer) surface at base. The endostome has a low basal membrane with filamentous, narrowly perforated segments, and cilia are usually absent. Even though the *Pilotrichella* peristome is significantly reduced in form, the presence at the base of the exostome teeth of horizontal striae indicates the peristome is basically hypnoid.

The name *Pilotrichella* combines the generic name *Pilotrichum* with the Latin substantival suffix *-ella* (diminutive).

Pilotrichella (C. Müll.) Besch., Mém. Soc. Sci. Nat. Cherbourg 16: 222. 1872.

Neckera subsect. *Pilotrichella* C. Müll., Syn. Musc. Frond. 2: 129. 1850. Lectotype: *Leskea flexilis* Sw. *ex* Hedw. (designated here).

Pilotrichella sect. *Turgidella* C. Müll., Flora 82: 464. 1896, invalid name, no description. Type: *Meteorium mauiensis* Sull.

Pilotrichella sect. *Gastrella* C. Müll., Flora 82: 464. 1896, invalid name, no description. Type: *Pilotrichella desmoclada* C. Müll.

Pilotrichella sect. *Eupilotrichella* Besch. ex Broth., Nat. Pflanzenfam. 1(3): 811. 1906, illegitimate name (Art. 21.3, Greuter 2000).

Plants small, medium-sized or large, dull, light green, green, yellow-green, reddish yellow, or golden brown, in loose or stiff mats, often with pendent strands. Stem and branches in cross section with sclerodermis, firm-walled cortical cells, central strand absent; paraphyllia absent; pseudoparaphyllia absent, scale leaves present over branch buds. Primary stems creeping; rhizoids generally on the parts of the stems that touch the substrate, in circular clusters abaxially to the leaf insertions, dark red, smooth to finely roughened, mostly not branched; leaves smaller but not different in form or structure from secondary stem and branch leaves. Secondary stems arising irregularly from the primary stems, or primary stems transformed at the tips into secondary stems, often pendent, irregularly branched; axillary hairs numerous, all cells reddish, basal cells short, subquadrate, upper cells long-cylindrical; rhizoids absent. Secondary stem and branch buds short and swollen or narrowly elongate and terete. Leaves not ranked, erect-spreading, spreading or wide-spreading, (sometimes turgid) when dry, erect to erect-spreading when wet, concave, ovate, oblong-ovate, obovate, or ovate-deltoid, at times panduriform, somewhat clasping at base and variously auriculate; apices acute or acuminate, mucronate, cuspidate or hair-pointed, leaf tips reflexed or straight; margins broadly incurved above, at times meeting or overlapping at upper margins, entire below, serrulate (rarely entire) below the apex; costa absent; leaf cells linear-flexuose, porose at base, porose or occasionally straight-walled above, alar cells in bulging, excavate groups, subquadrate to short-rectangular, usually dark red or reddish orange. Branch and stem tips occasionally flagelliform, plants sometimes with slender branchlets having microphyllous leaves, or short branches with deciduous leaves. Dioicous. Perigonia gemmate, lateral on secondary stems and branches, outer perigonial leaves clasping at base, squarrose recurved above, inner perigonia leaves broadly ovate, orange-red across the base; paraphyses and curved-cylindrical antheridia numerous. Perichaetia on short lateral branches; paraphyses and archegonia numerous; outer leaves clasping below, squarrose above, inner leaves sheathing, oblong-lanceolate, long-acuminate; vaginula of fertilized perichaetia densely hairy. Setae elongate, red, smooth below and papillose above or papillose roughened throughout. Capsules exserted, erect, ovoid to short-cylindrical; exothecial cells subquadrate to irregularly subrectangular, firm-walled; stomata superficial on neck; opercula long-rostrate; annuli rudimentary; peristome diplolepideous, yellowish white, exostome on dorsal (outer) surface lightly horizontally striate at base, finely papillose above, trabeculae weakly developed on both sides, endostome nearly as long as exostome, basal membrane low, segments filamentous, narrowly perforated, papillose, cilia rudimentary or absent. Calyptrae cucullate, densely hairy. Spores lightly roughened, oblong to rounded-triangular, 34–64 μm, or round, 18–28 μm.

1. Leaves ovate-deltoid, long-cuspidate to piliferous; branch buds narrow, elongate, and terete .... **1.** *P. cuspidans*
1. Leaves oblong-ovate to broadly ovate, mucronate to cuspidate; branch buds short and swollen .... **2.**
    2. Alar cells not restricted to an excavate group in the auriculate angle .... **5.** *P. reesei*
    2. Alar cells more or less restricted to an excavate group in the auriculate angle .... **3.**
3. Plants with slender branchlets having microphyllous leaves, or flagelliform branch tips, or deciduous leaves .... **4.**
3. Plants without slender branchlets, flagelliform branch tips, or deciduous leaves .... **5.**
    4. Leaves cuspidate, nearly all apices erect; slender branchlets with microphyllous leaves, flagelliform branch tips and/or deciduous leaves present .... **4.** *P. mauiensis*
    4. Leaves mucronate, most apices reflexed; plants only with deciduous leaves .... **2a.** *P. flexilis* form *nudiramulosa*
5. Leaves cuspidate, nearly all apices erect .... **4.** *P. mauiensis*
5. Leaves mucronate or apiculate, most apices reflexed .... **6.**
    6. Plants medium-sized to large, leaves 1.7–3.0 mm long .... **2.** *P. flexilis*
    6. Plants small to medium-sized, leaves 1.2–1.6 mm long .... **7.**

7. Leaves turgid when dry, often cochleariform, obtuse; upper leaf margins never overlapping .... **6.** *P. vermiformis*

7. Leaves erect to erect-spreading when dry, oblong-ovate, broadly acute, upper leaf margins usually overlapping .... **3.** *P. mascarenica*

1. *Pilotrichella cuspidans* Ren. & Card., Bull. Soc. Roy. Bot. Belgique 29(1): 180. 1890. Protologue: Haiti. Haiti, Port au Prince, ad truncos arborum (*Bertrand*). Holotype: Haiti: Port au Prince, Leg. *Bertrand*, Herb. J. Cardot (PC). Isotypes: Haiti, Leg. *R*[ev]. *P. Bertrand,* Herb. J. Cardot (H); Haiti, leg. *Rev. Bertrand,* Herb. R. Renauld (H); Haiti leg. *R*[ev]. *P. Bertrand* com. Brotherus, Herb. J. Cardot (S); Haiti. Leg. *R*[ev]. *P. Bertrand,* 1888, Herb. J. Cardot (NY); Port-au-Prince, Haiti, Leg. *Rev. R. P. Bertrand,* 1888, ex Herbarium of the New York Botanical Garden (FH).

Renauldia subpilifera Williams, J. Wash. Acad. Sci. 20: 176. 1930. Protologue: Dominican Republic. Dominican Republic: Polo, Prov. de Barahona, 600–1200 meters, Feb. 26–March 12, 1922 (*Abbot 1879c*). Holotype: Dominican Republic. Dominican Republic: Prov. de Barahona, Loma la Haut, Polo, Altitude 600–1300 m or less, Feb. 26–Mr. 12, 1922. *W. L. Abbot 1879c* (NY); Isotype: Dominican Republic. Loma la Haut, Polo 600–1300 m, Feb. 26–Mr. 12, 1929 [sic]. *W. L. Abbot 1879c.* (FH).

Nomenclatural note. The protologue of *P. cuspidans* does not indicate when the type material was gathered, and most type specimens likewise give no collection date. There are, however, several Bertrand collections of *P. cuspidans* in FH, PC, and NY dated either 1887 or 1888. The material in PC and NY collected in 1887 is not marked as type material, while a collection in NY from Cardot's herbarium marked "sp. nov." is dated 1888. The "1888" collection is identical to the holotype.

Plants medium-sized to large, dull, light green yellow-green, reddish yellow, or golden brown, in stiff mats often with pendent strands. Primary stems yellow-red, creeping, in cross section with sclerodermis of 4–6 thick-walled cells, cortical cells firm-walled, hyaline to yellow, central strand absent; rhizoids sparse, in circular clusters abaxially to the leaf insertions, dark red, smooth to finely roughened, mostly not branched. Leaves reduced, erect to appressed, broadly triangular to broadly ovate, auriculate at base, 0.9–1.5 mm long, acuminate, hair-pointed; leaf cells linear-flexuose, thick-walled, porose, alar cells dark red, subquadrate to short-rectangular, upper margins serrulate. Secondary stems horizontal, erect or pendent, to 15 cm long, irregularly branched, arrested branch primordia numerous, in cross section with sclerodermis of 4–5 small, thick-walled, reddish orange cells, cortex cells enlarged, firm-walled, pale yellow, central strand absent; axillary hairs 3–6 cells long, reddish throughout, basal cells 1–2, short, quadrate to subquadrate, upper cells 2–3, long-cylindrical; rhizoids not seen. Secondary stem and branch apices narrowly elongate and terete; leaves ovate-deltoid to broadly ovate, not ranked, wide-spreading to erect-spreading from the base when dry, erect to erect-spreading when wet, 2–3 mm long, concave, clasping at base, auriculate, apex acuminate, long-cuspidate to hair-pointed, leaf tips straight; margins broadly incurved, entire below, serrulate below the apex; costa absent; leaf cells linear-flexuose, porose throughout, median cells 30–60 × 4–6 μm, basal cells shorter and broader, alar cells extensively developed, subquadrate to short-rectangular, 14–30 × 10–14 μm, yellow-red, reddish orange or red. Dioicous. Perigonia gemmate, lateral on secondary stems and branches, 1.0–1.3 mm long, outer perigonial leaves clasping at base, squarrose recurved above, 0.8–1.0 mm long, inner perigonial leaves broadly ovate below, long-acuminate above, orange-red across the base, cells elongate-flexuose, porose throughout, costa absent; paraphyses and curved-cylindrical antheridia numerous. Perichaetia terminal on short lateral branches, unfertilized perichaetia to 2 mm long; paraphyses and archegonia numerous; leaves clasping below, squarrose above; fertilized perichaetia with hairy vaginula; outer leaves to 2 mm long, inner leaves oblong-lanceolate, long-acuminate, 3 mm long; costa absent, laminal cells long-linear and porose. Setae elongate, 6–8 mm long, smooth to lightly roughened below, papillose above, red to reddish yellow. Capsules exserted, erect, ovoid to short-cylindrical, 1.8–2.0 mm long; exothecial cells subquadrate to irregularly short-rectangular, firm-walled; stomata superficial on neck; opercula long-rostrate, 1.6–2.0 mm long; annuli rudimentary; peristome yellowish white, exostome to 0.5 mm long, dorsal (outer) surface lightly horizontally striate at base, finely papillose above, trabeculae weakly developed on both sides, endostome nearly as long as exostome, basal membrane low, segments filamentous, narrowly perforated, papillose, cilia rudimentary or absent. Mature calyptra not seen, immature calyptra cucullate, hairy. Spores round, lightly roughened, 18–22 μm.

Etymology. The specific epithet *cuspidans,* a Latin active present participle, means "pointed" and, refers to the long, terete stem and branch buds of the species.

Distribution. Caribbean (Cuba, Haiti, Dominican Republic).

Illustrations. Williams (1930, Fig. A 7–10); Duarte-Bello (1997, Pl. 201); Buck (1998, Pl. 90 7–12). Figures 1 & 2.

Ecology. Over limestone on road banks and on rotten logs, tree trunks, branches, and twigs, often pendent; 1158–1940 m.

Selected specimens examined. CUBA. Santiago de Cuba: *Clement* (S). HAITI. Ouest: *Imshaug 22806* (NY); Sud: *Duncan 53a* (MO); Sud-est: *Buck*

9453 (NY). DOMINICAN REPUBLIC. Barahona: *Steere 22825* (H, NY); Independencia: *Buck 14639* (B, NY); La Estrelleta: *Buck 4573* (NY); La Vega: *Norris et al. 4999* (NY); Pedernales: *Steere 22907* (H, NY).

Pilotrichella cuspidans has long, terete apical buds, deltoid stem leaves, and long-cuspidate to hair-pointed leaves. Seta length is a variable feature of most *Pilotrichella* species, but those of *P. cuspidans* are consistently short, and never more than 9 mm long. Unlike most other members of the genus which have massive irregularly shaped spores, *P. cuspidans* has small (18–21 μm), more or less round spores. The presence of hair-pointed stem and branch leaves make most collections of *P. cuspidans* unmistakable. There are, however, some collections of *P. cuspidans* with cuspidate stem and branch leaves that can be difficult to separate from *P. reesei.* In these cases it is necessary to examine the shape and length of the apical buds. In *P. cuspidans* the apical buds are exceptionally long and smoothly julaceous, no other species of *Pilotrichella* has this feature.

Pilotrichella flexilis differs *P. cuspidans* in having short, swollen apical buds and broad, oblong-ovate stem leaves with short mucros that are mostly recurved. Although the alar cells in *P. cuspidans* and *P. flexilis* are similar in color, those of *P. cuspidans* are more extensively developed than those of *P. flexilis.* The plants in some collections of *P. cuspidans* are noticeably smaller than those of *P. flexilis*, but *P. cuspidans* is so variable in size that this feature can not be relied on to separate the two species. The setae in *P. cuspidans* are generally smaller than those of *P. flexilis* which typically have setae greater than 10 mm long. Both species have similar exostome ornamentation and endostome development.

There are some collections of *P. cuspidans* with relatively short leaf apices and weakly developed apical buds (see *e.g.*, *Allard 17620* NY) that are difficult to distinguish from *P. mauiensis.* The presence in *P. mauiensis* of broadly ovate leaves and fewer alar cells that are restricted to the moderately developed auriculate-angle serves to distinguish it from all collections of *P. cuspidans.*

Pilotrichella reesei can be especially difficult to distinguish from *P. cuspidans* because it has somewhat attenuate stem apical buds, distinctly auriculate leaves, and similar alar cell development. In *P. reesei*, however, the branch apical buds are short and swollen, flagelliform branches sometimes occur, and its leaves are short-cuspidate (identical to those of *P. mauiensis*) to mucronate. Furthermore, while most of the leaf apices in *P. reesei* are erect, occasionally the leaves have recurved mucros (identical to those of *P. flexilis*).

2. *Pilotrichella flexilis* (Hedw.) Ångstr., Kongl. Svenska Vetensk. Acad.

Handl. 33(11): 34. 1876. *Leskea flexilis* Sw. *ex* Hedw., Sp. Musc. Frond. 234. 1801. *Hypnum flexile* (Hedw.) Sw. in Brid., Muscol. Recent. 2(2): 153. 1801. *Hookeria flexilis* (Hedw.) Sm., Trans. Linn. Soc. London 9: 281. 1808. *Isothecium flexile* (Hedw.) Brid., Bryol. Univ. 2: 361. 1827. *Neckera flexilis* (Hedw.) C. Müll., Syn. Musc. Frond. 2: 129. 1850. *Meteorium flexile* (Hedw.) Mitt., J. Linn. Soc., Bot. 12: 438. 1869. *Pilotrichum flexile* (Hedw.) C. Müll. in: Par., Index Bryol. (ed. 2). 4: 4. 1905. Protologue: Jamaica. Jamaica et insulae australes [Swartz]. Holotype: *Leskea flexilis* Spec. Musc. 234. Tab. 96. *Hypnum flexile* Swartz Prod. p. 141 (G) Isotypes: *Hyphnum flexile* Swz. N^o^ *2069*, Herbarium Swartz (S); Jamaica, *Swartz* (H); a celeb D. D. Ol. Swartz. Jamaica (S); *Leskea flexilis* Fl. Ind. Occ. from D. Swartz, Herb. Hooker, *H. 2592* (BM).

Pilotrichum cochlearifolium C. Müll., Linnaea 43: 599. 1843. *Neckera cochlearifolia* (C. Müll.) C. Müll., Syn. Musc. Frond. 2: 130. 1850. *Pilotrichella cochlearifolia* (C. Müll.) Besch., Mém. Soc. Sci. Nat. Cherbourg 16: 223. 1872. *Meteorium cochlearifolium* Mitt. *ex* Par., Index Bryol. (ed. 2) 4: 2. 1905. Protologue: Mexico. Habitat in regno Mexicano, ubi legit Cl. *C. Ehrenberg*. Lectotype: Mexico: leg. *C. Ehrenberg* (JE, designated here). Isolectotypes: Mexico leg. *C. Ehrenberg* (H, S).

Neckera turgescens C. Müll., Syn. Musc. Frond. 2: 131. 1850. *Meteorium turgescens* (C. Müll.) Mitt., J. Linn. Soc., Bot. 12: 440. 1869. *Pilotrichella turgescens* (C. Müll.) Besch., Mém. Soc. Sci. Nat. Cherbourg 16. 223. 1872. Protologue: Mexico. Mexico: *C. Ehrenberg*. Lectotype: Mexico. *Erhenberg*. Müller in Hb. Hook. (BM). Isolectotypes: Mexico. *Erhenberg*. Müller in Hb. Hook. (H, NY); Mexico: *C. Ehrenberg* (S).

Meteorium orbifolium Mitt., J. Linn. Soc., Bot. 12: 440. 1869, illegitimate name, includes an earlier name in synonymy. Based on: Mexico, *Ehrenberg* (H, JE, S); ins. Taboga, *Seemann*.

Pilotrichella recurvo-mucronata C. Müll., Bull. Herb. Boiss. 5: 563. 1897. Protologue: Guadeloupe and Puerto Rico. Guadeloupe: *L'Herminier*: Puerto Rico, prope Uticado, in sylva primaeva: *Sintensis* 10. III. 1889. Lectotype: Guadeloupe: *L'Herminier* (BM, designated here). Isolectotypes: Guadeloupe: *L'Herminier* (H, FH, NY, S).

Pilotrichella eroso-mucronata C. Müll., Bull. Herb. Boiss. 5: 563. 1897. Protologue: Jamaica. Jamaica, New Haven Pass, inter *Capressinam arcuatipedem*: W. Fawcett, 1896. Type not seen, synonymized by Britton (1913).

Pilotrichella squarrulosa C. Müll. in Broth., Acta Soc. Sci. Fenn. 19(5): 24. 1891. Protologue: Brazil. Prov. Minas Geraës, Caraça; sterilis [*E.*

Wainio]. Lectotype: Brasilia, prov. Minas Geraës, Caraça 1885. leg. *E. Wainio* (H, designated here). Isolectotypes: Brasilia, Minas Geraës, Caraça 1885 leg. *E. Wainio*, comm. Brotherus (BM, PC).

Pilotrichella pallidicaulis C. Müll., Bull. Herb. Boissier 6(2): 117. 1898. Protologue: Brazil. Brasilia, Sa. Catharina, Serra Geral, in araucarieto ad truncos arborum, Januario 1891 c.fr. parcissimis vetustis atque junioribus: *E. Ule, Coll. 1164*; Minas Geraës, Serra Italiaia, 2000 m alta, ad arbores sylvestres, Febr. 1894; sterilis: *idem, Coll.* N^o^ *1844*. Lectotype: Brasilia, Serra do Itatiaia, an Baümen im Walde 2000 m, 2/1894, leg. *E. Ule 1844* (H, designated here).

Pilotrichella araucarieti C. Müll., Hedwigia 40: 85. 1901. Protologue: Brazil. Brasilia, Sa. Catharina, Serra Geral, in truncis arborum araucarieti, Januario, Martio et Majo 1890 et 1891: *E. Ule*, Coll. L, M. N^o^ *873, 874, 1022*. Lectotype: Brasilia, prov. S. Catharina, Serra Geral, an Baümstaminen in Araucarienwalde, Maji 1890, leg. *E. Ule 873* (H. designated here). Syntype: *E. Ule 874* (H).

Pilotrichella araucarieti var. *crassicaulis* C. Müll., Hedwigia 40: 85. 1901, illegitimate name, includes the type of an earlier name. Based on: Brazil. In idem locis: idem, Coll. N^o^ [*Ule*] *868* (H); Minas Geraës, Serra Itabira, in truncis arborum sylvestrium, Febr. 1892: *E. Ule*, Coll. N^o^ *1459* sub Pil. squarruloso C. M. (H); Serra Caraça: *E. Wainio* (1885) in Hb. Brotheri (H); Rio de Janeiro, Mte. Tijuca, Oct. 1893: *E. Ule*, Coll. N^o^ *1688* (H), *1689* (H) sub Piltr. sediramea C. M.; Petropolis, in pseudobulbis Orchidearum: Hb. Döring 1862.

Pilotrichella sediramea C. Müll., Hedwigia 40: 85. 1901. Invalid name, lacking a description and mentioned in synonymy. Based on: [Brazil] Rio de Janeiro, Mte. Tijuca, Oct. 1893: *E. Ule* Coll. N^o^ *1688, 1689* (both H).

Pilotrichella rigens Card., Rev. Bryol. 37: 8. 1910. Protologue: Mexico. Etat de Hidalgo: Honey-station, 1904 (*Pringle, n. 15061*). Holotype: Plantae Mexicanae. State of Hidalgo, Honey Station, 10 May 1904, *C. G. Pringle 15061* (PC). Isotype: Plantae Mexicanae. State of Hidalgo, Near Honey Station, 10 May 1904, *C. G. Pringle 15061* (NY).

Pilotrichella flexilis var. *robusta* Broth. In: Thér., Mem. Soc. Cub. Hist. Nat. "Felipe Poey" 14: 360. 1940. Invalid name, lacking a description. Based on: Cuba, Sierra de Banao, Santa Clara (*Léon 8,326*) (NY).

Pilotrichella perrobusta P. de la Varde, Rev. Bryol. Lichénol. 19: 153. 1950. Protologue: Madagascar. Sommet oriental du massif de Marojéjy (N.E.) a l'ouest de la haute Manantenina, affluent de la Lokoho.

Gneiss et quartzite. Alt. 1850–2100 m. [*H. Humbert*]. Holotype: Madagascar. Sommet oriental du massif de Marojéjy (Nord-Est) a l'ouest de la haute Manantenina, affluent de la Lokoho. Gneiss et quartzite. Altitude. 1850–2137 m. Date de la récolte: 26 Mars–2 Avril 1949. Leg. *H. Humbert & G. Cours* (PC).

Pterobryopsis subcochlearifolia Thér. in Crum & Arzeni, Rev. Bryol. Lichénol. 22: 155. 1953. Invalid name, lacking a description and mentioned in synonymy. Based on: Panamá, s.l., *Bro. Hélion*, 1906 (H).

Nomenclatural note. Wijk et al. (1967) considered *P. araucarieti* an illegitimate name because its syntypes included the type of a species (*P. squarrulosa*) of earlier priority. This is not so, rather the variety *Pilotrichella araucarieti* var. *crassicaulis* is illegitimate because its protologue does included the type of *Pilotrichella squarrulosa.*

Plants medium-sized to large, dull, light green, green, yellow-green, reddish yellow, or golden brown, in loose mats, often with pendent strands. Primary stems yellow-red, creeping, in cross section with sclerodermis of 4–6 small, thick-walled cells, cortical cells enlarged, firm-walled, hyaline to yellow, central strand absent; rhizoids sparse, in circular clusters abaxially to the leaf insertions, dark red, smooth to finely roughened, mostly not branched. Paraphyllia absent. Pseudoparaphyllia absent, scale leaves present over branch buds. Leaves reduced, erect to appressed, ovate-oval, at times panduriform, 1.2–2.0 mm long, apex obtuse-rounded, mucronate to apiculate; leaf cells linear-flexuose, thick-walled, porose, alar cells subquadrate to short-rectangular. Secondary stems horizontal, erect or pendent, to 30 cm long, irregularly branched; in cross section with sclerodermis of 4–5 small, thick-walled, reddish orange cells, cortex cells enlarged, firm-walled, pale yellow, central strand absent; axillary hairs 3–5 cells long, reddish throughout, basal cells 1–2, short, quadrate to subquadrate, upper cells 2–3, long-cylindrical; rhizoids not seen. Secondary stem and branch buds short and swollen; leaves broadly oblong-ovate, not ranked, turgid, spreading to erect-spreading from the base, often with one margin broadly twisted inward when dry, erect to erect-spreading when wet, 1.7–3.0 mm long, to 1.6 mm wide, concave, clasping at base, variously auriculate; apex acute, generally mucronate, occasionally rounded or shortly apiculate, leaf tips mostly reflexed; margins broadly incurved above, often almost meeting at upper margins, entire below, usually serrulate below the apex; costa absent; leaf cells linear-flexuose, consistently porose at base, porose to occasionally smooth above, median cells 50–80 × 4–6 μm, basal cells shorter and broader, alar cells bulging in excavate groups, subquadrate to short-rectangular, 10–18 × 8–12 μm, usually dark red or reddish orange. Plants at times with deciduous leaves on short branches. Dioicous. Perigonia gemmate, lateral on secondary stems and branches, 1.0–1.5 mm long, outer perigonial leaves clasping at base, squarrose-recurved above, 0.8–1.0 mm long, inner perigonia leaves broadly ovate, orange-red across the base, cells elongate-flexuose, porose throughout, costa absent; paraphyses and curved-cylindrical antheridia numerous. Perichaetia terminal on short lateral branches, unfertilized perichaetial to 2 mm long; paraphyses and archegonia numerous; leaves clasping below, squarrose above; fertilized perichaetia with densely hairy vaginula; leaves sheathing, outer leaves to 1.5 mm long, inner leaves oblong-lanceolate, long-acuminate, 3.5–4.0 mm long; costa absent, laminal cells long-linear and porose. Setae elongate, 3–15 mm long, smooth below and papillose above or papillose-roughened throughout, red. Capsules exserted, erect, ovoid to short-cylindrical, 1.8–2 mm long; exothecial cells subquadrate to irregularly short-rectangular, firm-walled; stomata superficial on neck; opercula long-rostrate, 1.6–2.0 mm long; annuli rudimentary; peristome yellowish white, exostome teeth 0.57 mm long, dorsal (outer) surface lightly horizontally striate at base, finely papillose above, trabeculae weakly developed on both sides, endostome nearly as long as exostome, basal membrane low, segments filamentous, narrowly perforated, papillose, cilia rudimentary or absent. Calyptrae cucullate, 3–6 mm long, densely hairy. Spores oblong, lightly roughened, 36–64 μm.

Etymology. The specific epithet *flexilis* is a Latin adjective meaning "pliant or flexible" and refers to its long, flexuose, pendent stems.

Distribution. Mexico; Central America (Belize, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panamá); Caribbean (Cuba, Jamaica, Haiti, Dominican Republic, Puerto Rico, Guadeloupe, Dominica, Martinique); South America (Colombia, Venezuela, Ecuador, Peru, Bolivia, Brazil); Africa (Tanzania, Malagasy Republic).

Illustrations. Bartram (1949, Fig. 118 D–F); Potier de la Varde (1950, Fig. 5); Sharp et al. (1994, Fig. 536); Churchill and Linares (1995, Fig. 126 a–d); Buck (1998, Fig. 90 1–6); Duarte-Bello (1997, Pl. 202); Parra Cuspoca et al. (1999, Fig. 42); Restrepo and Para Cuspoca (2000, p. 108–109); Gradstein et al. (2001, Fig. 156 L–O). Figures 3 & 4.

Ecology. Often pendent on tree trunks and branches, shrubs, palm fronds, vines, twigs, also on stumps, rotting logs, soil of road banks, boulders, and on ground 600–3200 m (Central America); 550–2600 m (West Indies); 750–3550 m (South America); 1700–2140 m (Africa).

Selected specimens examined. MEXICO. Baja California: *Brandegee s.n.* (NY); Chiapas: *Breedlove 25849* (MO); Guerrero: *Croat 45663* (H, MEXU, MO, NY, US); Hidaldo: Pringle, *Plantae Mexicanae 10468* (FH, H, JE, L, MO, NY, S); Jalisco: *Crum 1061* (NY, US); Oaxaca: *Norris 77587*

(MO); Puebla: *Pringle 10856* (FH); Tamaulipas: *Sharp 8713* (FH); Veracruz: *Frahm 792298* (B, MO).

CENTRAL AMERICA. BELIZE. Cayo: *Allen 15238* (MO); Toledo: *Allen 18813* (BRH, MO). GUATEMALA. Alta Verapaz: *Standley 92407* (FH, NY); Chimaltenango: *Standley 58729* (FH); Chiquimula: *Steyermark 30601* (FH); El Progreso: *Steyermark 43550* (FH); Guatemala: *Standley 80694* (FH, NY); Huehuetenango: *Steyermark 48473* (FH, NY, US); Jalapa: *Steyermark 32487* (FH); Quezaltenango: *Sharp 2207* (FH, MO, US); Sactepéquez: *Standley 65103* (FH); San Marcos: *Sharp 5472* (NY); Sololá: *Steyermark 47236* (FH, MO, NY); Totonicapán: *Standley 62651* (FH). EL SALVADOR. Ahuachapán: *Monro et al. 2051* (MO); Santa Ana: *Davidse et al. 37193* (MO). HONDURAS. Atlántida: *Allen 17364* (MO, TEFH); Comayagua: *Allen 13999* (MO, TEFH); Cortés: *Allen 14221* (MO, TEFH); El Paraíso: *Nelson 4799* (MO); Francisco Morazán: *Allen 12366* (MO, NY, TEFH); Lempira: *Allen 11273* (MO, TEFH); Ocotepeque: *Allen 14446* (MO, TEFH); Olancho: *Allen 12699* (MO, TEFH). NICARAGUA. Estelí: *Stevens 16296* (MO, NIC, NY); *Granada: Almedo 1459a* (CINN, MO); Jinotega: *Henrich & Stevens 421* (MO, NIC, NY); Matagalpa: *Davidse et al. 30505* (MO, S); Rivas: *Stevens 6543* (MO). COSTA RICA. *Alajuela: Croat 43482* (MO); Cartago: *King C91-80* (MO); Heredia: *Crosby 3879* (MO); Limón: *Davidse et al. 25797* (CR, MO); Puntarenas: *Lyon 147* (MO); San José: *Cryptogamae exsiccatae 3599* (B, BM, H, L, MO, NY, S, US). PANAMA. Bocas Del Toro: *Allen 5236* (H, MO); Chiriquí: *Allen 5346* (MO); Colón: *Croat 33642B* (MO); Darién: *Allen 8896* (MO).

CARIBBEAN. CUBA. Granma: *Pócs & Duany 9083A* (MO, NY); Holguín: *Acuna & Morton 3916* (NY); Sancti Spíritus: *Clément & Léon 6544* (NY); Santiago de Cuba: *Buck 7738* (NY); Villa Clara: *Pócs & Borhidi 9011/V* (MO). JAMAICA. Portland: *Crosby 3164* (MO); St. Andrew: Grout, *North American Musci Pleurocarpi 389* (H, FH, MO, NY, S, US); St Thomas: *Hegewald & Hegewald 8146* (MO). HAITI. Sud: *Ekman 606* (NY, S). DOMINICAN REPUBLIC. Peravia: *Steere 23177* (NY); Puerto Plata: *Reese 15446* (NY); La Vega: *Norris 5724* (H, MO, NY). PUERTO RICO. Aguadilla: *Steere 5602* (FH, MO, NY); Guayama: *Steere 4627* (FH, MO, NY); Humacao: *Steere 4018* (MO); Mayagüez: *Steere 5514* (FH, MO, NY); Ponce: *Steere 6178* (FH, MO). GUADELOUPE. *L'Herminier s.n.* (FH, NY). DOMINICA. *Elliott 669b* (FH). MARTINIQUE. *Webster 734* (BM).

SOUTH AMERICA. VENEZUELA. Aragua: *Pursell et al. 9290* (MO); Barinas: *Dorr et al. 4872* (MO, NY); Bolívar: *Steyermark & Wurdack 844* (B, FH, MO, NY); Carabobo: *Steyermark & Steyermark 95564* (MO); Distrito Federal: *Steyermark et al. 127874* (MO); Falcon: *Griffin & Wingfield PV-1646* (MO); Lara: *Meijer et al. 124* (B, G, H, MO, NY, S, US, VEN); Mérida:

Griffin et al. 017476 (H, JE, MO, NY); Monagas: *Steyermark 62111b* (FH); Portuguesa: *Steyermark et al. 126620* (MO); Táchira: *Davidse & González 22105* (MO); Trujillo: *Liesner et al. 13031* (MO). COLOMBIA. Antioquia: *MacDougal et al. 4446* (MO, NY); Boyacá: *Churchill et al. 19011* (COL, MO, NY); Cauca: *Barclay & Juajibioy 6022-A* (MO); Chocó: *Churchill et al. 14536* (NY); Magdalena: *Mägdefrau 1066* (B); Narino: *Ramírez 10929* (MO); Norte de Santander: *Steere 7307* (NY); Putumayo: *Ramírez 10286* (MO); Santander: *Lewis 88-1307* (B, MO, NY); Valle: *Churchill et al. 15342* (CUVC, MO, NY). ECUADOR. Carchi: *Steere 9098* (NY); Imbabura: *Solís 8264* (NY); Loja: *Holm-Nielsen et al. 3679* (MO, S); Morona-Santiago: *Steere 27799* (NY); Napo: *Steere 9139* (NY); Pastaza: *Steere 8425* (NY); Pichincha: *Steere & Balslev 25566* (H, NY); Zamora: *Steere & Balslev 25826* (NY). PERU. Cajamarca: *Campos et al. 5252* (MO); San Martin: *Smith C295* (MO). BOLIVIA. Cochabamba: *Price et al. 1476* (MO); La Paz: *Lewis 89-990* (MO); Santa Cruz: *Nee 40677* (MO, NY, S). BRAZIL. Bahia: *Harley et al. 26238* (NY); Minas Geraes: *Vital & Buck 11535* (NY); Paraná: Bauer, *Musci Europ. et Amer. 2248* (BM, FH, H, L, MO, NY, S); Rio de Janeiro: *Landrum 2181* (MO, NY); Rio Grande do Sul: *Wasum et. al. 4248* (MO); Santa Catarina: *Vital & Buck 12382* (NY); Sao Paulo: *Schäfer-Verwimp 6954* (MO).

AFRICA. TANZANIA. Kilosa: Inoue, *Bryophyta Selecta Exsiccata 735* (H, JE, MO, NY, S); Morogoro: *Pócs 6467/D* (MO, NY). MALAGASY REPUBLIC. Antananarivo: *Pool s.n.* (NY). Antseranana: *Crosby & Crosby 7149* (BM, G, FH, H, MO, NY, US).

Pilotrichella flexilis is the most widespread species in the genus, there are thousands of herbarium collections of it. It is frequently encountered growing in dense pendent masses in shaded, very humid places. The species is remarkably stenotypic in most of its features and can often be recognized with a hand-lens by its usually golden-reddish color, turgid appearance, and erect-spreading leaves that are somewhat twisted above when dry and have consistently recurved mucros. Not all leaves in a single collection are liable to have recurved mucros, but the feature can always be found on at least some (usually most) leaves. The leaves near the branch buds are especially likely to have recurved mucros.

The leaves of *P. flexilis* are absolutely ecostate and consistently have auriculate leaf bases with bulging-excavate, generally dark-red alar cells, linear-flexuose, strongly porose cells, and broadly incurved upper margins. There are some collections of *P. flexilis* with straight-walled or very weakly porose upper leaf cells. These collections also are consistently green to light-green in color, and this suggests the feature may be associated with even more shaded, humid habitats than is normal for the species. The feature does not appear to be of taxonomic value since there are collections that exhibit all gradations of straight-walled to strongly porose upper leaf cells.

The leaves of *P. flexilis* are characteristically mucronate, but mucro length varies considerably within the species. Plants at one end of the variation have most leaves with rounded apices; leaves with distinct mucros occur only sporadically. This extreme is geographically centered in African and nomenclaturally centered on *P. perrobusta*.

Plants from Central and South America, however, occasionally have this type of leaf variation. The opposite extreme occurs in the Caribbean (see i.e., Cuba, *Pócs & Borhidi 9011/W* MO) where some plants with long mucronate leaves closely approach the leaves of *P. cuspidans* and *P. mauiensis*. This Caribbean expression of *P. flexilis* differs from *P. cuspidans* and *P. mauiensis* in having distinctly recurved leaf mucros.

Pilotrichella flexilis has exserted, shortly cylindrical capsules on setae that are usually 10 mm long. Its setae, however, vary from 3 mm long to 15 mm long. This variation in seta length does not appear to have taxonomic value since some collections have single stems with setae that range 3 mm to 11 mm long.

The upper leaf margins directly below the apex in *P. flexilis* are serrulate as the result of projecting cell ends. There seems to be a direct correlation between the degree of upper leaf margin incurving and marginal serrulation. Leaves with the strongest incurved margins have the most distinct marginal serrulations. Some collections of *P. flexilis* have leaves with entire margins, but even these collections also have some leaves with weakly serrulate upper leaf margins.

Pilotrichella flexilis has been confused with *Squamidium nigricans* (Hook.) Broth. and *Phyllogonium viscosum* (P. Beauv.) Mitt. These species are similar to *P. flexilis* in overall aspect, they grow in pendent masses, and their leaves have recurved mucros. *Squamidium nigricans* is a smaller plant than *P. flexilis*, it has spirally ranked leaves, and often the plants have an intense blackish color. It also differs from *P. flexilis* in having immersed capsules, and leaves with long (but faint) single costae. The alar cells in *S. nigricans* are more extensively developed than those of *P. flexilis*, they are often hyaline rather than reddish yellow, and not as strongly bulging as the alar cells of *P. flexilis*. *Phyllogonium viscosum* and *P. flexilis* have auriculate leaves and linear-flexuose, strongly porose leaf cells. The genus *Phyllogonium* is characterized by its distichous, conduplicate leaves and this feature usually can be relied on to separate it from *P. flexilis*. *Phyllogonium viscosum* however has swollen, turgid leaves that tend to obscure the distichous nature of the leaves. The costa in *P. viscosum* varies from short-double to absent, and this feature can be used to distinguish it from *P. flexilis* which is absolutely ecostate.

There is a collection of *P. flexilis* at the Missouri Botanical Garden labelled "Bermuda" The specimen is a duplicate from the "Elizabeth Gertrude Britton Moss Herbarium" at the New York Botanical Garden. There is no duplicate of this specimen at NY. It is very unlikely this specimen came from Bermuda which lacks the habitats and elevation commonly associated with *P. flexilis.* It seems more plausible that this is a labeling error.

2a. *Pilotrichella flexilis* form *nudiramulosa* (C. Müll.) Allen & Magill, *forma nova.*

> *Pilotrichella nudiramulosa* C. Müll., Hedwigia 40: 85. 1901. Protologue: Brazil. Brasilia, Sa Catharina, Serra Geral, ad truncos Araucariae Brasiliensis: *E. Ule*, Junio 1890, Coll. N^o^ *867.* Lectotype: Brasilia, prov. S. Catharina, Serra Geral, an Stammen von Araucaria, Junii 1890. leg. *E. Ule 867* (H).

Etymology. The epithet *nudiramulosa* combines the Latin adjectives *nudus* "naked" and *ramulosus* "bearing branchlets" in reference to its short branches with deciduous leaves.

Distribution. Mexico; Central America (Costa Rica, Panamá); South America (Colombia, Ecuador, Peru, Brazil); Africa (Madagascar).

Illustration. Figure 2 F.

Ecology. On tree trunks and branches; 800–2700 m.

Selected specimens examined. MEXICO. Chiapas: *Breedlove 14403* (MO); Hidalago: *Vela 598* (US); Veracruz: *Arsène 8003* (FH).

COSTA RICA. Alajuela: *Brenes 16691* (FH, NY); Cartago: *Standley 33582* (FH, US); Heredia: *Tonduz s.n.* [Pl. Costaricensis N^o^ *5680*] (G); Puntarenas: *Haber 6211* (CR, MO, NY); San José: *Crosby 10882* (CR, MO). PANAMA. Chiriquí: *Croat 13746* (MO).

COLOMBIA. Cundinamarca: *Apollinaire s.n.* (G). ECUADOR. Loja: Loja: *André K1801* [8 Nov.] (NY); Pichincha: *Spruce 1232* (BM). PERU. Arequipa: *André K1801* [17 Nov. 1876] (FH); BRAZIL. Rio Grande do Sul: *Lindman 122* (BM, H, S); Santa Catarina: *Ule 169* (B, BM, FH, JE, L, NY, S); Sao Paulo: *Wacket 1235* (H).

MALAGASY REPUBLIC. Antseranana: *Magill et al. 9948* (MO).

Pilotrichella flexilis form *nudiramulosa* is generally a smaller plant than most collections of *P. flexilis.* Typically it has short branches with leaves so deciduous that the branches are often naked. Plants of *P. flexilis* form *nudiramulosa* exhibit considerable gametophytic variation throughout their range, especially in the development of deciduous leaves. Gametophytic variation in form *nudiramulosa* shows more or less discrete geographical patterns, and this may indicate the taxon is not monophyletic. Rather the multiple evolution of this form may have been driven by the fact that deciduous leaves in a species rarely producing sporophytes would significantly increase the ability of the plants to spread asexually.

Pilotrichella mauiensis is similar in size to form *nudiramulosa,* and sometimes it also has short branches with deciduous leaves. The presence of flagelliform branch tips in *P. mauiensis* as well as slender branchlets with microphyllous leaves will often distinguish it from *P. flexilis* form *nudiramulosa.* Furthermore, the leaves of *P. mauiensis* are not nearly as auriculate at base as those of *P. flexilis,* and its usually cuspidate leaf apices are erect rather than recurved.

The ranges of *P. flexilis* form *nudiramulosa* and *P. mauiensis* overlap in Central America and Mexico. Unfortunately, collections of form *nudiramulosa* in these regions have inconsistently recurved leaf mucros. These collections are exceedingly difficult to distinguish from collections of *P. mauiensis* that have short cuspidate leaves. When slender branchlets and flagelliform branch tips are also absent from the collections of *P. mauiensis* with short cuspidate leaves the two taxa are essentially indistinguishable.

3. *Pilotrichella mascarenica* (C. Müll.) Jaeg., Ber. Thätigk. St. Gallischen Naturwiss. Ges. 1875–76: 259. 1877. *Neckera mascarenica* C. Müll., Bot. Zeitung (Berlin) 17: 237. 1859. Protologue: Réunion. Insula Borboniae: *Bory de St. Vincent.* Lectotype: Isle de Bourbon, *Bory St. Vincent (G).* Isolectotypes: Isle de Bourbon, *Bory St. Vincent* (BM); Bourbon, *Bory* (L); Mascareignes, *Bory de St. Vincent* (H).

Pilotrichella isleana Besch., Ann. Soc. Nat., Bot. sér. 6, 10: 267. 1880. Protologue: Réunion. La Réunion: plaine des Cafres, associé au *Phyllogonium, G. de L = Isle,* 1875. Holotype: La Reunion. Plaine de Cafres, *G. de Isle* (BM).

Pilotrichella islei Besch. *ex* Kindb., Enum. Bryin. Exot., Suppl. 2. 102. 1891, orthographical variant of *P. isleana* Besch.

Pilotrichella hampeana Kiaer. In: Wright, J. Bot. 26: 266. 1888, invalid name, lacks a description. Based on: Madagascar, Mt. Ankaratra (*Borgen 30*). Musci Madagascarienses, Herb. Kiaer. In montibus Ankaratra 1877–1879 legit *M. Borgen* N$^{\underline{o}}$ *30* (H); Musci Madagascarienses, Herb. Kiaer. In montibus Ankaratra 1875 legit *M. Borgen* N$^{\underline{o}}$ *30* (L).

Nomenclatural note. The two specimens on which the name *Pilotrichella hampeana* is based bear identical printed labels. The label on the specimen from L, however, has the date 1879 inked out and the date 1877 changed to 1875.

Plants small to medium-sized, dull, light green, green, yellow-green, or golden brown, in loose mats often with pendent strands. Primary stems red, creeping, in cross section sclerodermis with 4–5 small thick-walled cells, cortical cells enlarged, firm-walled, hyaline to yellow, central strand absent; rhizoids sparse, in circular clusters abaxially to the leaf insertions, dark red, smooth, mostly not branched. Paraphyllia absent. Pseudoparaphyllia absent, scale leaves present over branch buds. Leaves reduced, erect to appressed, ovate-oval, at times panduriform, to 1.4 mm long, apex obtuse-rounded, mucronate to apiculate; leaf cells linear-flexuose, thick-walled, porose, alar cells subquadrate to short-rectangular. Secondary stems arising irregularly from the primary stems, often pendent, to 14 cm long, irregularly branched, in cross section sclerodermis with 4–5 small, thick-walled, reddish orange cells, cortex cells enlarged, firm-walled, pale yellow, central strand absent; axillary hairs, 3–4 cells long, basal cells 1–2, short, quadrate to subquadrate, reddish, upper cells 2, long-cylindrical, yellowish; rhizoids rare, at base of branches, dark red, smooth, mostly not branched. Secondary stem and branch buds short and swollen; leaves oblong-ovate, not ranked, turgid, erect to erect-spreading from the base when dry, erect-spreading when wet, 1.2–1.6 mm long, concave, clasping at base, variously auriculate; apices acute, mucronate to shortly apiculate, leaf tips often reflexed; margins broadly incurved above, usually meeting or overlapping at upper margins, entire below, usually serrulate below the apex; costa absent; leaf cells linear-flexuose, porose, median cells 30–60 × 3–4 μm; basal cells shorter and broader, alar cells bulging in excavate groups, subquadrate to short-rectangular, 10–28 × 10–20 μm, usually dark red or reddish orange. Dioicous. Perigonia gemmate, lateral on secondary stems and branches, 1.0 mm long, outer perigonial leaves clasping at base, erect to recurved above, 0.8–1.0 mm long, inner perigonia leaves broadly ovate, orange-red across the base, cells elongate-flexuose, porose throughout, costa absent; paraphyses and curved-cylindrical antheridia numerous. Perichaetia terminal on short lateral branches, unfertilized perichaetial to 2 mm long; paraphyses and archegonia numerous; leaves clasping below, squarrose above; fertilized perichaetia with densely hairy vaginula; leaves sheathing, outer leaves to 1.5 mm long, inner leaves oblong-lanceolate, long-acuminate, 3.5–4.0 mm long; costa absent, laminal cells long-linear, porose. Setae elongate, 7–8 mm long, smooth below and papillose above, red or reddish brown. Capsules exserted, erect, ovoid to short-cylindrical, 1.5–2 mm long; exothecial cells subquadrate to shortly and irregularly rectangular, firm-walled; stomata superficial on neck; opercula long-rostrate, 1.5 mm long; annuli rudimentary; peristome yellowish white, exostome teeth 0.42 mm long, dorsal (outer) surface lightly horizontally striate at base, finely papillose above, trabeculae weakly developed on both sides, endostome 2/3 the exostome length, basal membrane low, segments filamentous, narrowly perforated, papillose, cilia rudimentary or absent. Calyptrae cucullate, 3–4 mm long, densely hairy. Spores oblong, spherical, rounded-triangular, lightly roughened, 34–54 μm.

Etymology. The specific epithet *mascarenica* refers to the Mascarene island group (Réunion, Mauritius, Rodrigues).

Distribution. Africa (Malagasy Republic, Réunion).

Illustration. Figure 5.

Ecology. On tree bark and twigs, often pendent from trees; 1350–2200 m.

Specimens examined. AFRICA. MALAGASY REPUBLIC. Antananarivo: *Crosby & Crosby 5272* (MO), *5383* (MO), *Cremers 1763* (MO), *Camboué* (H, S), *Borgen 30* (H, L), *Villaume* (FH); Antseranana: *Dufournet* (S); Fianarantsoa: *Crosby & Crosby 6830* (MO); Mahajanga: *Humbert & Capuron s.n.* (S), 29/11 1901, *indigenous collector* (L). REUNION. Arrondissement au Vent: *Bory St. Vincent* (BM, G, H, L), *Een 350* (MO, S), *321* (S); Arrondissement su le Vent: *Chauvet*, 1894, (FH, S), *Crosby & Crosby 9006* (FH, G, H, L, MO, NY, PC, S, US).

Pilotrichella mascarenica is a small to medium sized species with oblong-ovate leaves that have inconsistently recurved apices. It is identical in size to some forms of *P. mauiensis*, but that species differs from *P. mascarenica* in having cuspidate leaves with erect apices. Many collections of *P. mauiensis* also differ from *P. mascarenica* in having short branches with deciduous leaves, flagelliform branch tips or slender branchlets with microphyllous leaves. *Pilotrichella mascarenica* is identical to *P. flexilis* in many features, and both species have enlarged, irregularly shaped spores. The leaves of *P. mascarenica*, however, have strongly incurved upper leaf margins that commonly overlap just below the apex. It further differs from *P. flexilis* in having shorter, narrower leaves, and shorter setae.

Pilotrichella mascarenica is the same size as most species of *Orthostichella*. Typically *Orthostichella* has spirally arranged (especially branch) leaves, and this feature usually distinguishes it from *P. mascarenica.* There are some collections of *Orthostichella* with leaves indistinctly spirally ranked and these can be difficult to distinguish from *P. mascarenica.* The alar cells in all species of *Orthostichella*, however, are weakly differentiated and because they are not excavate-bulging the individual cells can be clearly seen.

4. *Pilotrichella mauiensis* (Sull.) Jaeg., Ber. Thätigk. St. Gallischen Naturwiss. Ges. 1875–76: 255. 1877. *Meteorium mauiensis* Sull., Proc. Amer. Acad. Arts 3: 182. 1855. Protologue: Hawaii. East Maui, Sandwich Islands;

on the north bank of the Crater, at an elevation of 10,200 feet. Holotype: East Maui, Sandwich Islands; on the north bank of the crater Haleakala, U.S.E.E. Wilkes 1838/42 (FH). Isotypes: East Maui, north Bauky [sic] Crater, 10200 ft high! Sandwich Island, Herbarium of the U. S. Exploring Expedition under the Command of Capt. Wilkes (NY); East Maui, Wilkes Expl. Exp. (NY); East Maui, North Bank of Crater, 10200 ft alt. Sandwich Isds. U. S. Ex. (NY); Hawaii, Wilkes Exped. E. Maui (FH).

Pilotrichella flagellifera Besch., Mexic. Pl. 39. 1872, illegitimate name, protologue includes an earlier name in synonymy. Based on: Mejico (*Ehrenberg*); Orizaba (*Bourgeau*). Mexico, Orizaba, 1866: *Bourgeau*, Herb. Émil Bescherelle: 1900. (BM). Mexico. leg. *C. Ehrenberg* (BM); Mexico. *C. Ehrenberg* (BM); Mexico, Orizaba, Herb. Hampe 1881 (BM).

Pilotrichella cochlearifolia var. *flagellifera* Besch., Mém. Soc. Sci. Nat. Cherbourg 16: 223. 1872. Protologue: Mexico. Orizaba (*Bourgeau*). Holotype. Mexico, Orizaba, 1866: *Bourgeau*, Herb. Émil Bescherelle: 1900. (BM).

Meteorium vulcanicum Mitt. In: Seem., Fl. Vit. 395. 1873. Protologue: Hawaii. Hawaii ad montem ignivomen (Macrae! in Herb. Musaei Brit.). Isotype. Owyhee. ad m. ignivomen. Macrae, Jan. 1825, sin. coll. (FH).

Pilotrichella desmoclada C. Müll., Flora 82: 464. 1896. *Weymouthia desmoclada* (C. Müll.) Broth., Nat. Pflanzenfam. 1(3): 812. 1906. Protologue: Hawaii. Insulae Hawaiicae, sine loco speciali, sed vero-similiter e regionibus altioribus: *Dr. Hillebrand*. Lectotype: Hawaii: sine loco designato. leg. *Dr. Hillebrand* (H, designated here). Isotypes: Hawaii: sine loc spec., leg. *Dr. W. Hillebrand* (FH); Hawaii. leg. *Hillebrand* (H).

Nomenclatural note. There is some confusion surrounding the type material of *P. cochlearifolium* and *P. flagellifera*. This is because the protologues of *P. cochlearifolium* and *P. flagellifera* cite similar specimens AHabitat in regno Mexicano, ubi legit Cl. *C. Ehrenberg* [*P. cochlearifolium*] or Mejico (*Ehrenberg*) [*P. flagellifera*], and all available type material give only "Mexico leg. *C. Ehrenberg*" or "Mexico. *C. Ehrenberg*" on their labels. This group of specimens represents two species; the material in BM is *P. flagellifera* (= *P. mauiensis*), and the material in H, JE, S is *P. cochlearifolia* (= *P. flexilis*).

Plants medium-sized, dull, light green, yellow-green, or golden brown, in stiff mats, sometimes with pendent strands. Primary stems yellow-red to red, creeping, in cross section sclerodermis with 4–6 thick-walled cells, cortical cells enlarged, firm-walled, hyaline to yellow, central strand absent; rhizoids in circular clusters abaxially to the leaf insertions, dark-red, smooth to finely roughened, mostly not branched. Paraphyllia absent. Pseudoparaphyllia absent, scale leaves present over branch buds. Leaves reduced, erect-clasping, broadly ovate, auriculate at base, 0.8–1.0 mm long; apices acuminate, hair-pointed; leaf cells linear-flexuose, thick-walled, porose, alar cells dark red, subquadrate to short-rectangular, upper margins serrulate. Secondary stems arising irregularly from the primary stems, creeping or pendent, to 25 cm long, irregularly branched; in cross section sclerodermis with 4–5 small, thick-walled, reddish orange cells, cortex cells enlarged, firm-walled, pale yellow, central strand absent; axillary hairs 4–5 cells long, basal cells 1–2, short, quadrate to subquadrate, reddish, upper cells 2–3, long-cylindrical, reddish; rhizoids present. Secondary stem and branch apices short and swollen; leaves ovate to oblong-ovate, not ranked, wide-spreading to erect-spreading, margins incurved when dry, erect-spreading when wet, 1–2 mm long, concave, clasping at base, rounded to the insertion or weakly auriculate; apex acuminate, long or short cuspidate, leaf tips straight not reflexed; margins broadly incurved above, entire below, serrulate below the apex; costa absent; leaf cells linear-flexuose, porose throughout, median cells 16–50 × 3–4 μm; basal cells shorter and broader, alar cells in bulging, excavate groups, subquadrate to short-rectangular, 14–20 × 2–12 μm, yellow-red, reddish orange or red. Plants often having slender branches with microphyllous leaves, flagelliform branch tips, or deciduous leaves. Dioicous. Perigonia gemmate, lateral on secondary stems and branches, 1.0–1.3 mm long, outer perigonial leaves clasping at base, squarrose recurved above, 0.8–1.0 mm long, inner perigonia leaves broadly ovate below, long-acuminate above, orange-red across the base, cells elongate-flexuose, porose throughout, costa absent; paraphyses and curved-cylindrical antheridia numerous. Perichaetia terminal on short lateral branches, unfertilized perichaetia to 2.5 mm long; paraphyses and archegonia numerous; leaves clasping below, squarrose above; fertilized perichaetia with hairy vaginula; leaves sheathing, outer leaves to 2.0 mm long, inner leaves oblong-lanceolate, long-acuminate, 3 mm long; costa absent, laminal cells linear and porose. Setae elongate, 5–15 mm long, smooth to lightly roughened below, papillose above, red. Capsules exserted, erect, ovoid to short-cylindrical, 1.5–2.0 mm long; exothecial cells subquadrate to short, irregularly rectangular, firm-walled; stomata superficial on neck; opercula long-rostrate, 1.0–1.5 mm long; annuli rudimentary; peristome yellowish white, exostome to 0.5 mm long, dorsal (outer) surface lightly horizontally striate at base, finely papillose above, trabeculae weakly developed on both sides, endostome 2/3 the exostome length, basal membrane low, segments filamentous, narrowly perforated, papillose, cilia rudimentary or absent. Calyptrae cucullate, hairy, to 3.5 mm long. Spores round, irregularly rounded to oblong, lightly roughened, 20–28 μm.

Etymology. The specific epithet *mauiensis* refers to the Hawaiian island on which the type of the species was collected.

Distribution. Hawaii; Mexico; Caribbean (Cuba); Central America (Belize, Guatemala, Honduras, Nicaragua, Costa Rica, Panamá); South America (Bolivia).

Illustrations. Bartram (1933, Fig. 125). Figures 6 & 7.

Ecology. On tree trunks, pendent from branches, on shrubs, vines or twigs; 120–3109 m.

Selected specimens examined. HAWAII. Hawaii: *Skottsberg 1341* (FH, H, S); Kauai: Small, *Mosses of the Hawaiian Islands 10* (F, FH, L, MO, NY, S); Maui: Hoe, *Bryophyta Hawaiica Exsiccata 37* (B, FH, H, MO, NY, S); Oahu: *Forbes, 2/12–19/09* (FH, L).

MEXICO. Chiapas: *Hermann 26405* (H, MO, NY); Guerrero: *Croat 45624A* (FH, G, H, MO, NY, US); Hidalgo: Pringle, *Plantae Mexicanae 10417* (B, BM, FH, G, H, JE, L, MO, NY, S); *Jalisco Crum 892* (S); Oaxaca: *Maldonado & Martin 237* (MO); Puebla: *Cárdenas 89* (H); San Luis Potosi: *Ferguson 7* (NY); Tamaulipas: *Pursell 5631* (MO); Veracruz: *Hermann 28836* (NY).

CUBA. Santiago de Cuba: *Clément 309* (NY).

BELIZE. Toledo: *Allen 18831* (BRH, MO). GUATEMALA. Alta Verapaz: *Standley 90725* (FH); Zacapa: *Steyermark 43227* (FH). HONDURAS. Atlántida: *Allen 17399A* (MO); Lempira: *Allen 11596* (MO); Yoro: *Allen 13589* (MO). NICARAGUA. Estelí: *Stevens & Grijalva 15632* (MO, NIC); Jinotega: *Henrich & Stevens 283* (MO); Matagalpa: *Granow de la Cerda 2167* (MO, NY). COSTA RICA. Alajuela: *Brenes 16985* (NY); Cartago: *Standley 41487* (FH, JE, S, US); Guanacaste: *Dodge et al. 7915* (FH); Heredia: *Crosby 10870* (H, NY); Puntarenas: *Croat 47131* (MO); San José: *Stevens 13704* (MO). PANAMA. Chiriquí: *Croat 16057* (MO, S).

BOLIVIA. Santa Cruz: *Herzog 3991* (JE).

Pilotrichella mauiensis was described from the Hawaiian islands and the species exhibits considerable variation there in plant size and overall aspect. Bartram (1933), however, considered the leaf characters of the species so consistent that he included all of its forms in a single species. The Hawaiian collections of *P. mauiensis* are instructive in showing important variations not only in plant size and aspect, but in leaf cuspid length, as well as the presence/absence of both flagelliform branch/stem apices and slender branchlets with microphyllous leaves. The plant variations exhibited by the Hawaiian plants, however, do not demonstrate the full range of variation found in the species. For example, plants of *P. mauiensis* from southern Mexico, Guatemala, Belize, and northern Honduras can be especially large and have long-cuspidate leaves (see *e.g.*, *Hermann 28836* NY or *Allen 17364* MO). When first encountered this extreme Neotropical expression seems to be distinct from the Hawaiian *P. mauiensis.* The species, however, when taken as a whole shows complete intergradation in size and leaf cuspid length. Furthermore, leaf cuspid length is remarkably variable within single collections. Critical features that separate *P. mauiensis* from other members of *Pilotrichella* include its erect, usually cuspidate leaf apices, weakly auriculate leaf bases, alar cells differentiated in a relatively small, discrete area, the occurrence of flagelliform branch apices, and the presence of slender branchlets with microphyllous leaves.

Although the slender branchlets in this species appear to be axillary, they in fact arise on the dorsal side of the leaf from the line of alar cells that marks the transition from the alar region to the laminal cells. Since they originate from a single cell they are extremely deciduous. When young the branchlets have the same appearance as the axillary propagula found in *Pohlia* Hedw., and as they begin to elongate they look similar to the axillary brood branches of *Pseudotaxiphyllum elegans* (Brid.) Iwats. When fully formed they can be 15 mm long and have microphyllous leaves with axillary brood bodies. These branchlets also occur around branch primordia. Newton (2002) gives an excellent, detailed account of these branchlets. Newton (2002) attributes these structure to *P. flexilis*, but flagelliform branchlets are unknown in that species and her plants almost certainly are *P. mauiensis.*

The leaf apices of *P. reesei* and *P. mauiensis* are similar, and both species have short, swollen apical buds as well as slender branchlets. *Pilotrichella reesei*, however, never has flagelliform branch apices, and its leaves are distinctly auriculate with extensively developed alar cells. Furthermore, the leaves of *P. reesei* differ from those of *P. mauiensis* in occasionally having shortly mucronate, recurved apices.

The leaves of *P. flexilis* and *P. mauiensis* are similar in the form and distribution of their alar cells, and both species can have deciduous leaves. Plants of *P. flexilis* are generally larger than those of *P. mauiensis*, and their leaf apices are more consistently mucronate with most of the apices distinctly recurved. *Pilotrichella flexilis* also never has flagelliform branch apices or slender branchlets.

5. *Pilotrichella reesei* Allen & Magill, *sp. nov.*

TYPE: Dominican Republic. Prov. La Vega: 12 km S of Constanza on road to Valle Nuevo, 6000 feet, 18o52'N, 70o42'W, 9 January 1987, *William R. Buck 14015* (holotype NY).

Species haec a *P. cuspidanti foliis* breviter cuspidatis vel mucronatis differt.

Plants slender to medium-sized, dull, light green, yellow-green, reddish yellow, or golden brown, in loose or stiff mats, at times with pendent strands. Primary stems yellow-red, creeping, in cross section sclerodermis with 4–6 cells thick-walled cells, cortex cells enlarged, thick-walled, hyaline to yellow, central strand absent; rhizoids sparse, in circular clusters abaxially to the leaf insertions, dark-red, smooth to finely roughened, mostly not branched. Paraphyllia absent. Pseudoparaphyllia absent, scale leaves present over branch buds. Leaves reduced, erect to appressed, broadly ovate, auriculate at base, 0.9–1.5 mm long, acuminate, hair-pointed; cells linear-flexuose, thick-walled, porose, alar cells dark red, subquadrate to short-rectangular, upper margins serrulate. Secondary stems arising irregularly from the primary stems, often pendent, to 10 cm long, irregularly branched; in cross section sclerodermis with 4–5 small, thick-walled reddish orange cells, cortex cells enlarged, firm-walled, pale yellow, central strand absent; axillary hairs reddish throughout, 3–5 cells long, basal cells 1–2, short, quadrate to subquadrate, upper cells 2–3, long-cylindrical; rhizoids not seen. Secondary stem and branch apices somewhat elongate and terete to short and swollen; leaves ovate-deltoid to broadly ovate, not ranked, wide-spreading to erect-spreading from the base, margins incurved dry, erect to erect-spreading when wet, 1.7–2.5 mm long, concave, clasping at base, auriculate; apices mucronate to short cuspidate, leaf tips straight or reflexed; margins broadly incurved, entire below, serrulate below the apex; costa absent; leaf cells linear-flexuose, porose throughout, median cells 40–60 × 3–5 μm; basal cells shorter and broader, alar cells bulging in strongly differentiated, excavate groups, subquadrate to short-rectangular, 14–30 × 10–14 μm, yellow-red, reddish orange or red. Dioicous. Perichaetia terminal on short lateral branches, unfertilized perichaetia to 1.5 mm long; paraphyses and archegonia numerous; leaves clasping below, squarrose above, costa absent, cells linear and porose. Perigonia and sporophytes not seen.

Etymology. This species is named for the American bryologist and Calymperaceae specialist William Dean Reese (10 September 1928–4 February 2002).

Distribution. Mexico and the Caribbean (Cuba, Dominican Republic, Puerto Rico).

Illustration. Figure 8.

Ecology. On tree trunks, old fern fronds, and logs; 1000–1829 m.

Selected specimens examined. MEXICO. Chiapas: *Hale & Soderstrom 20251* (MO).

CUBA. Sancti Spíritus: *Pócs & Borhidi 3. X. 1978* (NY); Santiago de Cuba: *Buck 7733* (NY). DOMINICAN REPUBLIC. Barahona: *Zanoni et al. 30212* (MO); La Estrelleta: *Reese 15340* (NY); La Vega: *Buck 7959*

(NY); Peravia: *Steere 22838* (NY). PUERTO RICO. Ponce: *Laubengayer s.n.* (MO, NY).

Pilotrichella reesei does not appear to have a single unique feature, rather its distinctiveness resides in the presence of a unique combination of features found variously in *P. cuspidans, P. mauiensis*, and *P. flexilis.* The species has been confused with *P. flexilis* and *P. cuspidans, e.g.*, some collections of *P. reesei* originally named *P. cuspidans* were later annotated as *P. flexilis*, and others originally named *P. flexilis* were annotated *P. cuspidans.*

Plants of *P. reesei* usually have attenuate stem apical buds, and leaves that are distinctly auriculate. These two features are indicative of *P. cuspidans.* In addition, the leaves of *P. reesei* have the extensive alar cell development characteristically found in *P. cuspidans.* These same collections, however, usually have short, swollen branch apical buds, and occasionally collections have flagelliform branchlets. These latter two features are associated with *P. flexilis* and *P. mauiensis.* The leaves of *P. reesei* are never as long-pointed as those of *P. cuspidans*, rather they vary from short cuspidate (identical to those of *P. mauiensis*) to mucronate (identical to those of *P. flexilis*). Significantly adding to the confusion surrounding this species is the fact that while usually the leaf apices are erect (a feature of *P. cuspidans* and *P. mauiensis*), occasionally its short mucronate leaves have

distinctly recurved apices (a critical feature of *P. flexilis*). On the basis of its distinctive alar cell development *P. reesei* seems more closely related to P. cuspidans than to either *P. mauiensis* or *P. flexilis.*

6. *Pilotrichella vermiformis* Allen & Magill, *sp. nov.*

TYPE: Peru. Dept. San Martin, Prov. Rioja, Strasse Chachapoyas-Moyobamba km 397, w-exponierter Hang im Bergregenwald auf Sandstein, 1500 msm, 30 August 1982, *J.-P. Frahm, P. Geissler, S. R. Gradstein, G. Philippi, W. Schultze-Motel 196* (holotype B, isotypes H, MO, NY).

Species haec a *P. flexili foliis* brevioribus cum superis marginibus breviter incurvis differt.

Plants small to medium-sized, dull, light green to brown-green, in loose, pendent mats. Primary stems not seen. Secondary stems long, trailing, and often pendent, to 12 cm long, irregularly branched, branches numerous, short or elongate, the elongate branches identical to the secondary stems; in cross section sclerodermis with 4–5 small, thick-walled, reddish orange cells, cortex cells enlarged, firm-walled, pale yellow, central strand absent; axillary hairs reddish throughout, 3–5 cells long, basal cells 1–2, short, quadrate to subquadrate, upper cells 2–3, long-cylindrical; paraphyllia absent; pseudoparaphyllia absent, branch primordia with scale leaves; rhizoids sparse, in circular clusters abaxially to the leaf insertions, dark-red, smooth to finely roughened, mostly not branched. Secondary stem and branch apices short and swollen; leaves broadly ovate to obovate, at times panduriform, not ranked, erect-spreading, margins incurved when dry, erect when wet, 1.2–1.6 mm long, concave, clasping at base, auriculate; apices acute to broadly rounded, mucronate, leaf tips straight or reflexed; margins shortly incurved to plane, entire to obscurely serrulate above; costa absent; leaf cells linear-flexuose, porose throughout, median cells 26–66 × 3–5 μm; basal cells shorter and broader, alar cells bulging in strongly differentiated excavate groups, subquadrate to short-rectangular, 14–20 × 10 μm, yellowish red. Perigonia gemmate, lateral on secondary stems and branches, to 1.0 mm long, outer perigonial leaves clasping at base, squarrose recurved above, to 1.0 mm long, inner perigonia leaves broadly ovate below, acuminate above, orange-red across the base, cells elongate-flexuose, porose throughout, costa absent; paraphyses and curved-cylindrical antheridia numerous. Perichaetia and sporophytes not seen.

Etymology. The specific epithet *vermiformis* refers to the turgid, worm-like appearance of its stems and branches.

Distribution. South America (Peru).

Illustration. Figure 9.

Ecology. Apparently epiphytic; 1500–1550 m.

Specimens examined. PERU. Huánuco: *Plowman & Schunke 11723A* (NY); San Martin: *Frahm et al. 186* (B, NY), *196* (B, H, MO, NY).

Pilotrichella vermiformis is a small to medium-sized species with turgid stems/branches, and short, often obovate leaves that are broadly rounded to mucronate at the apex. The species also characteristically has plane or weakly incurved upper leaf margins. The leaf apices of *P. vermiformis* are usually erect, especially those of the stem/branch apical buds, but some leaves have recurved apices. The presence of some leaves with recurved apices and alar cells that are restricted to small, bulging, excavate groups indicates *P. vermiformis* is close to *P. flexilis*. *Pilotrichella flexilis* is a larger plant than *P. vermiformis* and its upper leaf margins are much more broadly incurved. *Pilotrichella vermiformis* is similar in size to *P. mascarenica*, but that species has narrower, more abruptly acute leaves, and strongly incurved upper leaf margins that commonly overlap below the apex.

Type not seen.

Pilotrichella thunbergii (Brid.) Jaeg., Ber Thätigk. St. Gallischen Naturwiss. Ges. 1875–76: 258. 1877. *Hypnum thunbergii* Brid., Muscol. Recent. 2(2): 172. 1801. *Isothecium thunbergii* (Brid.) Brid., Bryol. Univ. 2: 381. 1827. *Meteorium thunbergii* (Brid.) Mitt., J. Linn. Soc., Bot. 12:

432. 1869. Protologue: Jamaica. In Jamaica habitat, unde Cel. *Thunbergius* ad Jussioeum anno 1788 misit.

Wijk et al. (1967) make this a synonym of *Pilotrichella flexilis* on the authority of Crum and Steere (1957). In fact, Crum & Steere (1957) and Crum & Bartram (1958) list this taxon as a synonym of *Orthostichella hexasticha* (Schwaegr.) Buck. The protologue for *Hypnum thunbergii* indicates the plant came from Jamaica, and it has double costate, six-ranked leaves. These features indicate the taxon does not belong in *Pilotrichella*. *Orthostichella hexasticha* has never been collected in Jamaica, and it seems likely *Hypnum thunbergii* is an older species name for *Orthostichidium guyanense* (Mont.) Broth. The type of *Hypnum thunbergii* Brid. is not present at B, it may be at PC.

Excluded species

1. *Pleurozium quitense* (Mitt.) Allen & Magill, *comb. nov.*

Meteorium quitense Mitt., J. Linn. Soc., Bot. 12: 439. 1869. *Pilotrichella quitensis* (Mitt.) Jaeger, Ber. Thätigk. St. Gallischen Naturwiss Ges. 1875–76: 257. 1877. Protologue: Ecuador. Andes Quitenses, *Jameson*; in monte Pichincha (11,000 ped.), *Spruce* n. *1042*. Lectotype (designated here): Ecuador. Andes Quitense in monte Pichincha (11,000 ped), *Spruce 1042* (BM); isolectotypes: And. Quito (ad terram mihi videtur!), *Spruce 1042* (H), Pichincha, *Spruce s.n.* (NY); syntype: Pichincha, S. A., *Jameson s.n.* (NY).

Hypnum quitense Mitt. In: Spruce, Cat. Musc. 15. 1867, invalid name, lacks a description.

Lembophyllum bolivianum Herz., Biblioth. Bot. 87: 123. 1916. Protologue: Bolivia. Zwischen Gras in der Felsschlucht von Toncoli, ca. 3500 m, N° *4382* [Herzog]; an der Waldgrenze des Rio Saujana ca. 3500 m, N° *3250*/a [Herzog]. Types not seen, synonymized by Churchill & Linares (1995).

Plants medium to large-sized, dull, light green to brown-green, in loose mats. Primary stems creeping. Secondary stems long and spreading, to 15 cm long, irregularly branched, branches short or elongate, 1–2 cm long, often attenuate or ending in flagellate tips; in cross section sclerodermis with 3–5 small, thick-walled, yellow to reddish orange cells, cortex cells enlarged, thin-walled, pale yellow, central strand present; axillary hairs 4–5 cells long, basal cells 2, short, subquadrate, reddish, upper cells 2–3, long-cylindrical, hyaline; paraphyllia absent; pseudoparaphyllia absent, branch primordia with scale leaves; rhizoids sparse, generally on the parts of the stems that touch the substrate, in circular clusters abaxially to the leaf insertions, dark-red, smooth, mostly not branched. Secondary stem and branch apices short and swollen; leaves broadly ovate to obovate, at times panduriform, not ranked, loosely erect with margins erect to broadly incurved when dry, erect when wet, 1.2–2.0 mm long, concave, clasping at base, variously auriculate; apices broadly acute to obtuse-rounded, leaf tips straight; margins broadly incurved above, serrulate at base, serrulate to serrate above and across the apex; costae short, indistinct, double or single; leaf cells linear-flexuose, apical cells 8–20 × 3–4 μm long, not porose, median cells 30–60 × 3–4 μm, smooth or weakly porose, basal cells porose, alar cells strongly differentiated in bulging, excavate groups, subquadrate to short-rectangular, partially bistratose, 4–5 μm × 6–8 μm, thick-walled, golden yellow, yellowish red, or brown. Dioicous. Perigonia not seen. Perichaetia lateral on secondary stems, to 2.0 mm long, perichaetial leaves erect-clasping at base, outer leaves, recurved above, broadly rounded to obtuse, to 1.0 mm long, inner leaves acuminate above, to 1.6 mm long, orange-red across the base, cells elongate-flexuose, porose at base, smooth above, costa absent; paraphyses and archegonia numerous. Setae elongate, 22–28 mm long, smooth, red. Capsules exserted, erect to slightly inclined above, long-cylindrical, 2.5 mm long; exothecial cells subrectangular, oblong, or rectangular, firm-walled; stomata superficial on neck; immature operculum rostrate, 1 mm long; annulus not seen; peristome diplolepideous, exostome yellow-brown, narrowly triangular, to 0.5 mm long, dorsal (outer) surface horizontally striate in lower :, with thick papillae above, median line and trabeculae thin at base, very thick in upper 1 of tooth. ventral (inner) surface smooth to lightly papillose, trabeculae thin, somewhat projecting, endostome yellow, lightly papillose, basal membrane high, segments broad, perforated, cilia not seen. Immature calyptra cucullate, smooth, 4 mm long. Spores spherical, lightly roughened, 16–24 μm.

Etymology. The specific epithet *quitense* refers to Quito, Ecuador, the region from which the type of the species was collected.

Distribution. South America (Ecuador, Peru, Bolivia).

Illustrations. Herzog (1916, Fig. 53, as *Lembophyllum bolivianum*).

Ecology. On tree and shrub trunks, soil banks, stones in creek, and at the base of cliffs; 2800–4000 m.

Selected specimens examined. ECUADOR. Cotopaxi: *Dorr & Barnett 6265* (NY); Pichincha: *Benoist 3263* (S). PERU. Ancash: (Prov. Yungay) *Hegewald & Hegewald 7598* (MO); Ayacucho: *Frahm 823916a* (B); Cajamarca: (Prov. Cajamarca) *Sagástegul 10297* (MO), (Prov. Contumazá) *Hegewald & Hegewald 7316* (MO), (Prov. Hualgayóc) *Raimondi 3093* (B); Cusco: (Prov. La Convencion) *Bües 1471* (MO); La Libertad: (Prov. Otuzco) *Hegewald & Hegewald 7167* (H, MO). BOLIVIA. La Paz: (Prov. Inquisivi) *Lewis 38580*

(MO, NY), (Prov. Larecaja) *Lewis 83-172* (H, MO, NY), (Prov. Saavedra) *Lewis 79–1046* (MO).

Pleurozium quitense occurs on humus or soil on the ground, over rocks and at the bases of trees. It has somewhat tumid, often attenuate stems and branches. Its leaves are broadly concave, have serrulate leaf margins, linear-flexuose cells, and short double (rarely single) costae. An especially critical feature of the species is the presence of a stem central strand. Sporophytically *P. quitense* has long setae, erect to slightly inclined cylindrical capsules and a standard hypnoid peristome.

This species has long been known as *Pilotrichella quitensis*, but its standard hypnoid peristome as well as leaves with short double costae, stems with a central strand, and its terrestrial habitat preference make it impossible to place the species in *Pilotrichella*. The taxon could perhaps be accommodated in *Weymouthia* since all of the important features of *Pleurozium quitense* are found in *Weymouthia* except for one; *Weymouthia* stems lack a central strand. *Acrocladium* is a south temperate genus with the same habitat preference as *P. quitense*, a similar peristome, and stems that have a central strand. The leaves of *Acrocladium* differ from those of *P. quitense* in having short, single costae, and inflated, thin-walled alar cells.

The genus *Pleurozium* is usually considered to have a single species, *P. schreberi* (Brid.) Mitt, which is common in the north temperate regions and also present in northern South America. *Pleurozium quitense* and *P. schreberi* have the same habitat preference and stems with central strands. Furthermore, both species have attenuate branches and similar leaf forms, leaf areolation, alar cell development, costa form, seta length, capsule shape, operculum form, and peristome structure. *Pleurozium quitense* differs from *P. schreberi* in having more or less erect capsules, yellowish to dull red rather than dark red, glossy stems, and more strongly developed attenuate branches. In addition, the leaves of *P. quitense* are turgid when dry, while those of *P. schreberi* are often somewhat flattened with narrower, more or less acuminate branch leaves that are curved to spreading when dry.

Mitten seems to have had some idea of associating *Pilotrichella quitense* with *Pleurozium*. The sheet bearing the syntypes of *Meteorium quitense* at NY came from the Mitten Herbarium and was annotated by R. S. Williams with the words "Found with *H. schreberi*." Williams considered the syntypes of *Meteorium quitense* to belong to *Weymouthia*. It is of interest to note that Hermann (1976) synonomized *Lembophyllum bolivianum* with *Pleurozium schreberi*.

2. *Pilotrichella flexilis* var. *gracilis* Broth. & Par. In: Thér., Trav. Bryol. Déd. P.-T. Husnot 2 [14]: 19. 1944. Invalid name, no description given.

Based on: Haiti, Croix-des-Bouquets, Badeau, 1,300–2,000 m. [*Ekman*] (N$^{\underline{o}}$ *7666 pp.*). Haiti: Massif de la Selle, Croix-des-Bouquets, Badeau, slope towards Camp-Franc, 1300 m, 22.II.1927, leg. *E. L. Ekman 7666* (S). = *Squamidium nigricans* (Hook.) Broth.

3. *Pilotrichella serricola* C. Müll. In: Paris, Index Bryol. 949. 1897. Invalid name, no description given. Based on: Ule Bryoth. brasil. *n. 67.* E. Ule: Bryotheca Brasiliensis, N$^{\underline{o}}$ *67.* Prov. Santa Catharina: Serra Geral, Junii 1890, leg. *E. Ule* (BM). = *Squamidium brasiliense* (Hornsch.) Broth.

New distributional records

1. *Camptochaete arbuscula* (Reicht.) Broth.

There is a collection in NY, previously named *Pilotrichella mauiensis*, of *Camptochaete arbuscula* (Reicht.) Broth. The collection label gives no collector or collection number, and gives the locality only as "Sandwich Islands" (= Hawaii).The only other species of *Camptochaete* in Hawaii is *C. pulvinata* (Hook. & Wils.) Jaeg. (see Bartram 1933). *Camptochaete arbuscula* is otherwise found in southeastern Australia and New Zealand (Tangney 1997).

2. *Weymouthia mollis* (Hedw.) Broth.

There are two collections of this species at F from Tahiti (Hab. troncos de montagne, 1896, *Nadeaud*), and one collection of it at L from the Falkland Islands (Ad. ins. Maclov. (Falklandii) orient. sinum Port William Standley, Sept. m, *W. Lechler* pl. ins. Maclovian, Ed. R. F. Hohenacker). *Weymouthia mollis* has previously been reported from the Australian mainland, Tasmania, Lord Howe Island, New Zealand, the Juan Fernandez Islands, and Chile.

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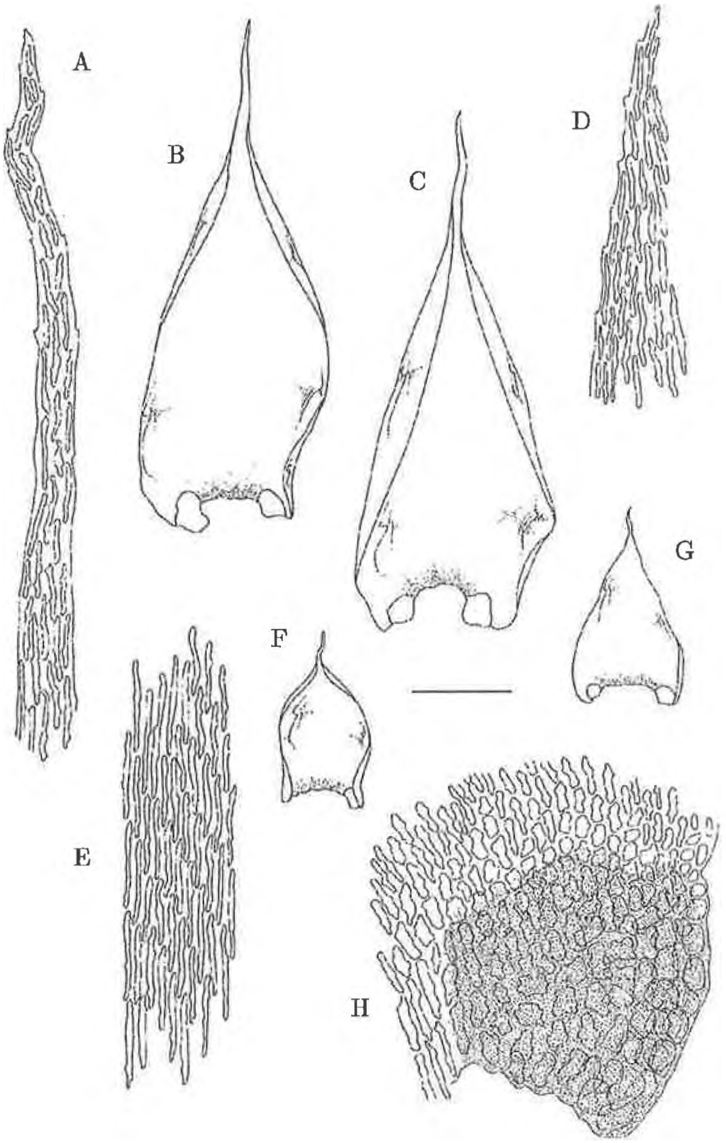

Figure 1. *Pilotrichella cuspidans.* A. Leaf apex. B & C. Branch and stem leaves. D. Upper leaf margin. E. Median leaf cells. F & G. Primary stem leaves. H. Alar cells. Scale in mm: bar = 0.06 (A, D, E, H); bar = 0.5 (B, C, F, G). Figures A–E, H from *Duncan 28*; figures F & G from *Zanoni 30375.*

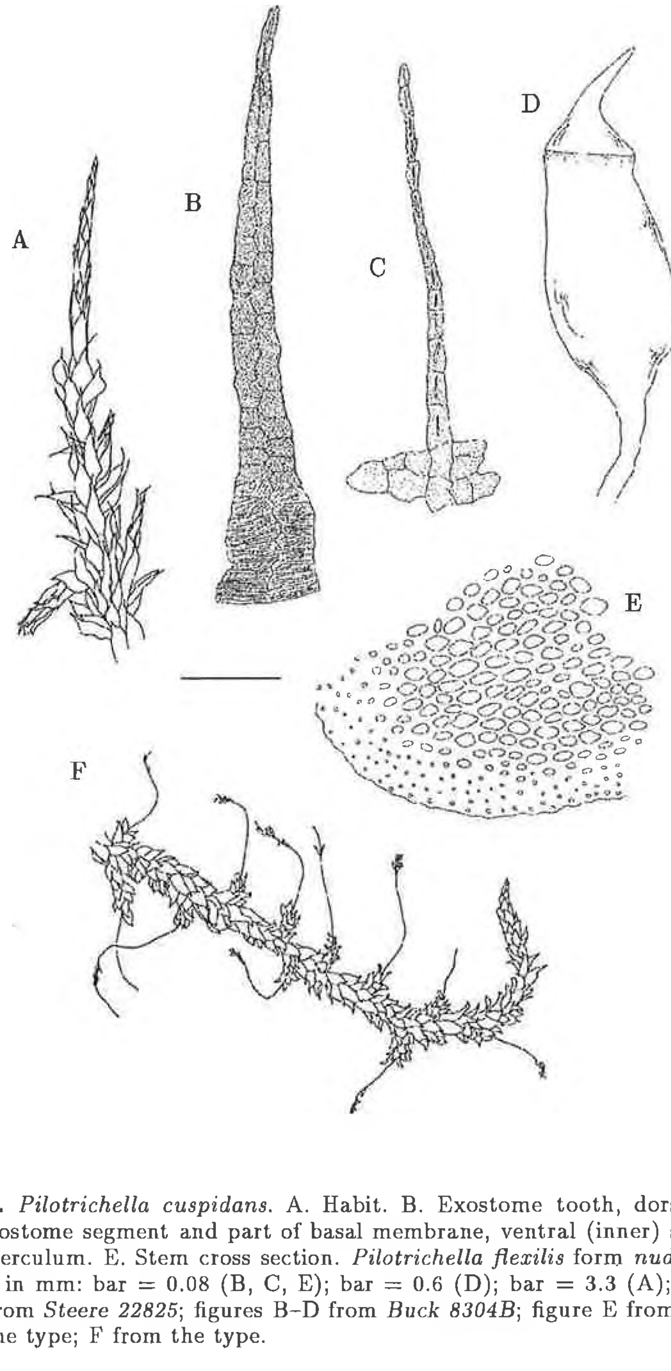

Figure 2. *Pilotrichella cuspidans*. A. Habit. B. Exostome tooth, dorsal (outer) surface. C. Endostome segment and part of basal membrane, ventral (inner) surface. D. Capsule and operculum. E. Stem cross section. *Pilotrichella flexilis* form *nudiramulosa*. F. Habit. Scale in mm: bar = 0.08 (B, C, E); bar = 0.6 (D); bar = 3.3 (A); bar = 5.1 (F). Figure A from *Steere 22825*; figures B–D from *Buck 8304B*; figure E from *Bolay 92*; figure E from the type; F from the type.

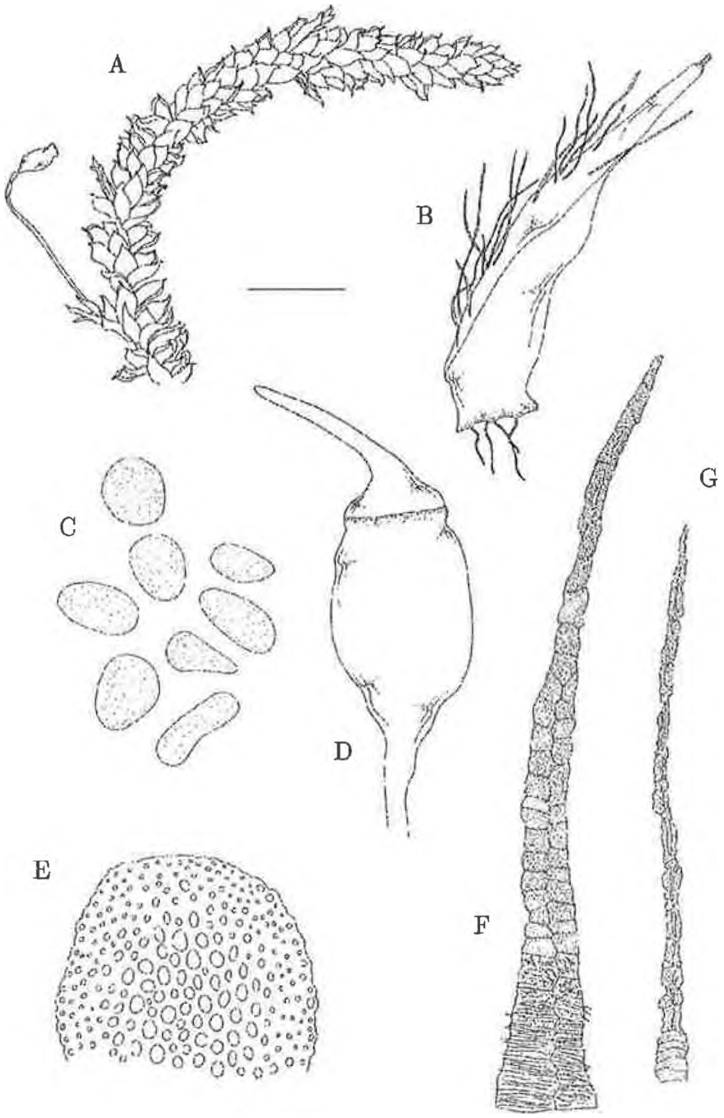

Figure 3. *Pilotrichella flexilis.* A. Habit. B. Calyptra. C. Spores. D. Capsule and operculum. E. Stem cross section. F. Exostome tooth, dorsal (outer) surface. G. Endostome segment, ventral (inner) surface and part of basal. Scale in mm: bar = 0.08 C & E); bar = 0.09 (F & G); bar = 0.71 (B & D); bar = 5.1 (A). Figures B & D from *Britton 100*; Figures A, C, E–G from *Allen 11549*.

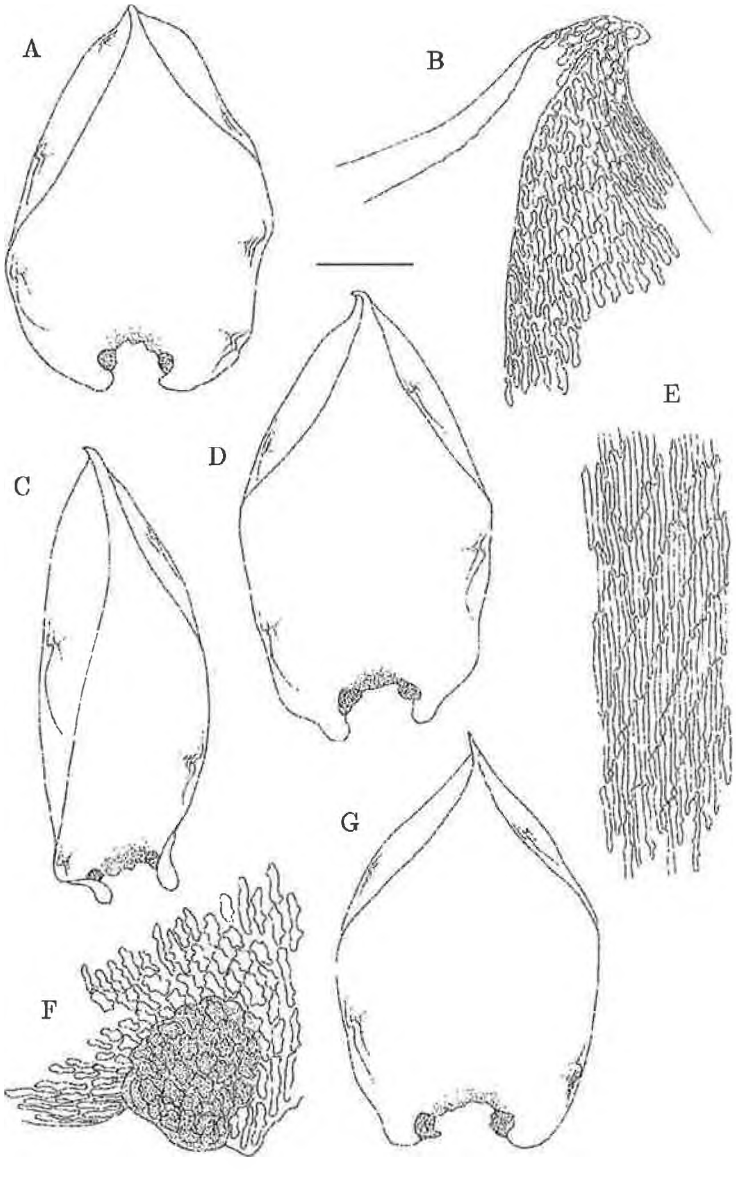

Figure 4. *Pilotrichella flexilis.* A, C, D, G. Leaves. B. Leaf apex and upper margin. E. Median leaf cells. F. Alar cells. Scale in mm: bar = 0.06 (B, E, F); bar = 0.5 (A, C, D, G). Figure A from *Pócs & Mwanjabe 6467D* (Tanzania); Figures B–F from *Allen 11549* (Honduras); Figure G from *Pócs 9011/W* (Cuba).

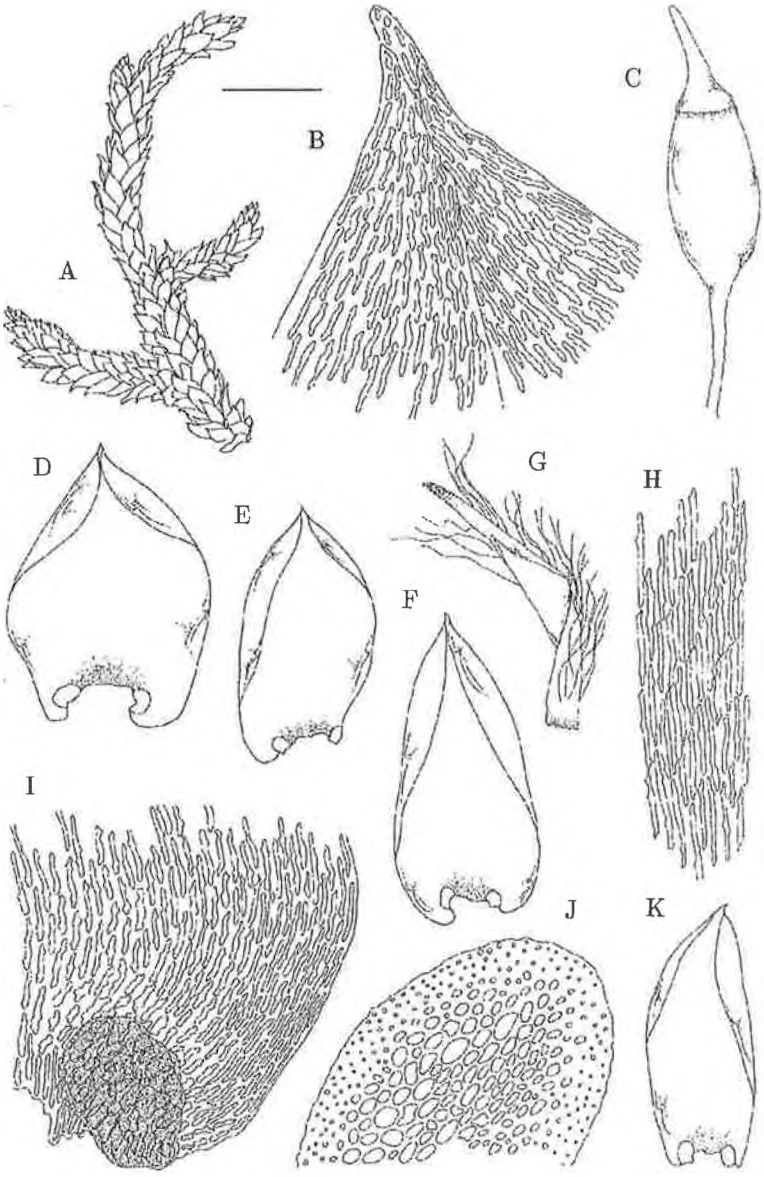

Figure 5. *Pilotrichella mascarenica.* A. Habit. B. Leaf apex and upper margin. C. Capsule and operculum. D. Stem leaf. E, F, K. Branch leaves. G. Calyptra. H. Median leaf cells. I. Alar cells and basal leaf margin. J. Stem cross section. Scale in mm: bar = 0.06 (B, H, I); bar = 0.08 (J); bar = 0.51 (C–F, K); bar = 1.3 (G); bar = 2.6 (A). Figures A, D, E, J from *Crosby & Crosby 9006*; figures B, H, F, I from the type; figures C, G from *Crosby & Crosby 5272*; Figure K from *Borgen 30*.

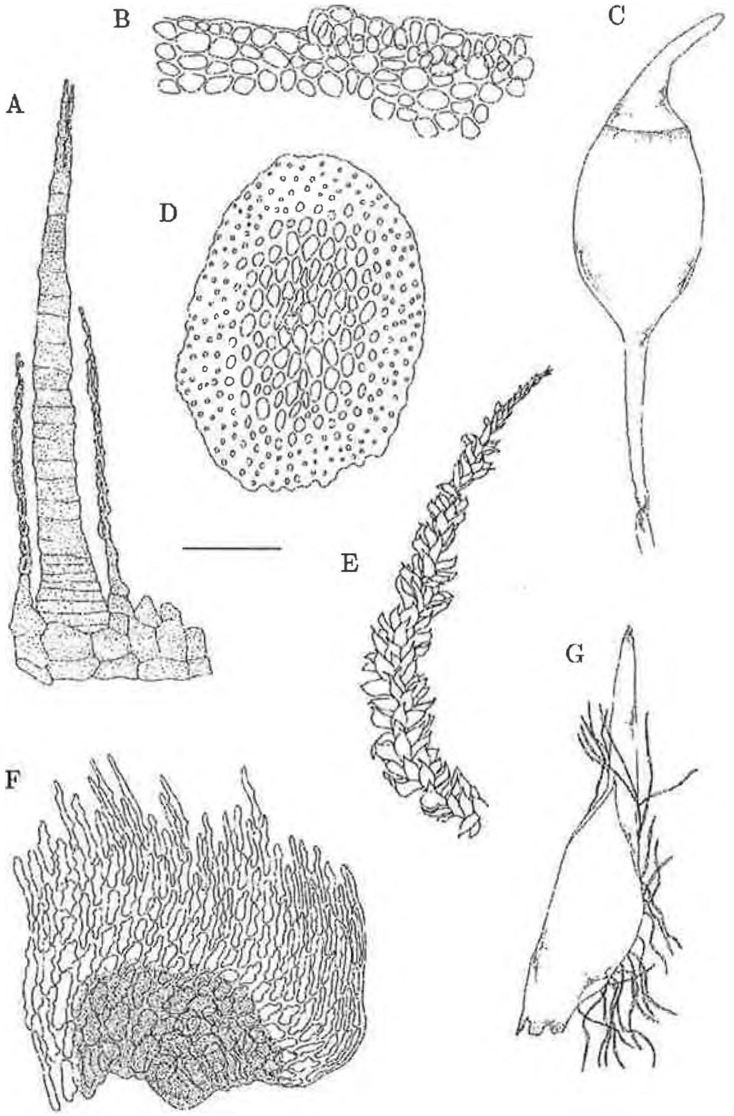

Figure 6. *Pilotrichella mauiensis.* A. Exostome tooth, two endostome segments, and part of basal membrane, ventral (inner) surface. B. Capsule mouth with rudimentary annulus. C. Capsule and operculum. D. Stem cross section. E. Habit. F. Alar cells and basal leaf margin. G. Calyptra. Scale in mm: bar = 0.06 (B, D, F); bar = 0.09 (A); bar = 0.9 C & G); bar = 2.7 (E). Figures A–C, G from Pringle 10417; figure D from the type; figure E from *Bryophyta Hawaiica Exsiccata 37*; Figure F from *Allen 17364*.

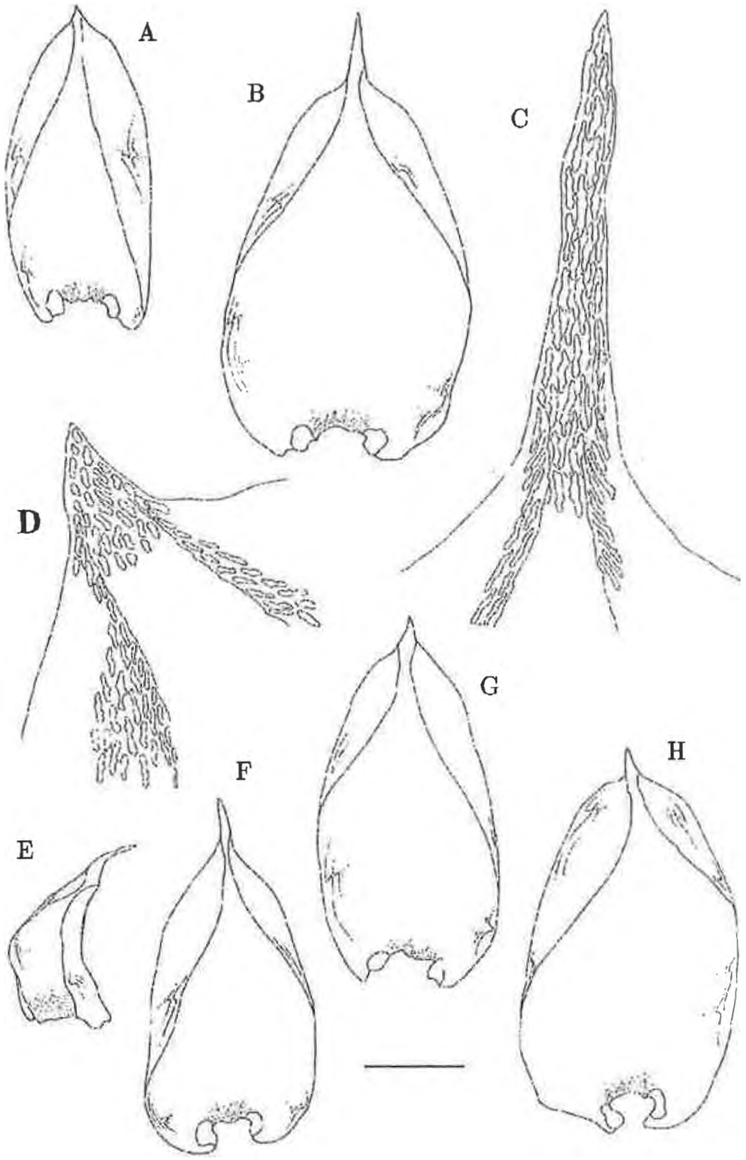

Figure 7. *Pilotrichella mauiensis.* A, B, F–H. Leaves. C & D. Leaf apices. E. Primary stem leaf. Scale in mm: bar = 0.06 (C & D); bar = 0.40 (A, B, E–H). Figures A & D from the type (Hawaii); figures B & C from Allen 17364; figures E & G from *Bryophyta Hawaiica Exsiccata 37* (Hawaii); figure F from *Hermann 28836* (Mexico); figure H from *Pringle 10417* (Mexico).

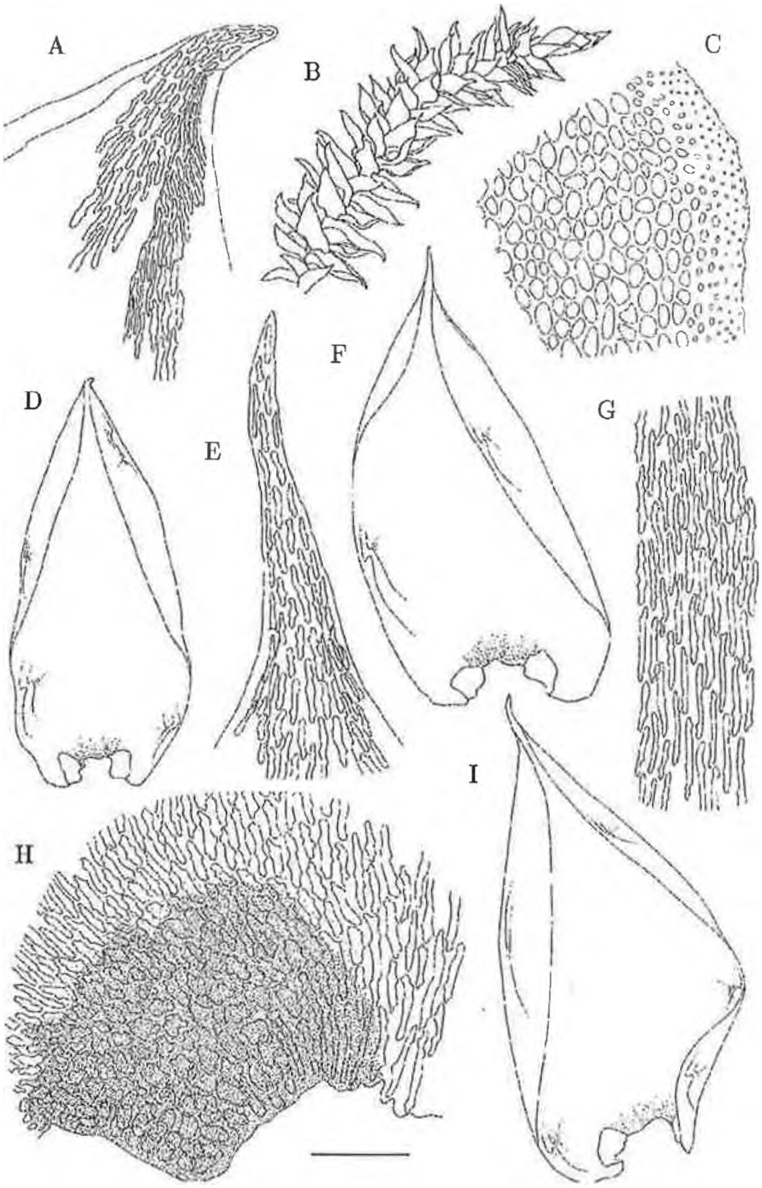

Figure 8. *Pilotrichella reesei.* A. Leaf apex and upper margin. B. Habit. C. Stem cross section. D, F, I. Leaves. E. Leaf apex. G. Median leaf cells. H. Alar cells. Scale in mm: bar = 0.06 (A, E, G, H); bar = 0.08 (C); bar = 0.5 (D, F, I); bar = 3.2 (B). All figures from the type.

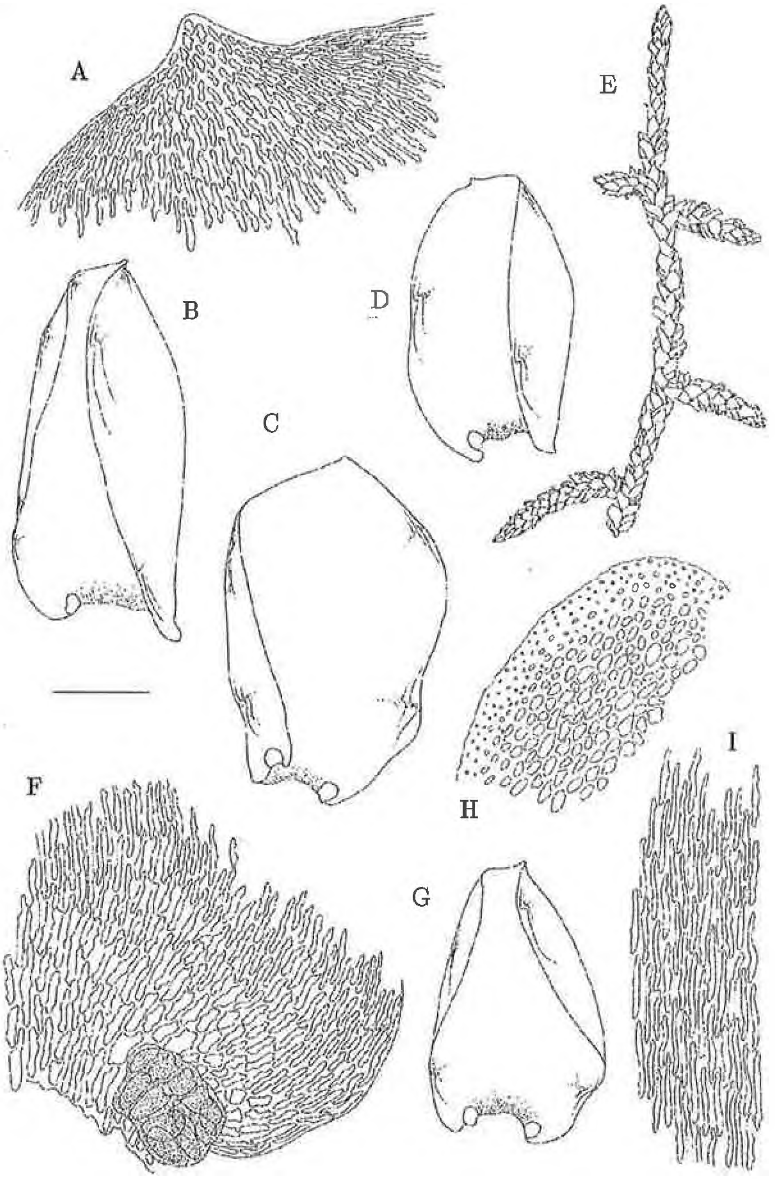

Figure 9. *Pilotrichella vermiformis.* A. Leaf apex. B & C. Stem leaves. D & G. Branch leaves. E. Habit. F. Alar cells and basal margin. H. Stem cross section. I. Median leaf cells. Scale in mm: bar = 0.06 (A, F, I); bar = 0.08 (H); bar = 0.5 (B–D, G); bar = 5.0 (E). All figures from the type.

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Vu Quang and other Vietnam Mosses Collected by Tran Ninh, B. C. Tan and T. Pócs in 2002

Tan, B. C.[1] **& Tran Ninh**[2]
[1] Department of Biological Sciences
National University of Singapore, Singapore 119260
`dbsbct@nus.edu.sg`

[2] Department of Botany, Faculty of Biology
Hanoi University of Science, Thanh Xuan, Hanoi, Vietnam
`tninh@bio-hu.edu.vn`

Abstract. A total of 77 species in 51 genera of mosses are documented for the first time from Vu Quang Nature Reserve near the Vietnam–Laos border and from the karstic area of Bien Son town in Thanh Hoa Province. *Diphyscium tamasii* B. C.Tan & Ninh is described as new to science. *Distichophyllum obtusifolium* var. *vuquangiensis* B. C. Tan & Ninh and *Trichostomum crispulum* var. *pseudocrispulum* B. C. Tan & Ninh are two new varieties described. Four taxa are reported new to Indochina, and 10 are new to Vietnam. *Isocladiella* Dix. is a new generic record for Vietnam. The composition of the moss flora of this interior part of Vietnam has been shown to be a mixture of continental Asiatic, Indochinese and Malesian taxa.

Introduction

The Vu Quang Nature Reserve (VQNR) is situated in north central region of Vietnam at about 350 km south of Hanoi in the Ha Tinh Province (see Map 1). The area of the Reserve is 55,000 hectares, with a core zone of 39,000 hectares. It lies between the latitudes of 18°09′ and 18°27′ N and longitudes of 105°16′ and 105°35′ E.

Vu Quang is an important catchment area for the major rivers in the nearby provinces bordering the Vietnam–Laos border. The average annual rainfall is 2,418 mm, while the average annual temperature is around 23 °C in the valley. The entire reserve includes a complex, massif topography of steep slopes and deeply dissected, narrow river valleys, with the highest peak, Rao Co, reaching 2,100 m in elevation. The vegetation zonation starts with seasonally dry lowland evergreen forest and gradually changes into moist montane forest at 1,400 m, and to upper montane cloud forest above 1,900 m. Most interestingly, the montane vegetation consists of expansive coniferous forest of *Fokienia hodginsii* and *Dacrydium elatum*, as well as *Dacrydium imbricatus* and species of *Amentotaxus* (Kuznetsov and Guigue, 2000).

Today Vu Quang Nature Reserve has obtained global attention because of the recent discovery of *Pseudoryx nghetinhensis*, a new species of large ungulate mammal popularly known as "Saola". Yet, the rich vascular plant resources of Vu Quang are only partly studied (Kuznetsov and Guigue, 2000) and its bryoflora has not been investigated at all.

Our survey of Vu Quang bryophytes was made in May of 2002 with funding provided by the ASEAN-ARCBC Biodiversity Program. The investigation covered mainly the gallery forest along the rivers and streams at low elevation, and on a few occasions, reaching the elevation of 1,200 m. On way to Vu Quang Nature Reserve, we also collected a few mosses from the karstic area near Bien Son town in Thanh Hoa Province. In total, 77 species in 51 genera are documented for this nature reserve and Thanh Hoa Province, with one new species, *Diphyscium tamasii*, and two new varieties, namely *Distichophyllum obtusifolium* var. *vuquangiensis* and *Trichostomum crispulum* var. *pseudocrispulum*. Additionally, 4 taxa are reported new to Indochina and 10 are new to Vietnam. *Isocladiella* Dix. is a new generic record for Vietnam.

Based on the list of mosses presented below, the Vu Quang moss flora represents an equal mixture of continental Asiatic, Indochinese and Malesian taxa. About 28% of the genera and 13% of the species of the Vietnamese moss flora are found in this nature reserve. The fact that there are three moss taxa new to science seems to indicate that the nature reserve has unique environmental conditions promoting local speciation in plants. Since the present survey has concentrated in the valleys at low elevations, further search of bryophytes at high elevations, especially along the jagged and isolated mountain ridges, will surely yield many more taxa, some of which may be new to science.

In the moss checklist below, we have included, under each species and varieties, the information of the collection sites, habitat, elevation, and also provided some taxonomic commentaries. The number inside the parenthesis [ ] indicates the locality inside the nature reserve where the specimen was collected. The citation of synonyms is limited to those found in Tan and Iwatsuki (1993). Species with one asterisk (*) is new to Vietnam, two asterisks (**), new to Indochina, and three asterisks (***), new to science.

Collection localities in Vu Quang Nature Reserve (VQNR), Ha Tinh Province

[2] Lowland riverine forest and *Homonoia riparia* bushes along Khe Cong River at Ngam Tay Du ford, 110 m, 18 May, 2002.

[3] Degraded lowland rain forest along the trail from Khe Cong River to Tram Sao-la Research Station, between 110–200 m, 19 May 2002.

[4] and [5] Degraded roadside lowland rain forest along Truoi River between Vu Quang village and Kim Quang village, ca 25–180 m, 20 May 2002.

[6] Wet primary lowland rain forest and large boulders near Bac Dau Waterfalls, at 200–270 m, 22 May 2002.

[7] Primary hill forest on the N slope of Man Dai River Valley about 2 km S of Tram Sao-la Research Station, at 200–650 m, 23 May 2003.

List of Vu Quang and other Vietnamese Mosses

***Aerobryopsis** subdivergens* (Broth.) Broth. — [3] *Tan 02-297*, [7] *Tan 02-275, 02-288, Pócs 02102*, epiphytic on branches inside forest.

This is the most common member of Meteoriaceae in the study area. The overall plant habit looks like species of *Pseudobarbella. Aerobryopsis subdivergens* can be distinguished by its oval to short-oblong leaf cells with a single papilla, whereas the species of *Pseudobarbella* has unipapillose leaf cells that are oblong-linear.

***Callicostella** papillata* (Mont.) Mitt. var. *prabaktiana* (C. Muell.) H. Streimann — [3] *Tan 02-233*, on shaded boulders along river bank.

This taxon is common in wet and shaded habitats in Vu Quang Nature Reserve. Interestingly, all the populations examined turned out to be the var. *prabaktiana*, with smooth or very weakly unipapillose leaf cells.

***Calymperes** fasciculatum* Dozy & Molk. — [7] *Tan 02-213*, on tree trunk along the trail; *Tran Ninh 70217, 70223, 70242, 702154, 702157, 702164,* on tree base and boulder along stream in Kim Quang Valley, VQNR.

The gradually long acuminate leaf apices and the thickened leaf border with bigeminate teeth are characteristic of this species.

Campylopus sp. — [2] *Tan 02-266*, on inundated, shaded river bank.

The specimen is sterile and the species determination can not be made.

***Claopodium** assurgens* (Sull. & Lesq.) Card. — [2, 3] *Tan 02-214, 02-208*, on branches and tree trunks inside forest.

**Claopodium prionophyllum* (C. Muell.) Broth. — [7] *Tan 02-285, Pócs 02102*, on boulder and shaded stream bank in forest.

The fine and slender plant habit coupled with the strongly unipapillose leaves are characteristic. The species is new to Vietnam.

***Cyathophorum** adiantum* (Griff.) Mitt. [syn. *Cyathophorella tonkinensis* (Broth. & Par.) Broth.] — *Tran Ninh 2001-102b, 2001-124*, on boulders inside forest near Tre stream, VQNR.

The synonymy of taxa of Hypopterygiaceae follows Kruijer (2002).

***Dicranella** coarctata* (C. Muell.) Bosch & Lac. — [3] *Tan 02-306*, on shaded soil bank along trail.

This is a common moss along roadside or trail margin.

***Diphyscium** mucronifoium* Mitt. [syn. *Diphyscium involutum* Mitt.] — [7] *Tan 02-210*, on rock inside forest, locally abundant.

******Diphyscium tamasii*** B. C. Tan & Ninh, spec. nov. Fig. 1: a–m.

Holotype: Vietnam, Vu Quang Nature Reserve, primary hill forest on the N slope of Man Dai River Valley about 2 km S of Tram Sao-la Research Station, at 200–650 m, on boulder in shaded forest margin near a stream, *Tan 02-207* (SINU; isotype, Herbarium of Hanoi University of Science).

Species insignis planta solitaria foliis vegetativis parvulis paucis distincta.

Plants dioicous (rhizoautoicous?), solitary, 0.5–10 mm long, including the aristate leaf tip, and 1 mm wide. Stem erect, leaves imbricate; vegetative leaves few and highly reduced, narrowly deltoid to lanceolate, about 0.25 mm wide and 3 mm long, plane, laminal cells polygonal to short rectangular, smooth, unistratose throughout, costa broad, slightly excurrent. Perichaetial leaves numerous, ovate-lanceolate, ca 3–4 mm wide and 7–8 mm long, acute to obtuse, with long excurrent and prorulose costa, the arista distally bent, often longer than the length of the unistratose lamina; inner perichaetial leaves oblong-lanceolate, emarginate or bifurcate apically, but not laciniate, margin entire, distally crenulate, non-ciliated; upper leaf cells polygonal to rectangular, (3–)5–8 μm wide and 13–18 μm long, thick-walled, smooth; basal leaf cells oblong to rectangular, 10–13 μm wide and 25–50 μm long, moderately thick-walled, smooth; marginal rows of cells broadly rectangular, thin-walled, forming a well differentiated, broad, transparent border on both sides of the perichaetial leaf; abaxial cells of costa linear, somewhat prorulose, in cross section made up of 2–3 rows of large, centrally located guide cells, with small and thick-walled cells forming the upper and lower layers. Male plant (or perigonium?) small, less than 0.7 mm tall, attached basally to perichaetial plant, perigonial leaves short, about 0.5 mm long including the shortly excurrent costa, broadly ovate-lanceolate, with imbricate leaf base. Sporophyte not seen.

The new species is distinctive in being solitary, and with few, highly reduced vegetative leaves. The entire plant nearly consists of perichaetial leaves. The leaf margins are entire, the excurrent costa is smooth to prorulose, the leaf cells are smooth, and the lamina is unistratose. *Diphyscium tamasii* is closely related to *D. involutum* Mitt., which was treated as a synonym of *D. mucronifolium* Mitt. in Eddy (1990), but not in O'Shea (2002).

Among the species of *Diphyscium*, this and *D. satoi* Tuzibe are the two in Asia that produces few, small and inconspicuous vegetative leaves around the base of large perichaetium. However, *D. tamasii* has unistratose lamina while *D. satoi* has bistrastose upper leaf cells (Noguchi 1987). Leaf costa of *D. tamasii* is heterogeneous while that of *D. satoi* is homogeneous. From the point of view of evolution, these two species seem to represent the culmination of a trend in the genus to invest more resources in the sporophyte through a decrease in the production of vegetative leaves.

It is a privilege to name this endemic *Disphyscium* from Vu Quang Nature Reserve in honour of our colleague and field companion during the expedition, Prof. Tamás Pócs, for his past and present contributions to our knowledge of Vietnam bryophytes. Interestingly, the honoree has another endemic species of *Dipshycium* from Tanzania in Africa named in his honour, *Diphyscium pócsii* (Bizot) Zander.

****Distichophyllum*** *nigricaule* Bosch & Sande Lac. var. *cirratum* (Ren. & Card.) Fleisch. [syn. *Distichophyllum cirratum* Ren. & Card.] — [5] *Tan 02-235*, on wet boulder in deeply shaded stream bank.

This taxon is reported here as new to Vietnam. It was treated as a species by Mohamed and Robinson (1991). We follow Tan and Robinson (1990) in accepting it as a variety of *D. nigricaule*. The taxon is identified by its relatively broad leaf border and the presence of several rows of maginal laminal cells that are clearly smaller than the paracostal laminal cells.

Distichophyllum obtusifolium* Thér. var. ***vuquangiensis B. C. Tan & Ninh, *var. nov.*

Holotype: Vietnam, Vu Quang Nature Reserve, wet primary lowland rain forest at Bac Dau Waterfalls, at 200–270 m, on fallen log inside forest near a shaded stream, *Tan 02-236* (SINU; isotype, Herbarium of Hanoi University of Science).

Differt a varietatis typica statura multum minore.

The new variety is distinguished mainly by nearly half the size of the plant specimen of typical variety. The leaves of the new variety measure less than 2 mm long and 0.75 mm at its widest part, whereas the leaves of var.

obtusifolium measure 3 mm long and 1.25 at its widest part of the blade. Both perichaetia and antheridia, but not the sporophyte, are seen in the type of this new variety.

Distichophyllum obtusifolium is known from China, Japan and Taiwan, and now extended to northern Vietnam. It is new to Indochina. The narrow leaf border forming a tiny mucro and a few small teeth present at the leaf apex is characteristic of the species.

***Duthiella** wallichii* (Mitt.) C. Muell. — *Tran Ninh 2001-43*, on rock, along Tre stream, VQNR.

Ectropothecium sp. — [7] *Tan 02-284*, on submerged and wet rock in stream.

The specimen is rather similar to the East Asiatic congener, *E. obtusulum* (Card.) Iwats., in having complanate, ovate to oblong leaves with obtuse to broadly acute and slightly toothed apices (see Noguchi 1994). The leaf areolation is also similar except at the leaf base. Their shared preference of wet rock habitat is also noteworthy. However, without the sporophyte, the species identity can not be ascertained.

***Entodon** flavescens* (Hook.) Jaeg. — *Tran Ninh 70214*, ca 1,100 m, on log in forest in Kim Quang Valley, VQNR.

***Exostratum** blumii* (C. Muell.) Ellis [syn. *Exodictyon blumii* (C. Muell.) Fleisch.] — [7] *Pócs 02103, p.p.*, on rotten log.

This species seems rare in the study area. Only a few individual plants were found growing on rotten log among other mosses.

Fissidens crispulus Brid. [syn. *Fissidens zippelianus* Dozy & Molk.] — [2, 3, 6, 7] *Tan 02-218, 02-217, 02-221, 02-224*, on rocks in shaded forest, river banks and at waterfall; *Tran Ninh 502159*, on rock by the Soy-lon River, VQNR.

One of the two most common *Fissidens* in the study area, the other one being *F. pellucidus*.

Fissidens javanicus Dozy & Molk. — [5, 6] *Tan 02-219, 02-220*, on shaded boulder at waterfall and on wet boulder near stream; *Tran Ninh 50291, 502159, 502192*, on wet rocks along Bac Nuong Stream, Khe Lim Waterfall and Soy-lon River, VQNR.

Surprisingly common in the study area, this species has bi- to tristratose leaf margins that are crenulate to serrulate in outline. The hyaline nodules are also well developed on the stem.

**Fissidens kinabaluensis* Iwats. — [7] Tan *02-201*, on soil bank in forest.

The species is new to Vietnam. It was known before to occur disjunctively in southern China, Thailand and Borneo.

Fissidens kinabaluensis is distinctive in having a "opened fan-shaped" foliation on a short stem. The leaves are narrowly elongate to linear, with limbidium present only on the vaginant laminae.

Fissidens nobilis Griff. — *Tran Ninh 200124b*, on shaded rock, Tre stream, VQNR.

Fissidens pellucidus Hornsch. [syn. *Fissidens laxus* Sull. & Lesq.] — [3] *Tan 02-215, 02-222*, on shaded forest soil.

****Gammiella** *panchienii* B. C. Tan & Jia Yu — *Tran Ninh 702188*, in forest, in Kim Quang Valley, VQNR.

The collection is a noteworthy extension of range of this recently described Chinese endemic from SE Xizang to Vu Quang Nature Reserve in Vietnam. The peculiar leaf alar of *G. panchienii* which consists of several rows or cluster of coloured, quadrat to short rectangular and thick-walled cells is unmistakable. The leaf margins are serrate. The overall morphology of *G. panchienii* looks like *G. ceylonensis*, but in *G. panchienii*, the plant is twice larger than *G. ceylonensis*, and the population does not develop mat-forming slender branchlets (cf. Tan & Jia, 1999).

Like the type specimen from Xizang Province of China, the collection of *G. panchienii* from Vietnam is also without sporophyte.

cf. **Garovaglia** *densifolia* Thwaites & Mitt. — *Tran Ninh 72011*, 1,100 m on tree trunk, Kim Quang valley, VQNR.

A few individual plants were collected from a tree trunk. The specimen has no reproductive structure and its species identity can only be tentatively proposed.

Homaliodendron *exiguum* (Bosch & Sande Lac.) Fleisch. — [3] *Tan 02-272*, on branch near river crossing point; *Tran Ninh 200126, 200141, 200142, 200147, 502181, 70272*, on tree trunk in forest and on rock by the stream, Lim Stream and Kim Quang Stream, VQNR.

Homaliodendron flabellatum (Sm.) Flesich. — [6] *Tan 02-289*, on fallen twig in forest; *Tran Ninh 70213, 70236, 70252*, on tree trunk and boulder, Kim Quang Valley, VQNR.

Homaliodendron microdendron (Mont.) Flesich. — [6] *Tan 02-231, 02-276*, on tree trunk inside forest, and on boulder by the river; *Tran Ninh 200139, 200156, 200194, 50292, 502178, 502182, 70251, 70258*, on rocks, and one specimen found on leaf, vicinity of Bac Nuong Stream, Kim Quang Stream and Leim Quang Stream, VQNR.

Hypopterygium *flavolimbatum* C. Muell. [syn. *H. apiculatum* Thwaites & Mitt., H. *vietnamicum* Pócs] — *Tran Ninh 70201, 702126*, Kim Quang Valley, VQNR.

The synonym of this species follows Kruijer (2002).

****Isocladiella*** *surcularis* (Dix.) B. C. Tan & Mohamed — [2] *Tan 02-204*, on branch in forest above the fast flowing river.

The many flagelliform and caducous branchlets are characteristic of this species that is now known from many places across SE Asia. It is, however, reported here for the first time in Vietnam.

Isopterygium *albescens* (Hook.) Jaeg. — [6] *Tan 02-255*, on decaying log inside forest.

cf. ***Isopterygium annamensis*** Broth. & Par. — [3, 6, 7] *Tan 02-256a, 02-279, 02-295*, on small branches of trees in shaded sites in forest.

This Vietnamese endemic seems common in the nature reserve. The plants are light yellowish green in color, somewhat complanate, and with erect-divergent, oblong- to ovate-lanceolate and long acuminate leaves. It looks like a large version of *Isopterygium minutirameum.* Its relationship with *I. albescens* needs careful comparison. The latter has somewhat broadly ovate-lanceolate leaves and equally long acuminate leaf apices,

Isopterygium minutirameum (C. Muell.) Jaeg. — [7] *Tan 02-302, Pócs 02103*, on fallen twig and branches on forest floor near stream.

Leucobryum *aduncum* Dozy & Molk. var. *scalare* (Fleisch.) Eddy — [7] *Tan 02-232*, on branches above the stream.

Leucobryum chlorophyllosum C. Muell. — [7] *Tan 02-230*, on log in forest.

Leucobryum bowringii Mitt. — *Tran Ninh 200162*, on rotten wood, Khe Tre valley, VQNR.

Leucoloma *amoene-virens* Mitt. — [6] *Tan 02-270*, on boulder away from the waterfall.

This species seems uncommon in Vietnam (see Tan and Iwatsuki, 1993).

Leucoloma molle (C. Muell.) Mitt. — *Tran Ninh 70208*, on tree trunk, 1,100 m, Kim Quang Valley, VQNR.

Leucophanes *octoblepharioides* Brid. — *Tran Ninh 200189, 200199*, on rocks, Khe Tre Valley, VQNR.

Lopidium *struthiopteris* (Brid.) Flesich. — *Tran Ninh 70281*, on tree base, Kim Quang Valley, VQNR.

****Microdus*** *miquelianus* (Mont.) Besch. — [4] *Tan 02-296*, on roadside soil bank; also collected near one of the Vietnam–Laotian border guard houses.

There are a number of reported endemic species of *Microdus* in Indochina (cf. Tan and Iwatsuki, 1993) which probably are taxonomic synonyms of the present species.

Neckeropsis *moutieri* (Broth. & Par.) Fleisch. — *Tran Ninh 200127*, on rock near Tre stream, VQNR.

*****Papillidiopsis*** *ramulina* (Thwaites & Mitt.) Buck & B. C. Tan — [7] *Tan 02-246*, on shaded boulder above water in stream.

This is the first report of this species from Vietnam and Indochina.

****Oxyrrhynchium*** *asperisetum* (C. Muell.) Broth. [syn. *Eurhynchium asperisetum* (C. Muell.) Bartr.] — *Pócs 02112*, Thanh Hoa Province, karstic area near Bien Son town, in dry evergreen forest, on shaded calcareous rocky wall at cave entrance.

The species, although widespread in SE Asia, is new to Vietnam. Its morphological distinction from the often confused but related species in SE Asia will be clarified in a separate paper.

Pelekium *bonianum* (Besch.) Touw [syn. *Thuidium bonianum* Besch.] — [6] *Tan 02-226*, on tree trunk base, in forest with bamboo thicket and on boulder near stream; *Tran Ninh 50286*, on rotten wood in forest, near Bac Nuong stream,VQNR.

The synonymy of this genus follows Touw (2001).

**Pelekium investe* (Mitt.) Touw [syn. *Thuidium investe* (Mitt.) Jaeg.] — [7] *Tan 02-274*, on wet rocks near a stream close to a small waterfall.

The small and delicate plant size, ovate-oblong leaves, strongly unipapillose leaf cells, and the nearly lack of paraphyllia in stems and branches identify this species.

Pelekium vesicolor (C. Muell.) Touw [syn. *Thuidium sparsifolium* (Mitt.) Jaeg., *T. tamariscellum* (C. Muell.) Bosch & Sande Lac.] — [3] *Tan 02-225*, on boulder near river.

The taxonomy and synonymy of this taxon follows Touw (2001).

Philonotis *hastata* (Duby) Wijk & Marg. — [6, 7] *Tan 02-286*, roadside away from waterfall.

For the species treatment of *Philonotis*, we follow the concepts of Noguchi (1989), instead of Koponen and Norris (1996). The latter treatment is applicable to tropical Malesian species but not the continental Asiatic taxa of this genus.

**Philonotis lancifolia* Mitt. — [6, 7] Tan *02-278, 02-287*, on boulder near waterfall.

The specimens have somewhat imbricate to falcate leaves with percurrent costa and the upper leaf cells are rather narrowly rectangular while the leaf margins are only moderately to weakly recurved. The species is a new record for Vietnam.

Philonotis mollis (Dozy & Molk.) Mitt. — *Tran Ninh 50298, 50248*, on rotten wood, ca 210 m, near Du stream, VQNR.

The long excurrent leaf costa is diagnostic of this species.

Philonotis turneriana (Schwaegr.) Mitt. — [3] *Tan 02-299*, on boulder by the stream near the rest house.

This species differs from *P. mollis* in having shorter excurrent leaf costa and also the broadest part of the lamina is at leaf insertion.

Plagiomnium *succulentum* (Mitt.) T. Kop. — *Tran Ninh 70210*, on rock, Kim Quang Valley, VQNR.

Pogonatum *camusii* (Thér.) Touw [syn. *Racelopus camusii* Ther.] — [7] *Tan 02-211*, on rock inside hill forest.

Pogonatum neesii (C. Muell.) Dozy — [3] *Tan 02-300*, on eroded trail bank.

Pseudobarbella *attenuata* (Thwaites & Mitt.) Nog. — [7] *Tan 02-268*, hanging from branches in forest near a stream.

Another common species of Meteoriaceae in the study area.

Pseudobarbella laosiensis (Broth. & Par.) Nog. — [7] *Tan 02-283*, on woody vine inside forest.

The Vu Quang specimen has many caducous, flagellate branchlets produced on the branches.

Pseudoleskiopsis *zeppellii* (Dozy & Molk.) Broth. — [2, 6, 7] *Tan 02-239, 02-305, 02-238*, on submerged boulders or by the river banks.

The species is rather common in the study area in river bed and along stream bank. The illustration of this semi-aquatic species in Fleischer (1904–1923) is excellent.

Pseudotaxiphyllum *pohliaecarpum* (Sull. & Lesq.) Iwats. — [6] *Tan 02-240*, [7] *Tan 02-264*, on rock near stream bank; Tran Ninh 502104, on rock, near Con Stream, VQNR.

This species is locally abundant inside forest. Its purplish color of the population is distinctive.

Pterobryopsis *crassicaulis* (C. Muell.) Fleisch. — [2, 7] Tan *02-228*, on branch in hill forest.

In the family Pterobryaceae, the erect stem with strongly concave leaves having abruptly constricted leaf apices, coupled with the attenuated stem terminal, is diagnostic for this species.

Pyrrhobryum *spiniforme* (Hedw.) Mitt. — [7] Tan *02-212*, on rock in forest.

Racopilum *cuspidigerum* (Schwaegr.) Aoengstr. [syn. *R. schmidii* (C. Muell.) Mitt.] — [7] *Tan 02-269*, on trunk base inside forest; *Tran Ninh 50274*, ca 100 m, on wet boulder in stream, Bac Nuong stream, VQNR.

Radulina *hamata* (Dozy & Molk.) Buck & B. C. Tan — [2] *Tan 02-257*, on tree trunk near base, partly flooded.

This species, with its falcate leaves that have seriately arranged papillae on the leaf cell, is distinctive in the family Sematophyllaceae.

Rhynchostegiella *menadensis* (Sande Lac.) Bartr. — [6, 7] *Tan 02-294, 02-280*, on branch inside forest by the stream; *Pócs & Tan 02-244*, Thanh Hoa Province, karstic area near Bien Son town, in dry evergreen forest, on calcareous substrate and on tree trunk base near the cave entrance.

This is the most common epiphytic species of Brachytheciaceae in the study area.

Rhynchostegium *aciculum* (Broth.) Broth. — *Tran Ninh 200144*, on branchlets, in Khe Tre Valley, VQNR.

****Schlotheimia*** *grevilleana* Mitt. — [7] Tan *02-308*, on branches inside forest.

The species is new to Vietnam. It has an earlier report from Thailand (cf. Tan and Iwatsuki, 1993).

Sematophyllum *subpinnatum* [syn. *S. caespitosum* (Hedw.) Mitt., *S. tristiculum* (Mitt.) Fleisch.) — [2, 3] Tan *02-242, 02-243, 02-252, 02-254, 02-248, 02-256b*, on shaded tree trunks, branches and boulders along the rivers; *Tran Ninh 50227, 50254*, on rock and branches along Bac Nuong and Cay Du streams, VQNR.

This is the most common species of Sematophyllaceae found in the study area. Plants vary greatly in size and grow epiphytically on various substrates along the river banks. The synonymy of this species follows Tan and Jia (1999).

Syrrhopodon *armatus* Mitt. [syn. *Syrrhopodon fimbriatulus* C. Muell.] — [7] Tan *02-200*, on log inside forest.

Indochina was included in the range of this species by Reese (1987) without reporting a specific Indochinese locality. The species is distinctive in having long cilia at the leaf shoulder region, strong papillae scattered on the abaxial side of the costa, and also the strongly unipapillose leaf cells. We can not see any differences between the Chinese *S. armatus,* and the widespread Malesian *S. fimbriatulus.*

Syrrhopodon japonicus (Besch.) Broth. — *Tran Ninh 702141*, on tree trunk of *Fokienia hodginsii*, at 1700 m, Kim Quang Valley, VQNR.

Taxiphyllum *taxirameum* (Mitt.) Flesich. — [6] Tan *02-293,* on wet and shaded boulder in stream.

Taxithelium *nepalense* (Schwaegr.) Broth. — [7] Tan *02-298*, on shaded rock, stream bank.

Taxithelium vernieri (Duby) Besch. — [7] *Tan 02-263*, on boulder in forest.

This is a widespread species in tropical SE Asia. The ovate lanceolate leaves have both acute and long acuminate leaf apices that are serrated.

Thuidium *assimile* (Mitt.) Jaeg. — *Tran Ninh 702184*, on rock inside forest, Kim Quang Valley, VQNR.

Thuidium pristocalyx (C. Muell.) Jaeg. [syn. *Thuidium glaucinum* (Mitt.) Bosch & Sande Lac.] — [2, 3, 7] *Tan 02-205, 02-206, 02-202*, on branches above water, but mostly on shaded boulder in forest; *Tran Ninh 70273, 702150, 200136*, on tree base and boulder in Kim Quang Valley, and on rock, along Tre stream, VQNR.

This is the most common species of *Thuidium* in the study area. For a discussion of its differences from *T. assimile*, see Touw (2001).

Trichosteleum *boschii* (Dozy & Molk.) Jaeg. — [6, 7] *Tan 02-249, 02-251*, on fallen log and boulder near river bank and inside forest.

This is a common and variable species in Vu Quang Nature Reserve.

* *Trichosteleum mammosum* (C. Muell.) Jaeg. — [2] *Tan 02-203*, epiphytic on branch inside forest.

The strongly unipapillose cum mammillose exothecial cells of the capsule of this species is very distinctive. The record is new to Vietnam.

** *Trichosteleum mindanense* Broth. — [7] *Tan 02-277,* on rock, trail along the river.

This species has been known hitherto as a Philippine endemic. Bartram (1939) opined that it is close to *T. mammosum* on the basis of its clearly mammillose exothecial cells. In our opinion, the species is more related to

T. boschii by virtues of its leaf morphology. Unlike *T. boschii, T. mindanense* has gradually acuminate leaf apices. It looks more like a miniature plant of *T. stigmosum* Mitt. Its taxonomic affinity within the genus needs reassessment. We report it here as new to Vietnam and Indochina region.

Trichosteleum stigmosum Mitt. — [7] *Tan 02-247*, on decaying log near stream in forest.

This species differs from the widespread *T. boschii* in having gradually long acumunate leaf apices. Seki (1968) included this species in the synonymy of T. boschii, a taxonomic judgment which we disagree.

Trichostomum** crispulum* Bruch var. ***pseudocrispulum B. C. Tan & Tran Ninh, *var. nov.*

Holotype: Thanh Hoa Province, karstic area near Bien Son town, dry evergreen forest on calcareous sustrate, on soil and root mass of *Microsorium* ferns attached to limestone cliff, 26 May 2002, *Tan 02-307* (SINU; isotype: Herbarium of Hanoi University of Science).

Differt a varietatis typica foliis constrictis supra basin.

The new variety differs from the var. crispulum in having a well constricted shoulder above the slightly expanded leaf base. In addition, its incurved leaf margins are more strongly developed in var. *pseudocrispulum.* The other leaf characters and the plant size are comparable with specimens of typical variety. The type of the new variety has no sporophyte.

Trichostomum platyphyllum (Broth. ex Ihs.) Chen — [3] *Tan 02-229, Tran Ninh 50207*, on wet boulder, submerged in stream.

***Vesicularia** montagnei* (Bel.) Broth. — [3, 7] *Tan 02-267, 02-271, 02-301*, on wet boulder and river bank.

This is a common species of mosses in wet, shaded sites in the study area.

***Wijkia** deflexifolia* (Ren. & Card.) Crum — *Tran Ninh 702152*, on rock, in forest in Kim Quang Valley, VQNR.

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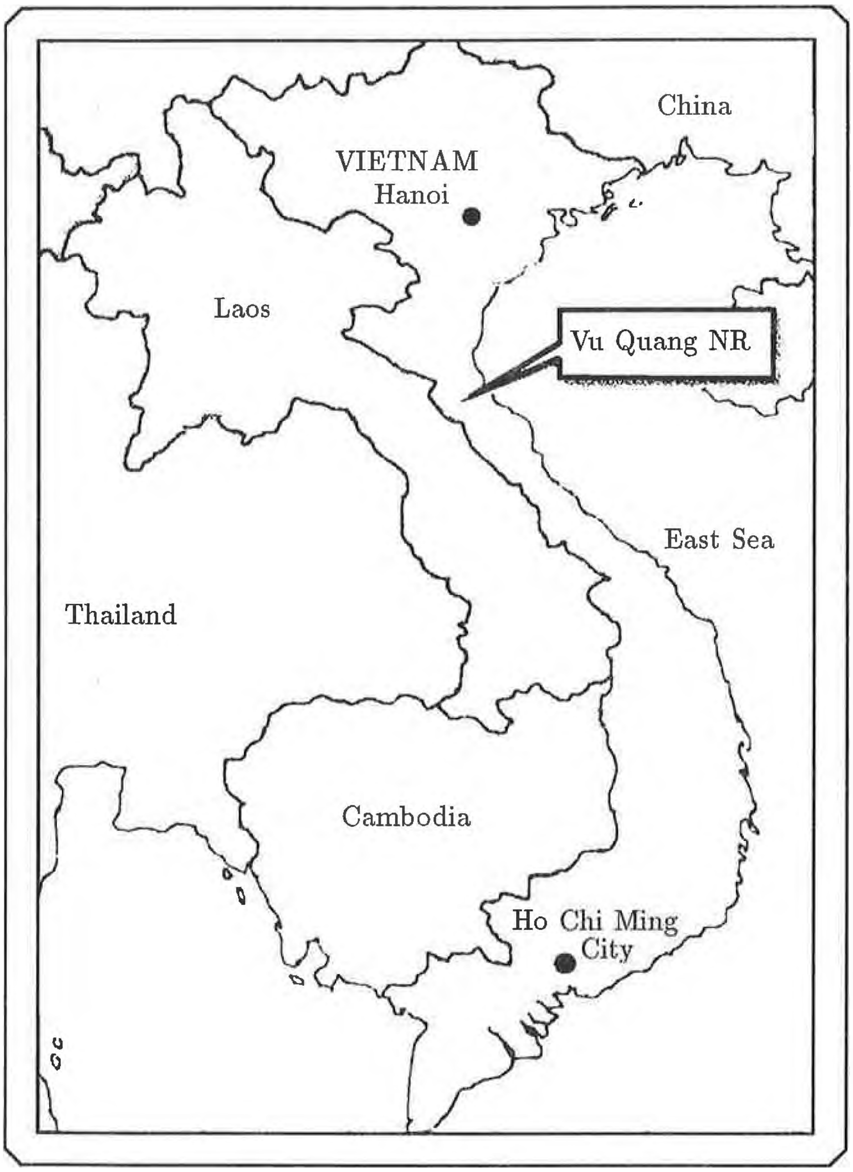

Map 1. Location of Vu Quang Nature Reserve in Vietnam

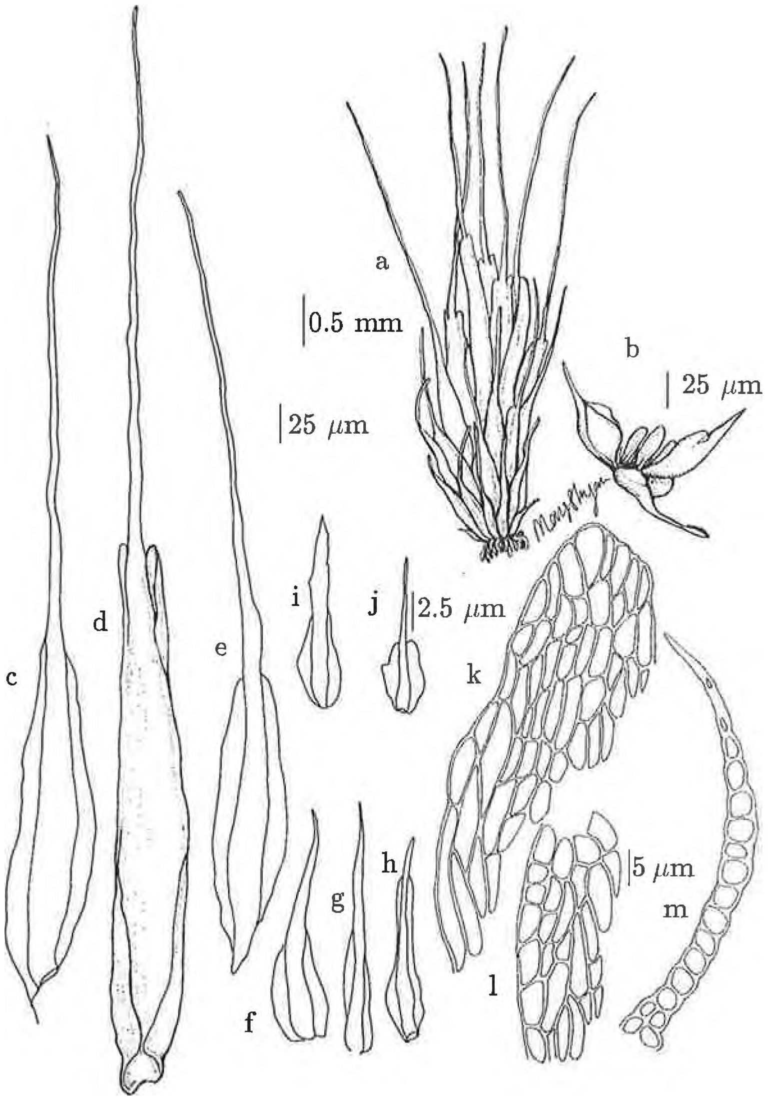

Fig. 1 *Diphyscium tamasii* B. C. Tan & Ninh (based on holotype at SINU) (a) Perichaetial plant; (b) Dissected perigonium; (c–e) Inner perichaetial leaves; (f–j) Outer perichaetial leaves; (k) Apical lobe of perichaetial leaf; (l) Basal margin of perichaetial leaf; (m) Cross-section of perichaetial lamina showing unistratose leaf cells.

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Oxyrrhynchium asperisetum (Brachytheciaceae, Musci) new to Malaysia and Vietnam, with the overview of Oxyrrhynchium in Southeast Asia

Ignatov, M. S.[1] **& Tan, B. C.**[2]
[1] Main Botanical Garden of Russian Acad. Science
Botanicheskaya 4, Moscow 127276 Russia

[2] Department of Biological Sciences
National University of Singapore, Singapore 119260
`dbsbct@nus.edu.sg`

Abstract. The taxonomic distinctions among four species of *Oxyrrhynchium*, i.e., *O. asperisetum, O. vagans, O. hians* and *O. savatieri* in SE Asia are discussed. *Oxyrrhynchium asperisetum* is reported new to Malaysia and Vietnam.

Introduction

Oxyrrhynchium asperisetum (C. Muell.) Broth. (= *Eurhynchium asperisetum* (C. Muell.) Bartr.) was originally described from Java and subsequently reported from the Philippines (Bartram, 1939), Thailand (Horikava & Ando, 1964; Tixier, 1971), Ryukyu in Japan (cf. Iwatsuki, 1991), southern China and Taiwan (cf. Redfearn et al., 1996), and Papua New Guinea (Ignatov et al., 1999).

Several new collections have expanded its range further to include:

(1) Vietnam (new record for the country, cf. Tan & Iwatsuki, 1993): Thanh Hoa Province, karstic area near Bien Son town, in dry evergreen forest, on shaded calcareous rocky wall at cave entrance, *Pócs 02112*. [SINU, MHA].

(2) Malaysia (new record for the country, cf. Mohamed & Tan, 1988): Peninsular Malaysia, Cameron Highland, Gn. Brinchang, on tree fern, 3.IX. 1998, *B. C. Tan, s.n.* (SINU, MHA).

(3) China, Yunnan, about 15 km SE of Xishuangbanna Tropical Bota-

nical Garden, roadside limestone rainforest in Tsui-Peng-Feng (Hill) along a river tributary, 12.XII.1999, *B. C. Tan 99-173* (SINU, MHA).

(4) Philippines, Mindanao, North Cotabato Province, Mt. Apo, tropical montane forest near Lake Venado, 7°00′ N, 125°16′ E, on humus above rocks, 2,270 m, 10.VIII.1999. *Schumm & Schwarz 4543* (SINU); ibid, on tree fern, 2,370 m, *Schumm & Schwarz 4544* (SINU); ibid, on bark, 2,210 m, 20.III.1999, *Schumm & Schwarz 3785* (SINU).

Earlier, Bartram (1939) noted that his Philippine material was sterile and therefore he retained the final judgement on the species identity to subsequent investigation. Fortunately in 1999, Schumm and Schwarz collected material with sporophytes that have very rough setae, thus confirming the occurrence of *O. asperisetum* in Philippines.

Oxyrrhynchium asperisteum belongs to the genus known as one of the most variable in Brachytheciaceae (see Ignatov & Huttunen, 2003, for revised generic classification). *Oxyrrhycnhium hians* (Hedw.) Loeske alone poses quite many taxonomical puzzles due to its enormous variability (cf. Touw & Knowl, 1978). In areas where two or more species of *Oxyrrhynchium* occur, the situation of correct species determination becomes much more difficult, for examples, in Europe, between the pair of *O. hian* and *O. schleicheri* (Hedw. f.) Roell, and in Malesia, between *O. vagans* (Jaeg.) Ignatov & Huttunen and *O. asperisetum.* The ultimate complication is the separation of *Oxyrrhynchium* species in areas where four species of the genus occur together, such as in Central China [*O. hians, O. protractum* (C. Muell.) Broth., *O. savatieri* (Schimp. ex Besch.) Broth. and *O. vagans* (cf. Ignatov et al., 2003)], and Southeast China [*O. hians, O. savatieri, O. vagans* and *O. asperisetum*]. Sterile collections of slender phenotypes of some taxa often are difficult, if not impossible, to assign to any species. This need for sporophyte material must always be considered when collecting specimens of *Oxyrrhynchium.*

Taxonomic key to four difficult species in Southeast Asia

1. Branch foliage complanate where leaves densely arranged .... *O. savatieri*

1. Branch foliage subjulaceous where leaves densely arranged .... **2.**

2. Laminal cells of branch leaves more commonly measure (50–)70–110(–120) × (4–)5–6(–7) μm wide; acumen of branch leaves more or less abruptly delimited; polyoicous or dioicous; seta rough .... *O. asperisetum*

2. Laminal cells of branch leaves more commonly measure (30–)50–100(–120) × (4–)5–8(–9) μm; acumen of branch leaves not abruptly delimited; dioicous; seta rough or smooth .... **3.**

3. Plants rather robust; medium laminal cells of branch leaves measure (70–)100–120(–140) × 5–9 μm; seta smooth .... *O. vagans*

3. Plants rather slender; median laminal cells measure (30–)50–80(–105) × 5–7 μm; seta rough .... *O. hians*

Taxonomic comments

Oxyrrhynchium asperisetum (C. Muell.) Broth.

This is a relatively small moss and we have no explanation why Bartram (1939) considered it to be larger than *O. vagans.* Fleischer (1923) also reported leaves of *O. asperisetum* up to 1.8 mm, but we never saw them larger than 1.5 mm. Branch leaves often have the characteristically abruptly constricted leaf acumen, though it is not always very well expressed in New Guinean specimens (cf. Figs. 13–14 in Ignatov et al., 1999). Leaf cells of *O. asperisetum* are usually 60–110 μm long, even in quite small leaves, and always narrow, ca. 5–6 μm wide. This allows the slender form of *O. asperisetum* to be distinguished from *O. vagans* that has leaf cells of about 5–9 μm wide and often longer than 100 μm. Takaki (1956) pointed that *O. asperisetum* has complanate branches; sometimes this aspect is more or less clear, though it is never so distinct as in *O. savatieri.* The distributional range of these two species has nearly no overlap, the later being a more northern one. In critical cases, *O. savatieri* is different from *O. asperisetum* in having smaller cells (50–)65–80(–110) × (4–)5(–6) μm [vs. (50–)70–110(–120) × (4–)5–6(–7) μm] and rarely having abruptly consticted acumen in branch leaves in Chinese materials (though observed in more xeric phenotypes in Japanese specimens). Brownish pigmentation is sometimes present, but in many collections plants of *O. asperisetum* are purely green.

Collection of *O. asperisetum* from Vietnam and Malaysia has no sporophytes and represent a relatively poorly developed phenotype growing in shade. Its attribution to this species is based largely on leaf shape and laminal cell dimensions.

O. savatieri (Schimp. ex Besch.) Broth.

Many authors have reported that the main diagnostic characters of the species is the complanate foliage. This statement needs some comments because the aspect of complanateness is characteristic for all species of the genus. However, in many species the foliage is more complanate in loose growth form and in remotely foliated parts of the plant, while in *O. savatieri* the pattern is opposite: the denser is its foliage, the more complanate is the leaf arrangement. Slender plants without the more or less densely foliated branches are almost impossible to identify. Brownish pigmentation is sometimes present, but in many collections plants are purely green (at least in Chinese collections).

O. hians (Hedw.) Loeske

Laminal cells of the Chinese specimens of this species have cells shorter than 60–70 μm. Most of Chinese plants are small to medium-sized and have brownish pigmentation.

O. vagans (Jaeg.) Ignatov & Huttunen

When sporophyte is present, this species can be separated immediately by its smooth seta (all other Asian species of *Oxyrrhynchium* have rough setae). However, many of the Chinese collections are sterile. *Oxyrrhynchium vagans* is the largest species of the genus in the region. When optimally developed it has long laminal cells of about 100–120 μm long (longer than in *O. savatieri*). Slender phenotypes with cells up to 80 μm would be extremely difficult to separate from the large phenotypes of *O. hians*. Branch leaves are very shortly acute in the slender plants of *O. vagans*, whereas they are variable and often narrowly acute in *O. hians*. Brownish pigmentation is commonly present.

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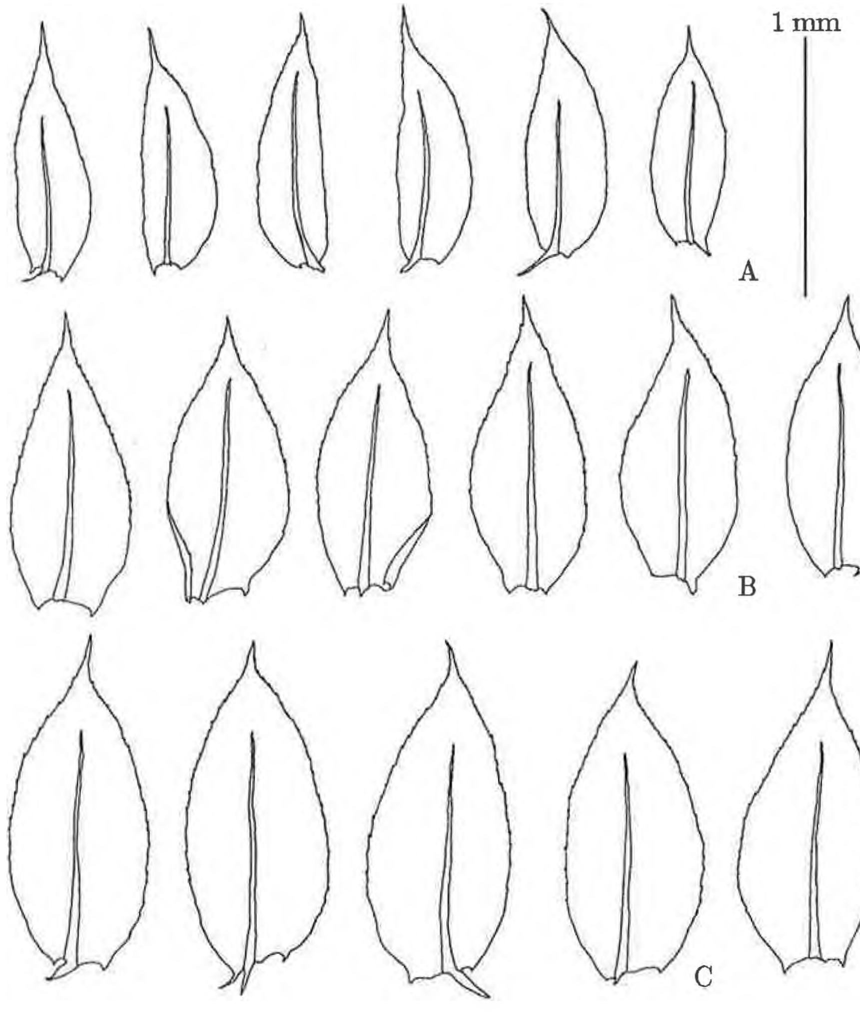

Fig. 1 Various shapes of branch leaves of ***Oxyrrhynchium asperisetum*** from three collections: A: Vietnam, *Pócs 02112*; B: Philippines, *Schumm & Schwarz 4544* (from plants with sporophytes); Papua New Guinea, *T. Koponen 30850* (from plants with sporophytes).

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Notes on Gymnomitriaceae (subf. Gymnomitrioideae) in Latin America

Váňa, J.
Department of Botany, Charles University
Benátská 2, CZ-128 01 Praha 2, Czech Republic

Abstract. An overview of the species of the family Gymnomitriaceae in Latin America is given. Keys to Latin American species of the genera *Gymnomitrion* (6 species) and *Marsupella* (9 species) is presented. Three new combinations (*Marsupella lacerata, M. moralesae and M. truncato-apiculata*) are made, two new taxa (*Gymnomitrion pacificum* and *Marsupella paroica*) are newly reported from the area and many additional data to the distribution and synonymies of different taxa are published. The problems connected with the concept of the genera *Gymnomitrion* and *Marsupella* are discussed.

The knowledge of the subfamily Gymnomitrioideae in Latin America is very poor. Nearly all species occurring in this area are very rare, and they are restricted mostly only to higher elevations (especially in the páramo region) or the subantarctic area. Nevertheless, the number of taxa in the subfamily in the area is significant (20 species at present, with 2 additional taxa in South Georgia).

In recent times two very important studies have contributed with many additional data to the knowledge of the subfamily in the study area (Schuster 1996, 2002). However, there are still many unanswered problems based on:

- the delimitation of the genera in the family, especially in the complex *Gymnomitrion* Corda – *Marsupella* Dumort., including newly separated genera (especially *Apomarsupella* R. M. Schust.) or subgenera in *Marsupella*,
- inadequate knowledge of distribution of nearly all taxa based on the limited number of collections and the relatively even more limited number of determined species (taxa of the present subfamily are not in the area of interest of most bryologists, and most of the species are difficult to determine),
- lack of good material (with gametangia, sporophytes) of some taxa,

- omission of some important and taxonomically problematical taxa by Schuster (1996, 2002) because of "poor knowledge"
- and, finally, lack of modern biosystematic or molecular study based on the taxa of the family Gymnomitriaceae.

The main problem seems to be the delimitation of the genera and subgenera in the complex *Gymnomitrion* – *Apomarsupella* – *Marsupella*. Although Váňa (1999) revised the subgeneric concept in *Marsupella*, his study is neither accepted nor mentioned in the study of Schuster (2002); moreover, Schuster described an additional subgenus (*Marsupella* subg. *Amphimarsupella* R. M. Schust.), further complicating the situation.

There are two "basic" concepts for delimitation of the genera *Gymnomitrion* and *Marsupella*. The "classical" concept used as the "crucial criterion separating *Gymnomitrion* from *Marsupella*" (cf. Schuster 2002: 565) concerns the structure of the female inflorescence, especially the presence or absence of a perianth and especially a perigynium. This concept was used by Müller (1906–1916), as it was in many other studies up to the end of the first half of the 20th century. *Gymnomitrion* was characterised by the lack of perianth and perigynium (although at least a reduced perigynium can be present), whereas in *Marsupella* a relatively well developed perigynium and perianth (at least in reduced form) must be present. Knapp (1930) established that the "classical" or "usual" distinctions drawn between *Marsupella* and *Gymnomitrion* failed to exist, and Müller (1951–1958), separating both mentioned genera, gives preference to the "gymnomitrioid" or "marsupelloid" characters of the habit over the "classical" differential characters in the structure of the gynaeceum. Thus, *Gymnomitrion* species form densely caespitose patches, and individual plants are mostly julaceous or filiform, of whitish, yellowish to greyish colour very rarely tinged with red or purple, with closely imbricate, densely appressed leaves, decolorate leaf tips and margins etc. In contrast, *Marsupella* species do not grow in such dense patches, they are not julaceous, are mostly greenish, often fuscous to purplish, and the leaves are mostly remotely arranged, not appressed and without decolorate margins and tips. The last concept is accepted in nearly all recent studies and treatments of the mentioned genera; it was accepted also in both mentioned treatments of Schuster (1996, 2002).

However, some problems connected with each concept and with the combining of both concepts complicate the situation:

1. The density of leaves and the decoloration of margins or leaf lobe tips are connected with the ecological characters of the locality. When plants of some *Gymnomitrion* species are growing in wet and shady places they have more remote leaves than usual, approaching many *Marsupella* species in habit. In contrast, some *Marsupella* species from extreme habitats such

as exposed rocks at very high altitudes etc. may have a julaceous habit and be decolorate, at least the tips of the lobes, as in *Gymnomitrion*.

2. The gynoecium structure is sometimes not correlated with the habit characters. There are some "primitive" species of "true" *Gymnomitrion* without perianth and perigynium with a somewhat "marsupelloid" habit (cf., f.e., fig. 424: 13, 14 of G. *asperulatum* R. M. Schust. in Schuster 2002: 568, where the leaves are not densely appressed and closely imbricate). Similarly, some species of *Marsupella* have the "gymnomitrioid" habit with julaceous or stoloniform shoots or with closely imbricate, appressed leaves, resembling *Gymnomitrion* (f.e. *M. adusta* (Nees) Spruce, *M. condensata* (Ångstr. ex C. Hartm.) Lindb. ex Kaal. or *M. stoloniformis* N. Kitag.).

3. The reduction of the perigynium is a continuous process in the evolution of species and it is very difficult to draw the line establishing whether it is present or not. This reduction can be relatively well demonstrated in the *Marsupella* subg. *Homocraspis* (Lindb. ex Schiffn.) Grolle culminating in *M. adusta*, where an exceptionally low perigynium is found, or more often it is completely missing. Not only *M. adusta*, but also some other species treated here have the perigynium completely absent. 3.6.

4. The exact form of the female bracts (more deeply lobed than the leaves, but still bilobed to separate in some lanceolate filaments), connected with the reduction in the perigynium, can be detected only when the plants are fertile. When unfertilised gynoecia are present, the female bracts can be similar to the leaves and mostly not yet separated into filaments. Moreover, in both genera (*Gymnomitrion* and *Marsupella*) in the present concept there are species with the innermost bracts basically bilobed with deeply lobed margins, or with bracts separated into irregular lanceolate filaments.

5. The segregation of plants with a "marsupelloid" habit and a "gymnomitrioid" gynaeceum structure (without any trace of a perigynium) in the genus *Apomarsupella* (described on the basis of the presence of *Anomoclada*-type branches) solved these problems only partially, and not for all the problematic species (*Anomoclada*-type branches were found also in *M. yakushimensis* S. Hatt., a typical *Marsupella* species with a perianth closely related to *M. emarginata* (Ehrh.) Dumort., the type of the genus). The reason is that not all taxa with a "marsupelloid" habit and a "gymnomitriod" gynaeceum have the *Anomoclada*-type branches. Schuster (2002) recently placed the rest of the *Marsupella* species with a "gymnomitrioid" gynaeceum in the subgenera *Micromarsupella* R. M. Schust. and *Amphimarsupella*.

6. In *Gymnomitrion* subg. *Nardiocalyx* (Jörg.) S. W. Arnell (*G. apiculatum* (Schiffn.) Müll. Frib.) both a low but distinct perianth and a ring-like perigynium occur. This species has a typical "gymnomitrioid" habit. Schuster (2002: 567) wrote that this species "does not fit well into *Gymnomitrion*".

Based on these points, it will be almost impossible to decide in which of the genera *Gymnomitrion* or *Marsupella* some species treated here should be placed—for example, *M. lacerata* (Steph.) Váňa, *M. moralesae* (Váňa) Váňa and *M. truncato-apiculata* () Váňa. I think that studies based on morphological characters alone, even when fertile and well-developed material is used, cannot answer the question of the generic placement of these (and other) species. Biosystematic studies based on molecular methods may provide more information, but so far such information is not available.

The present study presents some taxonomic and nomenclatural additions to the knowledge of the taxa occurring in the region and some additional data to their distribution. The taxa with no additional information available (*Acrolophozia fuegiana* R. M. Schust., *A. sulcata* Hässel, *Gymnomitrion concinnatum* (Lightf.) Corda, *Herzogobryum molle* Grolle, *H. teres* (Carrington et Pearson) Grolle, *H. vermiculare* (Schiffn.) Grolle, *Marsupella microphylla* R. M. Schust., *M. minutula* Hässel) are not treated in the following treatment.

Apomarsupella africana (Steph. ex Bonner) R. M. Schust., J. Hattori Bot. Lab. 80: 91, 1966

For the synonymy see Váňa (1985: 91).

Fig.: Arnell 1956, fig. 11, p. 543, fig. 12, p. 544.

Specimens examined (Latin America only): **Mexico**, Hildago, above Chapulhuacan, 3000 ft, 7.12.1944 A. J. Sharp, det. J. Váňa (TENN); Estado de Mexico, Gap at Nevado de Toluca trough which foot trail passes, 4350 m, 15.06.1973 A. J. & E. B. Sharp, E. C. Clebsch & K. R. Thornburgh 1518, 1525, det. J. Váňa (TENN); Estado de Mexico, Nevado de Toluca, NE side, outer wall of crater, 13000 ft, 19.12.1976 D. G. Horton 7882 (ALTA); Estado de Mexico, Mpio. De Toluca, crater of Nevado de Toluca volcano, 4800 m, 11.08.1995 J. Váňa (PRC); Estado de Mexico, Mt. Popocatepetl, 4000 m, 1.04.1973 G. Schwab SN 28, det. J. Váňa (JE); Puebla, Ixtaccihuatl above Huejotzingo, 13700 ft, 21.10.1945 A. J. Sharp 4274, det. J. Váňa (TENN); Veracruz, rod from Perote to Cofre, 4000 m, 30.09.1979 A. J. Sharp, G. Juárez, M. Baez & B. Boom 7175c, det. J. Váňa (TENN). **Guatemala**, Dept. San Marcos, between San Sebastián and summit of Volcán Tajumulco, 3800–4600 m, 13.02.1940 J. A. Steyermark 35542, det. J. Váňa (F). **Venezuela**, Estado Merida, Sierra Nevada de Merida, Pico Espejo, 3700–3900 m, 03.1969 B. & F. Oberwinkler & J. Poelt HV 69-125, HV 69-141, det. J. Váňa (JE). **Chile**, Gay (holotype of *Marsupella chilensis* Steph.; G-10880).

Distr.: Mexico, Guatemala, Venezuela, Chile; also in Uganda, Kenya, Tanzania, Rwanda and Zaire.

Notes: New for Guatemala; for Mexico mentioned in Váňa (1985) without citing of localities. The report of *Apomarsupella revoluta* (Nees) R. M. Schust. from Venezuela (Schuster 1974, Gradstein et Váňa 1987, Long et Grolle 1990, Schuster 2002; not mentioned already in Schuster 1996) is based on the specimens collected by B. & F. Oberwinkler and J. Poelt which belong to this species. I have seen no specimen of *A. revoluta* from Latin America.

Key to Latin American species of *Gymnomitrion*.

1. Leaf margin denticulate or crenulate. Small, wiry, filiform plants sometimes tinged with red, with slender stem under 10 cells in diam. and shallowly bilobed, ovate leaves with decolorate margins. .... **2.**

— Leaf margin entire. Larger, julaceous plants mostly whitish to silver-greyish, with stem more than 10 cells in diam. and at least to 0.2 their length bilobed leaves. .... **3.**

2. Marginal 1–2 (–3) rows of cells decolorate, mostly isodiametric, similar to other leaf cells (not differentiated), at least slightly obliquely elongated. [páramos of tropical America] .... *G. atrofilum*

— Marginal 1 (–2) rows of cells decolorate, differentiated, diagonally elongate, other leaf cells ± isodiametric. [only Mexico] ...... *G. pacificum*

5. Green to yellowish-brown plants with very closely imbricate or appressed leaves; cuticle strongly asperulate.♀ bracts never spinose or denticulate. [southernmost South America] .... *G. concinnatum*

3. Leaves sheath the stem, with setaceus lobes; lobe cells thick-walled. .... *G. setaceum*

— Leaves do not sheath the stem, without setaceous lobes; lobe cells thick- or thin-walled. .... **4.**

4. Leaves bilobed to 0.4–0.5 their length; marginal cells tangentially elongated. Terminal branching and small underleaves, sometimes connate with base of one leaf, present. .... *G. laceratum*

— Leaves bilobed to 0.2–0.3 (–0.4) their length; marginal cells not elongated or elongated at right angles to leaf margin or obliquely (never tangentially). Terminal branching and underleaves lacking. .... **5.**

5. Green to yellowish-brown plants with very closely imbricate or appressed leaves; cuticle strongly asperulate.♀ bracts never spinose or denticulate. [southernmost South America] .... *G. concinnatum*

— Whitish to greyish plants with ± distichous, suberect, loosely imbricate leaves; cuticle nearly smooth.♀ bracts armed with spinous teeth or denticulations. [páramos of tropical America] .... *G. asperulatum*

Gymnomitrion asperulatum R. M. Schust., J. Hattori Bot. Lab. 80: 106, fig. 19–20, 1996

Typus: Venezuela, Estado Merida, Sierra Nevada de Merida, above Merida, Loma Redonda station of the Teleferico, 4160 m, 02.1976 R. M. Schuster & L. Ruiz-Terán 76–1449 (herb. Schuster – holotype non vidi, PRC – isotype!)

Fig.: Schuster 1996, fig. 19, p. 109 and fig. 20, p. 111; the same fig. in Schuster 2002, fig. 423, p. 564 and fig. 424, p. 568.

Specimens examined: Costa Rica, Prov. de San José, Cerro de la Muerte, Páramo Buena Vista, 3100 m, 9.11.1999 I. Holz 99–620, det. J. Váňa (PRC). **Venezuela**, Estado Merida, Sierra Nevada de Merida, above Merida, Loma Redonda station of the Teleferico, 4160 m, 02.1976 R. M. Schuster & L. Ruiz-Terán 76-1432b as *G. laceratum* (MER); same locality, 4100 m, 19.01.1990 R. Lübenau-Nestle V 260 (herb. Lübenau-Nestle, PRC); Estado Merida, Distr. Rangel, Sierra de Santo Domingo, Páramo de Mucubají above Laguna Grande, 3500 m, 07–08.1972 D. Griffin III, M. Lopéz F. & L. Ruiz-Terán 1109 (FLAS); between Valéra and Aguila pass, 3900 m, 15.01.1990 A. Schäfer-Verwimp & I. Verwimp 12146, det. J. Váňa (herb. Schäfer-Verwimp, PRC).

Distr.: Costa Rica, Venezuela.

New for Costa Rica; until now known only on the basis of type specimen.

Gymnomitrion atrofilum Váňa, J. Hattori Bot. Lab. 41: 411, fig. 1, 1976

Typus: Colombia, Dept. Meta, Páramo de Sumapaz, Cerro Nevado del Sumapaz, 4015 m, 13.01.1973 A. M. Cleef 7757a (U – holotype!, PRC – isotype!)

Fig.: Váňa 1976, fig. 1, p. 412; Schuster 1996, fig. 11: 8–15, p. 67, the same fig. in Schuster 2002, fig. 419: 8–15, p. 552.

Specimens examined: Colombia, Cundinamarca, Páramo de Chirgaza, around lagunita along trail to St. Juanito, 3400 m, 23.09.1982 S. R. Gradstein & E. Santana 4266, det. S. R. Gradstein (U). **Ecuador**, Prov. Chimborazo, Morona Santiago, Cerros Yuibug – Pailacajas, 4400 m, 31.07.1997 P. Sklenař, det. J. Váňa (PRC); Prov. Tungurahua, Cerro Hermoso, 4300 m, 6.09.1997 P. Sklenař, det. J. Váňa (PRC).

Distr.: Colombia, Ecuador.

New for Ecuador; until now known only on the basis of type specimen.

Gymnomitrion laceratum (Steph.) Horik., Acta Phytotax. Geobot. 13: 212, 1943

For the synonymy see Váňa (1985: 89)

Fig.: Schuster 1949, fig. 1–4, p. 104, fig. 5–11, p. 106; Arnell 1956, fig. 6, p. 532, fig. 7, p. 533; Arnell 1963, fig. 220, p. 309; Kitagawa 1963, fig. 20, p. 113; Schuster 1974, fig. 325, p. 124, fig. 326, p. 128.

Specimens examined (Latin America only): **Mexico**, Estado de Mexico, Nevado de Toluca volcan, E side of the volcano, 13600 ft., 19.12.1976 D.G. Horton 78491 (TNS); Oaxaca, Gap in Sierra Juárez, 27.12.1969 A. J. Sharp 9817a, 9817e, 9850, 9850a p.p. (F, TENN); Oaxaca, Sierra Juárez, above Valle Nacional along road from Tuxtepec to Oaxaca, 5.09.1974 D. Richards, A. J. & E. B. Sharp 2771, 2774a, 2774b, 2777, det. A. J. Sharp (TENN); Oaxaca, above Llano de las Flores on the road between Ixtlán de Juárez and Tuxtepec, 9000 ft., 6.07.1996 A. J. Sharp, C. Delgadillo M., W. Chester & M. Folson 2712a, det. J. Váňa (TENN). **Peru**, Prov. La Libertad, Cerro la Gordas between Los Alisos and Quiruvilca, 3600 m, 16.05.1976 E. Hegewald 5972, 5976, det. J. Váňa (JE); Prov. Ancash, Prov. Recuay, between Tunnel Cahuish and Chavin (Quebrada Pucayado), 4050 m, 18.10.1973 P. & E. Hegewald 7716, 7717, 7722, 7733 (F, JE); Prov. Junin, Huayrapallana, 4900 m, 28.05.1960 G. Kunkel, det. S. Arnell (S). **Bolivia**, Dept. La Paz, Prov. Sur Yurgas, Taquesi East, E side of Taquesi pass along Inca Trail between Abra and Estancia Taquesi, 4480 m, 5–6.06.1983 M. Lewis 83-2154, 83-2172A, det. J. Váňa (F); Dept. Cochabamba, Prov. Chapare, along old Chapare road 7 km S of Incachasa, 3400 m, 8–13.11.1989 S. R. Gradstein 7393, det. J. Váňa (U).

Distr.: Mexico, Peru, Bolivia; U.S.A.: Tennessee; Uganda, Kenya, Tanzania, Zaire, Rwanda, Natal, Cape, Réunion; Russia: Altai Mts., Nepal, Japan.

New for Bolivia.

Gymnomitrion pacificum Grolle, Trans. Brit. Bryol. Soc. 5/1: 92, 2 f–k, 1966

Fig.: Grolle 1966a, fig. 2 f–k, p. 90.

Specimens examined (Latin America only): **Mexico**, Oaxaca, Gap in Sierra Juárez above Tuxtepec, 27.12.1969 A. J. Sharp 9850a p.p., det. J. Váňa (TENN); same locality, 10000 ft, 26.12.1970 A. J. Sharp 3860 as *G. laceratum*, 3861b, det. J. Váňa (F, TENN); Oaxaca, north of Oaxaca on Highway 175 at Sierra Juárez Gap, 9500–10000 ft., 24.12.1972 A. J. Sharp & al. 4180 as *G. laceratum*, 4231, det. J. Váňa (TENN).

Distr.: Mexico; S Alaska, Canada: British Columbia; Japan, Russia: Czukotka.

New for Mexico and the whole Latin America.

Gymnomitrion setaceum Grolle et Váña in Váña, J. Hattori Bot. Lab. 41: 411, 1976

Typus: Venezuela: Estado Merida, Sierra de Santo Domingo, Páramo de Muchuchies, near Laguna Negra, 3500 m, 03.1969 B. & F. Oberwinkler & J. Poelt HV 69-122 (JE – holotype!, PRC – isotype!)

Fig.: Váña 1967, fig. 2, p. 413; Schuster 1996, fig. 23, p.123, the same fig. in Schuster 2002, fig. 428, p. 575.

Specimens examined: Costa Rica, Prov. de San José, Cerro de la Muerte, Páramo Buena Vista south of Cartago, 3200–3270 m, 3–5.09.1973 D. Griffin III & D. Eakin 598, det. J. Váña (FLAS); Prov. de San José, Cerro de la Muerte, Páramo Buena Vista, 3100 m, 9. & 14.11.1999 I. Holz CR 99-0614, CR 99-0636, det. J. Váña (PRC); Prov. San José, Cerro de la Muerte, 3400 m, 26.12.1999 I. Holz & A. Schäfer-Verwimp CR 99-1199, det. J. Váña (PRC). **Venezuela**, Estado Merida, Sierra de Santo Domingo, Páramo de Muchuchies, near Laguna Negra, 3550 m, 18.04.1969 H. Hertel, B. & F. Oberwinkler, det. R. Grolle & J. Váña (JE, Herb. Hertel 10482); Estado Merida, Sierra de Santo Domingo, Páramo de Mucuchies, near Laguna Negra, 3500 m, 1969 F. Oberwinkler & J. Poelt HV 69-121 p.p., det. J. Váña (JE); Estado Trujillo, 3400 m, Las Paridor Lake, Páramo de Guiigay, 1975 M. López F. & L. Ruiz-Terán 10833, det. R. Grolle (JE). **Colombia**, S side of Sierra Nevada de Santa Marta, Chogurugue above San Sebastian, 3200 m, 26.01.1967 S. Winkler C 201 as *Herzogobryum paramophilum* n. sp. p.p., det. R. Grolle & J. Váña (JE); Boyacá, Páramos NW de Belen, Q. Minas, 3855 m, 2.03.1972 A. M. Cleef 2112a, det. J. Váña (U), Boyacá, Sierra Nevada del Cocuy, Quebrada Bocatoma, 4260 m, 5.10.1972 A. M. Cleef & P. Florschütz 5858, det. S. R. Gradstein (U); Cundinamarca, Páramo de Palacio, Lagunas de Buitrago, 3665 m, 29.09.1972 A. M. Cleef 6685b, det. J. Váña (U); Cundinamarca, Páramo de Palacio, Carretera hacia la Q. Chuza, 4 km SE from Mina de cal. Cabeceras Q. Chuscal, 3700 m, 9.09.1972 A. M. Cleef 5445, det. S. R. Gradstein (U); Cundinamarca, Páramo de Palacio, 4 km SE from Mina de Cal hacia Chusa, 3665 m, 29.11.1972 A. M. Cleef & L. Uribe 6685, det. S. R. Gradstein (U); Cundinamarca, Páramo de Chirgaza, around lagunita along trail to St. Juanito, 3400 m, 23.09.1982 S. R. Gradstein & E. Santana 4244, det. S. R. Gradstein (U); Meta, Páramo de Sumapaz, Cerro Nevado del Sumapaz, 4300 m, 11.01.1973 S. R. Gradstein 7632a (U).

Distr.: Costa Rica, Venezuela, Colombia.

Notes: Schuster (1996: 124) doubted the placement of this species in the sect. *Dianthelia* (R. M. Schust.) R. M. Schust., where it was placed by Váňa (1976). He suggested an affinity to the Nepalese *G. crenatilobum* Grolle, but this seems to be only a presumption, and not based on the study of specimens of the last species. This opinion seems not to be well founded, as it is probably based only on similar leaf cell structure. I agree with Schuster (1996, p. 124) that *G. setaceum* "is very different from 'normal' species of the genus, in that the leaves do not sheath the stem", but, examining the material of *G. crenatilobum*, it is clear that *G. crenatilobum* belongs to the "normal" species of the genus (leaves do not sheath the stem). Future studies can answer the question of whether *G. setaceum* should be placed in its own section; the infrageneric taxonomy of *Gymnomitrion* has not been yet fully clarified.

Key to Latin American species of *Marsupella*

1. Plants paroecious. .... **2.**
— Plants dioecious. .... **5.**

2. Perianth present. Leaves only rarely small and scale-like. .... **3.**
— Perianth lacking. Leaves small and scale-like, about 0.2 their length bilobed, appressed to stem. [South Georgia only] .... *M. minutula*

3. Plants with remote, scale-like leaves, their width scarcely or not exceeding that of the stem. .... *M. microphylla*
— Plants with imbricate leaves, at least in the upper parts of the shoots, their width twice or more exceeding that of the stem. .... **4.**

4. Plants minute (0.2–0.6 mm), brownish; leafy shoots arising from the system of stoloniform creeping axes with leaves slightly wider than the width of the stem, erect shoots abruptly larger-leaved distally. [Fuegia only] .... *M. sprucei*
— Plants larger (mostly more than 1 cm), green; stoloniform creeping axes lacking, shoots with large leaves throughout. [Mexico] .... *M. paroica*

5. Leaves strongly concave (flattening a leaf without tearing impossible), suborbicular, sinus lunate, descending to 0.1–0.2 the length; lobes subacute to apiculate. .... *M. truncato-apiculata*
— Leaves + canaliculate, only concave at base, sinus semilunate to acute, descending to 0.2–0.4 the length. .... **6.**

6. Leaves nearly orbicular; sinus flaring to semilunate; lobes much broader than long. .... **7.**
— Leaves ovate to egg-shaped, rarely nearly orbicular; sinus subacute to acute, lobes mostly longer than wide. .... **8.**

7. Perianth absent; leaves mostly bilobed to 0.1–0.2 their length. .... *M. moralesae*
— Perianth present; leaves bilobed to 0.2–0.3 their length. .... *M. emarginata*

8. Plants deep red to brownish, only lobe tips often decolorate; leafy shoots often arising from the system of stoloniform creeping axes. Leaves bilobed mostly to 0.2–0.3 their length; cells thin-walled with large to nodular trigones; lobes ending in 1–2 cells. Innermost ♀ bracts bifid, crispate, with dentate to laciniate margin and lateral teeth, never multifid and free. .... *M. miniata*
— Plants subhyaline to greyish-green, system of stolons and flagella not common. Leaves bilobed mostly to 0.3–0.4 their length; cells thick-walled; lobes ending in 3–4 (–5) cells. Innermost ♀ bracts deeply multifid, free, lacerate to laciniate. .... *M. lacerata*

Marsupella emarginata (Ehrh.) Dumort., Recueil Observ. Jungerm., p. 24, 1835

= ***Sarcoscyphus mexicanus*** Lindenb. et Gottsche in Gottsche, Lindenb. et Nees, Syn. Hepat., p. 618, 1846 ≡ ***Marsupella mexicana*** (Lindenb. et Gottsche) Steph., Spec. Hepat. 2: 25, 1901; syn. fide Gradstein et Váňa, Mem. New York Bot. Garden 45: 414, 1987

Typus: Mexico, Sempoaltepec, 06.1842 F. Liebmann, Pl. mex. 10.223 (Pl. mex. Liebm. 186) (C – lectotype!, W-Lindenb. Hep. 249 – isolectotype!, G-10885 – isolectotype!)

= ***Marsupella andina*** J. B. Jack et Steph., Hedwigia 31: 23, 1892; syn. fide Gradstein et Váňa, Mem. New York Bot. Garden 45: 414, 1987

Typus: Colombia, Nova Granada, Prov. Antiognio, Páramo de Sonsón, 10000 ft, 1872 G. Wallis (G-10879 – holotype!)

For the additional synonymy and figs. see manuals of European or North American hepatics.

Specimens examined (Latin America only): **Mexico**, 1913 Arsén 7419 (G-10887); Iztaccíhuatl, 4000 m, 27.08.1973 A. M. Cleef & C. Delgadillo M, 10268, det. J. Váňa (U); Edo Durango, along highway 40 about 9 mi. W of La Cuidad, 8600 ft, 30.12.1973 F. D. Bowers, C. Delgadillo M. & P. Sommers jr. 5082c, det. J. Váňa (F). **Colombia**, Dept. Cundinamarca, Mnpio. Guasca, Páramo de Guasca, along the road Guasca – Guachete, Cll. Pena Negra, valley of Chuscal, 3200 m, 6.09.1984 E. Linares, J. Aguirre C., S. R. Gradstein & B. O. van Zanten, det. S. R. Gradstein (U).

Distr.: Mexico, Colombia; Uganda, Tanzania, Rwanda, Zaire, Malesia, Sumatra, Philippines, widely distributed in the holarctic region.

Notes: Determination of three specimens cited in Gradstein et Váňa (1987) under *M. emarginata* is corrected in this paper (see *M. miniata* and *M. paroica*). The species is rare in the area.

Marsupella lacerata (Steph.) Váňa, comb. nova

Basionym: ***Sphenolobus laceratus*** Steph., Spec. Hepat. 2: 165, 1902 ≡ ***Gymnomitrion andinum*** R. M. Schust., Rev. Bryol. Lichénol. 34: 279, 1966 hom. illeg.

Typus (cf. Schuster, Rev. Bryol. Lichénol. 34: 279, 1966): **Colombia**, Andes Novogranatensis (Bogota), Lindig (G-11034 – lectotype!, FH – isolectotype!); same locality, Lindig sine no. (G-16002!, S!), Lindig 200 (G-16004!), Lindig 251 as *Jungermannia adulterina* f. etiolata (G-17212!), Lindig 253 (G-16003!) – syntypes.

= ***Anastrophyllum bolivianum*** Steph., Bibl. Bot. 87: 186, fig. 100, 1916

Typus: Bolivia, Yanakaka Montes, 4000 m, T. Herzog 3832 (G-17213 – holotype!)

= ***Marsupella cuspidata*** Steph., Bibl. Bot. 87: 181, fig. 93 a–b, 1916

Typus (cf. Váňa, Bryobrothera 5: 228, 1999): **Bolivia**, Hochtal Viloco, 4600 m, 10.1911 T. Herzog 3164/a (G-14539 – lectotype!, L – isolectotype!)

= ***Acolea andina*** Herzog, Bibl. Bot. 88: 27, fig. 14, 1921 ≡ ***Gymnomitrion andinum*** (Herzog) Herzog, Hedwigia 74: 81, 1934

Typus: Bolivia, an Felsen um Pinasgebiet gegen Cerro Incachacca, 4600 m, 08.1911 T. Herzog (JE – holotype!); same locality T. Herzog 2617, Stephani as *Anastrophyllum laxifolium* (JE – isotype or syntype!)

= ***Marsupella trollii*** Herzog, Hedwigia 74: 82, 1934

Typus: Bolivia, Mapiri, C. Troll no. 40 (JE – holotype!)

= ***Marsupella capensis*** S.W. Arnell, Bot. Notiser 110: 403, fig. 3, 1957

Typus: South Africa, Cape, Ceres Div., Hex River Mts., shale band from Witels Kloof up Buffelsshoek Peak, SW aspect, 4000 ft., 8.10.1956 E. Esterhuysen 26375 (BOL – holotype!, UPS – isotype!), same locality, E. Esterhuysen 26376, 26377 (syntypes non vidi).

= ? ***Marsupella subhyalina*** R. M. Schust., J. Hattori Bot. Lab. 80: 142, fig.27, 1996

Typus: Ecuador, hyperpáramo, N. of Pifo – Papallacta Rd., near microwave transmitter station at crest of Andes, 4200–4300 m, R. M. Schuster 93-218a (F – holotype non vidi)

Fig.: Stephani 1916, fig. 93 a–b, p. 181, fig. 100, p. 186; Herzog 1921, fig. 14, p. 28; Arnell 1957, fig. 3, p. 403, the same fig. in Arnell 1963, fig. 219, p. 308; Schuster 1996, fig. 27, p. 141; the same fig. in Schuster 2002, fig. 420, p. 554.

Specimens examined: Mexico, Estado de Mexico, Nevado de Toluca volcan, E side of the volcano, 13600 ft., 19.12.1976 D.H. Vitt 17879 as *G. laceratum* (TNS). **Costa Rica**, Prov. De San José, Cerro de la Muerte, 3450 m, 26.12.1999 A. Schäfer-Verwimp & I. Holz SV/H-0143, det. J. Váňa (PRC, Herb. Schäfer-Verwimp). **Venezuela**, Estado Merida, Sierra Nevada de Merida, E of Merida, 3700–3900 m, 1969 F. Oberwinkler & J. Poelt HV 69-119, det. R. Grolle (JE), Estado Merida, Sierra de St. Domingo, Páramo de Mucuchies, 1 km NW Passo El Aguila, 4250 m, 1969 H. Hertel & J. Poelt, det. R. Grolle (JE, Herb. Hertel 10541); Estado Merida, Páramo de Pinango (part of gran páramo de Mucuchíes), 4100 m, 18.07.1984 D. Griffin III & M. Lopéz F. PV-485 p.p., det. J. Váňa (FLAS); Estado Merida, Distr. Rangel, Páramo de Piedras Blancas, 4000–4220 m, 14.08.1975 D. Griffin III, M. López F. & L. Ruiz-Terán 1463, 1511, det. J. Váňa (FLAS). **Colombia**, S side of Sierra Nevada de Santa Marta, Chorugue above San Sebastian, 3200 m, 26.01.1967 S. Winkler C 201 as *Herzogobryum paramophilum* n. sp. p.p., det. J. Váňa (JE); S side of Sierra Nevada de Santa Marta, above Mamacanaca, 24.01.1967 S. Winkler C 402, det. J. Váňa (U); Caldas, W slope of Volcán Ruiz, Las Nereidas, 4300 m, 14.09.1984 E. Linares, J. Aguirre C., S. R. Gradstein & B. O. van Zanten 1433, 1434, det. J. Váňa (U); Boyacá, Páramo de Pisva, carretera Socha-La Punta, Filo Batanera, 2 km SW de la Laguna Batanera, Norros de S. Gabriel, 3750 m, 18.06.1972 A. M.Cleef 4692, det. J. Váňa (F, U); Meta, Páramo de Sumapaz, Hoya El Nevado, Laguna La Guitarra, 3425 m, 22.01.1972 A. M. Cleef 841, det. J. Váňa (U). **Ecuador**, sine loco spec., R. Espinosa 30, det. T. Herzog (JE); Prov. Chimborazo, Mt. Chimborazo, 4200 m, 4.07.1999 Z. Soldán, det. J. Váňa (PRC); Prov. Chimborazo, Mt. Chimborazo, near Hermanos Carrel, 4400, 6.07.1999 Z. Palice, det. J. Váňa (PRC); same locality, 4800–4830 m, 6.07.1999 Z. Soldán, det. J. Váňa (PRC). **Peru**, Dept. Cuzco, Prov. Paucartambo, Abra Acjanaco, near Paucartambo, upper part of Ceja de Selva, 3400–3500 m, 17.09.1984 H. Inoue 34011, det. J. Váňa (TNS); Dept. Puno, Prov. Melgar, between Santa Rosa and Sicuani, pass La Raya, 4300 m, 5.05.1973 P. & E. Hegewald 5507, 5522, det. J. Váňa (JE). **Bolivia**, Hochtal Viloco, 4600 m, 10.1911 T. Herzog 3162b, det. J. Váňa (JE); Quimzaoruz, Viloco, Miness valley, 4500–4600 m, 10.1911 T. Herzog 3166a (JE); Cerro Kaphir (Meseta), 4400 m, C. Troll 74, det. T. Herzog (JE, S); Dept. La Paz, Prov. Larecaja, along road between Sorata and Mina Mina Progresiva on mountain NE of Laripata and 5 km of Sarata, 3750 m, 5.12.1982 M. Lewis 82-122, 82-130, 82-132B, det. J. Váňa (F); Dept. La Paz, Prov. Murillo, uppermost headwaters of Río Livinosa, 33 km N of La Ceja de El Alto La Paz, 4880 m, 14.12.1982 M. Lewis 82-359, det. J. Váňa (F); Dept. La Paz, Prov. Loayza, ridge of Cerro Tres Cruces where it meets Cerro Quisma

Willkhi just S, 12 km of Caxata, 4900 m, 25.07.1983 M. Lewis 83-3010, det. J. Váňa (F); Dept. La Paz, Prov. Inquisivi, slopes between Río Chichipata (Río Huma Palca) and Hacienda Jucumarini, ca 2 km NW of Quime, 3260 m, 20.11.1986 M. Lewis 86-2197, det. J. Váňa (F); Dept. Cochabamba, Abra de San Benito, 3900 m, 01.1908 T. Herzog 6037, det. F. Stephani as *Marsupella* sp. (FI); Dept. Cochabamba, Prov. Chapaer, along old Chapare road 7 km S of Incachasa, 3400 m, 8–13.11.1989 S. R. Gradstein 7405, det. J. Váňa (U); Dept. Cochabamba, Prov. Ayopaya, Cordillera de Tunari on lower slopes of Cerro Khena Khena around N and W side of Laguna Cuyuntani, 22 km NW of Quillacollo, 4500 m, 9–10.10.1983 M. Lewis 83-4420A, det. J. Váňa (F); Dept. Cochabamba, Prov. Carrasco, Zona La Siberia along Cochabamba – Santa Cruz Highway ca 2 km NW of Cerro Bravo and 27 km NW of Comarapa, 2960–3010 m, 29.11.1983 M. Lewis 83-5117, det. J. Váňa (F).

Distr.: Bolivia, Peru, Ecuador, Colombia, Venezuela, Costa Rica, Mexico; South Africa.

Notes: This is a very critical and problematic taxon. It usually, but not always, has a typical "marsupelloid" habit and always has a typical "gymnomitrioid" gynaeceum, with no trace of a perigynium and with lanceolate lobes representing the inner female bracts. It is also "gymnomitrioid" in the colour of plants and the decolorate lobes. Schuster (2002) placed this species under *Gymnomitrion* on the basis of gynaeceum structure (cf. Schuster 1966, p. 277–278: "...", or Schuster 2002, p. 567: "*Sphenolobus laceratus* Steph. = *Gymnomitrion andinum* Schust. of Colombia, dealt with in Schuster (1966) ... has innermost♀ bracts reduced and "resolved into lanceolate filaments" and "deeply multifid", as shown in Schuster (1974) for *G. laceratum.*") and also under *Marsupella* on the basis of habit (cf. *M. subhyalina* R. M. Schust. in Schuster 1996, 2002). Herzog (1934) did the same for *Gymnomitrion andinum* and *Marsupella trollii* in Bolivia. African populations were accepted as undoubted *Marsupella* because of the habit characters (*M. capensis* S. W. Arnell).

In the author's present opinion this very variable species may belong to *Marsupella* subg. *Homocraspis* (Lindb. ex Schiffn.) Grolle sect. *Homocraspis* rather than to *Gymnomitrion* (as accepted by Schuster 1966 or Váňa 1999 on the basis of gynaeceum structure, decolorate lobes and greyish plants). Molecular studies will clarify if this opinion is correct or not. Typical "gymnomitrioid" plants with densely arranged leaves, of a greyish to silvery colour without any trace of purple, and decolorate parts of the leaf, occur mostly in Bolivia, where the species is relatively common. Typical "marsupelloid" plants were described f.e. as *Anastrophyllum bolivianum, Marsupella capensis* etc.

New for Mexico, Venezuela and Peru. For Costa Rica reported under the name *Marsupella trollii* (Morales 1991), but the specimens were not checked.

Marsupella miniata (Lindenb. et Gottsche) Grolle, J. Jap. Bot. 47: 144, 1966

Basionym: ***Gymnomitrion miniatum*** Lindenb. et Gott. in Gottsche, Lindenb. et Nees, Syn. Hepat., p. 617, 1846

Typus: Mexico, Mt. Orizaba, 10000 ft, 09.1841 F. Liebmann, Pl. mex. 10.026 (Pl. mex. Liebm. 358a) (C – lectotype!, G-14834 – isolectotype!, S – isolectotype!, W-Lindenb. Hep. 71 – isolectotype!)

= ***Marsupella lorentziana*** Steph., Spec. Hepat. 2: 19, 1901

Typus: Argentina, E. G. Lorentz (ex Herb. C. Müller Hal.) (G-10884 – holotype!, FH – isotype!, NY – herb. Mitten – isotype!)

= ? ***Marsupella andicola*** R. M. Schust., Austral Hepaticae 2: 555, 2002 (nomen nudum)

Typus: Venezuela, Sierra de Santo Domingo, Páramo de Mucubají, above Laguna Grande, 3600 m, R. M. Schuster 76-817a (herb. Schuster – holotype non vidi)

Fig.: Grolle 1966b, fig. 1, p. 15; Schuster 2002, fig. 420A, p. 556.

Specimens examined: Mexico, Estado de Mexico, Road to Nevado de Toluca, 4000 m, 15.06.1973 A. J. & E. B. Sharp, E. C. Clebsch & K. R. Thornburgh 1504b, 1509, det. J. Váňa (TENN); Estado de Mexico, Gap at Nevado de Toluca trough which fot trail passes, 4350 m, 15.06.1973 A. J. & E. B. Sharp, E. C. Clebsch & K. R. Thornburgh 1533, 1541, 1542b, 1545a, 1548c, det. J. Váňa (TENN); Estado de Mexico, Mpio. Toluca, NW slopes of Nevado de Toluca volcano, 3650 m, 11.08.1995 J. Váňa (PRC); Estade de Mexico, Mt. Popocatepetl, 4000 m, 1.04.1973 G. Schwab SN 26, SN 29, SN 31, det. J. Váňa (JE); same locality, 27.08.1973 A. M. Cleef & C. Delgadillo M. 10243, det. J. Váňa prius as *M. emarginata*, cf. Gradstein et Váňa 1987 (F, U); Puebla, Ixtaccihuatl above Huejotzingo, 13800 ft, 21.10.1945 A. J. Sharp 4288, det. J. Váňa (TENN); Veracruz, road from Perote to Cofre, 3900 m, 30.09.1979 A. J. Sharp, G. Juárez, M. Baez & B. Boom 7177c, det. J. Váňa (TENN). **Costa Rica**, Prov. Cartago, Parque Nacional Chirripó, NE Chirripó, 3775 m, 28.03. 1983 A. Chaverri, A. M. Cleef & R. Madrigal 1153, det. J. Váňa (U); Prov. Cartago, Volcán Irazú, 3300 m, 16.08.1993 C. Aedo, det. J. Váňa (Herb. Munoz 5124); Prov. de San José, Cordillera de Talamanca, Cerro de la Muerte, 3450 m, 26.12.1999 A. Schäfer-Verwimp & I. Holz SV/IH-0144, det. J. Váňa (Herb. Schäfer-Verwimp); Prov. de Limón, Parque Nacional Chirripó, Valle Crestones, 3430 m, 03.1983 A. Chaverri, A. M. Cleef & R. Madrigal 1036, 1045, det. J. Váňa (U, USJ); **Venezuela**, Estado Merida, Sierra de Santo Domingo, Páramo de Mucuchies, near Laguna

Negra, 3500 m, 1969 F. Oberwinkler & J. Poelt HV 69-121 p.p., det. J. Váňa (JE); Estado Merida, Sierra Nevada de Merida, Pico Espejo, 3500–3700 m, 1969 F. Oberwinkler & J. Poelt HV 69-140, det. J. Váňa (JE); Estado Merida, Páramo de Pinanango, part of Gran páramo de Mucuchíes, 4300 m, 17.06.1984 D. Grifin III & D. Diaz M PV-22, det. J. Váňa (FLAS); Estado Merida, between Valera – Aguila pass, 3900 m, 15.01.1990 A. Schäfer-Verwimp & I. Verwimp 12144 p.p., det. J. Váňa (Herb. Schäfer-Verwimp); Estado Merida, Pico d'Aguila, 3800–3900 m, 15.01.1990 R. Lübenau-Nestle V 119, det. J. Váňa (Herb. Lübenau-Nestle). **Colombia**, S side of Sierra Nevada de Santa Marta, Mamacanaca valley, 31.01.1967 S. Winkler, det. J. Váňa (U); Prov. de Magdalena, Sierra Nevada de Santa Marta, transecto del Rio Buritaca, Filo La Cumbre, 3500–3900 m, 15–19.08.1977 O. Rangel & A. M. Cleef 890, 1021, 1045, 1057 p.p., det. J. Váňa (U); Arauca, Sierra Nevada del Cocuy, Cabeceras de la Quebrada El Playón, Patio Bolos, Hoya S. Luís, 4350 m, 9.03.1973 A. M. Cleef 9002a, det. J. Váňa (U); Cundinamarca: Sabana de Bogotá, 2700 m, 05.1951 R.E.Schultes 12253, det. J. Váňa (FLAS); Cundinamarca, Páramo de Palacio, Lagunas de Buitrago, 3665 m, 29.09.1972 A. M. Cleef 6685b, det. J. Váňa (U); Cundinamarca, Guasca, 3150 m, 7.08.1980 S. R. Gradstein & J. Aguirre C. 3673, det. J. Váňa prius as *M. emarginata*, cf. Gradstein et Váňa 1987 (U); Cundinamarca, Páramo de Chirgaza, along trail to St. Juanito, 3400 m, 23.09.1982 S. R. Gradstein & E. Santana 4239, 4258, det. J. Váňa (U). **Ecuador**, Prov. Cotopaxi, SW of Paque Nacional Cotopaxi, 3600 m, 17.12.1983 W. R. Buck 10107, det. J. Váňa (NY).

Distr.: Mexico, Costa Rica, Venezuela, Colombia, Ecuador, Argentina.

Notes: Another "difficult" species, omitted in all Gymnomitriaceae treatments of Schuster. Based on the gyneaceum structure (correctly described previously by Stephani 1901), this species belongs to *Marsupella* subg. *Homocraspis* (Lindb. ex Schiffn.) Grolle sect. *Homocraspis.* Because the type specimen is very atypical (consisting of very small, reduced plants), the species has been known until now only on the basis of the type and normal plants were placed in herbaria under different names. Typically developed plants are 1–3 cm high, fuscous to reddish in colour, with a stoloniform system of axes and abruptly larger-leaved shoots distally. This form is more common in the páramos region. Probably *M. andicola* R. M. Schust. also belongs here and represents the "typical phase" of this species; at the time of writing, the description (cited as Schuster 2002 without specification) was not available, like the type specimen.

New for Costa Rica, Venezuela, Colombia, Ecuador, and northern Argentina.

Marsupella moralesae (Váňa) Váňa, comb. nova

Basionym: ***Gymnomitrion moralesae*** Váňa, J. Hattori Bot. Lab. 48: 230, fig. 4, 1980

Typus: Costa Rica, Alajuela, Parque Nacional Volcán Poás, 2400–2700 m, 30–31.07.1977 D. Griffin III et A. Araya P. 88 (FLAS – holotype!, PRC – isotype!)

Fig.: Váňa 1980, fig. 4, p. 231 and fig. 5, p. 232.

Distr.: Costa Rica.

Notes: Known only from the type specimen. Based on the gynaeceum structure, the species belongs to *Marsupella* subg. *Homocraspis* (Lindb. ex Schiffn.) Grolle sect. *Homocraspis*. This species has the habit of a dense-leaved *Marsupella emarginata* or a *Gymnomitrion* species. It is somewhat similar to *M. emarginata* in the form of the leaves, but the gynaeceum structure is completely different (perianth and perigynium absent etc.).

Marsupella paroica R. M. Schust., Bryologist 60: 145, 1957

Typus: U.S.A., North Carolina, Swain Co., Soco Falls, NE of Cherokee, 1.06.1952 R. M. Schuster 24203 (Herb. Schuster – holotype non vidi, H – isotype!)

Fig.: Schuster 1974, fig. 303: 10–11, p. 14, 317, p. 88, 318, p. 92.

Specimens examined (Latin America only): **Mexico**, Oaxaca, along road north of Llano de las Flores, N of Oaxaca, 2000–2500 m, 25.12.1965 A. J. Sharp & Z. Iwatsuki 5394, det. J. Váňa prius as *M. emarginata*, cf. Gradstein et Váňa 1987 (TENN).

Distr.: Mexico, U.S.A.

New for Mexico and the whole Latin America; until now regarded as endemic of eastern North America.

Marsupella truncato-apiculata (Herzog) Váňa, comb. nova

Basionym: ***Gymnomitrion truncato-apiculatum*** Herzog, Hedwigia 74: 81, fig. 2 a–b, 1934

Typus: Colombia, Paramo El Boquerón bei Bogota, 3500 m, 1929 K. Troll 2169 (JE – holotype!)

= ***Marsupella involuta*** Váňa, J. Hattori Bot. Lab. 41: 414, fig. 3, 1976

Typus: Colombia, Arauca, Sierra Nevada del Cocuy, Cabeceras de la Quebrada El Playon, Patio Bolos, Hoya S. José, ca 1 km SW from Alto de Patio Bolos, 4250 m, 7.03.1973 A. M. Cleef 8906a (PRC – holotype!, U – isotype!)

Fig.: Herzog 1934, fig. 2 a–b, p. 81; Váňa 1976, fig. 3, p. 415; Schuster 1966, fig. 11: 1–7, p. 67, the same fig. in Schuster 2002, fig. 419: 1–7, p. 552.

Specimens examined: Mexico, Estado de Mexico, Municipio Toluca, NW slopes of Nevado de Toluca volcan, 3650 m, 11.08.1995 J. Váňa (PRC). **Costa Rica**, Prov. de San José, Cerro de la Muerte, 3350–3450 m, 26.12.1999 A. Schäfer-Verwimp & I. Holz SV/H 0136, 0189, det. J. Váňa (PRC, Herb. Schäfer-Verwimp); Prov. de San José, Páramo Buena Vista, interamerican highway 90 km S of Cartago, 3200–3270 m, 3–5.09.1973 D. Griffin III & D. Eakin 590, det. J. Váňa (FLAS). **Venezuela**, Estado Merida, Sierra de Santo Domingo, Páramo de Mucubají, near Laguna Grande, 3600 m, 28.07.1984 D. & N. Griffin III PV-691, det. J. Váňa (FLAS); Estado Merida, between Valera – Aguila pass, 3900 m, 15.01.1990 A. Schäfer-Verwimp & I. Verwimp 12144 p.p., det. J. Váňa (Herb. Schäfer-Verwimp); Estado Merida, Pico del Espejo, 4675 m, 19.01.1990 R. Lübenau-Nestle, det. J. Váňa (Herb. Lübenau-Nestle). **Colombia**, S side of Sierra Nevada de Santa Marta, Mamacanaca, 4300 m, 29.01.1967 S. Winkler C 262 (U); Prov. de Magdalena, Sierra Nevada de Santa Marta, transecto del Rio Buritaca, Filo La Cumbre, 3500–3900 m, 15–19.08.1977 O. Rangel & A. M. Cleef 1057 p.p., det. J. Váňa (U); Boyacá, Páramo de Pisva, carretera Socha-La Punta, Alto de Granados, 3615 m, 12.06.1972 A. M. Cleef 4451a, det. J. Váňa (U); Boyacá, Páramos NW of Belén, cabeceras Quebrada Minas, Hoya Cll. Larga, 3835 m, 2.03.1973 A. M. Cleef 2128a, det. J. Váňa (U); Boyacá, Sierra Nevada del Cocuy, Boquerón de Cusirí, 4320 m, 5.03.1975 A. M. Cleef 8790, det. S. R. Gradstein (U); Boyacá, Páramo de Chisacá, along road Usmé – Nazareth, along Rio Santa Rosa, 3400 m, 4.09.1984 J. Aguirre C., S. R. Gradstein, B. O. van Zanten & E. Linares 4682a, det. J. Váňa (U); Cundinamarca, Páramo de Chirgaza, along trail to St. Juanito, 3400 m, 23.09.1982 S. R. Gradstein & E. Santana 4260, det. S. R. Gradstein (U); Meta, Páramo de Sumapaz, Cerro Nevado del Sumapaz, W. Rastrojo, 4015 m, 13.01.1973 A. M. Cleef 7758a, det. J. Váňa (U). **Ecuador**, Prov. Chimborazo, volcán Chimborazo, 4200 m, 4.07.1999 Z. Soldán, det. J. Váňa (PRC). **Bolivia**, Dept. Cochabamba, Prov. Arani, Cordillera de Tiraque, around shores of Laguna Cajitilla Khoda, 13 km S of Ne of Tiraque, 3950 m, 23.06.1985 M. Lewis 85-010, det. J. Váňa (F).

Distr.: Mexico, Costa Rica, Venezuela, Colombia, Ecuador, Bolivia.

Notes: The description of *Marsupella involuta* Váňa (accepted in Schuster 1996 and 2002 as a member of the genus Marsupella) was based on the commonly used "habit" concept of the genus. It was described on the basis of plants from wet habitats, in contrast to the type plants of *Gymnomitrion truncato-apiculatum* growing probably in dry and very exposed habitats. The species certainly has no perianth or perigynium (although Schuster 1996, 2002 doubts this) and should be placed, according to gynaeceum structure, in *Marsupella* subg. *Homocraspis* (Lindb. ex Schiffn.) Grolle sect. *Homocraspis* (in the Schuster's concept subg. *Amphimarsupella* R. M. Schust.), with *M. lacerata* (= ? *M. subhyalina*) and *M. miniata* (= ? *M. andicola*).

New for Mexico, Venezuela and Ecuador. For Bolivia reported by Váňa (1999) without citing of localities.

Marsupella sprucei (Limpr.) H. Bernet, Catal Hép. Sud-Ouest Suisse, p. 33, 1888

For the synonymy and figs. see manuals of European or North American hepatics; also Schuster 2002, fig. 415, p. 541.

Specimens examined (Latin America only): **South Georgia**, W side of Olsen valley, opposite Ruby Peak, Stromnes Bay, 100 ft, 17.03.1961 S. Greene 2975d, det. G. Hässel de Menéndez (AAS). **Chile**, Prov. Llanquihe, Dept. Osorno, Antillanaca, 1160 m, 1965/6 B. Ruthsatz 52/7, det. J. Váňa (GOET).

Distr.: South Georgia, Argentina (Schuster 1968), Chile; New Zealand; widely distributed in the holarctic region.

Reported for Chile in Váňa (1999); the exact locality is cited here.

Nanomarsupella xenophylla (R. M. Schust.) R. M. Schust., J. Hattori Bot. Lab. 80: 132, 1966

Basionym: ***Marsupella xenophylla*** R. M. Schust., Phytologia 39: 248, 1978.

Typus: Venezuela, Estado Merida, Sierra Nevada de Mérida, 4160 m, R. M. Schuster & L. Ruiz-Terán 76-1449 (Herb. Schuster – holotype non vidi, PRC – isotype!)

Fig.: Schuster 1996, fig. 24, p. 131; the same fig. in Schuster 2002, fig. 429, p. 579.

Specimens examined: Venezuela, Estado Merida, Páramo de Pinango (part of gran páramo de Mucuchíes), 4100 m, 18.07.1984 D. Griffin III & M. Lopéz F. PV-485 p.p., det. J. Váňa (FLAS). **Ecuador**, Prov. Napo, NE side of volcán Antisana, 4300 m, 17.08.1997 P. Slenař, det. J. Váňa (PRC); Prov. Chimborazo, volcán Chimborazo, 4200 m, 4.07.1999 Z. Soldán, det. J. Váňa (PRC).

New for Ecuador; until now known only from the type specimen.

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A Lunularia cruciata (L.) Lindb. régi-új hazai termőhelye

Simon T.
ELTE Növényrendszertani és Ökológiai Tanszék
`simontib@freemail.hu`

Abstract. **(The old-new home habitat of the Lunularia cruciata (L.) Lindb.)** The Lunularia cruciata—of an atlantic-mediterranous character—increases in Europe from south towards north (FRAHM, 1973). In Hungary — in the 20th century (since 1903)—it has been discovered in Botanical Garden (Budapest), among fresh sward (SZEPESFALVI 1903, BOROS 1935). But later *Lunularia* occured **only** in the greenhouse of Botanical Garden (Budapest and Szeged). (BOROS 1953, 1968, ORBÁN–VAJDA 1983). Author has observed *Lunularia* for the last ten years again in the *freeland-cultures* (on shady fresh sand-sward and on lime-stone of the rockery) of the Botanical Garden (Budapest). The light green colour thallus are all together some square metres. They are to a certain extent winterhart. PAPP, B. and RAJCZY, M. founded *Lunularia* — at the same time — in natural habitats (Szigetköz 1996/97) and recently on basalt-stone near to Salgótarján (PAPP, B. 1999) in Hungary, too! It becomes acclimatized in Hungary!

Bevezetés

Az atlanti-mediterrán jellegű holdserleg májmoha Európában délről észak felé lassú terjedésben van (FRAHM 1973). Először többnyire zárt terekben (kertészetek üveg- és fóliaházai, melegágyai, virágcserepek), majd a fagyoktól védettebb üde termőhelyeken (kertek, parkok gyepjeiben, virágkádjain, tenyészedényeiben) jelent meg. Nálunk most újra kilépett az üvegházakból a kert *szabadföldi* területeire, ahol tartósan a nem ritka hideg telek ellenére (pl. 2002—2003) is fennmaradó. Az elmúlt években a Szigetközi ágrendszer több lelőhelyén is felfedezték mint pionir fajt, nedves agyagon (PAPP B. 1992, PAPP B., RAJCZY M. 1996/97). Pár év múlva Salgótarján fölött meleg, párás bazaltsziklán is előkerült (PAPP B. 1999). További előfordulásai is várhatók! A szomszédos Szlovákiában 1955 óta ismert, újabban Bratislava (Pozsony: Csallóköz) és Nitra (Nyitra) közelében találták (JANOVICOVÁ, K., SOMOGYI, J. 1996).

A Botanikus Kertben SZEPESFALVI (1941) fedezte fel 1903-ban, sétaút mentén, ahová — szerinte — az üvegházakból került, és szaporodott gemmái segítségével. 1906-ig figyelte meg, aztán eltűnt. Majd BOROS Á. 1935-ben újra megfigyelte (ezt Szepesfalvihoz írt levelében jelezte), majd az 1953-ban megjelent határozójában pedig innét és Szegedről *csak mint üvegházi növényt* említette. Mohaföldrajzában (1968) ugyanígy és átmenetileg megtelepült (vorübergehend eingebürgert) előfordulásnak tekinti. Szerinte atlanti-szubmediterrán jellegű, majdnem kozmopolita, hazánkban adventív, higromezofiton, árnyékkedvelő, talajlakó (nedves apró kavicson termő), indifferens, cönológiailag ruderális faj.

Nálunk steril, de vegetatív módon (félhold alakú tartókban keletkező rügytestekkel) szaporodik. WATTSON (1964) is mint üvegházi „gyom"-ot jellemzi, amely csillogó zöld gemmáival könnyedén szaporodik. A gemmatartó karéj (innét a „holdsarló") eleinte kissé zárt, majd később kitárul (l. 1. ábra). A Magyarország mohaflórájának kézikönyvében (ORBÁN S., VAJDA L. 1983) szintén mint üvegházi növény szerepel a budapesti és szegedi botanikus kertből.

A hazai előfordulás

A szerző először a 90-es években figyelt fel a budapesti egyetemi botanikus kert üde gyepjeiben e fényes-középzöld teleptestű májmoha néhány tenyérnyi telepeire. Tudomásom szerint korábban az üvegházak cserepeiben, tenyésztalaján gyűjtöttek májmohát (*Marchantia polymorpha, Conocephalum conicum,* HORÁNSZKY A. *szóbeli közlése ezt megerősítette*) a tanszék hallgatói rendszertani gyakorlatokra. Ezek között ott lehetett a *Lunularia* is. Az üvegházakban később csak kevés teleptestű májmohát láttam. Mostanában is, így pl. a szaporítóházban, fóliaházban, magvetések cserepeiben él *Lunularia* (kísérői: *Funaria hygrometrica, Ceratodon purpureus*). Lehetséges, hogy az új és modern üvegházak melegebb és párásabb légköre, az új típusú talajkeverékek és a gyakori védőpermetezések nem kedveznek e teleptestű májmohák tenyészetének. Feltehető, hogy szabadban, de védett helyeken tartott magvetéses cserepekben kezdődött a *Lunularia* terjedése, s innét esetleg a rigók kapirgálásával (a gemmák hangyák általi széthordásával?) került a szabadföldi gyepekbe, pázsitokba, nedves talajra.

Mikor alaposabban tanulmányoztam a *kerti pázsitokat* (2001—2002), egyre több helyen kerültek elő, tenyérnyi vagy több deciméteres telepei. Főleg az üdébb, nedvesebb élőhelyeken, és a gyepszegélyes sétautak mélyebb fekvésű humuszos talaján tenyészik. [Kísérői: *Eurhynchium hians, Duchesnea indica (az 1950-es években kezdett honosodni, s ma már minden gyepben* *gyakori alkotóelem), Bellis perennis, Poa annua, Lolium perenne, Viola palionacea, Corydalis solida, Taraxacum off.*]. Árnyasabb hasonlókon a valódi májmoha (*Marchantia polymorpha*) telepeivel együtt fordul elő. Megtaláltam a sziklakert árnyas mészkövein is több helyen kisebbb méretű — néhány négyzetdeciméteres — telepkéit mohagyepben (*Amblystegium serpens, Tortula muralis, Cymbalarias muralis, Primula vulgaris, Sesleria heufleriana*).

Általános elterjedése, ökológiai-cönológiai viszonyai

Eredeti hazája Dél-Európa—Észak-Afrika (Mediterraneum), Észak-Amerika déli része, Dél-Amerika, Ausztrália. Müller, K. (1957) fő elterjedésének az északi szélesség 20. és 45. fok közötti övezetet tekinti. Gyakori faj a mediterrán tölgyesek zónájában, többnyire bázikus aljzaton pl. az Ibériai-félszigeten (SERGIO, C. et al. 1987), a Balkánon (pl. PETROV, SZL. 1975, PAVLETIC, ZL. 1955) és Itáliában (GIACOMINI, V. 1951). Európában észak felé terjedőben van. A déli félgömbön csak elszórtan, néhol fordul elő. Kétlaki faj, az atlanti-mediterrán térségekben generatív és vegetatív módon jól szaporodik.

Nyugat-, Közép-, és Észak-Európában (Oslóig) csak női példányok élnek, és vegetatív (az angliai Cornwall kivételével) úton szaporodnak. WATSON, E. V. (1968) Angliában kolonizáló (pionír) fajnak tekinti. Itt virágcserepekben, téglafalakon, sziklakertek kövein, kerti utakon él. Jóval ritkább másutt, de patak partokon és erdei utakon is elég gyakori. Észak-Európában vasúti töltések déli oldalán, ruderalis élőhelyeken. Az erősebb téli fagyokra érzékeny, hatására elpusztulhat. Előfordul Moszkva és Kiev botanikus kertjeinek üvegházaiban (ZEROV, D. K. 1964) is. HERZOG, TH. (1926) eleve kozmopolita fajnak tartja, amely részben az emberi (kertészeti) kultúrával és sikeres vegetatív szaporodásával hódít egyre újabb élőhelyeket. Terjedését az enyhe telek növekedő gyakoriságával, az általános klímaváltozással is összefüggésbe hozzák (FRAHM, J. P. 1973). Nálunk, az egyetemi Botanikus Kertben tapasztalt viselkedése alapján, amely *határozott terjedést* mutat, szerintem is a felmelegedés indikátora lehet.

Cönológiája

Mint adventív faj, térhódítása új területein általában szekunder élőhelyen mutatkozik. Szűkebb közössége németföldön a *Lunaria cruciata*-társulás (HÜBSCHMANN, A., 1986), amelynek faji összetétele (8 minta alapján) is erről tanúskodik. Konstans faj maga a *Lunularia* és a *Barbula unguicu-*

lata. További konstans fajok a *Calliergonella cuspidata, Bryum argenteum, Ceratodon purpureus*. Együttese a megművelt területek talajlakó társulásai (*Barbuletea unguiculatae* HÜBSCHMANN 1967) osztályába tartozik, a hasonló nevű sorozatba (*Barbuletalia u.*) és ezen belül a *Phascion cuspidatae* WALDHEIM 1947 csoportba (csoportfajok pl: *Phascum cuspidatum, Acaulon muticum, Riccia fajok, Pleuridium acuminatum, P. subulatum*).

Mediterrán élőhelyein életfeltételei, cönológiája (GIACOMINI. V. 1951) teljesen más jellegű. Erdős, gyepes élőhelyek bázisokban és humuszban gazdag, üde talaján él, patakok mentén, üde völgyi réteken, nedves-nyirkos sziklákon, kő- és téglafalakon, árkokban, mindig fagymentes termőhelyen, ahol gyakran nagy kiterjedésű gyepeket alkot. Itt a kísérő fajok is teljesen mások, mint újonnan meghódított termőhelyein, így természetesen más a társulása faji összetétele és megnevezése is.

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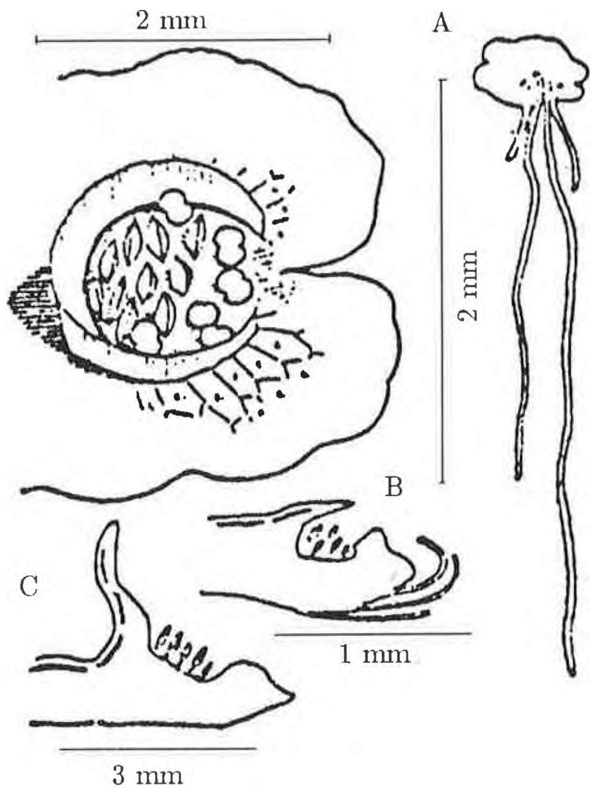
Képek — Figures

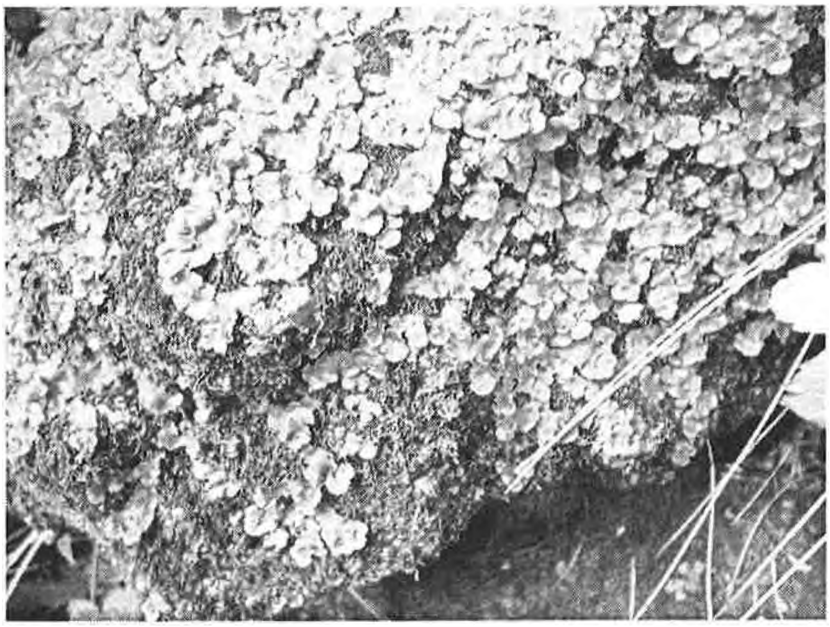


1. ábra. A *Lunularia* rügytestecske tartója (a) korai (b) és kifejlett (c) állapotban Csírázó rügytestecske (d). Wattson 1968 után.

Fig.1 Gemma receptacle (a), young (b), matured (c) of *Lunularia* and germinating gemma (d). After Wattson 1968.

2. ábra. *Lunularia* a botanikus kerti (Budapest) árnyas pázsiton, 2002-ben. (Susa Ágnes felvétele.)

Fig.2 *Lunularia* on the shady fresh sward of the Botanical Garden (Budapest), in year 2000. (Photo by Ágnes Susa.)



3. ábra. *Lunularia* a botanikus kerti felárnyékos mészkősziklán, 2002-ben (Susa Ágnes felvétele).

Fig.3 *Lunularia* on the shady limestone of the Botanical Garden (Budapest), in year 2002. (Photo by Ágnes Susa.)

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Új adatok a Retyezát hegység mohaflórájához

Orbán S. & Sass-Gyarmati A.
MTA—EKF Bryológiai Kutatócsoport
`orban@ektf.hu; gyarmati@ektf.hu`

Abstract. New data to the bryophyte flora of Retezat Mountains (Romania). *Andreaea obovata* Thed. is new to the Romanian bryoflora, 7 species are new to the studied area (those marked with an asterisk).

Bevezetés

A Retyezát hegység a Déli Kárpátok vonulatának egyik legfestőibb része. A hegység a Szörényi-havasok a Vulkán-hegység és a Hátszegi-medence déli pereme közé ékelődött. Nyugaton és északon a Rîul Mare folyó, délkeleten a Keleti-Zsil, keleten a Bărbat-folyó határolja.

A hegység központjában végighúzódó hatalmas gerincek alapkőzete a gránit, mely alatt üledékes kőzetek (agyagpala, homokkövek) és gyengén metamorfizálodott kristályos palák vannak. A hegység déli peremén középkori mészkőlerakódásokat is találunk. Bővizű hegyi patakok szállítják a völgyekbe a télen lehulló nagy mennyiségű hó és a gyakori nyári záporok vizét. Jóformán minden gleccserkatlanból ered egy-egy patak. A Retyezát körzetében több mint 70 tengerszemet számlálhatunk, melyek közül a legnagyobb gleccsertó a Bucura-tó (Lacul Bucura) összfelülete eléri a 10 ha-t, mélysége a 15 m-t is meghaladja. A második legnagyobb tengerszem a Zenoga-tó (Lacul Zănoaga) 1973 m magasságban, felülete 6,5 ha, mélysége 29 m. A Retyezát hegységben két klimatikus zónát különböztetünk meg: a szubalpesi régió ahol 700—1400 m között vegyes erdő, 1400 m felett fenyőerdő, efelett (az erdőhatár felett) található az alpesi régió 1700 m-től összefüggő törpefenyőből álló vegetációval, legvégül egyre kisebb borókabokrok és különböző évelő cserjék következnek. A déli oldalakon havasi legelőkkel borított hegyhátakkal találkozunk.

Legrégebbi mohaflorisztikai adatokat a Retyezát hegységből Simonkai (1872), ill. Péterfi (1903—1904, 1904) munkáiban találunk.

A Kárpátok szisztematikus bryoflorisztikai és bryogeográfiai kutatása az 1960-as évektől veszi kezdetét többek között a Pareng-hegység (M-ţii Parîng) bryoflórájának feltárásával. (Pócs, 1961, 1962, 1968). Jelen cikk első szerzője 1974 táján a Tarna-vidék mohaflórájának a feldolgozása kapcsán (Bakalár—Orbán—Pócs—Suba. & Vajda, 1975) ismerte meg Pócs Tamást aki határtalan lelkesedéssel számolt be gyűjtőútjairól és önzetlenül adta át kárpáti felfedezéseinek eredményeit az ifjabb kutatógenerációnak.

Ezen indíttatás is alapul szolgált annak a robbanásszerűen fejlődésnek induló feltárásnak, amely az 1970-es években veszi kezdetét. Sorozatban jelennek az egész Kárpát—Pannóniai térséget felölelő munkák. Ezek elsődleges célja azon meghatározó faktor vagy faktorok feltárása volt, amelyek adott mohafaj elterjedését döntő módon befolyásolják, és ezáltal növényföldrajzi szempontból pontosabban értékelhetővé vált, ezenfelül egy egész sor új adat került elő a ritka és érdekes fajokról. (Orbán—Debreczy 1973, Orbán, 1974, Orbán, 1975, Orbán, 1976, Orbán, 1977, Orbán—Pócs, 1977).

Ezzel párhuzamosan a román kutatók közül Pall St. közöl adatokat a hegység bryoflórájáról (Pall, 1962, 1964), Plămadă E. pedig kutatásokat végez elsősorban a Retyezát Nemzeti Park területén levő mohaflórán és vegetáción (Plămadă, 1975), a hegységben fellelhető és Románia mohaflórájában igen ritka máj- és lombosmohákról (Plămadă, 1973a; 1974a), bryoflorisztikai tanulmányokat végzett a hegység lápcönózisain (Plămadă, 1973b) és a hidrofil mohavegetáción (Plămadă, 1974b). Leírt egy új hibrid eredetű *Polytrichum* fajt a Retyezát hegységből (Plămadă, 1973c) és értékelte az *Andreaea nivalis* fajnak a romániai bryoflórájában betöltött szerepét(Plămadă, 1970).

Jelen cikk az 1974-ben Orbán Sándor és Debreczy Zsolt által a Zenogatónál gyűjtött anyagnak a feldolgozását tartalmazza.

Az elterjedési adatok minősítésénél Mohan (1998) munkája szolgált alapul. A májmohák nomenklaturájánál Schumaker et al. (2000), a lombosmoháknál Frahm et al. (1995) munkáját követtük.

A herbáriumi példányok az Eszterházy Károly Főiskola Herbáriumában (EGR) találhatók.

Májmohák (Marchantiopsida)

Pelliaceae Klinggr.

Pellia epiphylla (L.) Corda
Zenoga-tó, láp. Coll.: Orbán S. & Debreczy Zs. 27. 07. 1974.

Lepidoziaceae Limpr.

Bazzania *tricrenata* (Wahlenb.) Lindb.
Zenoga-tó, sziklák. Coll.: Orbán S. & Debreczy Zs. 26. 07. 1974.; É-i oldal, Saxifragás. Coll.: Orbán S. & Debreczy Zs. 28. 07. 1974.

Calypogeiaceae (C. Müll.) H. Arn.

****Calypogeia sphagnicola*** (H. Arn. & J. Perss.) Warnst. & Loeske

Zenoga-tó, láp. Coll.: Orbán S. & Debreczy Zs. 27. 07. 1974.

Calypogeia neesiana (Mass & Corest) K. Müll.
Zenoga-tó, forrásláp. Coll.: Orbán S. & Debreczy Zs. 27. 07. 1974.

Cephaloziaceae Migula

Pleurocladula albescens (Hook.) Grolle ***var. albescens***
Zenoga-tó felett, Zenoga-hegyen, D-i exp. Coll.: Orbán S. & Debreczy Zs. 26. 07. 1974.; É-i oldal, Saxifragás. Coll.: Orbán S. & Debreczy Zs. 28. 07. 1974.

Antheliaceae Schust.

Anthelia julacea (L.) Dum. subsp. ***julacea***
É-i Saxifragás oldal; Zenoga-hegyen glaciális törmeléklejtőn. Coll.: Orbán S. & Debreczy Zs. 27. 07. 1974.

Jungermanniaceae Reichb.

Tritomaria exsecta (Schmid.) Schiffn. ex Loeske
É-i oldal, Saxifragás. 27. 07. 1974.; Zenoga-tó feletti források. Coll.: Orbán S. & Debreczy Zs. 28. 07. 1974.

Barbilophozia lycopodioides (Wallr.) Loeske
É-i oldal Saxifragás; Zenoga-tó, sziklák; Zenoga-tó, láp; Zenoga-hegyen glaciális törmeléklejtőn. D-DNyi-exp. Alt.: 2200 m. Coll.: Orbán S. & Debreczy Zs. 27. 07. 1974.

Jungermannia gracillima Sm.
Zenoga-tó, forrásláp; Zenoga-hegyen glaciális törmeléklejtőn. Alt.: 2200 m. Coll.: Orbán S. & Debreczy Zs. 27. 07. 1974.

Jamesoniella autumnalis (DC.) Steph.
Zenoga-tó, sziklák. Coll.: Orbán S. & Debreczy Zs. 27. 07. 1974.

Gymnomitriaceae Klinggr.

Gymnomitrion concinnatum (Lightf.) Corda
D-DNy-i exp. Zenoga-hegyen, glaciális törmeléklejtőn. Alt.: 2200 m; É-i oldal Saxifragás. Coll.: Orbán S. & Debreczy Zs. 27. 07. 1974.

Marsupella sphacelata (Gieseke ex Lindb.) Dum.
Zenoga-hegyen, glaciális törmeléklejtőn. Alt.: 2200 m; Zenoga-tó, sziklák Coll.: Orbán S. & Debreczy Zs. 27. 07. 1974.

Marsupella brevissima (Dum.) Grolle
É-i Saxifragás oldal. Coll.: Orbán S. & Debreczy Zs. 27. 07. 1974.

Scapaniaceae Migula

Diplophyllum taxifolium (Wahlenb.) Dum.
Zenoga-tó fölötti források; É-i exp. Saxifragás gyepből. Coll.: Orbán S. & Debreczy Zs. 28. 07. 1974 ; Zenoga-hegyen, glaciális törmeléklejtőn 2200 m. D-DNyi exp. Coll.: Orbán S. & Debreczy Zs. 27. 07. 1974.

Diplophyllum albicans (L.) Dum.
Zenoga-tó feletti sziklák. Coll.: Orbán S. & Debreczy Zs. 26. 07. 1974.

Scapania undulata (L.) Dum.
Zenoga-tó melletti láp; Zenoga-tó, sziklák. Coll.: Orbán S. & Debreczy Zs. 27. 07. 1974.

Plagiochilaceae (Jörg.) K. Müll.

Plagiochila porelloides (Torrey et Nees.) Lindb.
Zenoga-tó, szikláról. Coll.: Orbán S. & Debreczy Zs. 27. 07. 1974.

Lombosmohák (Musciphyta)

Andreaceae Schimp.

****Andreaea obovata*** Thed.
É-i oldal, Saxifragás. Coll.: Orbán S. & Debreczy Zs. 27. 07. 1974.

Andreaea rupestris Hedw.
Zenoga-tó, szikláról. Coll.: Orbán S. & Debreczy Zs. 27. 07. 1974.; É-i oldal, Saxifragás; Zenoga-hegyen glaciális törmeléklejtőn. Coll.: Orbán S. & Debreczy Zs. 27. 07. 1974.

Andreaea frigida Hueb.
Zenoga-tó, É-i oldal, Saxifragás. Coll.: Orbán S. & Debreczy Zs. 27. 07. 1974.

Andreaea nivalis Hook.
É-i oldal, Saxifragás. Coll.: Orbán S. & Debreczy Zs. 27. 07. 1974.

Sphagnaceae K. Müll.

Sphagnum fimbriatum Wils.
Zenoga-tó, láp. Coll.: Orbán S. & Debreczy Zs. 29. 07. 1974

Sphagnum compactum DC.
Zenoga-tó felett gyűjtve, Alt.: 1800 – 1900 m. Eriophorumos-gyepből. 26. 07. 1974.; Zenoga-tó, láp. Coll.: Orbán S. & Debreczy Zs. 29. 07. 1974.

Polytrichaceae K. Müll.

Polytrichum commune Hedw.
Zenoga-tó fölötti források. 28. 07. 1974.; Zenoga-tó. Coll.: Orbán S. & Debreczy Zs. 29. 07. 1974.

****Polytrichum commune*** (L.) Hedw. ***var. uliginosum*** Huben
Zenoga-tó fölötti források. Coll.: Orbán S. & Debreczy Zs. 28. 07. 1974.

Polytrichum piliferum Hedw.
Zenoga-tó melletti láp; Zenoga-hegyen glaciális törmeléklejtőn. D-DNyi exp. Alt. 2200 m. Coll.: Orbán S. & Debreczy Zs. 27. 07. 1974.

Polytrichastrum alpinum (Hedw.) G. Sm.
É-i exp. Saxifragás gyepből. Coll.: Orbán S. & Debreczy Zs. 27. 07. 1974.

Polytrichum juniperinum Hedw.
Zenoga-tó, sziklák. Coll.: Orbán S. & Debreczy Zs. 29. 07. 1974.

Oligotrichum hercynicum (Hedw.) Lam. & DC.
Zenoga-tó, forrásláp; Zenoga-hegyen glaciális törmeléklejtőn. Alt.: 2200 m. Coll. Orbán S. & Debreczy Zs. 27. 07. 1974.

Dicranaceae K. Müll.

Rhabdoweisia fugax (Hedw.) B. S. G.
É-i exp. Saxifragás gyepből; Zenoga-tó felett, Zenoga-hegyen, D-i kitettségű sziklán. Coll.: Orbán S. & Debreczy Zs. 27. 07. 1974.

Dicranoweisia crispula (Hedw.) Milde
Zenoga-tó, szikláról. Alt.: 1800 – 1900 m. Coll.: Orbán S. & Debreczy Zs. 26. 07. 1974.

Paraleucobryum enerve (Thed.) Loeske
É-i oldal, Saxifragás; Zenoga-hegyen, glaciális törmeléklejtőn. Alt.: 2200 m. Coll.: Orbán S. & Debreczy Zs. 27. 07. 1974.; Zenoga-tó fölötti források. Coll.: Orbán S. & Debreczy Zs. 28. 07. 1974.

Dicranum scoparium Hedw.
Zenoga-hegyen, glaciális törmeléklejtőn. Alt.: 2200 m. Coll.: Orbán S. & Debreczy Zs. 27. 07. 1974.

Orthodicranum flagellare (Hedw.) Loeske
Zenoga-tó feletti sziklák. Alt.: 1800—1900 m. Coll.: Orbán S. & Debreczy Zs. 26. 07. 1974.

Kiaeria starkei (Web. et Mohr) Hag.
Zenoga-tó feletti sziklák. Alt.: 1800—1900 m. Coll.: Orbán S. & Debreczy Zs. 26. 07. 1974.

Kiaeria falcata (Hedw.) Hag.
Zenoga-hegyen, glaciális törmeléklejtőn. D-Dnyi exp. Alt.: 2200 m. 27. 07. 1974.

Cynodontium gracilescens (Web. et Mohr.) Schimp.
Zenoga-tó melletti láp. Coll.: Orbán S. & Debreczy Zs. 27. 07. 1974.; Zenoga-tó, sziklák. Coll.: Orbán S. & Debreczy Zs. 29. 07. 1974.

Oncophorus virens (Hedw.) Brid.
Zenoga-tó melletti sziklák. Alt.: 1800—1900 m. Coll.: Orbán S. & Debreczy Zs. 1974. 07.26.

*****Cynodontium tenellum*** (B. S. G.) Limpr.
É-i oldal, Saxifragás. Coll.: Orbán S. & Debreczy Zs. 27. 07. 1974.

Diphysciaceae Fleisch.

Diphyscium foliosum (Hedw.) Mohr.
Zenoga-hegyen, glaciális törmeléklejtőn, D-DNy exp. Alt.: 2200 m. Coll.: Orbán S. & Debreczy Zs. 28. 07. 1974.

Ditrichaceae Limpr.

Ceratodon purpureus (Hedw.) Brid.
Zenoga-tó sziklák. 26. 07. 1974.; Zenoga-tó feletti forrás; Zenoga-tó, szikla; É-i oldal Saxifragás. Coll.: Orbán S. & Debreczy Zs. 28. 07. 1974.

Ditrichum heteromallum (Hedw.) Britt.
Zenoga-tó, sziklák. Coll.: Orbán S. & Debreczy Zs. 26. 07. 1974.

Pottiaceae K. Müll.

Desmatodon latifolius (Hedw.) Brid. ***var. muticus*** Brid.
Zenoga-tó feletti forrás. Coll.: Orbán S. & Debreczy Zs. 28. 07. 1974.

Grimmiaceae B. S. G.

Schistidium alpicola (Hedw.) Limp.
Zenoga-tó sziklák. Alt.: 1800—1900 m. Coll.: Orbán S. & Debreczy Zs. 26. 07. 1974.; Zenoga-hegyen glaciális törmeléklejtőn. Coll.: Orbán S. & Debreczy Zs. 27. 07. 1974.

Racomitrium aciculare (Hedw.) Brid.
Zenoga-tó fölött gyűjtve, Eryophorumos-gyepből. Alt.: 1800—1900 m. Coll.: Orbán S. & Debreczy Zs. 26. 07. 1974.; Zenoga-tó melletti láp. Coll.: Orbán S. & Debreczy Zs. 27. 07. 1974.

Racomitrium canescens (Hedw.) Brid.
Zenoga-tó, É-i oldal, Saxifragás. Coll.: Orbán S. & Debreczy Zs. 28. 07. 1974.

Racomitrium heterostichum (Hedw.) Brid.
Zenoga-tó, sziklák. 26. 07. 1974.; É-i oldal, Saxifragás. Coll.: Orbán S. & Debreczy Zs. 27. 07. 1974

Racomitrium lanuginosum (Hedw.) Brid.

Zenoga-tó felett, Zenoga-hegyen. Coll.: Orbán S. & Debreczy Zs. 27. 07. 1974.

Racomitrium sudeticum (Funck.) B. S. G.
Zenoga-tó melletti láp. Coll.: Orbán S. & Debreczy Zs. 27. 07. 1974.; Zenoga-tó, É-i oldal. Coll.: Orbán S. & Debreczy Zs. 28. 07. 1974.

Grimmia atrata Mielichh ex Hoppe & Hornsch.
Zenoga-hegyen, glaciális törmeléklejtőn. Alt.: 2200 m. Coll.: Orbán S. & Debreczy Zs. 27. 07. 1974.

Grimmia elongata Kaulf.
Zenoga-tó melletti sziklák. Alt.: 1800–1900 m. Coll.: Orbán S & Debreczy Zs. 26. 07. 1974.

Grimmia alpestris Limpr.
Zenoga-tó melletti sziklák. Alt.: 1800–1900 m. Coll.: Orbán S. & Debreczy Zs. 26. 07. 1974.

Grimmia ovalis (Hedw.) Lindb.
É-i oldal, Saxifragás. Coll.: Orbán S. & Debreczy Zs. 28. 07. 1974.

Aulacomniaceae Boul.

Aulacomnium palustre (Hedw.) Schwaegr.
Zenoga-tó melletti láp; Zenoga-tó, forrásláp. 27. 07. 1974.; Zenoga-tó feletti források Coll.: Orbán S. & Debreczy Zs. 28. 07. 1974.

Aulacomnium turgidum (Wahlenb.) Schwaegr.
Zenoga-tó fölötti források. Coll.: Orbán S. & Debreczy Zs. 28. 07. 1974.

Bartramiaceae B. S. G.

Bartramia ithyphylla Brid.
Zenoga-tó, sziklák. Coll.: Orbán S. & Debreczy Zs. 29. 07. 1974.

Philonotis fontana (Hedw.) Brid.
Zenoga-tó, forrásláp. Coll.: Orbán S. & Debreczy Zs. 27. 07. 1974.

Philonotis seriata Mitt.
Zenoga-tó, forrásláp; Zenoga-tó feletti források. Coll.: Orbán S. & Debreczy Zs. 27. 07. 1974.

Mniaceae K. Müll.

Rhizomnium pseudopunctatum (Br. & Schimp.) T. Kop.
Zenoga-tó forrásláp. Coll.: Orbán S. & Debreczy Zs. 27. 07. 1974.; Zenoga-tó feletti források. Coll.: Orbán S. & Debreczy Zs. 28. 07. 1974.

Rhizomnium magnifolium (Horik.) T. Kop.
Zenoga-tó feletti források. Coll.: Orbán S. & Debreczy Zs. 28. 07. 1974.

Plagiomnium elatum (B. S. G.) T. Kop.
Zenoga-tó fölötti források. Coll.: Orbán S. & Debreczy Zs. 28. 07. 1974.

Plagiomnium medium (B. S. G.) T. Kop.
Zenoga-tó fölötti források. Coll.: Orbán S. & Debreczy Zs. 28. 07. 1974.

Bryaceae K. Müll.

Bryum weigelii Spreng.
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Pohlia nutans (Hedw.) Lindb.
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Fontinalaceae B. S. G.

Dichelyma falcatum (Hedw.) Myrin
Zenoga-tó fölötti források. Coll.: Orbán S. & Debreczy Zs. 28. 07. 1974.

Fontinalis antipyretica Hedw. ***var. gracilis*** (Lindb.) Schimp.
Zenoga-tó fölötti források. Coll.: Orbán S. & Debreczy Zs. 28. 07. 1974.

Thuidiaceae Kindb.

Heterocladium dimorphum (Brid.) B. S. G.
Zenoga-tó, É-i oldal, Saxifragás. Coll.: Orbán S. & Debreczy Zs. 27. 07. 1974.

Leskeaceae Rab.

****Lescurea mutabilis*** (Brid.) Lindb. ex Hag. ***var. decipiens*** (Limpr.) Moenk.
Zenoga-tó feletti források. Coll.: Orbán S. & Debreczy Zs. 28. 07. 1974.

Pseudoleskeella tectorum (Brid.) Kindb. ex Broth.
Zenoga-tó fölötti források. Coll.: Orbán S. & Debreczy Zs. 28. 07. 1974.

Lescurea patens (Lindb.) H. Arn. & C. Jens.
Zenoga-hegyen, glaciális törmeléklejtőn, D-DNy exp.; Zenoga-tó melletti láp. Coll.: Orbán S. & Debreczy Zs. 27. 07. 1974.

Amblystegiaceae Roth

Cratoneuron filicinum (Hedw.) Spruce
Zenoga-tó feletti források. 28. 07. 1974.

Calliergon stramineum (Brid.) Kindb.
Zenoga-tó, sziklák; Zenoga-tó, forrásláp. Coll.: Orbán S. & Debreczy Zs. 27. 07. 1974.

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Zenoga-tó, láprét. Coll.: Orbán S. & Debreczy Zs. 27. 07. 1974.

Drepanocladus uncinatus (Hedw.) Warnst.
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Zenoga-tó feletti források. Coll.: Orbán S. & Debreczy Zs. 28. 07. 1974.

Hygrohypnum alpinum (Lindb.) Loeske
Zenoga-tó feletti források. Coll.: Orbán S. & Debreczy Zs. 28. 07. 1974.

****Hygrohypnum eugyrium*** (B. S. G.) Broth.
Zenoga-tó feletti források. Coll.: Orbán S. & Debreczy Zs. 28. 07. 1974.

Brachytheciaceae B. S. G.

Brachythecium rivulare B. S. G.
Zenoga-tó, lápos. Coll.: Orbán S. & Debreczy Zs. 29. 07. 1974.

Hypnaceae Fleisch.

Hylocomium splendens (Hedw.) B. S. G.
Zenoga-tó, É-i oldal, Saxifragás. Coll.: Orbán S. & Debreczy Zs. 27. 07. 1974.

Rhytidiacae Fleisch.

Rhytidiadelphus triquetrus (Hedw.) Warnst.
Zenoga-tó, É-i oldal, Saxifragás. Coll.: Orbán S. & Debreczy Zs. 27. 07. 1974.

Plagiotheciaceae Fleisch.

Plagiothecium undulatum (Hedw.) B. S. G.
É-i Saxifragás oldal. Coll.: Orbán S. & Debreczy Zs. 27. 07. 1971

Plagiothecium laetum B. S. G.
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Pseudotaxiphyllum elegans (Brid.) Iwats.
É-i Saxifragás oldal. Coll.: Orbán S. & Debreczy Zs. 27. 07. 1971

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Köszönetnyilvánítás

A szerzők jelen helyen mondanak köszönetet Pócs Tamásnak, a májmohák meghatározásában nyújtott segítségéért.

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Pocsiella hydrogonioides **Bizot**, 1980. Rev. Bryol. Lichénol. 1: 424.
HOLOTYPE: Tanzania, Kilimanjaro Mts.
Coll.: T. Pócs 6788/AM (EGR)

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Tőzegmohalápok diatómái (Adatok a Nyírjes-tó diatómaflórájához)

Buczkó K.
Magyar Természettudományi Múzeum Növénytára
`buczko@bot.nhmus.hu`

Abstract. This is a brief summary about the coexistence of diatoms and mosses. We failed to find Hungarian data from the aerophytic, and found only a few from aquatic habitat about these two plant groups. The occurrences of the diatoms living in Hungarian mires are discussed in detail. Some very preliminary new diatom data can be also found from Nyírjes-mire at Sirok. Remarkable differences were found between the diatom flora and vegetation on *Sphagnum angustifolium, Sphagnum fallax and Sphagnum palustre. Eunotia paludosa* was the only dominant taxon on the first two mosses while it was absent from *S. palustre. Tabellaria flocculosa* and *Frustulia vulgaris* were abundant among the 6 taxa on *S. palustre.* The knowledge about the seasonality of algae living in mires is very restricted.

Amikor meghallottam a hírét, hogy Pócs Tamás születésnapjára egy Őt köszöntő kötet készül, olyan egyszerűnek és kézenfekvőnek tűnt az ötlet, hogy összegyűjtöm a mohákon élő diatómákról való ismereteket. A cikk címe „Briofita diatómák” lett volna.

Három okot is találtam a munka megkezdésére:

1. Johansen (1999) írásában bukkantam a briofita vagy briofitikus diatómák kifejezésre. A szerző azért javasolta a bevezetését, mert szerinte a moháknak gyakran csak rájuk jellemző flórájuk van. Becslések szerint mintegy 400 kovamoszattaxon él a szilárd-levegő fázis határán (aeroterreszetis diatómák) és ezek közül 130 olyan ismert, amely mohákon él. Ezek egy része csak a mohákban található meg (pl. Ando 1977, 1978).

2. További bátorítást jelentett, hogy Pócs Tamás érdeklődése a kryptobiotikus kéreg felé fordult. A Növénytár nevében külön öröm volt számunkra, hogy akadémiai székfoglaló előadásában megemlékezett P.-Komáromy Zsuzsáról (1942—1985), aki hazánkban kutatta a talajfelszínen élő algákat. Rövid életében is sok adattal járult hozzá a tudományterület megismeréséhez. Sajnos mohákon élő algákkal kapcsolatos eredményeket nem találtunk a munkái között.

3. Mivel vélhetően a kötet elsősorban a briológusok, mohakutatók által és számára íródik, remélem találnak benne érdekes információkat, és ha felkeltette érdeklődésüket a téma, akkor még közös munka is kialakulhat...

A több hónapnyi irodalmazás után azonban kiderült, hogy világviszonylatban is nagyon kevés a mohákon élő aerofita diatómákkal foglalkozó munka, Magyarországról pedig nincs publikált adat. A vízben élő mohákon található diatómákról is csak szórványadatokat találtam. A legtöbb adat nem túl meglepő módon a sarki területekről származik (pl. Alfinito és mtsai 1998, Douglas és Smol 1995, 1999).

Magyar vonatkozású adatok meglepő módon inkább a 19. század végéről, 20. század első feléből vannak, de nagyon kis számban. A 19. századiak a történelmi Magyarország területéről származnak. 1941-ben jelent meg Halász Márta munkája, amelyben Vajda László, a Zenoga tóban (Retyezát, Déli-Kárpátok) gyűjtött 3 mohafaján élő diatómákat dolgozta fel. Megállapítja, hogy a 3 fajon (*Dichelyma capillaceum, Scapania undulata és Fontinalis squamosa*) a taxonok száma és mennyiségi arányai is eltérőek. Igaz, hogy ez a cikk is a mai határokon kívüli gyűjtést dolgoz fel, de vizsgálati módszerei miatt (nem egyszerű florisztikai cikk) mégsem lehet említés nélkül hagyni. A következő dolgozat, amiben mohákon élő diatómákról olvashatunk, a barcsi borókás élővilágáról íródott. A Macsilla-láptóból *Fontinalis antipyretica*-n élő algákról számol be Uherkovich, összesen 3 fajt említ (*Eunotia faba Ehr., Eunotia subarcuatoides Alles, Nörpel and Lange-Bertalot, Nitzschia palea (Kuetz.) W. Smith* (Uherkovich és Kádár 1983). Sokat ígérő címe ellenére: „A mohák és algák szerepe a forrásmészkő képződésben" címmel megjelent munkában sem találunk adatot e két növénycsoport együttes előfordulásáról (Hevesi 1971).

A mohák és diatómák együttes előfordulására a tőzegmohalápokkal kapcsolatos munkákban találjuk a legtöbb adatot. Tehát úgy tűnik, hogy jelenleg még nincs itt az ideje, hogy a mohákon élő diatómákról áttekintést készítsünk. A téma érdekessége miatt érdemes tovább folytatni a gyűjtést és ennek első lépéseként a tőzegmohalápok diatómáiról való ismereteket gyűjtöttem össze. Pontosabban a tőzegmohalápokon belül is közvetlenül a tőzegmohákon vagy azok közvetlen közelében „*Sphagnum* facsarék"-ban előforduló diatómákkal foglalkozom.

A tőzegmohák diatómái

Gömörszőlősön 2000. március 17. és 19. között került megrendezésre a „Tőzegmohás élőhelyek hazánkban: kutatás, kezelés, védelem" című munkaértekezlet. A szervezők célkitűzései között külön pontként szerepel a „a hiányzó kutatási területekre a résztvevők figyelmét felhívni". A munkaértekezlet összefoglalójaként megjelent kötetben (Szurdoki 2000 a, b) összesen 6 algológiai munkát találunk, amelyek közül 3 a Csömöri tó algáit említi, ahonnan azóta már eltűntek a *tőzegmohák*. Ezen kívül Uherkovich Gábor 3 munkáját találjuk az összefoglalóban. Ez a tény elsősorban arra hívja fel a figyelmet, hogy még a téma iránt jobban érdeklődő kutatók látóteréből is gyakran kiesnek az algák. (Részben ennek pótlására hivatkozunk ebben az írásban azokra a lápokkal foglalkozó dolgozatokra, amelyekben nincsenek diatómaadatok.)

Az igazi „élő" láp Magyarországon már ritka jelenség (Lájer 1998), előbb tűnnek el, mint ahogy megismernénk őket.

A magyarországi lápokon (nem csak tőzegmohás) végzett algológiai kutatásokat Borics Gábor PhD dolgozatában (Borics 2001), összefoglalta és megállapította, hogy „A magyarországi lápok algológiai kutatása komoly múlttal rendelkezik. [...] az elmúlt szűk másfél évszázad csaknem valamennyi jeles hazai algológusa részt vett lápjaink kutatásában." Megállapítja, hogy több mint félszáz algológiai cikk foglalkozik a lápok flórájával. Ezek között 13 nyomtatásban megjelent közleményben találtam tőzegmohalápok algáival foglalkozó cikket. Az 1. táblázat ismerteti a cikkeket, valamint azt, hány taxont találtak a tőzegmohás mintavételi helyen. Kigyűjöttük a csak tőzegmohán, vagy „*Sphagnum*-facsarékból" közölt adatokat, tehát a táblázatban szereplő adatok nem egyeznek a cikkekben található összes diatómaszámmal. A planktonból és lagzónából származó adatokat nem vettük figyelembe a táblázat összeállításánál.

1. táblázat

Algológiai vizsgálatok magyarországi tőzegmohalápokon és a talált taxonok száma

Szerző, publikálás éve	Hely	Sphagnum fajokon talált diatómataxonok száma
Kol, 1930	Lesenceistvánd	nem közöl diatómát
Palik, 1938	Kőszeg, Alsóerdő lápja	nem közöl diatómát
Palik, 1940	Pomáz, Tólaki-tó	nem közöl diatómát
Kol, 1967	Farkasfa, Fekete-tó	nem közöl diatómát
Kol, 1973	Grajka-patak	nem közöl diatómát
Uherkovich, 1979	Öcsi Nagy-tó	46
Uherkovich, 1981	Barcs, Szűrűhely-folyás	38
Uherkovich, 1982	Fekete-hegy, Kerek- vagy Monostori-tó	26
Uherkovich, 1984	Kovácsi-hegy, Vad-tó	48
Uherkovich és Szilvágyi, 1985	Barcs, Nagyberek	6
Vízkelety, 1987	Fekete-tó	21

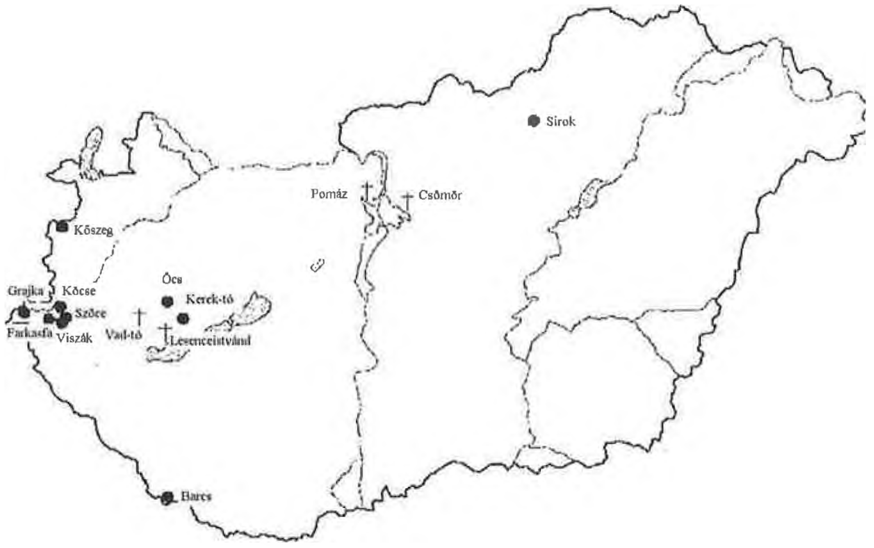
	Ördög-tó	10
Stollmayer-Boncz, 1988	Csömöri-tó	13
Uherkovich, Szilvágyi, Vízkelety, 1994	Szőce	46
Borics, 2001	Fekete-tó	0
	Ördög-tó	5
	Öcsi Nagy-tó	7
	Grajka	33
	Huszászi-patak	7
	Vadkacsás-tó	6
	Szőce	15
Buczkó, 2003	Sirok, Nyírjes-tó	7

A magyar vonatkozású (értem ez alatt a magyar algológusok Kárpát-medencében végzett kutatásait) lápi-algológiai irodalom részletes ismertetése ugyancsak megtalálható Borics munkájában, itt csak a mai Magyarország területén található tőzegmohalápok algológiai vizsgálatait foglaljuk össze (1. ábra).

Az első közlemény Kol Erzsébet nevéhez fűződik. A lesenceistvándi láp őszi vegetációjáról szóló dolgozatában (Kol 1930) ugyan nem közöl adatokat diatómákról, de felhívja a figyelmet arra, hogy az alacsony vízszint is oka lehet a talált alacsony fajszámnak a szezonalitás mellett. Időrendben Palik Piroska dolgozatai következnek, 1938-ban jelent a Kőszegi Alsóerdő lápjáról majd 1940-ban az azóta már eltűnt pomázi Tólaki-tóról szóló cikk, amelyekben szintén nem találunk kovamoszatokra vonatkozó adatokat. Kol Erzsébet érdeklődése a 60-as 70-es években ismét a lápok felé fordult, a Farkasfa község (Vas megye) melletti Fekete-tó algaflóráját (Kol, 1967) dolgozza fel: 110 fajt említ, de egyetlen kovamoszatot sem, csakúgy mint az 1973-ban megjelent, a Grajka-patak forráslápjáról szóló munkájában.

Igencsak meglepő, hogy az első publikáció, amelyben adatokat találunk a tőzegmohalápok diatómáiról, 1979-ben jelent meg. Uherkovich Gábor az öcsi Nagy-tóról írott részletes munkájában 1973 májusában és novemberében és 1974 áprilisában és júniusában gyűjtött mintasorozatot dolgoz fel (Uherkovich 1979). A 100 taxon közül 46 fordul elő tőzegmohákban, és ezek közül is érdemes megemlíteni a *Navicula variostrata*-t amely csak tőzegmohalápokban él. A fajt leíró George Krasske egyébként két mohakutató, a Dresdában dolgozó Dr. Schade, és a Kasselben dolgozó Dr. Grimme indítására kezdett a mohákon élő diatómák vizsgálatához, és számos „Sphagnophil" taxont írt le.

Uherkovich Gábor második tőzegmohalápokhoz kötődő munkája 1981-ban jelent meg. Szűrűhely-folyásban (Barcs) 1979-ben és 1980-ban gyűjtött mintákban 67 taxont talált, ezek közül 38 élt tőzegmohán vagy annak közvetlen közelében. (Uherkovich 1981). Jellemző az *Eunotia* és *Pinnularia* fajok magas aránya. A szerző felhívja a figyelmet arra, hogy az erdőkkel körülvett, hullámzás által nem bolygatott területen nagyon mozaikos élővilág alakul ki.



1. ábra.

Tőzegmoha- és tőzegmohás lápok, ahol algológiai vizsgálatok történtek (**Grajka**, Grajka-patak: Kol 1973, Borics 2001; **Kőszeg**, Alsóerdő lápja: Palik 1938; **Farkasfa**, Fekete-tó: Kol 1967, Vízkelety 1987, Borics 2001; Ördög-tó: Vízkelety 1987, Borics 2001; Huszászi-patak Borics 2001; **Szőce**: Uherkovich és mtsai 1984, Borics 2001; **Köcse**: Buczkó 2003; **Viszák**, Vadkacsás-tó: Borics 2001; **Vad-tó**: Uherkovich 1984; **Öcs**, Nagy-tó: Uherkovich 1979, Borics 2001; **Lesenceistvánd**: Kol 1930; **Csömör**: Stollmayer-Boncz 1988; **Sirok**, Nyírjes-tó: Buczkó 2003; **Barcs**: Uherkovich 1981; Borics 2001; **Pomáz**, Tólaki tőzegmohás tó: Palik 1940.) Kereszttel jelöltük azokat a mintavételi helyeket, ahol ma már nem található tőzegmoha.

Ezután a Balaton-felvidéki Fekete-hegy Kerek-tava vegetációjának bemutatása következik (Uherkovich 1982). Az 1976 és 1979 között végzett vizsgálatsorozatban Uherkovich 41 kovamoszat előfordulásáról számol be. Az eredményeket ismertetve így ír: „Még nem érkezett el az ideje, hogy a hazai tőzegmohalápos vizeink limnológiai viszonyairól és ezen belül algavegetációjáról áttekintést tudjunk adni."

1984-ben jelent meg a Vad-tó (Kovácsi-hegy, Zala megye) algavegetációjáról írt munkája (Uherkovich 1984). Amint a Szerző a bevezetőben írja

„in memoriam Vad-tó" hangvétellel íródott a cikk. Negyvennyolc diatómát említ, kiemeli az *Eunotia* és *Pinnularia* fajok magas arányát (12, ill. 17 taxon). A cikkben Uherkovich összehasonlítja az általa korábban vizsgált Öcsi-tóban és Kerek-tóban talált algák törzsenkénti megoszlását. Megállapítja, hogy a Vad-tóban találta a legkevesebb algataxont (132), de a legtöbb diatómát. Szerinte „a Vad-tó alacsonyabb taxonszáma arra utalhat, hogy az algák folyamatos tenyészéséhez szükséges vízellátás nincs biztosítva."

1982 és 1984 között Vízkelety Éva az őrségi Ördög-tó és a Fekete-tó algáit vizsgálta. Megállapította, hogy fajszegény, kovadominált. A nyáron gyűjtött (június, július), ill. 1984 októberében összesen 29 diatómataxon jelenlétéről számol be — 21 taxont a Fekete-tóból, 10-et az Ördög-tóból jegyzett fel (Vízkelety 1987).

1984-től kezdődően 7 évig vizsgálta Stollmayerné Boncz Emília a Csömör melletti tó növényvilágát. 1987 telén a láp kör száraz gyékény és nád leégett, a közben kivágott fákkal együtt, a tőzegmohák eltűntek. A leégés előtt, 1984—85-ből 13 taxon előfordulásáról számol be a tőzegmohák mellől (Stollmayer-Boncz 1988).

A Szőcei láp botanikai leírását Pócs és mtsai (1958) munkájában találjuk, részletes algológiai vizsgálatát Uherkovich és mtsai 1994-ben megjelent munkája ismerteti. Itt is jellemző az *Eunotia* és *Pinnularia* nemzetség jelenléte (18 ill. 13 taxonnal), az összesen talált 46 taxon 67%-át adja ez a két nemzetség.

A hazai algológiai lápkutatásban Borics Gábor 2001-ben megvédett PhD-dolgozata mérföldkőnek számít. Ez az első munka, melyben mennyiségi adatokat is találunk. A fent idézett munkák mindegyike elsősorban florisztikai feltárásra törekedett, a dominanciaviszonyokra utalva legfeljebb három kategóriába osztja (Vízkelety 1987) a megtalált taxonokat (ritka-közepes-gyakori). A hidrobiológiában, és ezen belül a fitoplankton-kutatásban, a 20. század közepén, jelentek meg először mennyiségi adatok (Padisák 1998). A mennyiségi planktonvizsgálatok feltétele volt a fordított rendszerű mikroszkóp kifejlesztése, amiről 1958-ban olvashatunk először.

Borics Gábor dolgozata elsősorban a Baláta tóval foglalkozik, de 12 más lápról is vannak adatai. Ezek közül 7 tőzegmohás (1. táblázat). A gyűjtés 1999. augusztus 28. és szeptember 1. között történt. Láponként általában 1 vagy 2 *Sphagnum*-os minta került feldolgozásra, egyedül a Grajka-patakból volt 4 mintája. Ennek fényében nem túl meglepő, hogy a Grajka bizonyult a legfajgazdagabbnak, 33 taxont talált itt. A Szőcei-lápról 15 taxonról számol be, közülük 2 *Eunotia* 4 *Pinnularia* faj volt. Az Ördög-tó 5 faja közül a *Pinnularia subcapitata* domináns volt. A Huszászi-patak 7 taxonja közül csak 1 *Eunotia* és 2 *Pinnularia* faj szerepel a listában. A Vadkacsás tó 6 taxonjából 2 *Eunotia* és 3 *Pinnularia* faj. Meglepő, hogy az öcsi Nagy-tóban talált 7 taxonból hiányoznak az *Eunotia* fajok. A Fekete-tóban csak a lagzónából közöl adatokat. Összesen 39 taxon szerepel a felsorolásokban.

Borics dolgozata összefoglalójában megállapítja, hogy a korábbi vizsgálatokkal összehasonlítva kevesebb algafajt talált a vizsgált lápon. Ezt egyrészt mintavételi okokkal magyarázza, másrészt az 1981 és 1994 közötti száraz időszakkal.

Az utolsó adatsor, amit ismertetni szeretnék, 2003-ban készült, és itt számolok be róla először. A 2003-ban kezdett munka alapkérdése az, hogy a különböző tőzegmohákon különbözik-e a közösség. Ehhez 4 tőzegmohafajt vizsgáltam meg Szurdoki Erzsébet gyűjtéséből:

Sphagnum angustifolium Kőszeg, Alsóerdő lápja 1994. 10. 15.
Sphagnum squarrosum Petőfibánya, Köcse-tó 1994. 08. 09.
Sphagnum palustre var. palustre Kőszeg, Alsóerdő lápja 1994. 10. 15.
Sphagnum magellanicum Petőfibánya, Köcse-tó 1994. 08. 09.

A teljes mohanövénykét 30%-os hidrogénperoxidba tettük, egy napon át forró vízfürdőben tartottuk. A szervesanyag roncsolása után, és háromszoros desztillált vízzel történő mosás után magas törésmutatójú műgyantába ágyaztuk a kovaalgákat (Zrax, törésmutató ≈1,7). Az így elkészített preparátumokat 1000-szeres nagyítással immerziós lencsével vizsgáljuk fénymikroszkóppal (Nikon Eclipse 600).

Az 1994-ben gyűjtött minták egyikében sem találtam egyetlen diatómavázat sem. Többször megismételtük a mintaelőkészítést (több moha elroncsolása, közvetlen mikroszkópi vizsgálat), a keresés eredménytelen maradt.

Az 1994-es minták sterilitásának talán abban keresendő az oka, hogy a korábbi évek tartós szárazsága (vö. Borics 2001) miatt a tőzegmohák kiszáradtak. Feltevéseink szerint rövid idejű kiszáradás mellett meg kellett volna találni a diatómavázakat. Ugyanakkor várható lenne, hogy aerophyta diatómák jelennek meg. A kérdés tovább vizsgálandó.

Ezzel egyidőben kezdtem meg a Nyírjes-tó vizsgálatát. A választást az indokolta, hogy algológiailag feltáratlan, azon kevés lápjaink egyike, ahol érdemes lehet fúrásokat végezni klímarekonstrukciós célokkal. Jó megközelíthetősége miatt gyakori mintavétellel vizsgálható a szezonalitás, ami korábbi lápkutatásaink nagy hiányossága. A legtöbb publikáció egy vagy néhány nyári minta alapján készült.

2003. március 31-én és 2003. május 4-én a Sirok közelében található Nyírjes-tóban végeztünk gyűjtéseket. A láp leírása megtalálható Szurdoki munkáiban (Szurdoki és Nagy 2002, Szurdoki 2003).

A Sphganum-facsarék diatómáit hideg hidrogénperoxiddal tisztítottam és a fent leírt módon tartós preparátumokat készítettem. Az algológiai gyakorlatban mintánként 400 egyedet számolunk meg és ebből számoljuk a relalatív gyakoriságot. Így ±10%-ra tehető a számolás hibája. A minták ritkasága miatt ez ugyan nem mindig sikerült, de legalább 100 egyedet minden mintából megszámoltam.

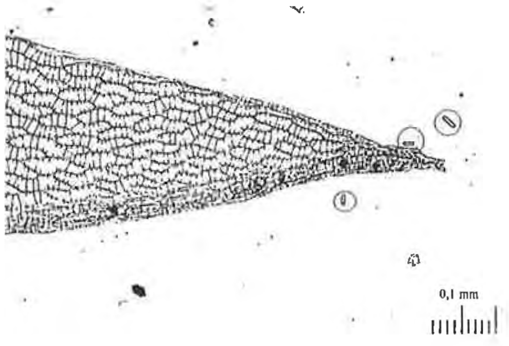
Nyírjes-tó két tavaszi mintájában összesen 14 diatómataxont találtam (részben a nyíltvízben, nádbevonatban, békalencsén). A 14 közül 7 taxont találtam tőzegmohán vagy annak facsarékában. A lagzónában békalencsén az *Eunotia bilunaris (Ehr.) Mills* és a *Pinnularia subcapitata Gregory* „kettőse" élt durván 3:1 arányban. Ugyancsak ezt és csak ezt a két fajt találta Borics (2001) a Fekete-tavon, bár ott *Pinnularia subcapitata* 99%-os dominanciája mellett az *Eunotia bilunaris* előfordulása szórványosnak tekinthető.

2. táblázat

A Nyírjes tó tavaszi mintáiban, tőzegmohákon talált diatómák relatív gyakoriságai

	S. angustifolium 2003. 03. 31.	S. angustifolium 2003. 05. 14.	S. fallax 2003. 03. 31.	S. palustre 2003. 05. 14.
Cymbella gracilis (Ehr.) Kuetz.		0,0086		0,0455
Eunotia paludosa Grun.	0,9733	0,9914	1,0000	
Eunotia tenella (Grun.) Hust.				0,0909
Frustulia vulgaris (Thwaites) De Toni				0,3182
Pinnularia microstauron (Ehr.) Cl.	0,0267			0,0455
Stauroneis cf. gracillima Hust.				0,0909
Tabellaria flocculosa (Roth.) Kuetz.				0,4091

A kora tavaszi mintákban egyeduralkodik az *Eunotia paludosa*, a tőzegmohákra jellemző „Sphagnum-bog-species" (Petersen 1950). A *S. fallax*-on nem is találtam rajta kívül más diatómát (2. ábra).



2. ábra.

Enotia paludosa vázak Sphagnum fallax áglevél mellett

Ugyanakkor szembetűnő, hogy a *S. palustre*-ből teljesen hiányzik. Itt a *Tabellaria flocculosa* a leggyakoribb faj, és a *Frustulia vulgaris* adja az egyedszám 30%-át. Fontos megjegyezni, hogy a *S. palustre*-t a mintavétel során nedves volt, de nem fedte víz, míg a két másik *Sphagnum* faj teljesen a víz alatt volt.

A Nyírjes-tó algológiai vizsgálatát éppen csak elkezdtük, ezek az adatok még elővizsgálatnak is kevesek. Két dolgot azonban már most is érdemes megjegyezni. Az első az évszakosság ténye. A *S. palustré*-n talált fajok a korábbi láptanulmányokban alig fordulnak elő. Ennek lehet az az oka, hogy a legtöbb láptanulmány jellemzően nyári, kora őszi minták gyűjtése alapján készültek.

A másik a lápon belüli mikroheterogenitás, a mozaikosság jelensége. Erre az idézett szerzők szinte mindegyike felhívja a figyelmet (Kol 1967, Uherkovich 1981, Borics 2001). Borics 7 tényező hatását elemzi, ami hozzájárul a sokféleségéhez, megemlítve, hogy nyilván mások (pl. biotikus hatások) is vannak:

1. változatos fényviszonyok
2. a víz színe
3. a vízterek lenitikus jellege
4. oldott szerves anyagok
5. alzatbőség
6. alacsony pH
7. tápanyagtartalom

Előzetes megfigyeléseim szerint ehhez járulhat még a vertikális zonáció, amit az említett alzatbőség részeként tekinthetünk. A vízzel teljesen fedett fajok diatómaflórája másnak tűnik, mint a kiemelkedőké (vö. dagadólápok). A kiszáradás során terresztris fajok megjelenésére is számíthatunk.

Egyetlen idézett munkában sem különböztetik meg az algológusok a tőzegmohákat faji szinten. A bevezetőben leírják, hogy milyen fajok fordulnak elő, de hogy a konkrét gyűjtés honnan származik, arra már nincs adat (kivétel Uherkovich Szűrűhelyről írt dolgozata, ahol csak *S. palustre* élt). Tervezem annak vizsgálatát, vajon a különböző Sphagnum fajokon különbözik-e a diatómaflóra és vegetáció.

A talált fajszámok alapján egyszerű lenne egy összefoglaló táblázatot adni a *Sphagnum* fajokon vagy azok közvetlen közelében élő diatómákról. Ez azonban félrevezető lenne, a nomenklatúriai változások átvezetése nélkül. Nagyobb gond azonban, hogy Uherkovich számos formát és változatot különít el. A Szőcei-lápról 18 *Eunotia*-t közöl. Az *Eunotia* nemzetség az egyik legproblematikusabb diatómanemzetség (pl. Petersen 1950), a régi adatok és az új adatok egységes kezelése szükséges. Ez a nem megkerülhető kérdés a további vizsgálatok tárgyát kell hogy képezze. Enélkül nem értelmezhető, hogy milyen változások történtek.

Összefoglalás

„Még nem érkezett el az ideje, hogy a hazai tőzegmohalápos vizeink limnológiai viszonyairól és ezen belül algavegetációjáról áttekintést tudjunk adni." írja 1982-ben megjelent dolgozatában Uherkovich Gábor. Ez az állítás most is igaz. Ha Pócs Tamás két évvel később születik, akkor most terjedelmesebb adatsorral köszönthetném Őt.

Köszönetnyilvánítás

Elsősorban Szurdoki Erzsébetnek szeretném megköszönni a segítségét, aki a munka minden lépésében nagyban hozzájárult a kézirat elkészültéhez. Átengedte saját gyűjtéseit, eddig publikálatlan adatait, a terepen is velem volt, és a kézirat számos változatát olvasta és javította. Borics Gábor PhD dolgozata, gyűjései és publikálatlan adatai is hozzáférhetőek voltak számomra. Ez az írás az OTKA T043078 pályázathoz kötődik és annak első évében íródott.

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Löszlakó zuzmók Magyarországon

Lőkös L.
MTM Növénytár, 1476 Budapest, Pf. 222
`lokos@bot.nhmus.hu`

Abstract. (**Loess coloniser lichens in Hungary**) An overview on the research of lichens occurring in Hungarian loess areas is given. Collecting data of 520 specimens of a recent collection of T. Pócs and his co-workers together with some former Hungarian specimens are reported. Some aspects on the distribution and identification are discussed.

Keywords: Hungary, lichens, loess walls

Bevezetés

Magyarországon a löszfalak, löszterületek zuzmói kutatásának az elmúlt századokban kevés figyelmet szenteltek. Ezt tükrözik Boros Ádám sorai is (BOROS 1942): „*A hazai lichenológiai irodalomban alig találtam adatot a lösz zuzmóiról; úgy látszik, a zuzmókkal foglalkozó szaktársaink e talaj érdekes zuzmóvegetációjának tanulmányozását elhanyagolták. Meg vagyok győződve róla, ha erre figyelmet fordítanak, vagy a saját kis anyagom feldolgozására valaki vállalkozik, érdekes eredményekre fog jutni.*" A mellőzés oka talán a löszfalaknak a sziklás területekhez viszonyított szegényes zuzmóflórájában kereshető, amint azt Sántha László a Tolnai-dombság löszterületeit bejárva megállapítja (SÁNTHA 1924): „*A bejárt terület lichenológiai szempontból nem valami változatos. Az egész környék úgyszólván tiszta lösz, a gazdagabb zuzmóflóra kialakulásához szükséges köves, sziklás területek hiányzanak, úgy hogy a tulajdonképeni zuzmóflórát csak a kéreglakó zuzmók szolgáltatják. A lösztalajon az utak és vízmosások meredek falain Thrombium-, Dermatocarpon-, Endocarpon-, Heppia- és néhány Bacidia-fajt találtam.*"

A Magyar Természettudományi Múzeum zuzmógyűjteményében Magyarországról mindössze 47 korábbi, löszről származó példány található. Ez csakugyan arról tanúskodik, hogy löszről elenyésző mértékben gyűjtöttek zuzmókat, jóllehet a lichenológusok zöme szerepel a gyűjtők névlistájában (a nevek után a gyűjtési évszámot, majd zárójelben a példányok számát tüntettük fel). Boros Ádám 1921—1952 (18), (Kőfaragó-)Gyelnik Vilmos 1933—1940 (13), Károlyi Árpád 1954 (4), Mágocsy-Dietz Sándor 191? (1), Polgár Sándor 1921—1941 (3), Timkó György 1925 (2), Verseghy Klára 1968 (1), Farkas Edit és Lőkös László 1985 (5). A felsorolásból látható, hogy a legkorábbi példány az 1910-es évekből származik. Figyelemre méltó, hogy Boros Ádám csaknem annyi példányt gyűjtött, mint a lichenológusok együttvéve. Sántha Lászlót itt azért nem említjük, mert sem a cikkében (a bevezetőt nem számítva), sem a példányain nem szerepel a „lösz" szó, helyette pusztán az „ad terram..."-ot használta. Hasonló megfontolásból semmi biztos nem deríthető ki arra vonatkozóan, hogy Hazslinszky Frigyes, Lojka Hugó, Fóriss Ferenc, ill. Szatala Ödön gyűjtött-e zuzmókat löszről. Gallé László gyűjteményének zöme, így löszgyűjtései is a szegedi Móra Ferenc Múzeum herbáriumában találhatók. Tovább bonyolítja a helyzetet, hogy a lösznek számos változata van, attól függően, hogy milyen arányban van benne homok, ill. agyag. Így a skála széleit képező homokos lösz, ill. agyagos lösz elkülönítése nehézkes és bizonytalan az esetleg egy kevés löszt is tartalmazó homoktól, ill. agyagtól. Szokásos gyűjtési körülmények között a talaj részletekbe menő vizsgálatára rendszerint nem kerül sor. Másik végletként ezért az is elképzelhető, hogy egyes példányok ténylegesen mégsem löszről származnak, annak ellenére, hogy a cédulán lösz megjelölés szerepel.

Nagy lendületet adott a löszlakó zuzmók kutatásának Pócs Tamás és munkatársai 1996-ban indított átfogó vizsgálatsorozata a löszfalak kriptogám növényzetén, melybe a zuzmókat is belevonták. Gyűjtéseikből mintegy 520 zuzmópéldányt sikerült azonosítani, melyeket részben az MTM Növénytárában (BP), részben az Eszterházy Károly Főiskola Növénytani Tanszékének herbáriumában (EGR) helyeztünk el.

A löszlakó zuzmók adatait közlő publikációk közül elsőként Sántha László már idézett munkája említhető (SÁNTHA 1924). A cikk bevezetőjében hét fajt említ löszről, az enumerációban további hat fajt jelez talajról. Polgár Sándor Győr megye flórájának feldolgozása során Ravazd környékéről (POLGÁR 1941, BOROS és POLGÁR 1941), Boros Ádám a Kőpite-hegy térségéből (BOROS 1942) és Zólyomi Bálint Dunaföldvár mellől (ZÓLYOMI 1958) közlik löszlakó zuzmók adatait is. Gallé László talán Boros Ádám ösztönzésére vagy a külföldi eredmények (SUZA 1935, KARCZMARZ 1961) hatására számos hazai és vajdasági löszterületen végez zuzmó- és mohakutatást, melyről több közleménye is megjelent (GALLÉ 1964, 1967, 1974, 1975, 1977). A tokaji Nagy-Kopasz Szeles-tető alatti lejtőjéről egy új zuzmó-mohatársulást írt le (*Endocarpetum pusilli*), melyet a mozsori és a titeli löszterületeken is megtalált. Ottilie Wilmanns a németországi változatot Tübingen mellől a jellemző mohafajok alapján *Didymodonto-Endocarpetum pusilli*-ként (WILMANNS 1966), Norbert Spenling az osztrák változatot *Endocarpetum pusilli* subass.

austriacum néven (SPENLING 1969, 1971) írták le. Rolf Marstaller a németországi Thüringiából az alaptársulást azonosította (MARSTALLER 1969). Ugyancsak a tokaji Nagy-Kopaszról írt le egy új löszlakó mohatársulást Harald Kürschner és Pócs Tamás *Hilpertio velenovskyi-Pterygoneuretum compacti* néven (KÜRSCHNER és PÓCS 2002). A típusfelvételben zuzmókat nem sorolnak fel, de az újabban megtalált erdélyi lelőhelyeken több esetben is említik az *Endocarpon pusillum* dominanciáját (PÓCS et al. 2003). Néhány további löszzuzmóadatot közölt LŐKÖS (2000) a Villányi-hegységből Dénes Andrea gyűjtéséből.

Enumeráció

A lelőhelyi adatok írásmódjánál a példányokon használt eredeti nyelvet és szövegezést követtük. A felsorolásba Pócs Tamás és munkatársai gyűjtései mellett a Növénytár korábbi löszzuzmóadatait és az irodalmi adatokat is felvettük.

Acarospora sp. — VESZPRÉM MEGYE: Balatonkenese, löszfalon. Leg.: Gyelnik, V., 1940.08.12. [BP].

Arthonia lapidicola (Taylor) Branth et Rostr. — PEST MEGYE: Hungaria centr.: Érd, Dunaparton, löszbabán. Leg.: Gyelnik, V., 1933.04.07. [BP 1024, sub *Allarthonia l.* (Tayl.)].

Bacidia bagliettoana (A. Massal. et De Not. in A. Massal.) Jatta — COMIT. ESZTERGOM. In abrupte loessacea „Diós-árok" ad pagum Süttő. Alt. cca. 150 m. s. m. Leg.: Boros, Á., 1948.11.07. [BP 38984, sub *B. muscorum* (Sw.) var. *terrestris* (Nyl.)]. — TOLNA MEGYE: Földön, a Kovácsi és Hőgyész felé vezető útak mentén, Tevel közelében. [SÁNTHA 1924, sub *B. muscorum*].

Caloplaca cerina (Ehrh. ex Hedwig) Th. Fr. — BORSOD-ABAÚJ-ZEMPLÉN MEGYE: Tokaj, Nagy-Kopasz, Szeles-tető. [GALLÉ 1964, sub *C. c. chlorina*].

Caloplaca citrina (Hoffm.) Th. Fr. — BARANYA COUNTY: Baranyai-dombság. Dunaszekcső. On the huge ESE exposed loess cliffs facing the Danube, at 100—180 m alt. 46° 4.7' N, 18° 46' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97185/Z, AB), 19.X.1997; Baranyai-dombság. Ócsárd. Small (6—8 m), S facing cliff at 130 m alt. 45° 55.7' N, 18° 9' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97188/E, F, G), 20.X.1997; Villányi-hegység. S end of Túrony village. W facing loess cliff along the Harkány-Pécs road, at 180 m alt. 45° 53.8' N, 18° 14' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97194/H—M, N, O, P), 20.X.1997. — BORSOD-ABAÚJ-ZEMPLÉN COUNTY: Hegyalja Hills, SE side of Mt. Nagy-kopasz. Hollow road called „Kusajti-árok", W of Tokaj town. *Agropyro-Kochietum* community on the loess cliffs, 120—140 m alt. 48° 7' N, 21° 23' E. Coll.: T. Pócs & B. O. van Zanten (96106/K), 4.XI.1996. — PEST COUNTY: Gödöllői-dombság. Bénye village. On artificial cliffs of the vine cellars in Jókai street, at 140 m alt. 47° 20.8’ N, 19° 32.8’ E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97168/N), 12.X.1997; Gödöllő Hills. Loess cliff near Isaszeg village, at the railway crossing near Rákos brook, at 180 m alt. 17° 31.5’ N, 19° 22’ E. Coll.: T. Pócs, B. O. van Zanten, G. Kis & A. Szabó (96122/H, I, K), 7.XI.1996; Gödöllői-dombság. Vár-hegy at the NE side of Pécel town, on 50 m high, SE facing loess cliff, at 160—210 m alt. 47° 29.7’ N, 19 °20’ E. Coll.: S. Pócs & T. Pócs (9761/A, B, C, D), 27.VI.1997; Gödöllői-dombság. 10 m high seminatural cliffs at the SW side of Tápióbicske, at 120 m alt. 47° 21’ N, 19° 41’ E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97165/B, C, D), 12.X.1997. — TOLNA COUNTY: Geresdi-dombság. Mined loess cliff 1.5 km NW of Cikó. 140 m alt. 46° 15’ N, 18° 32.5’ E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97178/A), 18.X.1997; Geresdi-dombság. Hard natural loess cliff along the road in the valley of Lajvér stream at the SE end of Kismórágy, at 120 m alt. 46° 13’ N, 18° 39.3’ E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97181/B, D), 18. & 21.X.1997; Geresdi-dombság. Mórágy, loess cliffs along vine cellars and hollow road on Pince Hill, at the W edge of village, at 180—210 m alt. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97183/O, P, Q, R), 18.X.1997; Mezőföld, Dunakömlőd (Paks). 6—8 m high S exposed loess cliffs above Béke utca, at 120 m alt. 46° 39.3’ N, 18° 52’ E. Coll.: S. Pócs, T. Pócs, G. Kis & A. Szabó (9773/A), 10.VII.1997; Mezőföld, Dunakömlőd (Paks). On 6—20 m high, N exposed loess cliffs at the N end of Sánc-hegy, with rich cryptogamic vegetation, at 110—130 m alt. 46° 39.3’ N, 18° 52’ E. Coll.: S. Pócs, T. Pócs, G. Kis & A. Szabó (9769/B, F, I, Q, S, AF), 8—9.VII.1997; Szekszárdi-dombság. E side of Alsónána village „Pincesor”. W exposed vine cellars carved in 3 rows in loess cliff, at 180 m alt. 46° 14.4’ N, 18° 39.5’ E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97217/M, W), 28.X.1997; Szekszárdi-dombság. Loess cliffs on the summit of Bali-hegy, at vineyards or roadside, at 220 m alt. 46° 20.6’ N, 18° 37’ E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97213/B), 27.X.1997; Szekszárdi-dombság. Grábóc. Small hollow road and roadcuts in loess, at 160 m alt. 46° 16.5’ N, 18° 36.4’ E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97211/K), 27.X.1997; S end of Szekszárdi-dombság. Lajvérpuszta village NW of Bátaszék town. Loess cliffs along old vine cellars and in hollow road, at 100—140 m alt. 46° 12’ N, 18° 41.5’ E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97216/Z, AB), 28.X.1997; Szekszárdi-dombság. S facing natural loess cliffs from Bartina Valley to Kerék Hill along the blue trail, at the W end of Szekszárd town. 200—240 m alt. 48° 20’ N, 18° 40.6’ E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97204/A, B, F, Q), 26.X.1997; Tolnai-hegyhát. Artificial, 2—3 m high loess cliffs in Kisszékely village, at 210 m alt. 46° 40.4’ N, 18° 32.5’ E. Coll.: S. Pócs & T. Pócs (9777/H, I), 2.VIII.1997; Völgység. On artificial cliffs and in hollow roads S of Ozora, at 180—200 m alt. 46° 44.7’ N, 18° 28.7’ E. Coll.: S. Pócs & T. Pócs (9787/C, D, E, F, G), 4.VIII.1997.

Caloplaca crenulatella (Nyl.) H. Olivier — BARANYA COUNTY: Baranyai-dombság. Palotabozsok. Small W facing artificial cliff behind the house No. 13 in Fő utca (street), at 160 m alt. 46° 6.8’ N, 18° 8.2’ E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97195/D, E), 21.X.1997; Villányi-hegység. S end of Túrony village. W facing loess cliff along the Harkány-Pécs road, at 180 m alt. 45° 53.8' N, 18° 14' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97194/N, O, P), 20.X.1997; Villányi-hegység. Small, S facing natural loess cliff at the E end of Szársomlyó hegy, between Villány and Nagyharsány, at 200 m alt. 45° 51.5' N, 18° 26' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97192/B, C, D), 20.X.1997. — BORSOD-ABAÚJ-ZEMPLÉN COUNTY: Hegyalja Hills. Isolated volcanic cone at the N end of Tokaj town with its half side mined away. Its summit at 180 m alt is covered with 8—10 m thick loess layer, forming steep slopes and cliffs. 48° 8' N, 21° 24' E. Coll.: T. Pócs & B. O. van Zanten (96108/H, I), 4.XI.1996. — KOMÁROM COUNTY: Gerecse Mts, Vöröskő Hills S of Dunaalmás village. Loess layer on the top of a huge limestone (travertino) cliff faced to ENE, at 250 m alt. 47° 43' N, 18° 20' E. Coll.: T. Pócs, B. O. van Zanten, G. Kis & A. Szabó (96115/M), 6.XI.1996. — NÓGRÁD COUNTY: NW foothills of Mátra Mts. On different natural and artificial cliffs at the E end of Kisterenye, at 200 m alt. 48° 03' N, 19° 51' E. Coll.: T. Pócs, B. O. van Zanten & A. Varga (97176/M), 15.X.1997. — PEST COUNTY: Gödöllő Hills. Loess cliff near Isaszeg village, at the railway crossing near Rákos brook, at 180 m alt.17° 31.5' N, 19° 22' E. Coll.: T. Pócs, B. O. van Zanten, G. Kis & A. Szabó (96122/H, I, K), 7.XI.1996; Gödöllői-dombság. Vár-hegy at the NE side of Pécel town, on 50 m high, SE facing loess cliff, at 160—210 m alt. 47° 29.7' N, 19 °20' E. Coll.: S. Pócs & T. Pócs (9761/B, C, D, H), 27.VI.1997. — TOLNA COUNTY: Geresdi-dombság. Hard natural loess cliff along the road in the valley of Lajvér stream at the SE end of Kismórágy, at 120 m alt. 46° 13' N, 18° 39.3' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97181/S), 18. & 21.X.1997; Geresdi-dombság. Mórágy, loess cliffs along vine cellars and hollow road on Pince Hill, at the W edge of village, at 180—210 m alt. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97183/O—Q), 18.X.1997; Mezőföld, Dunaföldvár. Natural loess cliffs and gorges on the N side of Kálvária hill, at 130 m alt. 46° 47.6' N, 18° 55' E. Coll.: S. Pócs & T. Pócs (9785/E), 4.VIII.1997; Mezőföld, Paks. Sánc-hegy. Great loess cliff in front of the Railways Museum, at 150 m alt. 46° 36.8' N, 18° 52' E. Coll.: S. Pócs, T. Pócs, G. Kis & A. Szabó (9768/A, E, G, H), 8.VII.1997; Szekszárdi-dombság. E side of Alsónána village „Pincesor". W exposed vine cellars carved in 3 rows in loess cliff, at 180 m alt. 46° 14.4' N, 18° 39.5' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97217/M, T), 28.X.1997; Szekszárdi-dombság. S facing natural loess cliffs from Bartina Valley to Kerék Hill along the blue trail, at the W end of Szekszárd town. 200—240 m alt. 48° 20' N, 18° 40.6' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97204/F), 26.X.1997; N part of Szekszárdi-dombság. „Szarvas-szurdok", 4 km W of Szekszárd town, at 260 m alt. 46° 20' N, 18° 39' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97205/V), 26.X.1997; Szekszárdi-dombság. 12 m deep hollow road called Benedek-szurdok (and a few minor cliffs) on the SW side of Palánkai-hegy at the W side of Szekszárd town, at 200—270 m alt. 46° 20' N, 18° 4' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97203/Z), 26.X.1997; Völgység. On artificial cliffs and in hollow roads S of Ozora, at 180—200 m alt. 46° 44.7' N, 18° 28.7' E. Coll.: S. Pócs & T. Pócs (9787/E), 4.VIII.1997. — VESZPRÉM COUNTY: Balaton Highlands, Tihany Peninsula. Small loess cliff on the W slope of Csúcs-hegy, S of

Sajkod, at 120 m alt.46° 54.5' N, 17° 51' E. Coll.: T. Pócs & B. O. van Zanten (9694/P), 30.X.1996.

Caloplaca decipiens (Arnold) Blomb. et Forss. — Baranya county: Baranyai-dombság. Ócsárd. Small (6—8 m), S facing cliff at 130 m alt. 45° 55.7' N, 18° 9' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97188/E, F, G), 20.X.1997. — Borsod-Abaúj-Zemplén megye: Tokaj, Nagy-Kopasz, Szeles-tető. [Gallé 1964, sub *C. d. leprosa*]. — Pest county: Gödöllői-dombság. Bénye village. On artificial cliffs of the vine cellars in Jókai street, at 140 m alt. 47° 20.8' N, 19° 32.8' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97168/M), 12.X.1997. — Somogy county: Külső-Somogy. 3 m high artificial loess cliff at the S end of Törökkoppány. Coll.: S. Pócs & T. Pócs (9791/G, H), 5.VIII.1997. — Tolna county: Geresdi-dombság. Hard natural loess cliff along the road in the valley of Lajvér stream at the SE end of Kismórágy, at 120 m alt. 46° 13' N, 18° 39.3' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97181/B), 18. & 21.X.1997; Geresdi-dombság. Mórágy, loess cliffs along vine cellars and hollow road on Pince Hill, at the W edge of village, at 180—210 m alt. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97183/O, P, Q, R), 18.X.1997; Mezőföld, Dunakömlőd (Paks). On 6—20 m high, N exposed loess cliffs at the N end of Sánc-hegy, with rich cryptogamic vegetation, at 110—130 m alt. 46° 39.3' N, 18° 52' E. Coll.: S. Pócs, T. Pócs, G. Kis & A. Szabó (9769/A, F, I, Q, S, AF), 8—9.VII.1997; Szekszárdi-dombság. E side of Alsónána village „Pincesor". W exposed vine cellars carved in 3 rows in loess cliff, at 180 m alt. 46° 14.4' N, 18° 39.5' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97217/M, S, T, W), 28.X.1997; Szekszárdi-dombság. Grábóc. Small hollow road and roadcuts in loess, at 160 m alt. 46° 16.5' N, 18° 36.4' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97211/I), 27.X.1997; S end of Szekszárdi-dombság. Lajvérpuszta village NW of Bátaszék town. Loess cliffs along old vine cellars and in hollow road, at 100—140 m alt. 46° 12' N, 18° 41.5' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97216/Z), 28.X.1997; Tolnai-hegyhát. Artificial, 2—3 m high loess cliffs in Kisszékely village, at 210 m alt. 46° 40.4' N, 18° 32.5' E. Coll.: S. Pócs & T. Pócs (9777/H, I), 2.VIII.1997; Tolnai-hegyhát. Natural and artificial loess cliffs 15 m high in Nagyszékely village, at 125 m alt. 46° 38.8' N, 18° 32' E. Coll.: S. Pócs & T. Pócs (9784/B), 3.VIII.1997; Völgység. On artificial cliffs and in hollow roads S of Ozora, at 180—200 m alt. 46° 44.7' N, 18° 28.7' E. Coll.: S. Pócs & T. Pócs (9787/C, D, G), 4.VIII.1997.

Caloplaca ferruginea (Hudson) Th. Fr. — Borsod-Abaúj-Zemplén megye: Tokaj, Nagy-Kopasz, Szeles-tető. [Gallé 1964].

Caloplaca flavorubescens (Hudson) Laundon — Borsod-Abaúj-Zemplén megye: Tokaj, Nagy-Kopasz, Szeles-tető. [Gallé 1964, sub *C. aurantiaca*].

Caloplaca holocarpa (Hoffm. ex Ach.) A. E. Wade — Borsod-Abaúj-Zemplén megye: Tokaj, Nagy-Kopasz, Szeles-tető. [Gallé 1964, sub *C. pyracea pyrithroma*]. — Pest county: Gödöllői-dombság. Bénye village. On artificial cliffs of the vine cellars in Jókai street, at 140 m alt. 47° 20.8' N, 19° 32.8' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97168/L), 12.X.1997. — Tolna county: Tolnai-hegyhát. Partly mined loess cliffs with remnants of steppe at the N end of Pincehely, at 240 m alt. 46° 41.6' N, 18° 27.5' E. Coll.: S. Pócs & T. Pócs (9780/T), 2.VIII.1997.

Caloplaca lactea (*A. Massal.*) Zahlbr. — Hungaria centr. Érd, löszbabán, Dunaparton. Leg.: Gyelnik, V., 1933.04.07. [BP 27641, sub *C. l.* f. *saxicola* Rabh.].

Caloplaca teicholyta (Ach.) J. Steiner — BORSOD-ABAÚJ-ZEMPLÉN MEGYE: Tokaj, Nagy-Kopasz, Szeles-tető. [GALLÉ 1964, sub *C. arenaria*]. — PEST COUNTY: Gödöllői-dombság. 10 m high seminatural cliffs at the SW side of Tápióbicske, at 120 m alt. 47° 21' N, 19° 41' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97165/D), 12.X.1997; Gödöllői-dombság. Vár-hegy at the NE side of Pécel town, on 50 m high, SE facing loess cliff, at 160—210 m alt. 47° 29.7' N, 19 °20' E. Coll.: S. Pócs & T. Pócs (9761/A), 27.VI.1997. — TOLNA COUNTY: Geresdi-dombság. Mórágy, loess cliffs along vine cellars and hollow road on Pince Hill, at the W edge of village, at 180—210 m alt. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97183/O, P, Q, R), 18.X.1997; Mezőföld, N of Dunaföldvár. Natural loess cliffs along Danube River near the camping site, at 97 m alt. 46° 49' N, 18° 54.7' E. Coll.: S. Pócs & T. Pócs (9786/A, F), 3.VIII.1997; Mezőföld, Dunakömlőd (Paks). On 6—20 m high, N exposed loess cliffs at the N end of Sánc-hegy, with rich cryptogamic vegetation, at 110—130 m alt. 46° 39.3' N, 18° 52' E. Coll.: S. Pócs, T. Pócs, G. Kis & A. Szabó (9769/S, AF(?)), 8—9.VII.1997; Szekszárdi-dombság. E side of Alsónána village „Pincesor". W exposed vine cellars carved in 3 rows in loess cliff, at 180 m alt. 46° 14.4' N, 18° 39.5' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97217/T, X), 28.X.1997; Tolnai-hegyhát. Natural and artificial loess cliffs 15 m high in Nagyszékely village, at 125 m alt. 46° 38.8' N, 18° 32' E. Coll.: S. Pócs & T. Pócs (9784/C), 3.VIII.1997.

Candelariella aurella (Hoffm.) Zahlbr. — BARANYA COUNTY: Baranyai-dombság. Dunaszekcső. On the huge ESE exposed loess cliffs facing the Danube, at 100—180 m alt. 46° 4.7' N, 18° 46' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97185/Y), 19.X.1997; Villányi-hegység. S end of Túrony village. W facing loess cliff along the Harkány-Pécs road, at 180 m alt. 45° 53.8' N, 18° 14' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97194/H—M), 20.X.1997; Villányi-hegység. Small, S facing natural loess cliff at the E end of Szársomlyó hegy, between Villány and Nagyharsány, at 200 m alt. 45° 51.5' N, 18° 26' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97192/B, C, D), 20.X.1997. — BORSOD-ABAÚJ-ZEMPLÉN COUNTY: Tokaj, Nagy-Kopasz, Szeles-tető. [GALLÉ 1964, sub *C. a.* + *C. a. effusa*]; Hegyalja Hills, SE side of Mt. Nagy-kopasz. Hollow road called „Kusajti-árok", W of Tokaj town. *Agropyro-Kochietum* community on the loess cliffs, 120—140 m alt. 48° 7' N, 21° 23' E. Coll.: T. Pócs & B. O. van Zanten (96106/K), 4.XI.1996; Hegyalja Hills. Isolated volcanic cone at the N end of Tokaj town with its half side mined away. Its summit at 180 m alt is covered with 8—10 m thick loess layer, forming steep slopes and cliffs. 48° 8' N, 21° 24' E. Coll.: T. Pócs & B. O. van Zanten (96108/H, I), 4.XI.1996. — KOMÁROM COUNTY: Gerecse Mts, Vöröskő Hills S of Dunaalmás village. Loess layer on the top of a huge limestone (travertino) cliff faced to ENE, at 250 m alt. 47° 43' N, 18° 20' E. Coll.: T. Pócs, B. O.

van Zanten, G. Kis & A. Szabó (96115/L), 6.XI.1996; Gerecse Mts, Loess cliff on the W edge of Pap Hill, with rich steppe on the hill-top, at 200 m alt., E from Neszmély village. 47° 43' N, 18° 21.5' E. Coll.: T. Pócs, B. O. van Zanten, G. Kis & A. Szabó (96111/U), 5.XI.1996. — NÓGRÁD COUNTY: NW foothills of Mátra Mts. On different natural and artificial cliffs at the E end of Kisterenye, at 200 m alt. 48° 03' N, 19° 51' E. Coll.: T. Pócs, B. O. van Zanten & A.Varga (97176/M), 15.X.1997. — PEST COUNTY: Érd, dunaparton, löszbabán (calc.) Leg.: Gyelnik, V., 1933.04.07. [BP 20659, sub f. *minor*]; Százhalombatta, Dunaparton, löszfalon. Leg.: Gyelnik, V., 1933.04.07. [BP 76818, sub f. *effusa*]; Gödöllői-dombság. Bénye village. On artificial cliffs of the vine cellars in Jókai street, at 140 m alt. 47° 20.8' N, 19° 32.8' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97168/L, M), 12.X.1997; Gödöllő Hills. Loess cliff near Isaszeg village, at the railway crossing near Rákos brook, at 180 m alt.17° 31.5' N, 19° 22' E. Coll.: T. Pócs, B. O. van Zanten, G. Kis & A. Szabó (96122/H, I, K), 7.XI.1996; Gödöllői-dombság. Vár-hegy at the NE side of Pécel town, on steppe grassland below the 50 m high, SE facing loess cliff, at 160—210 m alt. 47° 29.7' N, 19° 20' E. Coll.: S. Pócs & T. Pócs (9760/D, E(?)), 27.VI.1997; Gödöllői-dombság. Vár-hegy at the NE side of Pécel town, on 50 m high, SE facing loess cliff, at 160—210 m alt. 47° 29.7' N, 19 °20' E. Coll.: S. Pócs & T. Pócs (9761/B, H), 27.VI.1997. — TOLNA COUNTY: Geresdi-dombság. N facing cliffs 2 km NE from Bátaapáti, at 160 m alt. 46° 12.6' N, 18° 36' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97180/D), 18.X.1997; Geresdi-dombság. Mined loess cliff 1.5 km NW of Cikó. 140 m alt. 46° 15' N, 18° 32.5' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97178/A), 18.X.1997; Geresdi-dombság. Hard natural loess cliff along the road in the valley of Lajvér stream at the SE end of Kismórágy, at 120 m alt. 46° 13' N, 18° 39.3' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97181/S), 18. & 21.X.1997; Geresdi-dombság. Mórágy, loess cliffs along vine cellars and hollow road on Pince Hill, at the W edge of village, at 180—210 m alt. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97183/R), 18.X.1997; Geresdi-dombság. Small cliff at 120 m alt., near Mórágy railway station. 46° 12.3' N, 18° 40' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97199/G, L), 21.X.1997; Mezőföld, Dunaföldvár. Natural loess cliffs and gorges on the N side of Kálvária hill, at 130 m alt. 46° 47.6' N, 18° 55' E. Coll.: S. Pócs & T. Pócs (9785/A, E), 4.VIII.1997; Mezőföld, N of Dunaföldvár. Natural loess cliffs along Danube River near the camping site, at 97 m alt. 46° 49' N, 18° 54.7' E. Coll.: S. Pócs & T. Pócs (9786/A, E, F), 3.VIII.1997; Mezőföld, Paks. Sánc-hegy. Great loess cliff in front of the Railways Museum, at 150 m alt. 46° 36.8' N, 18° 52' E. Coll.: S. Pócs, T. Pócs, G. Kis & A. Szabó (9768/A, G), 8.VII.1997; Mezőföld, Dunakömlőd (Paks). On 6—20 m high, N exposed loess cliffs at the N end of Sánc-hegy, with rich cryptogamic vegetation, at 110—130 m alt. 46° 39.3' N, 18° 52' E. Coll.: S. Pócs, T. Pócs, G. Kis & A. Szabó (9769/B, I, AF(?)), 8—9.VII.1997; Szekszárdi-dombság. E side of Alsónána village „Pincesor". W exposed vine cellars carved in 3 rows in loess cliff, at 180 m alt. 46° 14.4' N, 18° 39.5' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97217/M, S, T(?)), W, X), 28.X.1997; S end of Szekszárdi-dombság. Lajvérpuszta village NW of Bátaszék town. Loess cliffs along old vine cellars and in hollow road, at 100—140 m alt. 46° 12' N, 18° 41.5' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97216/Z), 28.X.1997; Szekszárdi-dombság. 12 m deep hollow road called Benedek-szurdok (and a few minor cliffs) on the SW side of Palánkai-hegy at the W side of Szekszárd town, at 200—270 m alt. 46° 20' N, 18° 4' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97203/A), 26.X.1997; Szekszárdi-dombság. S facing natural loess cliffs from Bartina Valley to Kerék Hill along the blue trail, at the W end of Szekszárd town. 200—240 m alt. 48° 20' N, 18° 40.6' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97204/Q), 26.X.1997; Tolnai-hegyhát. Natural and artificial loess cliffs 15 m high in Nagyszékely village, at 125 m alt. 46° 38.8' N, 18° 32' E. Coll.: S. Pócs & T. Pócs (9784/B, I), 3.VIII.1997; Tolnai-hegyhát. Simontornya. On the vineyard hill Derék-hegy S of the town, at 240 m alt. On artificial cliffs along vinecellars. 46° 44' N, 18° 33' E. Coll.: S. Pócs & T. Pócs (9783/E), 3.VIII.1997; Völgység. On artificial cliffs and in hollow roads S of Ozora, at 180—200 m alt. 46° 44.7' N, 18° 28.7' E. Coll.: S. Pócs & T. Pócs (9787/E, G), 4.VIII.1997. — VESZPRÉM MEGYE: Balatonicum. Balatonkenese, löszfalon. Leg.: Gyelnik, V., 1940.08.12. [BP 20639, sub *C. a.* (Hoffm.) f. *effusa* Hakul.]; Löszfal Balatonaliga és Balatonakarattya között. Leg.: Farkas, E. és Lőkös, L., 1985.XI.8. [BP].

Candelariella deflexa (Nyl.) Zahlbr. — BORSOD-ABAÚJ-ZEMPLÉN MEGYE: Tokaj, Nagy-Kopasz, Szeles-tető. [GALLÉ 1964].

Candelariella subdeflexa (Nyl.) Lettau — BORSOD-ABAÚJ-ZEMPLÉN MEGYE: Tokaj, Nagy-Kopasz, Szeles-tető. [GALLÉ 1964].

Candelariella vitellina (Hoffm.) Müll. Arg. — TOLNA COUNTY: Mezőföld, Paks. Steep SE slopes above the Danube River near the „Halászcsárda", at 130 m alt. 46° 37.9' N, 18° 51' E. Coll.: S. Pócs, T. Pócs, G. Kis & A. Szabó (9767/F), 8—10.VII.1997.

Cladonia coniocraea (Flörke) Spreng. — HEVES COUNTY: foothills of Bükk Mts. At the N end of Demjén village. Small loess slopes at the beginning and W foot of Pünkösd Hill, „Olajos" road. 47° 49' N, 20° 20' E. Coll.: T. Pócs, G. Kis & A. Szabó (96125/E), 18.XI.1996.

Cladonia rangiformis Hoffm. — ZALA COUNTY: In pascuis pr. pag. Zalasárszeg. Solo loessaceo. Alt.: 150 m. s. m. Leg.: Károlyi, Á., 1954.05.30. [BP 48802].

Cladonia subulata (L.) Weber ex F. H. Wigg. — HEVES COUNTY: foothills of Bükk Mts. At the N end of Demjén village. Small loess slopes at the beginning and W foot of Pünkösd Hill, „Olajos" road. 47° 49' N, 20° 20' E. Coll.: T. Pócs, G. Kis & A. Szabó (96125/R), 18.XI.1996.

Cladonia symphycarpa (Flörke) Fr. — HEVES COUNTY: foothills of Bükk Mts. At the N end of Demjén village. Small loess slopes at the beginning and W foot of Pünkösd Hill, „Olajos" road. 47° 49' N, 20° 20' E. Coll.: T. Pócs, G. Kis & A. Szabó (96125/E, Q(?)), 18.XI.1996.

Collema coccophorum Tuck. — VESZPRÉM MEGYE: Balatonicum. Balatonkenese, löszfalon. Leg.: Gyelnik, V., 1940.08.12. [BP 2044, sub *C. pulposulum* Nyl.].

Collema crispum (Huds.) Weber ex F. H. Wigg. — BARANYA COUNTY: Villányi-hegység. Hollow road in „Palkonyai szöllők" SW of Palkonya village, at 160—180 m alt. 45° 53' N, 18° 23' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97190/K), 20.X.1997. — Borsod-Abaúj-Zemplén county: Hegyalja Hills. Mt. Nagy-kopasz. Quarry No. III SE of Tarcal village, on the W slopes. 2—4 m thick loess layer forming cliffs above the mine, at 200 m alt. 48° 8' N, 21° 22' E. Coll.: T. Pócs & B. O. van Zanten (96105/E), 3.XI.1996. — Komárom county: Visegrád Mts. Natural and artificial loess cliffs in and near the abandoned mine of Basaharc brick factory, facing Danube River, at 120—150 m alt. 47° 48.2' N, 18° 50.8' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (9841/B, G, M), 30.VI.1998. — Tolna county: Mezőföld, Dunaföldvár. Natural loess cliffs and gorges on the N side of Kálvária hill, at 130 m alt. 46° 47.6' N, 18° 55' E. Coll.: S. Pócs & T. Pócs (9785/G), 4.VIII.1997; Szekszárdi-dombság. Loess cliffs on the summit of Bali-hegy, at vineyards or roadside, at 220 m alt. 46° 20.6' N, 18° 37' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97213/A), 27.X.1997; Szekszárdi-dombság. Artificial, SW exposed cliffs of vine cellars at the N end of Szálka village, 200 m alt. 46° 16' N, 18° 38' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97209/B, C), 27.X.1997; Szekszárdi-dombság. S facing natural loess cliffs from Bartina Valley to Kerék Hill along the blue trail, at the W end of Szekszárd town. 200— 240 m alt. 48° 20' N, 18° 40.6' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97204/N), 26.X.1997; Tolnai-hegyhát. Partly mined loess cliffs with remnants of steppe at the N end of Pincehely, at 240 m alt. 46° 41.6' N, 18° 27.5' E. Coll.: S. Pócs & T. Pócs (9780/F), 2.VIII.1997.

Collema limosum (Ach.) Ach. — Baranya county: Villányi-hegység. Hollow road in „Palkonyai szöllők" SW of Palkonya village, at 160—180 m alt. 45° 53' N, 18° 23' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97190/K), 20.X.1997; Siklós, Máriagyűd, Macska-lyuk, loess wall, leg. A. Dénes (07.08.1999) [BP]. — Veszprém megye: Mt. Bakony: pr. Bakonybél, ad vias „Tervut", ad terram loessaceam. Leg.: Verseghy, K., 1968.09.11. [BP 75927]; In muris loessaceis vallis Aranyos-patak prope Csesznek. Alt. s. met.ca: 300. Leg.: Boros, Á., 1938.03.27. [BP 36244, sub *C. Fórissii* Szat.]. — Zala megye: Secus vias pr. pag. Búcsúszentlászló. Solo loessaceo. Alt. cca. 200 m. Leg.: Károlyi, Á., 1954.06.06. [BP 88143].

Collema tenax (Sw.) Ach. emend. Degel. — Borsod-Abaúj-Zemplén county: Tokaj, Nagy-Kopasz, Szeles-tető. [Gallé 1964, sub *C. pulposum*]; Hegyalja Hills. Mt. Nagy-kopasz. Abandoned vineyards, terrace slopes and cliffs on loess with *Aster oleifolius* and with cultivated *Ficus carica*, at 200 m alt, on the SW slopes above Tarcal village. 48° 7' N, 21° 22' E. Coll.: T. Pócs & B. O. van Zanten (96102/Q), 3.XI.1996. — Győr m. Nyúl hegy. „Sárkánylik" löszfalon, homokkővé összetapadt homokon. Leg.: Polgár, S., 1941.10.23. [BP 36340, sub *C. pulposum* (Bernh.) Ach.].

Collema undulatum Laurer ex Flot. — Comit. Esztergom: In declivibus petrosis calc. loessaceis versus Ádámmajor pr. pag. Dunaalmás. Alt. s. m. met. cca: 200. Leg.: Boros, Á., 1924.03.23. [BP 77284, sub var. *granulosum*].

Endocarpon cf. adscendens (Anzi) Müll. Arg. — Borsod-Abaúj-Zemplén megye: Tokaj, Nagy-Kopasz, Szeles-tető. [Gallé 1964, sub *E. sorediatum*]. — Győr-

MOSON-SOPRON MEGYE: ad abrupta loessacea cavae Likas horog, prope pagum Ravazd. Leg.: Polgár, S., 1940.11.11. [BP 72743, sub *E. sorediatum* Hook.]. — TOLNA COUNTY: Szekszárdi-dombság. Kakasd village. Hollow road and vine cellars cut in loess, at 140 m alt. 46° 20' N, 18° 35.6' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97212/Q), 27.X.1997. — VESZPRÉM MEGYE: Balatonkenese, löszfalon. Leg.: Gyelnik, V., 1940.08.12. [BP 435, sub *E. sorediatum* Hook.].

Endocarpon pusillum Hedw. — BÁCS-KISKUN COUNTY: Duna-Tisza köze Solti-síkság. On a 20 m natural loess ridge near the brick factory of Császártöltés, at 100—120 m alt. 46° 24' N, 19° 10' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97202/D), 22.X.1997. — BARANYA COUNTY: Baranyai-dombság. Dunaszekcső. On the huge ESE exposed loess cliffs facing the Danube, at 100—180 m alt. 46° 4.7' N, 18° 46' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97185/Y, Z, AB), 19.X.1997; Baranyai-dombság. Ócsárd. Small (6—8 m), S facing cliff at 130 m alt. 45° 55.7' N, 18° 9' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97188/E, F, G), 20.X.1997; Baranyai-dombság. Palotabozsok. Small W facing artificial cliff behind the house No. 13 in Fő utca (street), at 160 m alt. 46° 6.8' N, 18° 8.2' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97195/D, E), 21.X.1997; Villányi-hegység. S end of Túrony village. W facing loess cliff along the Harkány-Pécs road, at 180 m alt. 45° 53.8' N, 18° 14' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97194/H—M, N, O, P), 20.X.1997; Villányi-hegység. Small, S facing natural loess cliff at the E end of Szársomlyó hegy, between Villány and Nagyharsány, at 200 m alt. 45° 51.5' N, 18° 26' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97192/B, C, D), 20.X.1997; Siklós: Máriagyűd, Macska-lyuk, loess wall, leg. A. Dénes (07.08.1999) [BP]. — BORSOD-ABAÚJ-ZEMPLÉN COUNTY: Tokaj, Nagy-Kopasz, Szeles-tető. [GALLÉ 1964, sub *E. pusillum* + *E. pallidum*]; Hegyalja Hills. Mt. Nagy-kopasz. Quarry No. III SE of Tarcal village, on the W slopes. 2—4 m thick loess layer forming cliffs above the mine, at 200 m alt. 48° 8' N, 21° 22' E. Coll.: T. Pócs & B. O. van Zanten (96105/E), 3.XI.1996; Hegyalja Hills, SE side of Mt. Nagy-kopasz. Hollow road called „Kusajti-árok", W of Tokaj town. *Agropyro-Kochietum* community on the loess cliffs, 120—140 m alt. 48° 7' N, 21° 23' E. Coll.: T. Pócs & B. O. van Zanten (96106/K, L), 4.XI.1996; Hegyalja Hills. Isolated volcanic cone at the N end of Tokaj town with its half side mined away. Its summit at 180 m alt is covered with 8—10 m thick loess layer, forming steep slopes and cliffs. 48° 8' N, 21° 24' E. Coll.: T. Pócs & B. O. van Zanten (96108/H, I, P), 4.XI.1996. — KOMÁROM COUNTY: In locis loessaceo-calcareis montis Kőpite-hegy prope pagum Dunaalmás. Leg.: Boros, Á., 1942.09.14. [BP 34778]; In abrupte loessacea collis Vár-hegy prope pag. Neszmély. Alt. cca 200 m. s. m. Leg.: Boros, Á., 1942.06.04. [BP 34780]; Gerecse Mts, Vöröskő Hills S of Dunaalmás village. Loess layer on the top of a huge limestone (travertino) cliff faced to ENE, at 250 m alt. 47° 43' N, 18° 20' E. Coll.: T. Pócs, B. O. van Zanten, G. Kis & A. Szabó (96115/N), 6.XI.1996; Gerecse Mts. Loess cliff on the W edge of Pap Hill, with rich steppe on the hill-top, at 200 m alt., E from Neszmély village. 47° 43' N, 18° 21.5' E. Coll.: T. Pócs, B. O. van Zanten, G. Kis & A. Szabó (96111/T, U), 5.XI.1996; Gerecse Mts. Hollow road of Diósárok S of Süttő village, with loess cliffs, at 200 m alt. 47° 44' N, 18° 27' E. Coll.: T. Pócs, B. O. van Zanten, G. Kis & A. Szabó (96117/C, D, E), 6.XI.1996; Visegrád Mts. Natural and artificial loess cliffs in and near the abandoned mine of Basaharc brick factory, facing Danube River, at 120—150 m alt. 47° 48.2' N, 18° 50.8' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (9841/G, M), 30.VI.1998. — PEST COUNTY: Százhalombatta, Dunaparton, löszfalon. Leg.: Gyelnik, V., 1933.04.07. [BP 76818]; Gödöllői-dombság. Bénye village. On artificial cliffs of the vine cellars in Jókai street, at 140 m alt. 47° 20.8' N, 19° 32.8' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97168/N), 12.X.1997; Gödöllő Hills. Loess cliff near Isaszeg village, at the railway crossing near Rákos brook, at 180 m alt.17° 31.5' N, 19° 22' E. Coll.: T. Pócs, B. O. van Zanten, G. Kis & A. Szabó (96122/H, I, K), 7.XI.1996; Gödöllői-dombság. Vár-hegy at the NE side of Pécel town, on steppe grassland below the 50 m high, SE facing loess cliff, at 160—210 m alt. 47° 29.7' N, 19° 20' E. Coll.: S. Pócs & T. Pócs (9760/D, E), 27.VI.1997; Gödöllői-dombság. Vár-hegy at the NE side of Pécel town, on 50 m high, SE facing loess cliff, at 160—210 m alt. 47° 29.7' N, 19 °20' E. Coll.: S. Pócs & T. Pócs (9761/A(?), B, C, D, H), 27.VI.1997; Gödöllői-dombság. 10 m high seminatural cliffs at the SW side of Tápióbicske, at 120 m alt. 47° 21' N, 19° 41' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97165/B, C, D), 12.X.1997. — SOMOGY COUNTY: Külső-Somogy. 3 m high artificial loess cliff at the S end of Törökkoppány. Coll.: S. Pócs & T. Pócs (9791/M), 5.VIII.1997. — TOLNA COUNTY: Földön, a Kovácsi felé vezető út mentén, Tevel mellett. [SÁNTHA 1924]; Geresdi-dombság. N facing cliffs 2 km NE from Bátaapáti, at 160 m alt. 46° 12.6' N, 18° 36' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97180/A), 18.X.1997; Geresdi-dombság. Hard natural loess cliff along the road in the valley of Lajvér stream at the SE end of Kismórágy, at 120 m alt. 46° 13' N, 18° 39.3' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97181/A, B, C, D, S), 18. & 21.X.1997; Geresdi-dombság. Mórágy, loess cliffs along vine cellars and hollow road on Pince Hill, at the W edge of village, at 180—210 m alt. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97183/O—Q), 18.X.1997; Geresdi-dombság. Small cliff at 120 m alt., near Mórágy railway station. 46° 12.3' N, 18° 40' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97199/G), 21.X.1997; Mezőföld, Dunaföldvár. Natural loess cliffs and gorges on the N side of Kálvária hill, at 130 m alt. 46° 47.6' N, 18° 55' E. Coll.: S. Pócs & T. Pócs (9785/A, E, G), 4.VIII.1997; Mezőföld, N of Dunaföldvár. Natural loess cliffs along Danube River near the camping site, at 97 m alt. 46° 49' N, 18° 54.7' E. Coll.: S. Pócs & T. Pócs (9786/A, E, F), 3.VIII.1997; Mezőföld, Dunakömlőd (Paks). 6—8 m high S exposed loess cliffs above Béke utca, at 120 m alt. 46° 39.3' N, 18° 52' E. Coll.: S. Pócs, T. Pócs, G. Kis & A. Szabó (9773/A), 10.VII.1997; Mezőföld, Paks. Sánc-hegy. Great loess cliff in front of the Railways Museum, at 150 m alt. 46° 36.8' N, 18° 52' E. Coll.: S. Pócs, T. Pócs, G. Kis & A. Szabó (9768/A, B, E, G, H), 8.VII.1997; Mezőföld, Dunakömlőd (Paks). On 6—20 m high, N exposed loess cliffs at the N end of Sánc-hegy, with rich cryptogamic vegetation, at 110—130 m alt. 46° 39.3' N, 18° 52' E. Coll.: S. Pócs, T. Pócs, G. Kis & A. Szabó (9769/B, F, I, Q, S, AF), 8—9.VII.1997; Szekszárdi-dombság. E side of Alsónána village „Pincesor". W exposed vine cellars carved in 3 rows in loess cliff, at 180 m alt. 46° 14.4' N, 18° 39.5' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97217/M, S, T, X), 28.X.1997; S end of Szekszárdi-dombság. Lajvérpuszta village NW of Bátaszék town. Loess cliffs along old vine cellars and in hollow road, at 100—140 m alt. 46° 12' N, 18° 41.5' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97216/Z, AA, AB), 28.X.1997; Szekszárdi-dombság. Grábóc. Small hollow road and roadcuts in loess, at 160 m alt. 46° 16.5' N, 18° 36.4' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97211/G), 27.X.1997; Szekszárdi-dombság. Kakasd village. Hollow road and vine cellars cut in loess, at 140 m alt. 46° 20' N, 18° 35.6' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97212/Q), 27.X.1997; Szekszárdi-dombság. Artificial, SW exposed cliffs of vine cellars at the N end of Szálka village, 200 m alt. 46° 16' N, 18° 38' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97209/B, C), 27.X.1997; Szekszárdi-dombság. Loess cliffs on the summit of Bali-hegy, at vineyards or roadside, at 220 m alt. 46° 20.6' N, 18° 37' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97213/A, B, Q, R), 27.X.1997; Szekszárdi-dombság. S facing natural loess cliffs from Bartina Valley to Kerék Hill along the blue trail, at the W end of Szekszárd town. 200—240 m alt. 48° 20' N, 18° 40.6' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97204/A, B, F, N, Q), 26.X.1997; Szekszárdi-dombság. 12 m deep hollow road called Benedek-szurdok (and a few minor cliffs) on the SW side of Palánkai-hegy at the W side of Szekszárd town, at 200—270 m alt. 46° 20' N, 18° 4' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97203/A, Z), 26.X.1997; N part of Szekszárdi-dombság. „Szarvas-szurdok", 4 km W of Szekszárd town, at 260 m alt. 46° 20' N, 18° 39' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97205/H, V), 26.X.1997; Szekszárdi-dombság. Hollow road at the W end of Várdomb village, at 140 m alt. 46° 15.3' N, 18° 39.5' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97218/K), 28.X.1997; Tolnai-hegyhát. Artificial, 2—3 m high loess cliffs in Kisszékely village, at 210 m alt. 46° 40.4' N, 18° 32.5' E. Coll.: S. Pócs & T. Pócs (9777/H), 2.VIII.1997; Tolnai-hegyhát. Natural and artificial loess cliffs 15 m high in Nagyszékely village, at 125 m alt. 46° 38.8' N, 18° 32' E. Coll.: S. Pócs & T. Pócs (9784/A, B, C), 3.VIII.1997; Tolnai-hegyhát. Partly mined loess cliffs with remnants of steppe at the N end of Pincehely, at 240 m alt. 46° 41.6' N, 18° 27.5' E. Coll.: S. Pócs & T. Pócs (9780/F), 2.VIII.1997; Tolnai-hegyhát. Simontornya. On the vineyard hill Derék-hegy S of the town, at 240 m alt. On artificial cliffs along vinecellars. 46° 44' N, 18° 33' E. Coll.: S. Pócs & T. Pócs (9783/E), 3.VIII.1997; Völgység. On artificial cliffs and in hollow roads S of Ozora, at 180—200 m alt. 46° 44.7' N, 18° 28.7' E. Coll.: S. Pócs & T. Pócs (9787/C, D, E, F, G), 4.VIII.1997. — VESZPRÉM COUNTY: Löszfal Balatonaliga és Balatonakarattya között. Leg.: Farkas, E. és Lőkös, L., 1985.XI.8. [BP]; Balaton Highlands, Tihany Peninsula. Small loess cliff on the W slope of Csúcs-hegy, S of Sajkod, at 120 m alt.46° 54.5' N, 17° 51' E. Coll.: T. Pócs & B. O. van Zanten (9694/P), 30.X.1996.

Fulgensia fulgens (Sw.) Elenk. — KOMÁROM COUNTY: In decliv. loessaceis „Diós-árok" ad pag. Süttő. Alt. cca 170 m. s. m. Leg.: Boros, Á., 1948.11.07. [BP 46932]; Gerecse Mts, Vöröskő Hills S of Dunaalmás village. Loess layer on the top of a huge limestone (travertino) cliff faced to ENE, at 250 m alt. 47° 43' N, 18° 20' E. Coll.: T. Pócs, B. O. van Zanten, G. Kis & A. Szabó (96115/O), 6.XI.1996.

Heppia lutosa (Ach.) Nyl. — TOLNA MEGYE: Földön, a Hőgyész felé vezető út mentén, Tevel közelében. [SÁNTHA 1924, sub *H. virescens*].

Lecania turicensis (Hepp) Müll. Arg. — TOLNA COUNTY: Geresdi-dombság. Hard natural loess cliff along the road in the valley of Lajvér stream at the SE end of Kismórágy, at 120 m alt. 46° 13' N, 18° 39.3' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97181/C), 18. & 21.X.1997; Szekszárdi-dombság. Grábóc. Small hollow road and roadcuts in loess, at 160 m alt. 46° 16.5' N, 18° 36.4' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97211/H), 27.X.1997; Völgység. On artificial cliffs and in hollow roads S of Ozora, at 180—200 m alt. 46° 44.7' N, 18° 28.7' E. Coll.: S. Pócs & T. Pócs (9787/D), 4.VIII.1997.

Lecanora albescens (Hoffm.) Branth et Rostrup — BORSOD-ABAÚJ-ZEMPLÉN MEGYE: Tokaj, Nagy-Kopasz, Szeles-tető. [GALLÉ 1964, sub. *L. a. deminuta*].

Lecanora crenulata Hook. — BARANYA COUNTY: Baranyai-dombság. Dunaszekcső. On the huge ESE exposed loess cliffs facing the Danube, at 100—180 m alt. 46° 4.7' N, 18° 46' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97185/Z, AB), 19.X.1997; Villányi-hegység. S end of Túrony village. W facing loess cliff along the Harkány-Pécs road, at 180 m alt. 45° 53.8' N, 18° 14' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97194/H—M, N, O, P), 20.X.1997. — BORSOD-ABAÚJ-ZEMPLÉN COUNTY: Tokaj, Nagy-Kopasz, Szeles-tető. [GALLÉ 1964, sub *L. c. argillicola*]; Hegyalja Hills, SE side of Mt. Nagy-kopasz. Hollow road called „Kusajti-árok", W of Tokaj town. *Agropyro-Kochietum* community on the loess cliffs, 120—140 m alt. 48° 7' N, 21° 23' E. Coll.: T. Pócs & B. O. van Zanten (96106/L), 4.XI.1996. — KOMÁROM COUNTY: Gerecse Mts. Hollow road of Diósárok S of Süttő village, with loess cliffs, at 200 m alt. 47° 44' N, 18° 27' E. Coll.: T. Pócs, B. O. van Zanten, G. Kis & A. Szabó (96117/C, D, E), 6.XI.1996; Visegrád Mts. Natural and artificial loess cliffs in and near the abandoned mine of Basaharc brick factory, facing Danube River, at 120—150 m alt. 47° 48.2' N, 18° 50.8' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (9841/G(?)), 30.VI.1998. — PEST COUMTY: Gödöllői-dombság. Vár-hegy at the NE side of Pécel town, on 50 m high, SE facing loess cliff, at 160—210 m alt. 47° 29.7' N, 19 °20' E. Coll.: S. Pócs & T. Pócs (9761/A, B, C, D, H), 27.VI.1997. — TOLNA COUNTY: Mezőföld, Dunaföldvár. Natural loess cliffs and gorges on the N side of Kálvária hill, at 130 m alt. 46° 47.6' N, 18° 55' E. Coll.: S. Pócs & T. Pócs (9785/A, E), 4.VIII.1997; Mezőföld, Paks. Sánc-hegy. Great loess cliff in front of the Railways Museum, at 150 m alt. 46° 36.8' N, 18° 52' E. Coll.: S. Pócs, T. Pócs, G. Kis & A. Szabó (9768/A, B, G, H), 8.VII.1997; Szekszárdi-dombság. E side of Alsónána village „Pincesor". W exposed vine cellars carved in 3 rows in loess cliff, at 180 m alt. 46° 14.4' N, 18° 39.5' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97217/S, W, X), 28.X.1997; Szekszárdi-dombság. S facing natural loess cliffs from Bartina Valley to Kerék Hill along the blue trail, at the W end of Szekszárd town. 200—240 m alt. 48° 20' N, 18° 40.6' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97204/A), 26.X.1997;

Szekszárdi-dombság. 12 m deep hollow road called Benedek-szurdok (and a few minor cliffs) on the SW side of Palánkai-hegy at the W side of Szekszárd town, at 200—270 m alt. 46° 20’ N, 18° 4’ E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97203/A, B, C(?)), 26.X.1997; N part of Szekszárdi-dombság. „Szarvas-szurdok”, 4 km W of Szekszárd town, at 260 m alt. 46° 20’ N, 18° 39’ E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97205/V), 26.X.1997; Tolnai-hegyhát. Simontornya. On the vineyard hill Derék-hegy S of the town, at 240 m alt. On artificial cliffs along vinecellars. 46° 44’ N, 18° 33’ E. Coll.: S. Pócs & T. Pócs (9783/E), 3.VIII.1997. — Veszprém megye: Balatonkenese, löszfalon. Leg.: Gyelnik, V., 1940.08.12. [BP 17311, sub var. *terrigena*].

Lecanora dispersa (Pers.) Sommerf. — Baranya county: Baranyai-dombság. Ócsárd. Small (6—8 m), S facing cliff at 130 m alt. 45° 55.7’ N, 18° 9’ E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97188/ E, F, G), 20.X.1997; Baranyai-dombság. Palotabozsok. Small W facing artificial cliff behind the house No. 13 in Fő utca (street), at 160 m alt. 46° 6.8’ N, 18° 8.2’ E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97195/D, E), 21.X.1997; Villányi-hegység. Small, S facing natural loess cliff at the E end of Szársomlyó hegy, between Villány and Nagyharsány, at 200 m alt. 45° 51.5’ N, 18° 26’ E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97192/B, C, D), 20.X.1997. — Borsod-Abaúj-Zemplén megye: Tokaj, Nagy-Kopasz, Szeles-tető. [Gallé 1964]. — Komárom county: Gerecse Mts, Vöröskő Hills S of Dunaalmás village. Loess layer on the top of a huge limestone (travertino) cliff faced to ENE, at 250 m alt. 47° 43’ N, 18° 20’ E. Coll.: T. Pócs, B. O. van Zanten, G. Kis & A. Szabó (96115/L), 6.XI.1996; Gerecse Mts. Loess cliff on the W edge of Pap Hill, with rich steppe on the hill-top, at 200 m alt., E from Neszmély village. 47° 43’ N, 18° 21.5’ E. Coll.: T. Pócs, B. O. van Zanten, G. Kis & A. Szabó (96111/T(?), U(?)), 5.XI.1996; Gerecse Mts. Hollow road of Diósárok S of Süttő village, with loess cliffs, at 200 m alt. 47° 44’ N, 18° 27’ E. Coll.: T. Pócs, B. O. van Zanten, G. Kis & A. Szabó (96117/C, D, E), 6.XI.1996. — Nógrád county: NW foothills of Mátra Mts. On different natural and artificial cliffs at the E end of Kisterenye, at 200 m alt. 48° 03’ N, 19° 51’ E. Coll.: T. Pócs, B. O. van Zanten & A.Varga (97176/M), 15.X.1997. — Pest county: Gödöllői-dombság. Bénye village. On artificial cliffs of the vine cellars in Jókai street, at 140 m alt. 47° 20.8’ N, 19° 32.8’ E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97168/L(?)), 12.X.1997; Gödöllő Hills. Loess cliff near Isaszeg village, at the railway crossing near Rákos brook, at 180 m alt.17° 31.5’ N, 19° 22’ E. Coll.: T. Pócs, B. O. van Zanten, G. Kis & A. Szabó (96122/H, I, K), 7.XI.1996. — Tolna county: Geresdi-dombság. Hard natural loess cliff along the road in the valley of Lajvér stream at the SE end of Kismórágy, at 120 m alt. 46° 13’ N, 18° 39.3’ E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97181/S), 18. & 21.X.1997; Geresdi-dombság. N facing cliffs 2 km NE from Bátaapáti, at 160 m alt. 46° 12.6’ N, 18° 36’ E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97180/D), 18.X.1997; Mezőföld, Dunaföldvár. Natural loess cliffs and gorges on the N side of Kálvária hill, at 130 m alt. 46° 47.6’ N, 18° 55’ E. Coll.: S. Pócs & T. Pócs (9785/A, G), 4.VIII.1997; Mezőföld, N of Dunaföldvár. Natural loess cliffs along Danube River near the camping site, at 97 m alt. 46° 49’ N, 18°

54.7' E. Coll.: S. Pócs & T. Pócs (9786/A, E), 3.VIII.1997; Mezőföld, Dunakömlőd (Paks). On 6—20 m high, N exposed loess cliffs at the N end of Sánc-hegy, with rich cryptogamic vegetation, at 110—130 m alt. 46° 39.3' N, 18° 52' E. Coll.: S. Pócs, T. Pócs, G. Kis & A. Szabó (9769/F, I, Q), 8—9.VII.1997; Szekszárdi-dombság. E side of Alsónána village „Pincesor". W exposed vine cellars carved in 3 rows in loess cliff, at 180 m alt. 46° 14.4' N, 18° 39.5' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97217/M), 28.X.1997; S end of Szekszárdi-dombság. Lajvérpuszta village NW of Bátaszék town. Loess cliffs along old vine cellars and in hollow road, at 100—140 m alt. 46° 12' N, 18° 41.5' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97216/Z), 28.X.1997; Szekszárdi-dombság. S facing natural loess cliffs from Bartina Valley to Kerék Hill along the blue trail, at the W end of Szekszárd town. 200—240 m alt. 48° 20' N, 18° 40.6' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97204/Q), 26.X.1997; Tolnai-hegyhát. Artificial, 2—3 m high loess cliffs in Kisszékely village, at 210 m alt. 46° 40.4' N, 18° 32.5' E. Coll.: S. Pócs & T. Pócs (9777/I), 2.VIII.1997; Völgység. On artificial cliffs and in hollow roads S of Ozora, at 180—200 m alt. 46° 44.7' N, 18° 28.7' E. Coll.: S. Pócs & T. Pócs (9787/C, F, G), 4.VIII.1997. — VESZPRÉM COUNTY: Löszfal Balatonaliga és Balatonakarattya között. Leg.: Farkas, E. és Lőkös, L., 1985.XI.8. [BP]; Balaton Highlands, Tihany Peninsula. Small loess cliff on the W slope of Csúcs-hegy, S of Sajkod, at 120 m alt.46° 54.5' N, 17° 51' E. Coll.: T. Pócs & B. O. van Zanten (9694/P), 30.X.1996.

Lecanora hagenii (Ach.) Ach. — BORSOD-ABAÚJ-ZEMPLÉN MEGYE: Tokaj, Nagy-Kopasz, Szeles-tető. [GALLÉ 1964, sub *L. umbrina terrigena*]. — COMIT. ESZTERGOM: In abrupte loessacea viae cavae ad Agostyán. Alt. s. met. ca: 200. Leg.: Boros, Á., 1944.06.13. [BP 43065, sub f. *terricola* Nyl.]; In abrupte loessacea „Diós-árok" ad pagum Süttő. Alt. cca. 150 m. s. m. Leg.: Boros, Á., 1948.11.07. [BP 43053, sub f. *argillacea*]. — COMIT. PEST: Százhalombatta, Dunaparton, löszfalon. Leg.: Gyelnik, V., 1933.04.07. [BP 17806, sub f. *terricola*]; In muris loessaceis ad „Sz. Mihály kápolna" pr. opp. Vácz. Alt. s. m. met. ca: 120. Leg.: Boros, Á., 1921.07.15. [BP 42914, sub f. *terricola* Nyl.]; In muris loesseceis ad pag. Visegrád, ca 200 m. Leg.: Boros, Á., 1921.08.14. [BP 42917, sub f. *terricola*]. — COMIT. VESZPRÉM MEGYE: Ad praeruptum loessaceum pr. pag. Alsóörs, alt. cca 150 m. s. m. Leg.: Timkó, Gy., 1925.07.07. [BP 17808, sub f. *terricola*].

Lecanora muralis (Schreber) Rabenh. — BORSOD-ABAÚJ-ZEMPLÉN MEGYE: Tokaj, Nagy-Kopasz, Szeles-tető. [GALLÉ 1964, sub *L. albomarginata*].

Leptogium lichenoides (L.) Zahlbr. — BORSOD-ABAÚJ-ZEMPLÉN MEGYE: Tokaj, Nagy-Kopasz, Szeles-tető. [GALLÉ 1964].

Micarea prasina Fr. — KOMÁROM COUNTY: Gerecse Mts, Vöröskő Hills S of Dunaalmás village. Loess layer on the top of a huge limestone (travertino) cliff faced to ENE, at 250 m alt. 47° 43' N, 18° 20' E. Coll.: T. Pócs, B. O. van Zanten, G. Kis & A. Szabó (96115/L), 6.XI.1996. — TOLNA COUNTY: Szekszárdi-dombság. 12 m deep hollow road called Benedek-szurdok (and a few minor cliffs) on the SW side of Palánkai-hegy at the W side of Szekszárd town, at 200—270 m alt. 46° 20' N, 18° 4' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97203/B), 26.X.1997.

Moelleropsis nebulosa (Hoffm.) Gyelnik — ZALA MEGYE: Secus vias pr. pag. Bucsuszentlászló. Solo loessaceo. Alt. cca. 200 m. Leg.: Károlyi, Á., 1954.06.06. [BP 49854].

Mycobilimbia tetramera (De Not.) Brunnb. — TOLNA MEGYE: Földön, a Hőgyész felé vezető út mentén, Tevel közelében. [SÁNTHA 1924, sub *Bacidia obscurata*].

Myxobilimbia sabuletorum (Schreb.) Hafellner — BARANYA COUNTY: Villányi-hegység. 3 km NE from Kisharsány. Hollow road leading towards Palkony village from the W end of Fekete-hegy, at 140—180 m alt. 45° 52.6' N, 18° 23.4' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97193/K), 20.X.1997. — BORSOD-ABAÚJ-ZEMPLÉN COUNTY: Hegyalja Hills. Isolated volcanic cone at the N end of Tokaj town with its half side mined away. Its summit at 180 m alt is covered with 8—10 m thick loess layer, forming steep slopes and cliffs. 48° 8' N, 21° 24' E. Coll.: T. Pócs & B. O. van Zanten (96108/P), 4.XI.1996. — GYŐR-SOPRON COUNTY: Sokoró Hills. On loess cliffs of hollow roads among vineyards, W of Écs village, at 200—250 m alt. 47° 53.3' N, 17° 42' E. Coll.: T. Pócs & B. O. van Zanten (9693/L), 29.X.1996. — KOMÁROM COUNTY: Visegrád Mts. Natural and artificial loess cliffs in and near the abandoned mine of Basaharc brick factory, facing Danube River, at 120—150 m alt. 47° 48.2' N, 18° 50.8' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (9841/B, AH), 30.VI.1998. — TOLNA COUNTY: Mohos földön, a Hőgyész felé vezető út mentén, Tevel közelében. [SÁNTHA 1924, sub *Bacidia s.*]; Geresdi-dombság. Mórágy, loess cliffs along vine cellars and hollow road on Pince Hill, at the W edge of village, at 180—210 m alt. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97183/N), 18.X.1997; Mezőföld, Dunakömlőd (Paks). On 6—20 m high, N exposed loess cliffs at the N end of Sánc-hegy, with rich cryptogamic vegetation, at 110—130 m alt. 46° 39.3' N, 18° 52' E. Coll.: S. Pócs, T. Pócs, G. Kis & A. Szabó (9769/AI), 8—9.VII.1997; Szekszárdi-dombság. 12 m deep hollow road called Benedek-szurdok (and a few minor cliffs) on the SW side of Palánkai-hegy at the W side of Szekszárd town, at 200—270 m alt. 46° 20' N, 18° 4' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97203/A), 26.X.1997; N part of Szekszárdi-dombság. „Szarvas-szurdok", 4 km W of Szekszárd town, at 260 m alt. 46° 20' N, 18° 39' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97205/G), 26.X.1997; Tolnai-hegyhát. Natural and artificial loess cliffs 15 m high in Nagyszékely village, at 125 m alt. 46° 38.8' N, 18° 32' E. Coll.: S. Pócs & T. Pócs (9784/L, P), 3.VIII.1997; Tolnai-hegyhát. Partly mined loess cliffs with remnants of steppe at the N end of Pincehely, at 240 m alt. 46° 41.6' N, 18° 27.5' E. Coll.: S. Pócs & T. Pócs (9780/U), 2.VIII.1997.

Peltigera horizontalis (Huds.) Baumg. — ZALA MEGYE: Secus vias pr. pag. Bucsuszentlászló. Solo loessaceo. Alt. cca 180 m. Leg.: Károlyi, Á., 1954.06.06. [BP 3051].

Phaeophyscia chloantha (Ach.) Moberg — TOLNA COUNTY: Geresdi-dombság. Hard natural loess cliff along the road in the valley of Lajvér stream at the SE end of Kismórágy, at 120 m alt. 46° 13' N, 18° 39.3' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97181/A), 18. & 21.X.1997.

Phaeophyscia nigricans (Flörke) Moberg — BARANYA COUNTY: Baranyai-dombság. Dunaszekcső. On the huge ESE exposed loess cliffs facing the Danube, at

100—180 m alt. 46° 4.7' N, 18° 46' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97185/Z), 19.X.1997; Baranyai-dombság. Ócsárd. Small (6—8 m), S facing cliff at 130 m alt. 45° 55.7' N, 18° 9' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97188/E, F, G), 20.X.1997; Villányi-hegység. Siklós, Máriagyűd, Macska-lyuk, loess wall, leg. A. Dénes (07.08.1999) [BP]; S end of Túrony village. W facing loess cliff along the Harkány—Pécs road, at 180 m alt. 45° 53.8' N, 18° 14' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97194/H—M), 20.X.1997. — KOMÁROM COUNTY: Gerecse Mts. Loess cliff on the W edge of Pap Hill, with rich steppe on the hill-top, at 200 m alt., E from Neszmély village. 47° 43' N, 18° 21.5' E. Coll.: T. Pócs, B. O. van Zanten, G. Kis & A. Szabó (96111/T), 5.XI.1996. — PEST COUNTY: Gödöllő Hills. Loess cliff near Isaszeg village, at the railway crossing near Rákos brook, at 180 m alt.17° 31.5' N, 19° 22' E. Coll.: T. Pócs, B. O. van Zanten, G. Kis & A. Szabó (96122/H, I, K), 7.XI.1996. — SOMOGY COUNTY: Külső-Somogy. 3 m high artificial loess cliff at the S end of Törökkoppány. Coll.: S. Pócs & T. Pócs (9791/G), 5.VIII.1997. — TOLNA COUNTY: Geresdi-dombság. Hard natural loess cliff along the road in the valley of Lajvér stream at the SE end of Kismórágy, at 120 m alt. 46° 13' N, 18° 39.3' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97181/B), 18. & 21.X.1997; Geresdi-dombság. N facing cliffs 2 km NE from Bátaapáti, at 160 m alt. 46° 12.6' N, 18° 36' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97180/D), 18.X.1997; Geresdi-dombság. Mórágy, loess cliffs along vine cellars and hollow road on Pince Hill, at the W edge of village, at 180—210 m alt. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97183/O,P,Q,R), 18.X.1997; Geresdi-dombság. Mórágy, loess cliffs along vine cellars and hollow road on Pince Hill, at the W edge of village, at 180—210 m alt. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97183/O—Q), 18.X.1997; Mezőföld, N of Dunaföldvár. Natural loess cliffs along Danube River near the camping site, at 97 m alt. 46° 49' N, 18° 54.7' E. Coll.: S. Pócs & T. Pócs (9786/E), 3.VIII.1997; Mezőföld, Dunakömlőd (Paks). 6—8 m high S exposed loess cliffs above Béke utca, at 120 m alt. 46° 39.3' N, 18° 52' E. Coll.: S. Pócs, T. Pócs, G. Kis & A. Szabó (9773/A), 10.VII.1997; Mezőföld, Dunakömlőd (Paks). On 6—20 m high, N exposed loess cliffs at the N end of Sánc-hegy, with rich cryptogamic vegetation, at 110—130 m alt. 46° 39.3' N, 18° 52' E. Coll.: S. Pócs, T. Pócs, G. Kis & A. Szabó (9769/I, AF), 8—9.VII.1997; Szekszárdi-dombság. E side of Alsónána village „Pincesor". W exposed vine cellars carved in 3 rows in loess cliff, at 180 m alt. 46° 14.4' N, 18° 39.5' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97217/M, S, T), 28.X.1997; S end of Szekszárdi-dombság. Lajvérpuszta village NW of Bátaszék town. Loess cliffs along old vine cellars and in hollow road, at 100—140 m alt. 46° 12' N, 18° 41.5' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97216/AB), 28.X.1997; Szekszárdi-dombság. S facing natural loess cliffs from Bartina Valley to Kerék Hill along the blue trail, at the W end of Szekszárd town. 200—240 m alt. 48° 20' N, 18° 40.6' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97204/A, B, Q), 26.X.1997; Szekszárdi-dombság. 12 m deep hollow road called Benedek-szurdok (and a few minor cliffs) on the SW side of Palánkai-hegy at the W side of Szekszárd town, at 200—270 m alt. 46° 20' N, 18° 4' E. Coll.: S. Pócs, T. Pócs

& B. O. van Zanten (97203/A), 26.X.1997; Szekszárdi-dombság. Hollow road at the W end of Várdomb village, at 140 m alt. 46° 15.3' N, 18° 39.5' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97218/K), 28.X.1997; Tolnai-hegyhát. Artificial, 2—3 m high loess cliffs in Kisszékely village, at 210 m alt. 46° 40.4' N, 18° 32.5' E. Coll.: S. Pócs & T. Pócs (9777/H), 2.VIII.1997.

Phaeophyscia orbicularis (Neck.) Moberg — BARANYA COUNTY: Baranyai-dombság. Dunaszekcső. On the huge ESE exposed loess cliffs facing the Danube, at 100—180 m alt. 46° 4.7' N, 18° 46' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97185/Y), 19.X.1997; Baranyai-dombság. Ócsárd. Small (6—8 m), S facing cliff at 130 m alt. 45° 55.7' N, 18° 9' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97188/E, F, G), 20.X.1997; Villányi-hegység. Siklós, Máriagyűd, Macska-lyuk, loess wall, leg. A. Dénes (07.08.1999) [BP]; S end of Túrony village. W facing loess cliff along the Harkány-Pécs road, at 180 m alt. 45° 53.8' N, 18° 14' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97194/N, O, P), 20.X.1997. — KOMÁROM COUNTY: Gerecse Mts. Loess cliff on the W edge of Pap Hill, with rich steppe on the hill-top, at 200 m alt., E from Neszmély village. 47° 43' N, 18° 21.5' E. Coll.: T. Pócs, B. O. van Zanten, G. Kis & A. Szabó (96111/T, U), 5.XI.1996. — PEST COUNTY: Érd, Dunaparton, löszbabán. Leg.: Gyelnik, V., 1933.04.07. [BP 31504, sub *Physcia o.* (Neck.) f. *tristis* Räs.]; Gödöllői-dombság. Bénye village. On artificial cliffs of the vine cellars in Jókai. street, at 140 m alt. 47° 20.8' N, 19° 32.8' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97168/L), 12.X.1997; Gödöllő Hills. Loess cliff near Isaszeg village, at the railway crossing near Rákos brook, at 180 m alt.17° 31.5' N, 19° 22' E. Coll.: T. Pócs, B. O. van Zanten, G. Kis & A. Szabó (96122/H, I, K), 7.XI.1996. — SOMOGY COUNTY: Külső-Somogy. 3 m high artificial loess cliff at the S end of Törökkoppány. Coll.: S. Pócs & T. Pócs (9791/H), 5.VIII.1997. — TOLNA COUNTY: Geresdi-dombság. N facing cliffs 2 km NE from Bátaapáti, at 160 m alt. 46° 12.6' N, 18° 36' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97180/D), 18.X.1997; Geresdi-dombság. Hard natural loess cliff along the road in the valley of Lajvér stream at the SE end of Kismórágy, at 120 m alt. 46° 13' N, 18° 39.3' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97181/A, B, C, S), 18. & 21.X.1997; Geresdi-dombság. Mórágy, loess cliffs along vine cellars and hollow road on Pince Hill, at the W edge of village, at 180—210 m alt. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97183/O, P, Q, R), 18.X.1997; Geresdi-dombság. Small cliff at 120 m alt., near Mórágy railway station. 46° 12.3' N, 18° 40' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97199/H), 21.X.1997; Mezőföld, N of Dunaföldvár. Natural loess cliffs along Danube River near the camping site, at 97 m alt. 46° 49' N, 18° 54.7' E. Coll.: S. Pócs & T. Pócs (9786/K), 3.VIII.1997; Mezőföld, Paks. Sánc-hegy. Great loess cliff in front of the Railways Museum, at 150 m alt. 46° 36.8' N, 18° 52' E. Coll.: S. Pócs, T. Pócs, G. Kis & A. Szabó (9768/A), 8.VII.1997; Mezőföld, Dunakömlőd (Paks). On 6—20 m high, N exposed loess cliffs at the N end of Sánc-hegy, with rich cryptogamic vegetation, at 110—130 m alt. 46° 39.3' N, 18° 52' E. Coll.: S. Pócs, T. Pócs, G. Kis & A. Szabó (9769/A, B, S, AF), 8—9.VII.1997; Szekszárdi-dombság. E side of Alsónána village „Pincesor". W exposed vine cellars carved in 3 rows in loess cliff, at 180 m alt. 46° 14.4' N, 18° 39.5' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97217/M, T), 28.X.1997; Szekszárdi-dombság. Grábóc. Small hollow road and roadcuts in loess, at 160 m alt. 46° 16.5' N, 18° 36.4' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97211/J), 27.X.1997; Szekszárdi-dombság. Loess cliffs on the summit of Bali-hegy, at vineyards or roadside, at 220 m alt. 46° 20.6' N, 18° 37' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97213/B), 27.X.1997; Szekszárdi-dombság. S facing natural loess cliffs from Bartina Valley to Kerék Hill along the blue trail, at the W end of Szekszárd town. 200—240 m alt. 48° 20' N, 18° 40.6' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97204/A), 26.X.1997; Szekszárdi-dombság. 12 m deep hollow road called Benedek-szurdok (and a few minor cliffs) on the SW side of Palánkai-hegy at the W side of Szekszárd town, at 200—270 m alt. 46° 20' N, 18° 4' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97203/A, AA), 26.X.1997; Tolnai-hegyhát. Artificial, 2—3 m high loess cliffs in Kisszékely village, at 210 m alt. 46° 40.4' N, 18° 32.5' E. Coll.: S. Pócs & T. Pócs (9777/I), 2.VIII.1997; Tolnai-hegyhát. Simontornya. On the vineyard hill Derék-hegy S of the town, at 240 m alt. On artificial cliffs along vinecellars. 46° 44' N, 18° 33' E. Coll.: S. Pócs & T. Pócs (9783/E), 3.VIII.1997; Völgység. On artificial cliffs and in hollow roads S of Ozora, at 180—200 m alt. 46° 44.7' N, 18° 28.7' E. Coll.: S. Pócs & T. Pócs (9787/C, G), 4.VIII.1997.

Physcia adscendens (Fr.) H. Olivier — BARANYA COUNTY: Baranyai-dombság. Dunaszekcső. On the huge ESE exposed loess cliffs facing the Danube, at 100—180 m alt. 46° 4.7' N, 18° 46' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97185/Y, AA), 19.X.1997; Villányi-hegység: Siklós, Máriagyűd, Macska-lyuk, loess wall, leg. A. Dénes (07.08.1999) [BP]. — KOMÁROM COUNTY: Gerecse Mts. Loess cliff on the W edge of Pap Hill, with rich steppe on the hill-top, at 200 m alt, E from Neszmély village. 47° 43' N, 18° 21.5' E. Coll.: T. Pócs, B. O. van Zanten, G. Kis & A. Szabó (96111/T, U), 5.XI.1996. — TOLNA COUNTY: Geresdi-dombság. Mórágy, loess cliffs along vine cellars and hollow road on Pince Hill, at the W edge of village, at 180—210 m alt. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97183/O, P, Q, R), 18.X.1997; Geresdi-dombság. Small cliff at 120 m alt., near Mórágy railway station. 46° 12.3' N, 18° 40' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97199/G(?)), 21.X.1997; Mezőföld, N of Dunaföldvár. Natural loess cliffs along Danube River near the camping site, at 97 m alt. 46° 49' N, 18° 54.7' E. Coll.: S. Pócs & T. Pócs (9786/A), 3.VIII.1997; Szekszárdi-dombság. 12 m deep hollow road called Benedek-szurdok (and a few minor cliffs) on the SW side of Palánkai-hegy at the W side of Szekszárd town, at 200—270 m alt. 46° 20' N, 18° 4' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97203/A), 26.X.1997.

Physcia dimidiata (Arnold) Nyl. — BARANYA COUNTY: Baranyai-dombság. Dunaszekcső. On the huge ESE exposed loess cliffs facing the Danube, at 100—180 m alt. 46° 4.7' N, 18° 46' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97185/Y), 19.X.1997.

Physcia tenella (Scop.) DC. — BORSOD-ABAÚJ-ZEMPLÉN MEGYE: Tokaj, Nagy-Kopasz, Szeles-tető. [GALLÉ 1964].

Placidium rufescens (Ach.) O. Breuss — Tolna megye: Földön, a Kovácsi felé vezető úton, Tevel mellett. [SÁNTHA 1924, sub *Dermatocarpon r.*].

Placynthiella icmalea (Ach.) Coppins et P. James — Heves county: foothills of Bükk Mts. At the N end of Demjén village. Small loess slopes at the beginning and W foot of Pünkösd Hill, „Olajos" road. 47° 49' N, 20° 20' E. Coll.: T. Pócs, G. Kis & A. Szabó (96125/E, Q), 18.XI.1996.

Polysporina simplex (Davies) Vězda — Heves county: foothills of Bükk Mts. At the N end of Demjén village. Small loess slopes at the beginning and W foot of Pünkösd Hill, „Olajos" road. 47° 49' N, 20° 20' E. Coll.: T. Pócs, G. Kis & A. Szabó (96125/A), 18.XI.1996.

Protoblastenia incrustans (DC.) J. Steiner — Borsod-Abaúj-Zemplén megye: Tokaj, Nagy-Kopasz, Szeles-tető. [Gallé 1964, sub *Caloplaca i.*].

Protoblastenia rupestris (Scop.) J. Steiner — Komárom county: Gerecse Mts, Vöröskő Hills S of Dunaalmás village. Loess layer on the top of a huge limestone (travertino) cliff faced to ENE, at 250 m alt. 47° 43' N, 18° 20' E. Coll.: T. Pócs, B. O. van Zanten, G. Kis & A. Szabó (96115/L), 6.XI.1996.

Psora decipiens (Hedw.) Hoffm. — Comit. Esztergom: In decliv. loesseaceis „Diós-árok" ad pag. Süttő. Alt. cca 170 m. s. m. Leg.: Boros, Á., 1948.11.07. [BP 38864, sub *Lecidea d.* Hedw., BP 76848]. — Borsod-Abaúj-Zemplén megye: Tokaj, Nagy-Kopasz, Szeles-tető. [Gallé 1964, sub *Lecidea d.*].

Rinodina exigua (Ach.) Gray — Pest county: Gödöllői-dombság. Bénye village. On artificial cliffs of the vine cellars in Jókai street, at 140 m alt. 47° 20.8' N, 19° 32.8' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97168/L), 12.X.1997.

Sarcogyne regularis Körber — Pest county: Gödöllő Hills. Loess cliff near Isaszeg village, at the railway crossing near Rákos brook, at 180 m alt.17° 31.5' N, 19° 22' E. Coll.: T. Pócs, B. O. van Zanten, G. Kis & A. Szabó (96122/H, I, K), 7.XI.1996. — Tolna county: Szekszárdi-dombság. „Görög szőllők" vineyards 3 km E of Szálka village near Mausz chapel. Old artificial loess cliffs, at 200 m alt. 46° 16.5' N, 18° 40' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97208/R), 27.X.1997. — Veszprém megye: Löszfal Balatonaliga és Balatonakarattya között. Leg.: Farkas, E. és Lőkös, L., 1985.XI.8. [BP].

Solorinella asteriscus Anzi — Komárom county: In abrupte loessacea „Diós-árok" ad Süttő. Alt. ca: 150 m. s. m. Leg.: Boros, Á., 1943.08.29. [BP 36654]; In loessaceis arenosis pedis montis Hegyeskő prope Tokod. Alt. ca: 200 m. s. m. Leg.: Boros, Á., 1952.10.19. [BP 50557]; In locis loessaceo-calcareis montis Kőpite-hegy prope pagum Dunaalmás. Alt. ca: 250 m. s. m. Leg.: Boros, Á., 1942.09.14. [BP 36656]; Visegrád Mts. Natural and artificial loess cliffs in and near the abandoned mine of Basaharc brick factory, facing Danube River, at 120—150 m alt. 47° 48.2' N, 18° 50.8' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (9841/K), 30.VI.1998. [Pócs 1999].

Squamarina lentigera (Weber) Poelt — Somogy megye: Szárszó a Lösz magasfalakon? Leg.: Mágocsy-Dietz, S., 191?. [BP 19286, sub *Lecanora l.*]. — Tolna megye:

In collibus siccis loessaceis „Mosi hegy" prope Simontornya (supra Styrum kápolna). Alt. ca: 300 m. Leg.: Boros, Á., 1922.07.06. [BP 43503, sub *Lecanora l.* (Hoffm.)].

Thrombium epigaeum (Pers.) Wallr. — CSONGRÁD MEGYE: Szőreg: Lössboden. [GALLÉ 1967]. — TOLNA MEGYE: Földön, a Hőgyész felé vezető út meredek partján, Tevel mellett. [SÁNTHA 1924].

Toninia physaroides (Opiz) Zahlbr. — GYŐR-MOSON-SOPRON MEGYE: Ravazd, ad abrupta loessacea. Leg.: Polgár, S., 1921.07.07. [BP 72784, sub *T. coeruleonigricans* (Lightf.) f. *dispersa* (Nyl.) A. Zahlbr.]. — KOMÁROM MEGYE: In decliv. loessaceis „Diósárok" ad pag. Süttő. Alt. ca. 170 m. s. m. Leg.: Boros, Á., 1948.11.07. [BP 39197, sub *Thalloidima coeruleonigricans* (Lightf.) f. *dispersa* (Nyl.)].

Toninia sedifolia (Scop.) Timdal — KOMÁROM COUNTY: Gerecse Mts, Vöröskő Hills S of Dunaalmás village. Loess layer on the top of a huge limestone (travertino) cliff faced to ENE, at 250 m alt. 47° 43' N, 18° 20' E. Coll.: T. Pócs, B. O. van Zanten, G. Kis & A. Szabó (96115/N, O), 6.XI.1996.

Verrucaria muralis Ach. — BÁCS-KISKUN COUNTY: Duna-Tisza köze Solti-síkság. On a 20 m natural loess ridge near the brick factory of Császártöltés, at 100—120 m alt. 46° 24' N, 19° 10' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97202/H), 22.X.1997; Duna-Tisza köze, Solti-síkság. Nemesnádudvar. Loess cliff on the upper part of a sand mine near Nemesnádudvar at 10 m alt. 46° 19' N, 19° 2.5' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97201/L), 22.X.1997. — BARANYA COUNTY: Baranyai-dombság. Dunaszekcső. On the huge ESE exposed loess cliffs facing the Danube, at 100—180 m alt. 46° 4.7' N, 18° 46' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97185/AA), 19.X.1997; Baranyai-dombság. Ócsárd. Small (6—8 m), S facing cliff at 130 m alt. 45° 55.7' N, 18° 9' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97188/AA), 20.X.1997; Baranyai-dombság. Palotabozsok. Small W facing artificial cliff behind the house No. 13 in Fő utca (street), at 160 m alt. 46° 6.8' N, 18° 8.2' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97195/D, E), 21.X.1997; Villányi-hegység. S end of Túrony village. W facing loess cliff along the Harkány-Pécs road, at 180 m alt. 45° 53.8' N, 18° 14' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97194/N, O, P), 20.X.1997; Villányi-hegység. Small, S facing natural loess cliff at the E end of Szársomlyó hegy, between Villány and Nagyharsány, at 200 m alt. 45° 51.5' N, 18° 26' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97192/B, C, D), 20.X.1997; Siklós, Máriagyűd, Macska-lyuk, loess wall, leg. A. Dénes (07.08.1999) [BP]. — BORSOD-ABAÚJ-ZEMPLÉN COUNTY: Bükk Mts. NNE of Cserépfalu. Mész-berek Valley. Open or half shady riolite tuff cliffs of roadside or of an abandoned hollow road at Túr Bucka Hill, 210 m alt. 47° 57.6' N, 20° 32.9' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (9811/P), 15.VI.1998; Hegyalja Hills. Mt. Nagy-kopasz. Abandoned vineyards, terrace slopes and cliffs on loess with *Aster oleifolius* and with cultivated *Ficus carica*, at 200 m alt, on the SW slopes above Tarcal village. 48° 7' N, 21° 22' E. Coll.: T. Pócs & B. O. van Zanten (96102/U), 3.XI.1996. — GYŐR-SOPRON COUNTY: Sokoró Hills. On loess cliffs of hollow roads among vineyards, W of Écs village, at 200—250 m alt. 47° 53.3' N, 17° 42' E. Coll.: T. Pócs

& B. O. van Zanten (9693/M), 29.X.1996. — HEVES COUNTY: Ózdi-dombság. Partly natural, partly mined loess cliffs at the N side of Pétervására town, below „Szőlőhegy" hill, at 200 m alt. 48° 4' N, 20° 6' E. Coll.: S. Pócs & T. Pócs (97219/D), 11.XI.1997. — KOMÁROM COUNTY: Visegrád Mts. Natural and artificial loess cliffs in and near the abandoned mine of Basaharc brick factory, facing Danube River, at 120—150 m alt. 47° 48.2' N, 18° 50.8' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (9841/B), 30.VI.1998. — NÓGRÁD COUNTY: NW foothills of Mátra Mts. On different natural and artificial cliffs at the E end of Kisterenye, at 200 m alt. 48° 03' N, 19° 51' E. Coll.: T. Pócs, B. O. van Zanten & A.Varga (97176/M), 15.X.1997. — PEST COUNTY: Gödöllői-dombság. Vár-hegy at the NE side of Pécel town, on 50 m high, SE facing loess cliff, at 160—210 m alt. 47° 29.7' N, 19 °20' E. Coll.: S. Pócs & T. Pócs (9761/C), 27.VI.1997. — TOLNA COUNTY: Geresdi-dombság. Hard natural loess cliff along the road in the valley of Lajvér stream at the SE end of Kismórágy, at 120 m alt. 46° 13' N, 18° 39.3' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97181/D), 18. & 21.X.1997; Geresdi-dombság. Small cliff at 120 m alt., near Mórágy railway station. 46° 12.3' N, 18° 40' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97199/G, L), 21.X.1997; Mezőföld, Dunakömlőd (Paks). On 6—20 m high, N exposed loess cliffs at the N end of Sánc-hegy, with rich cryptogamic vegetation, at 110—130 m alt. 46° 39.3' N, 18° 52' E. Coll.: S. Pócs, T. Pócs, G. Kis & A. Szabó (9769/I), 8—9.VII.1997; S end of Szekszárdi-dombság. Lajvérpuszta village NW of Bátaszék town. Loess cliffs along old vine cellars and in hollow road, at 100—140 m alt. 46° 12' N, 18° 41.5' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97216/AB), 28.X.1997; Szekszárdi-dombság. „Görög szőllők" vineyards 3 km E of Szálka village near Mausz chapel. Old artificial loess cliffs, at 200 m alt. 46° 16.5' N, 18° 40' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97208/R), 27.X.1997; Szekszárdi-dombság. Artificial, SW exposed cliffs of vine cellars at the N end of Szálka village, 200 m alt. 46° 16' N, 18° 38' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97209/B, C), 27.X.1997; Szekszárdi-dombság, SW side of Szekszárd town. Abandoned hollow road on the S side of Bartina hill, at 260 m alt. 46° 19.5' N, 18° 41' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97206/H), 26.X.1997; Szekszárdi-dombság. 12 m deep hollow road called Benedek-szurdok (and a few minor cliffs) on the SW side of Palánkai-hegy at the W side of Szekszárd town, at 200—270 m alt. 46° 20' N, 18° 4' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97203/Z), 26.X.1997; N part of Szekszárdi-dombság. „Szarvas-szurdok", 4 km W of Szekszárd town, at 260 m alt. 46° 20' N, 18° 39' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97205/H), 26.X.1997; Szekszárdi-dombság. Hollow road at the W end of Várdomb village, at 140 m alt. 46° 15.3' N, 18° 39.5' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97218/K), 28.X.1997. — VESZPRÉM MEGYE: Löszfal Balatonaliga és Balatonakarattya között. Leg.: Farkas, E. és Lőkös, L., 1985.XI.8. [BP].

Verrucaria sp. — PEST MEGYE: Iuxta opp. Vác. löszfal konkrécióján. Leg.: Gyelnik, V., 1937.08.12. [BP]. — VESZPRÉM MEGYE: Ad praeruptum loessaceum pr. pag. Alsóörs, alt. cca. 150 m. s. m. Leg.: Timkó, Gy., 1925.07.07. [BP].

Xanthoparmelia somloensis (Gyelnik) Hale — COMIT. ESZTERGOM: In graminosis loessaceis ad Ádám-major pr. pag. Dunaalmás. Alt. ca: 250. Leg.: Boros, Á., 1924.03.23. [BP 44573, sub *Parmelia conspersa* var. *stenophylla* Ach.].

Xanthoria fallax (Hepp) Arnold — BARANYA MEGYE: Villányi-hegység: Siklós, Máriagyűd, Macska-lyuk, loess wall, leg. A. Dénes (07.08.1999) [BP].

Xanthoria parietina (L.) Th. Fr. — BARANYA MEGYE: Villányi-hegység: Siklós, Máriagyűd, Macska-lyuk, loess wall, leg. A. Dénes (07.08.1999) [BP]. — BORSOD-ABAÚJ-ZEMPLÉN MEGYE: Tokaj, Nagy-Kopasz, Szeles-tető. [GALLÉ 1964]. — PEST COUNTY: Gödöllői-dombság. Bénye village. On artificial cliffs of the vine cellars in Jókai street, at 140 m alt. 47° 20.8' N, 19° 32.8' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97168/L), 12.X.1997. — TOLNA COUNTY: Geresdi-dombság. N facing cliffs 2 km NE from Bátaapáti, at 160 m alt. 46° 12.6' N, 18° 36' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97180/D), 18.X.1997; Tolnai-hegyhát. Simontornya. On the vineyard hill Derék-hegy S of the town, at 240 m alt. On artificial cliffs along vinecellars. 46° 44' N, 18° 33' E. Coll.: S. Pócs & T. Pócs (9783/H), 3.VIII.1997.

A teljesség kedvéért részletezzük az alábbi pár példányt is, melyekből nem állt rendelkezésre a határozáshoz szükséges mennyiségű anyag, így ezeket nem sikerült egyértelműen azonosítani.

cf. ***Bacidina delicata*** (Larbal. et Leighton) V. Wirth et Vězda — BARANYA COUNTY: Villányi-hegység. 3 km NE from Kisharsány. Hollow road leading towards Palkony village from the W end of Fekete-hegy, at 140—180 m alt. 45° 52.6' N, 18° 23.4' E. Coll.: S. Pócs, T. Pócs, B. O. van Zanten & A. Szabó (97193/K), 20.X.1997.

cf. ***Caloplaca*** sp. — TOLNA COUNTY: Szekszárdi-dombság. E side of Alsónána village „Pincesor". W exposed vine cellars carved in 3 rows in loess cliff, at 180 m alt. 46° 14.4' N, 18° 39.5' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97217/X), 28.X.1997.

cf. ***Endocarpon/Psora/Lecidea*** — BORSOD-ABAÚJ-ZEMPLÉN COUNTY: Hegyalja Hills. Mt. Nagy-kopasz. Abandoned vineyards, terrace slopes and cliffs on loess with *Aster oleifolius* and with cultivated *Ficus carica*, at 200 m alt, on the SW slopes above Tarcal village. 48° 7' N, 21° 22' E. Coll.: T. Pócs & B. O. van Zanten (96102/U), 3.XI.1996.

cf. ***Lepraria*** sp. — PEST COUNTY: Gödöllői-dombság. 10 m high seminatural cliffs at the SW side of Tápióbicske, at 120 m alt. 47° 21' N, 19° 41' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97165/), 12.X.1997.

cf. ***Thyrea confusa Henssen*** — TOLNA COUNTY: Mezőföld, Paks. Sánc-hegy. Great loess cliff in front of the Railways Museum, at 150 m alt. 46° 36.8' N, 18° 52' E. Coll.: S. Pócs, T. Pócs, G. Kis & A. Szabó (9768/A), 8.VII.1997.

?szürke pikkelyestelepű faj — PEST COUNTY: Gödöllői-dombság. 10 m high seminatural cliffs at the SW side of Tápióbicske, at 120 m alt. 47° 21' N, 19° 41' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97165/C), 12.X.1997. — TOLNA COUNTY: Szekszárdi-dombság. Loess cliffs on the summit of Bali-hegy, at vineyards or roadside, at

220 m alt. 46° 20.6' N, 18° 37' E. Coll.: S. Pócs, T. Pócs & B. O. van Zanten (97213/B), 27.X.1997.

Értékelés

Pócs Tamás és munkatársai gyűjtései nyomán (520 példány) a magyarországi lelőhelyek száma a korábbi 30-ról 85-re (1. ábra), a löszlakó zuzmófajok száma a korábbi 48-ról 65-re emelkedett. Ez a 65 faj a nyílt, laza homoktalajok jellegzetes fajaitól (*Cladonia symphycarpa, Fulgensia fulgens, Psora decipiens, Toninia physaroides, T. sedifolia*) a tipikusan talajlakó fajokon (*Cladonia* spp., *Collema* spp., *Endocarpon pusillum, Solorinella asteriscus*) át a jellemzően csak kőzetlakó fajokig (*Caloplaca decipiens, Lecania turicensis, Lecanora albescens, L. muralis, Polysporina simplex, Protoblastenia incrustans, P. rupestris, Sarcogyne regularis*) a fajok széles skáláját öleli fel, amely jól tükrözi a szubsztrátumként szolgáló lösztalaj különböző kötöttséggel jellemezhető fajtáit (homokos, vályogos, agyagos, homokkővé cementálódott lösz). A zuzmófajok között kizárólag csak löszön élő, tipikusan löszlakó faj nincs, a felsorolt talaj- (kőzet-) lakó fajok más szubsztrátumokon is előfordulnak. Növényi korhadékon, mohán él a *Caloplaca holocarpa, Candelariella vitellina, Micarea prasina, Myxobilimbia sabuletorum, Placynthiella icmalea, Rinodina exigua, Xanthoria parietina.* GALLÉ (1964) négy, jellegzetesen epifiton zuzmófajt is felsorol az Endocarpetum pusilli típusfelvételében (*Caloplaca ferruginea, C. flavorubescens, Candelariella deflexa, C. subdeflexa*). Ezek előfordulása lösztalajon kétségeket támaszt, így az eredeti példányok revíziója elkerülhetetlen.

A talaj- (kőzet-) lakó fajok közül, a *Protoblastenia rupestris*-t kivéve (amely jellemzően árnyas mészkőfalakon él), természetesen az összes faj a xerotherm körülményekhez alkalmazkodott (anabiotikus állapotra való képesség, telepeik felszíni deressége (pruinózussága), fényvédő- visszaverő pigmentek stb. révén). Képesek túlélni hosszabb-rövidebb szárazabb periódusokat, fényvédő pigmentjeik révén még a kitett helyeken is képesek elviselni az erős napsugárzást. Kimondottan sivatagi-félsivatagi körülményekhez alkalmazkodott zuzmókat (pl. ablak-, manna-, szukkulens, ill. vándorzuzmók) a löszlakók közül nem sikerült kimutatni, mindazonáltal a „pikkelyes" zuzmók (*Endocarpon pusillum, Placidium rufescens, Psora decipiens*) saját élőhelyüket stabilizáló morfológiai adaptációja figyelemre méltó. Lapos, kerek telepi pikkelyeiket- lebenyeiket egy központi, 1-2 cm mélyre nyúló, szétágazó rhizinaköteg rögzíti a laza talajba. A talaj felszínét kellő sűrűségben borító, szorosan záródó telepi pikkelyek, ill. a hálózattá összefonódó rhizinakötegek igen hatékonyan kötik meg a talaj felső rétegét.

Az újabb gyűjtések zömét adó (80%), leggyakoribb fajok gyakorisági sorrendje (az 520-as összmintaszámhoz viszonyítva): *Endocarpon pusillum* (22%), *Caloplaca citrina* (10%), *Candelariella aurella* (8%), *Phaeophyscia orbicularis* (7%), *Caloplaca decipiens* (6%), *Lecanora crenulata* (6%), *Caloplaca crenulatella* (5%), *Lecanora dispersa* (5%), *Phaeophyscia nigricans* (5%), *Verrucaria muralis* (5%). Ha az *Endocarpon pusillum*-tól eltekintünk, ezek a fajok szinte kivétel nélkül előfordulnak és gyakoriak más, antropogén szubsztrátumokon (pl. palatető, betonkerítés, kőfal stb., azaz szintén mikroklimatikus félsivatagnak felfogható helyeken), különösen a kitett, madaraktól sűrűn látogatott „trágyázott" helyeken. Mivel a löszfalak szintén köztudottan kedvelt madárfészkelő (gyurgyalag, parti fecske stb.), ill. (a jó kilátás lehetősége miatt a háztetőkkel analóg) madárpihenő helyek, ezeknek a nitrofil fajoknak az előfordulása a löszfalak speciális mikroklimatikus viszonyai mellett nagy valószínűséggel a madártrágya jelenlétének is köszönhető. Úgy látszik, hogy a „löszlakó" zuzmófajok nem az aljzat minőségét (azaz lösz mivoltát), hanem a löszfalakon kialakult mikroklimatikus és szubsztrátumkémiai viszonyokat preferálják.

Kritikai megjegyzések egyes taxonokhoz

A *Caloplaca citrina* példányok között keverten fordultak elő olyanok, amelyeknél vagy a felszín volt teljesen szorédiumos (ez a tipikus forma), vagy a szorédiumok apró, sima felszínű pikkelyek szegélyén helyezkedtek el. Az utóbbit újabban *Caloplaca flavocitrina* néven (korábban a *C. citrina* változataként értékelt taxon) is megkülönböztetik.

A *Caloplaca crenulatella* sárga teleppel és keskeny válaszfalú (max. 2,5 μm) spórákkal jellemezhető faj. Magyarországról korábban nem ismerték (Verseghy 1994), de újabban egyre több helyről mutatták ki. Ennek az lehet az egyik oka, hogy csak az újabb határozókönyvek tárgyalják, így a korábbi kulcsok alapján könnyen félrehatározható volt (pl. a hasonló spóratulajdonságokkal rendelkező *C. lactea*-ként).

A *Candelariella aurella* példányok között háromféle teleptípust lehetett megfigyelni: a) sárga színű nagy telepi szemölcsökkel („göbös"); b) fehéres, halványsárgás lapos telepi pikkelyekkel, ill. c) látható telep nélküli példányok. Nyolcspórás aszkuszuk alapján a három teleptípust a *C. aurella* fajon belüli változatosságának tulajdonítottuk. Egy példánynak apró, sugarasan redőzött, „minirozettás" telepei voltak (*C. medians* kizárva), amit egyik kulcs sem említ, és más, növénytári példányon sem látható sehol. Ez utóbbi faj pontosabb taxonómiai behatárolásához az eredeti lelőhelyen folytatott további vizsgálat szükséges.

Az *Endocarpon pusillum* is nagyon változatos megjelenéssel fordult elő a mintákban az apró, sötétbarna (nedvesen sötétzöldre váltó) színű pikkelyektől a halványbarna, szürkés (nedvesítésre nem változó színű), nagyobb, ráncosan felemelkedő, vagy a talajra simuló formákkal, több esetben apró sötétbarnás-feketés színű „szorédiumokkal" szegélyezve, vagy néhány esetben repedezett, vastag, nekrotikus réteggel a felszínen. A „rhizinák" a világostól a sötétig változó színűek voltak és a telepi pikkelyek fonáka is vegyesen hol világos, hol sötét színű volt. A peritécium szájadéka vagy fekete volt, vagy egy fehéres, pruinózus bevonat miatt világos színű. Ettől függetlenül ezeket az *E. pusillum* különböző fejlődési formáinak vagy „morfotípusainak" értékelhetjük. Az *E. pusillum* faji rangra emelt korábbi változatait (*E. glomeruliferum, E. pallidum, E. sorediatum*) nem sikerült egyértelműen kimutatni. Egy esetben fordult elő tipikus *E. adscendensre* (a korábbi *E. pallidum*) utaló telepszerkezet (tetőzsindely-szerűen egymásra boruló felálló szélű apró pikkelykék). Az *E. pusillum* termőhelyi és társulási viszonyaival, ill. hazai elterjedésével (VERSEGHY 1974) foglalkozott. Ebben a munkájában nagyon ritkának, flóraművében (VERSEGHY 1994) ritkának ítélte e fajt. Az utóbbi évek gyűjtéseiből előkerült nagyszámú *E. pusillum* példány alapján e faj újabban meglehetősen gyakorinak mutatkozik.

Szintén problematikus a *Lecanora dispersa* komplex értelmezése. A korábbi, talajon élő, deres apotéciumú *L. hagenii* változatokat (var. *terrigena*, var. *argillicola* stb.) ma a *L. umbrina* alá sorolják, a *L. umbriná*-t pedig az angolok és a németek is a *L. dispersa* alá vonják. Ezek alapján a nem repedezett apotécium karimájú példányokra (akár deres volt az apotécium felszíne, akár nem) a *L. dispersa* nevet alkalmaztuk. A repedezett karimájú fajnak (*L. crenulata*) az elkülönítése a nem tipikus példányoknál ingadozhat.

SUZA (1935) munkája nyomán a *Solorinella asteriscus*-t sokáig a középeurópai lösztalajok tipikus zuzmójának tartották. A magyarországi példányokról azonban kiderült, hogy nem típusos löszről gyűjtötték őket. Boros Ádám rendszeresen és hosszú ideig kutatott e faj után különféle löszterületeken, míg a kőpite-hegyi lelőhelyre rábukkant, ahol a *S. asteriscus* szintén nem típusos löszön, hanem mészkőmálladékkal kevert talajon nőtt (BOROS 1942). A faj ökológiai viszonyaival, hazai, ill. európai elterjedésével VERSEGHY (1974), ill. FARKAS és LŐKÖS (1994) foglalkoztak. Több ismert lelőhelyének ismételt felkeresése is eredménytelennek bizonyult, így sokáig kihaltnak véltük (VERSEGHY 1994, LŐKÖS és TÓTH 1997). Pócs Tamásnak és munkatársainak az intenzív löszkutatás méltó eredményeként sikerült újra felfedezni Magyarországon a *S. asteriscus*-t egy új lelőhelyen (PÓCS 1999).

A hazai löszlakó zuzmók további kutatóinak ajánljuk figyelmébe Gallé László sorait (GALLÉ 1964): *„A lösztalajok virágtalan növényei, a löszfalak zuzmó-moha társulásai minden időben a kutatók fokozott érdeklődését vál-*

tották ki. A lösz virágos növényeinek vizsgálata után hazánkban is sor került a löszkedvelő zuzmó- és mohafajok florisztikai kutatására".

Köszönetnyilvánítás

Munkánkat az OTKA T022575 és T030209 számú pályázatai támogatták. Külön köszönet illeti dr. Farkas Editet (Vácrátót) a kézirathoz fűzött hasznos tanácsaiért, ill. a *Toninia physaroides* példányok revíziójáért.

Irodalomjegyzék

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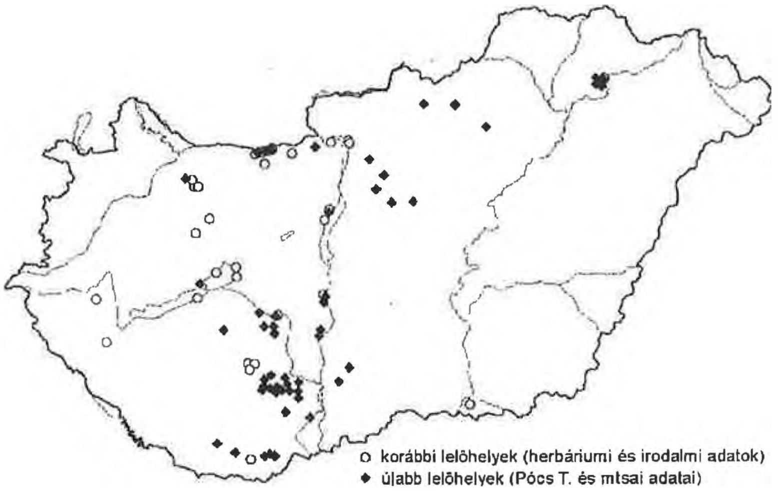

1. ábra

A löszlakó zuzmók lelőhelyeinek elhelyezkedése Magyarországon

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Threat Status of Some Protected Bryophytes in Hungary

Papp, B.[1], Ódor, P.[2], Szurdoki, E.[1]
[1] Department of Botany, Hungarian Natural History Musem
Budapest, Pf.: 222, H-1476, Hungary
`pappbea@bot.nhmus.hu`, `szurdoki@bot.nhmus.hu`

[2] Department of Plant Taxonomy and Ecology, L. Eötvös University
Budapest, Pázmány P. sétány 1/c, 1117, Hungary
`odor@ramet.elte.hu`

Abstract. In this paper estimation of threat status in Hungary is given for five bryophyte species (*Buxbaumia viridis, Dicranum viride, Frullania inflata, Lophozia ascendens, Pyramidula tetragona*). All of these species should be placed into the critically endangered (CR) new IUCN category. In most cases decline can be detected. The number of the localities of three species has decreased. The area of occupancy is usually very restricted. But the most severe threat is the very small size of the populations, subpopulations. This latter criterion has crucial importance in the estimation of threat status of these species in Hungary.

Keywords: threat status, bryophytes, Hungary

Introduction

Recently 80 bryophyte species are legally protected in Hungary. Most of them (50 species) are included in the Red Data Book of European Bryophytes (RDB) (ECCB 1995), and the others are locally rare species living in endangered mires and wet meadows. The Hungarian legally protected bryophyte species are enumerated in the Appendix of PAPP et al. (2002). Intensive bryological investigations are going on concerning the distribution of these rare species, changes of their populations and estimate their threat status according to new IUCN categories (IUCN 1994). Guidelines for application of new IUCN threat categories to bryophytes were given by HALLINGBÄCK et al. (1998).

This paper deals with five bryophyte species (*Buxbaumia viridis, Dicranum viride, Frullania inflata, Lophozia ascendens, Pyramidula tetragona*), whose investigation almost has finished in Hungary and our knowledge about them is enough to the estimation of their threat status. Similar paper was published by HALLINGBÄCK (1998) about the evaluation of threat categories for rare Swedish bryophytes. A case study for estimating population size and threat status of *Fissidens arnoldii* in Hungary was given in Papp et al. (2000).

Methods

To obtain the earlier distribution data of the investigated species the Bryophyte Herbarium of the Hungarian Natural History Museum, Budapest (BP) and Eger Teacher's College (EGR) were consulted. The retrieval was mainly based on locality description of herbarium specimens and the diaries of Ádám Boros and László Vajda about their field trips (Boros 1915–1971, Vajda 1933–1978) as well as published records (BOROS 1968, ORBÁN and VAJDA 1983).

The earlier found localities were visited (in the case of unsuccessful confirmations two or three times). If the bryophyte was found on the locality, the size of its population was estimated and its potential habitats in other localities were also investigated. In the case of unsuccessful confirmation habitat conditions of the site were investigated in order to see if we may expect finding it again, or if the site has changed so dramatically (or even had been destroyed) that we can not regard the site as the potential habitat of the species any more.

To estimate the threat status according to the new IUCN categories (IUCN 1994) the following criteria should be taken into consideration (HALLINGBÄCK et al. 1998):

Criteria

(A) Large decline

Major population decline observed, estimated, inferred or suspected in the last 10 years or 3 generations, whichever is the longer, based on:

80% or more = CR (Critically Endangered)
50% or more = EN (Endangered)
20% or more = VU (Vulnerable)

(B) Restricted area of occupancy, few localities

Recently recorded within only one 10 km × 10 km square and found in only one locality or the populations are severely fragmented. It means small subpopulations that are all more or less isolated = CR.

Recently recorded in five or fewer 10 km × 10 km squares and found in two to five localities or the populations are severely fragmented = EN.

Recently recorded in ten or fewer 10 km × 10 km squares and found in ten or fewer localities or the populations are severely fragmented = VU.

(C) Small population and decline
Small population:
fewer than 250 mature individuals = CR
fewer than 2,500 mature individuals = EN
fewer than 10,000 mature individuals = VU
together with either
(C1) Large decline:
at least 25% in 3 y. or 1 generation = CR
at least 20% in 5 y. or 2 generations = EN
at least 10% in 10 y. or 3 generations = VU
or

(C2) Continuing decline and restricted only a single population or continuing decline and small subpopulations:
no subpopulation estimated to contain more than 50 mature individuals = CR
no subpopulation estimated to contain more than 250 mature individuals = EN
no subpopulation estimated to contain more than 1000 mature individuals = VU

(D) Very small or restricted populations
Fewer than 50 mature individuals = CR
Fewer than 250 mature individuals = EN
Fewer than 1000 mature individuals (sub-criterion D1) or an area of occupancy less than five 5 km × 5 km squares or 4 or fewer localities (sub-criterion D2) = VU

In the course of the evaluation of the threat status, the species should be categorized as far as possible according to all criteria and at last the highest IUCN category has to be taken into consideration.

Results

Buxbaumia viridis (Moug. ex Lam. et DC.) Brid. ex Moug. et Nestl. is a boreal, montane moss. In Hungary, it has only one record from decaying wood, (which is its main substrate in Western and North Europe, (ECCB 1995)) and in the other localities it was found on acidic soils in humid forests (Papp et al. 2002). It is included in the Bern Convention (The Convention on Conservation of European Wildlife and Natural Habitats, 1979), and in the European Community Directive on the Conservation of Natural Habitats and Wild Fauna and Flora, 1992. It is vulnerable according to the Red Data Book of European Bryophytes (ECCB 1995). It has 7 earlier records from Hungary (PAPP et al. 2000). The identification of the species is proved to be not easy (PAPP et al. 2002). As a result of the revision of the specimens deposited in the Herbarium of the Hungarian Natural History Museum (BP) two earlier localities can be excluded and other two are doubtful data (see below).

Old occurrence confirmed: Borsod-Abaúj-Zemplén County, Bükk Mts. Nagyvisnyó, in valley Leány-völgy at Hollókő rocks, on decaying beech log, 720 m a.s.l., 01.10.1999, leg. and det. Ódor, P., Papp, B., Szurdoki, E. Earlier data from here: 07.08.1953, leg. and det. Boros, Á. The size of the population was very small. In total 14 sporophytes were counted in 1999 on three logs in a very advanced stage of decay. In 2000 only one tree was already colonized by the species. In 2001 and 2002 the species was not found. For the estimation of population size the colonized trees can be counted as individuals because the destruction of the substrate will affect all plants growing on it. The biggest population size detected in last years is 3.

Former locations checked without success: Borsod-Abaúj-Zemplén County, Zemplén Mts, Nagy-Hemzső hill at Telkibánya, 19.06.1960. leg. and det. Vajda, L. It was collected from soil in a *Quercetum.*

Veszprém County, Viszló forest at Tapolca, 02.05.1959. leg. and det. Vajda, L. It was found on soil in a *Quercetum.*

Earlier specimens with juvenile sporophytes, the data are doubtful, localities are recently checked without success: Nógrád County, Börzsöny Mts, Bacsina-valley at Királyháza, under the hill Rakottyás-bérc, from soil, 08.05.1959. leg. and det. Vajda, L.

Budapest, Buda Mts, Hárs hill at Hűvösvölgy (Budapest), from soil along the footpath, 10.02.1957. leg. and det. Vajda, L.

Excluded earlier localities, specimens turned out to be Buxbaumia aphylla: Baranya County, Mecsek Mts, Éger-valley at Magyarürög (Pécs), 27.06.1952. leg. and det. Vajda, L.

Heves County, Mátra Mts, Hársas-tető hill above the stream valley of Köszörű-patak at Parád, 01.10.1956. leg. and det. Boros, Á.

(A) The presence of the species was confirmed only in one locality in Hungary. According to the old specimens it has 5 earlier localities. The decline is about 80%.

(B) It has been recorded recently from one 10 km × 10 km square.

(C) and (D) The population size is smaller than 50 individuals.

Conclusion: It corresponds to the critically endangered (CR) category according to all Criteria (A, B, C, D) of IUCN.

Dicranum viride (Sull. et Lesq.) Lindb. is a subcontinental, montane moss. It occurs on tree trunks in humid forests, mainly on the lower part of the trees. It is included in the Bern Convention (The Convention on Conservation of European Wildlife and Natural Habitats, 1979), and in the European Community Directive on the Conservation of Natural Habitats and Wild Fauna and Flora, 1992. It is vulnerable according to the Red Data Book of European Bryophytes (ECCB 1995). Some of the new occurrences in Hungary had been published earlier (ERZBERGER 1999).

New occurrences: Borsod-Abaúj-Zemplén County, Bükk Mts, Őserdő (Old Forest), Répáshuta, on *Fagus* trees, ca 860 m a.s.l., 12.08.2001. leg. and det. Papp, B., Erzberger, P.

In this forest the close relative of *Dicranum viride, D. tauricum* also lives. It is difficult to distinguish them in the field (PAPP et al. 2002). *Dicranum viride* like patches were detected on 37 *Fagus* trees. On the basis of the identification of the samples *Dicranum viride* were found on 26 trees, while *D. tauricum* was collected from 11 trees. 2 trees were colonized by both species. The population size is equivalent to the number of trees colonized as destruction of the phorophyte will affect all plants growing on it. Therefore, counting the individual bryophyte plants or cushions on each tree would lead to an over-estimation of population size and to an under-estimation of threat. Hence the population size of *Dicranum viride* is 26.

Borsod-Abaúj-Zemplén County, Bükk Mts, Ódor-vár hill in Hór-valley, Cserépfalu, *Quercetum* on the southern slope, on *Quercus cerris*, ca 350 m a.s.l., 06.08.1998. leg. de Bruyn, U., Erzberger, P. det. Erzberger, P. The species was collected from one tree.

Heves County, Bükk Mts, Várhegy hill, Felsőtárkány, *Quercetum*, on siliceous rock, ca 600 m a.s.l., 08.08.1998. leg. Siemsen, M., Erzberger, P., det. Erzberger, P. The species was found on one rock.

Borsod-Abaúj-Zemplén County, Bükk Mts, Szárba-oldal hill in Hór-valley, Cserépfalu, *Quercetum*, on *Quercus* tree, ca 450 m a.s.l., 09.08.1998. leg. Klawitter, J., Erzberger, P., det. Erzberger, P. and 06.11.2001. leg. and det. Papp, B. The species was found on several trees. But the population size certainly does not reach 50.

Old occurences confirmed: Borsod-Abaúj-Zemplén County, Bükk Mts, Füzérkő in Hór-valley, Cserépfalu, on the southern and eastern slope of the hill, on deciduous trees and on decaying wood, (N 47°59,993′, E 20°31,226′), ca 340 m a.s.l., 28.09.2001. leg. Papp, B., Szurdoki, E., det. Papp, B. Earlier data: 30.03.1959. leg. and det. Boros, Á. The species was detected on 9 *Quercus*, 4 *Carpinus*, 2 *Fagus*, 1 *Tilia*, 1 *Crataegus* trees and 2 decaying wood. The size of this population is 19.

Borsod-Abaúj-Zemplén County, Zemplén Mts, Vadásztető hill, Pálháza, on *Fagus* tree, ca 450 m a.s.l., 19.06.2000. leg. and det. Papp, B. Earlier data: 01.08.1953. leg. and det. Vajda, L. The species was collected from one tree.

Borsod-Abaúj-Zemplén County, Zemplén Mts, Vajda-valley, Pálháza, on andesite rock, ca 300 m a.s.l., 19.06.2000. leg. and det. Papp, B. Earlier data: 06.10.1953. leg. and det. Boros, Á., Vajda, L. One small patch of the species was found on an andesite rock. Around the beech forest was cut down. There is no suitable substrate for the species. This population is very endangered, almost died out.

Borsod-Abaúj-Zemplén County, Zemplén Mts, Piszkéstető hill, Hollóháza, on *Fagus* tree, (N 48°31, 222′, E 21°25, 058′) ca 500 m a.s.l., 27.09.2001. leg. Papp, B., Szurdoki, E., det. Papp, B. Earlier data: 30.02.1954. leg. and det. Vajda, L. The species was collected from one tree.

Szabolcs-Szatmár-Bereg County, Nyírség region, Bátorliget, *Betula* trees in meadow, ca 120 m a.s.l., 08.09.2000. leg. Papp, B., Szurdoki, E., det. Papp, B. Earlier data: 04.11.1989. leg. Barabás, K., Tóth, Z. det. Tóth, Z., Orbán, S. and 30.06.1996. leg. and det. Jakab, G. Several trees are colonized by *Dicranum viride* like species. *D. tauricum* also occurs on the territory, hence the estimation of population size is difficult. But the population size certainly does not reach 50.

Zala County, Göcsej region, in the Vétyem Forest Reserve, Tormaföld, on decaying wood, ca 200 m a.s.l., 24.06.2001. leg. Papp, B., Szurdoki, E., det. Papp, B. Earlier data: 12.07.1955. leg. and det. Boros, Á. One decaying beech tree of large size was colonized by the species near a small stream. The species cover 60 cm^2 on the tree. The population size 1.

Former locations checked without success: Borsod-Abaúj-Zemplén County, Aggteleki-karszt Mts, Vecsembükki-zsomboly, Bódvaszilas, 02.11.1937. leg. and det. Boros, Á.

Borsod-Abaúj-Zemplén County, Bükk Mts, Szent István kilátó hill, Lillafüred, 25.06.1932. leg. and det. Boros, Á.

Borsod-Abaúj-Zemplén County, Bükk Mts, Savós-valley, Hámor, 03.08.1922. leg. and det. Boros, Á.

Borsod-Abaúj-Zemplén County, Bükk Mts, at Létrás cave, Jávorkút, 19.09.1968. leg. and det. Boros, Á.

Borsod-Abaúj-Zemplén County, Bükk Mts, Magoskő hill, Ómassa, 16.05.1951. leg. and det. Boros, Á.

Borsod, Abaúj-Zemplén County, Bükk Mts, Tarkő hill, Szilvásvárad, 06.10.1951. leg. and det. Boros, Á., Vajda, L.

Borsod-Abaúj-Zemplén County, Zemplén Mts, Szárazkút valley at Kökapu rocks, Pálháza, 25.05.1947. leg. and det. Vajda, L., 29.06.1969. leg. and det. Boros, Á.

Veszprém County, Bakony Mts, Sombereki-séd valley, Ugod, 17.05.1954. leg. and det. Boros, Á., Vajda, L.

Usually the forests have changed on these localities, became drier, the stands are influenced by intensive forestry activity, contain individuals in the same age and only a few old trees have remained, the forest parts are fragmented by clearcut and young regeneration of trees.

(A) The species was confirmed in 6 earlier locality, it has 4 new records and on 8 earlier localities the search was unsuccesful. The decline is about 30% if take into consideration the 14 earlier and the recently known 10 localities, but it supposed that the decline occurred more than 10 years ago. It corresponds to the VU category.

(B) The recently existing 10 populations can be found in 7 10 km × 10 km squares. It corresponds to the VU category.

(C) The population size does not exceed 250 mature individuals. The subpopulations are usually very small, not more than 50 mature individuals. It corresponds to the CR category.

(D) The number of individuals does not exceed 50 in any locality. This also corresponds to the CR category.

Conclusion: Since always the highest IUCN category has to be taken into consideration we can conclude that *Dicranum viride* is a critically endangered (CR) species in Hungary.

Frullania inflata Gottsche var. *inflata* is a thermophilic, submediterranean, montane liverwort. It lives on siliceous rocks (granite, basalt, gneiss). The species is very rare throughout its range in Europe. It is known from 6 European countries only (SÖDERSTRÖM et al. 2002). It is vulnerable in Europe according to the Red Data Book of European Bryophytes (ECCB 1995).

Old occurrence confirmed: Zala County, Balaton-felvidék region, Mt Tátika, Zalaszántó, Tinóállás rocks at the southern slope of the hill, on shaded basalt rocks, ca 350 m a.s.l., 30.03.2002. leg. and det. Papp, B., Erzberger, P. Earlier data from here: 03.06.1955, leg. and det. Vajda, L., 30.04.1956, leg. and det. Boros, Á., Vajda, L. Three patches of 3 cm^2 × 3 cm^2 were found on two rocks. For the estimation of population size the small patches can be treated as individuals, hence the population size is 3.

New occurrence: Heves County, Bükk Mts, Szarvaskő, 10 km NNW of Eger, Vár-hegy, southern slope of the hill, on partly shaded volcanic bedrock (diabas), (UTM DU 51), ca. 250 m a.s.l., 23.04.1998. leg. Pócs, T.

and Erzberger, P., det. Pócs, T. Several (not more than 10) small patches (a few cm^2 each) were found. The population size is not more than 10.

(A) Decline is not detectable.

(B) It has been recorded recently from two 10 km × 10 km squares. It corresponds to the EN category.

(C) and (D) The population size is smaller than 50 individuals and the populations are severely fragmented as the two localities are very far from each other. It corresponds to the CR category.

Conclusion: Frullania inflata is considered as critically endangered (CR) species in Hungary.

Lophozia ascendens (Warnst.) Schust. is a boreal, montane liverwort, it lives on well-decayed logs (obligate epixylic species). It is a rare species according to the Red Data Book of European Bryophytes (ECCB 1995).

New occurrences: Heves County, Mátra Mts, Mátraháza, N slope of the Kékes hill in the Kékes North Forest Reserve, on decaying logs, ca 900 m a.s.l., 20.06.1999, leg. and det. Ódor, P. It occurs on 4 well-decayed logs, the size of the patch inhabited by the population is ca 1 m^2. As in the case of *Buxbaumia viridis* the colonized trees can be counted as individuals. The population size is 4.

Heves County, Bükk Mts, Nagyvisnyó, in valley Leány-völgy at Hollókő rocks, on decaying beech log, 720 m a.s.l., 17.11.1999, leg. Ódor P., Papp B. det. Ódor P. (Papp et al. 2000). It occurs in a well-decayed log, the size of the patch inhabited by the population is ca 100 cm^2. The population size is 1.

Localities checked without success: Borsod-Abaúj-Zemplén County, Bükk Mts, Jávorkút, on decaying log in a planted old spruce forest, 27.08.1959, leg. and det. Vajda, L. The forest was cut, the habitat is completely destroyed.

Borsod-Abaúj-Zemplén County, Zemplén Mts, on decaying log near the stream in valley Határ-völgy at Kőkapu near Pálháza, 24.06.1953, leg. and det. Vajda, L. Around the valley big parts of the forests were cut, the habitat became drier and there are only a few decaying logs.

(A) The species has disappeared from Zemplén Mts, but it was discovered in Mátra Mts. An earlier location has been destroyed in Bükk Mts, but it was found in a new location in the mountain. Decline is not detectable.

(B) It has been recorded recently from two 10 km × 10 km squares. It corresponds to the EN category.

(C) and (D) The population size is very small, only a few individuals and the populations are severely fragmented, located in different mountains. It corresponds to the CR category.

Conclusion: Lophozia ascendens can be regarded as critically endangered (CR category) species in Hungary.

Pyramidula tetragona (Brid.) Brid. is a submediterranean, subatlantic species. It is a short lived moss occurring in open grasslands mainly in spring and autumn. It is included in the Bern Convention (The Convention on Conservation of European Wildlife and Natural Habitats, 1979), and in the European Community Directive on the Conservation of Natural Habitats and Wild Fauna and Flora, 1992. It is vulnerable according to the Red Data Book of European Bryophytes (ECCB 1995). It was known from 8 localities in Hungary (PAPP et al. 2000). Usually it grows in patches of 1–2 cm diameter. Frequently several patches can be found close to each other within a 1 m^2 square. In extended grasslands, as e.g. in Szent György hill, 5–10 m away from such a square, other groups of 2–5 patches can often be found. As the life strategy of this species is annual shuttle (AS), it appears in spring, produces spores very quickly, then it dies in the dry season and in autumn it may appear again. The size of the population could be very variable in different years, because the presence of the species is strongly connected with the weather conditions as e.g. the time and quantity of rains (PAPP et al. 2002). To estimate the population size, patches of 1–2 cm diameter, which are dense turf of shoots probably growing from the same prothallium, can be regarded as individuals.

Old occurrences confirmed: Zala County, Balaton-felvidék, Mt Tátika at Zalaszántó. On soil in open basalt grassland facing NW, ca 300 m a.s.l., 22.04.1999, leg. and det. Papp, B., Ódor, P. Earlier data from here: 03.05.1954. leg. and det. Boros, Á.

Zala County, Balaton-felvidék, Mt Gulács at Nemesgulács. On soil in open, SE facing basalt grassland, ca 360 m a.s.l., 29.04.2000, leg. and det. Erzberger, P., Papp, B., Ódor, P. Earlier data: 02.05.1955, leg. and det. Boros, Á.

New occurrence: Zala County, Balaton-felvidék, Szent György hill, on soil of SE facing open basalt grassland, ca 350 m a.s.l., 13.08.1999. leg. Papp, B., Lőkös, L., Bérces, S. det. Papp, B.

The population sizes in the three localities are summarized in Table 1.

	1999	2000	2001	2002	2003
Mt Tátika	7	4	0	0	0
Szent György hill	8	29	35	13	9
Mt Gulács		10	1	0	0

Table 1. Population size of *Pyramidula tetragona* in the recently known localities in different years. Individuals are equivalent with patches of ca 1 cm^2; dense turf of shoots probably growing from the same prothallium.

Former locations checked without success: Budapest county, Buda Mts, Vihar-hill, Budapest, 24.02.1921. leg. and det. Győrffy, I. Limestone open grassland.

Borsod-Abaúj-Zemplén County, Zemplén Mts, Vajda-valley at Pálháza, 06.10.1953. leg. and det. Boros, Á. On the edge of the forest in a ditch.

Borsod-Abaúj-Zemplén County, Zemplén Mts, Nagy-Milic hill at Füzér, 03.10.1953. leg. and det. Boros, Á., Vajda, L. On the edge of the forest on a stubble field.

Heves County, Mátra Mts, Remete-bérc hill at Mátraháza, 31.10.1931. and 27.04.1961. leg. and det. Boros, Á.

Completely destroyed habitats: Borsod-Abaúj-Zemplén County, Zemplén Mts, Kopasz-hill at Tállya, 27.05.1952. leg. and det. Vajda, L. On open grassland.

Komárom-Esztergom County, Gerecse Mts, Sárási-kő hill at Bajna, 04.04.1949. leg. and det. Boros, Á. On open limestone grassland.

Due to mining activity almost all of the hill slopes with open grasslands are lacking.

(A) The species has two old confirmed and one new localities from some basalt hills close to each other in the same region of Hungary. In 6 earlier known localities the search was unsuccessful. The decline is about 60%, probably occurred more than 10 years ago. But it corresponds to the EN category.

(B) The species has three localities in two 10 km × 10 km squares, which also corresponds to the EN category.

(C) The population size is not more than 250 mature individuals and there is no subpopulation, which contains more than 50 individuals.

(D) The populations are very small, does not exceed 50 mature individuals even in the case of the biggest population (Szent György hill) in the most favourable years (2000, 2001). The threat status of the species is CR category on the basis of the two latter criteria.

Conclusion: Pyramidula tetragona should be placed to the CR category in Hungary.

Conclusions

All the five investigated species should be placed into the critically endangered (CR) new IUCN category. In most cases decline can be detected. The number of the localities of three species has decreased. The area of occupancy is usually very restricted. But the most severe threat is the very small size of the populations, subpopulations. This latter criterion has crucial importance in the estimation of threat status of these species in Hungary.

Acknowledgement.

The study was supported by the Hungarian Scientific Research Fund (OTKA T 034664) and by the Environmental Ministry in the frame of the National Biodiversity monitoring System.

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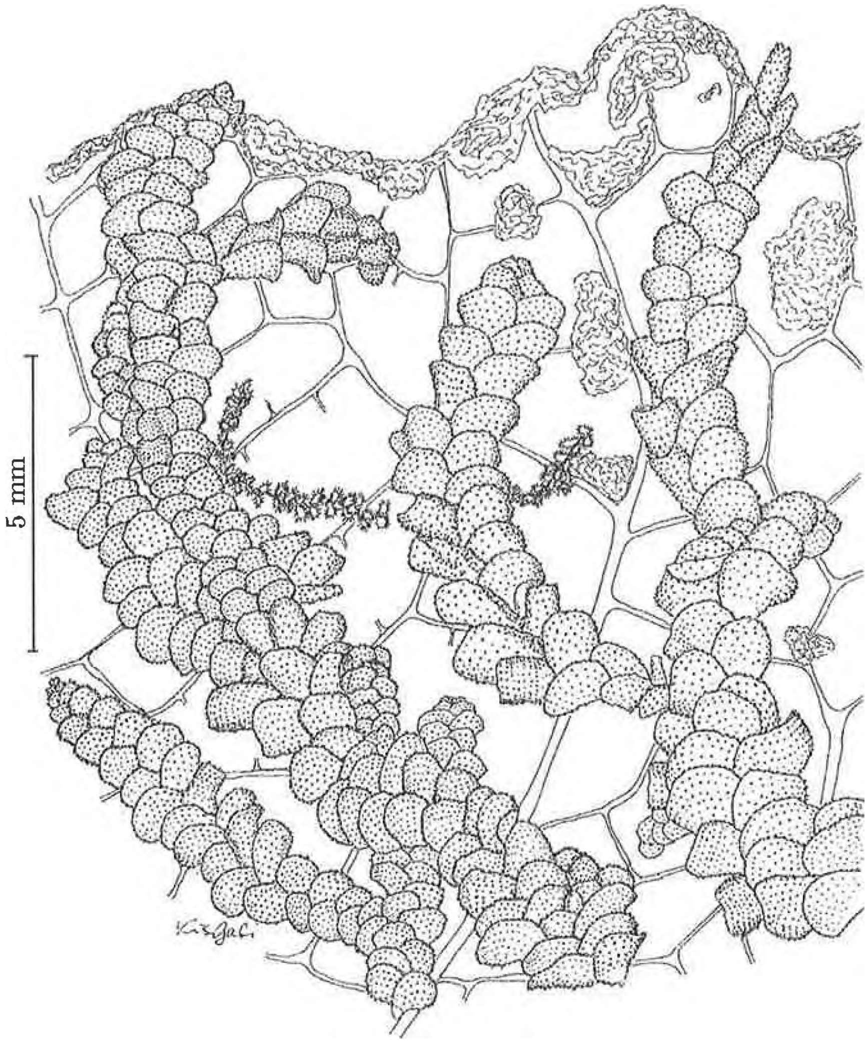

Papillolejeunea **Pócs**, 1997. Tropical Bryology 13: 2.
Papillolejeunea balázsii **Pócs**, 1997. Tropical Bryology 13: 3.
HOLOTYPE: Papua New Guinea
Coll.: D. Balázs NG-14AA (EGR)

Acta Acad. Paed. Agriensis, Sectio Biologiae **XXIV** *(2003) 201–213*

The Effect of Animal Disturbance on the Spatial Pattern and Dynamics of Leucobryum juniperoideum (Brid.) C. Muell

Pénzes Kónya, E.
Botanical Department of Eszterházy College, H-3300 Eger Pf. 43.
`konya@ektf.hu`

Abstract. In forest communities on radiolarian bedrock where the shrub layer is missing and the soil surface is very narrow the bryophyte and lichen species living in the ground appear with big dominance and have great importance forming a continuous cryptogamic layer there, but the pattern of it is influenced mainly by the disturbance of wild animals. The dynamic of spatial pattern changes most directly in the cases of the dominant bryophyte species, one of which is *Leucobryum juniperoideum* in the examined area in the Bükk mountains.

Introduction

The forest communities growing on radiolarit bedrocks are special habitats for bryophyte species because the shrub layer is almost completely missing and the acidic soil and radiolarian chert bedrock provide favourable conditions for many bryophyte species.They occur with great dominance and diversity in these areas where a bryofloristic examination was carried out. (Pénzes Kónya–Orbán 2000). One of these places has got a special importance, it can be found near Felsőtárkány, on the North Western slope of Csák-Pilis mountain. This community is Deschampsio-Fagetum, where some perennial bryophyte species appear with great dominance: about 80 percent of the soil surface is covered by bryophytes (Fig.1).

The observation of the spatial pattern and the dynamics of bryophyte species has been carried out since 1999 in permanent quadrats and as it happened in the same way in other areas of the Bükk mountains, the growing disturbance of wild animals can be observed among the vascular plant species and for bryophyte species, mainly by way of treading.

This forest habitat type with thin soil layer and with little number of shrubs and the density of the animals is emerging every year, wich is a disturbance danger for plants.

Radiolarian bearing rocks are widely distributed in mountain ranges exposing geological units of oceanic affinities and radiolarites have special physical and chemical features which have been examined for about 25 years (Racki–Cordey 2000) These rocks are prone to rubbling in a similar way as dolomites and may cause the fragmentation and the entire destruction of the vegetation close to the surface.

In the examined area the number of species is low but their absolute cover value of them is high. The dominant species of the sampling area is *Leucobryum juniperoideum* (Brid.) C. Muell which has been considered as a rare species in Hungary with one floristic data (Boros 1968, Orbán–Vajda 1983), but several occurrences have been discovered recently (Pénzes Kónya 2003).

As the type of bedrock and the dominant bryophyte species are worth for further examinations, the aim of the study is to discover and detect the degradation-regeneration processes during which the spatial pattern of *Leucobryum juniperoideum* changes as a consequence of the repeated and growing disturbance.

Materials and methods

12 permanent quadrats were chosen, the size of them are 30 × 30 cm, divided into 10 × 10 cells. Four quadrats are touched with their one side, so they form sample blocks. The locality of blocks was chosen randomly.

The cover of bryophyte species was estimated in each cell using the following scale that consisted of three values. **1:** The cover of the bryophyte species is less than 30% in the cell. **2:** The cover of the bryophyte species is between 30% and 70% in one cell. **3:** The cover of the bryophyte species is above 70% in the cell.

The cover data of the bryophyte species were recorded once a year. The cover estimation values were analysed using spatial pattern analyses, the method was the Paired Quadrat Variance, PQV (Dale 1999) as the spatial pattern and spatial distribution of bryophytes are close to the two-dimensional distributions and almost all of their growing forms are patchy in space, only the scale of pattern is different. In the method we applied it is persumed that the cover variance of the neighbouring cells is less than of those that are not neighbours (Dale 1999). If there is any repeated spatial pattern in the data, the peaks of variance show the presence of patches at a given spatial scale which can be presented by diagramms. Another type of examination was directed to the anatomical-morphological response of *Leucobryum juniperoideum* to the repeated and emerging disturbance of wild animals and to examine the regeneration capacity of the species. Microscopic examinations were done and photographs were taken about them.

Results

It can be observed from the results (Fig.2 a, b, c) that the number of bryophyte species is low, but the relative percent cover of them is high, it is near 90–100% the dominant species of the area is *Leucobryum juniperoideum* and at the same time the changes of this species int he cover is the most intensive on the basis of the cover estimation in 12 quadrats in three years The other bryophyte species which occupy less space in the area have not as much changes in their cover values in the three years' period.

If we observe the spatial distribution of *Leucobryum juniperoideum* during three years (Fig.3) it can be seen from the results of PQV pattern analysis that the cushion growing form which was the tipical spatial appearance of *Leucobryum juniperoideum* in the first year (smoothly repeated peaks in variance along distance scale, Fig.4), confused for the third year, the cushions were fragmented which is manifested in the little peaks of the diagram of the third year. The disturbance of big wild animals and the extremely dry spring can be among the causes of this dynamics of the drastically changed spatial pattern of *Leucobryum juniperoideum.*

Considering the previous observations the assumption was that the absolute cover of *L. juniperoideum* slowly decreases, the big cushions are fragmented and the species is getting dangerously destroyed. But the regenerative capacity of the species provided another direction of the process of pattern dynamics.

The type of disturbance when big wild animals like deers and mouflons overturn whole cushions of *Leucobryum juniperoideum*, induces some special morphological and anatomical processes. It seems at first sight that these cushions or fragments are entirely destroyed and dead, especially the ones turned to the soil surface with their top. If we examine them after some weeks it can be observed that they are strongly connected to the ground. Fig.4 and 5 shows the bottom and the top of these turned cushions. During the further regeneration processeses on the top side which was originally on the ground surface green, new leaves are developing while at the bottom of the cushion which was originally directed to the top leaves are getting yellowish-brown and rhizoids are growing to the soil surface.

If we observe the morphological features during the regeneration processes of the turned cushions of *Leucobryum juniperoideum* on microscopical photographs (Fig.6) we can see special morphological processes during which apical rhizoids are growing from the leaf apex which are the formations of the green cells (Yamaguchi 1993) among the hyaline cells and when the cushion turns these rhizoids grow longer and thick. On the other side in the cells of old leaves protonema-like cell groups are growing and new leafy stems are formed (Fig.7). In many cases the taxa of Leucobryum form caducous leaves that function in asexual reproduction. These particular caducous leaves are defined as gemmae (Yamaguchi 1993). This type of regeneration process is getting faster in the rainy periods and it slows down in dry seasons. At this time the permanent disturbance and the rock fragmentation is very dangerous for the dominant bryophyte species, *Leucobryum juniperoideum*, because the regeneration processes are slower than the intensity of the disturbance. Considering these results and the type of the special extended habitat of *Leucobryum juniperoideum* the area is worth to treat in a special conservational way as other forest communities on radiolarian bedrock in the Bükk mountains.

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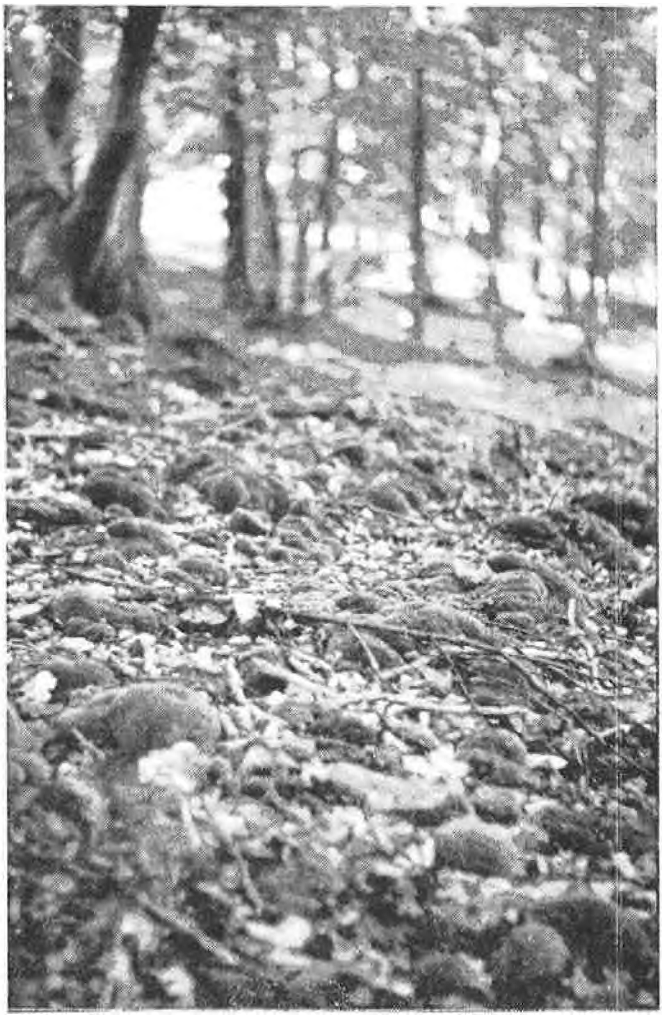
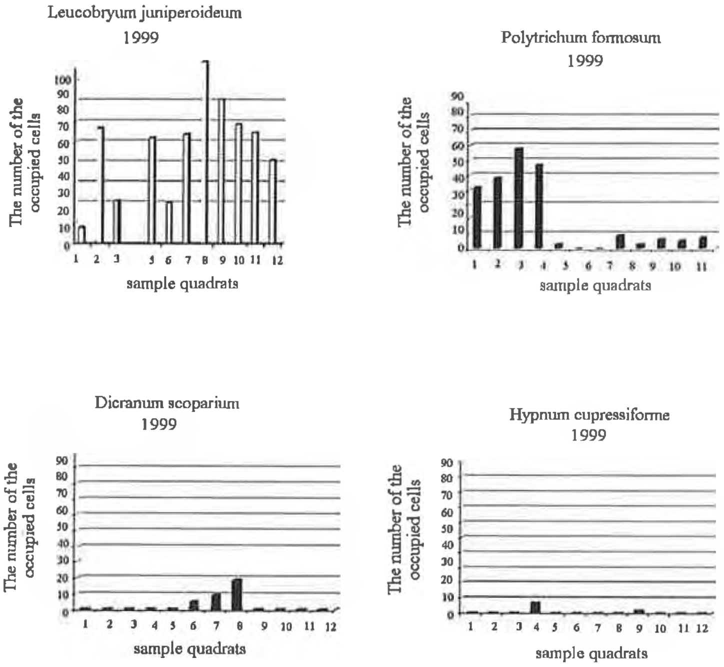


Fig.1 The community Deschampsio-Fagetum with the great dominance of *Leucobryum juniperoideum*.



Leucobryum juniperoideum 1999

Polytrichum formosum 1999

Dicranum scoparium 1999

Hypnum cupressiforme 1999

Fig.2a

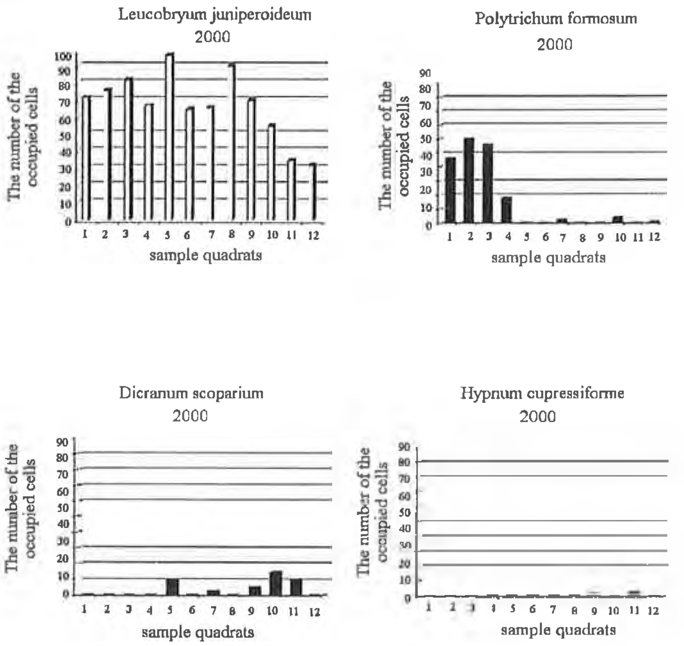

Leucobryum juniperoideum
2000
The number of the occupied cells
100
90
80
70
60
50
40
30
20
10
0
1 2 3 4 5 6 7 8 9 10 11 12
sample quadrats
Polytrichum formosum
2000
The number of the occupied cells
90
80
70
60
50
40
30
20
10
0
1 2 3 4 5 6 7 8 9 10 11 12
sample quadrats
Dicranum scoparium
2000
The number of the occupied cells
90
80
70
60
50
40
30
20
10
0
1 2 3 4 5 6 7 8 9 10 11 12
sample quadrats
Hypnum cupressiforme
2000
The number of the occupied cells
90
80
70
60
50
40
30
20
10
0
1 2 3 4 5 6 7 8 9 10 11 12
sample quadrats

Fig.2b

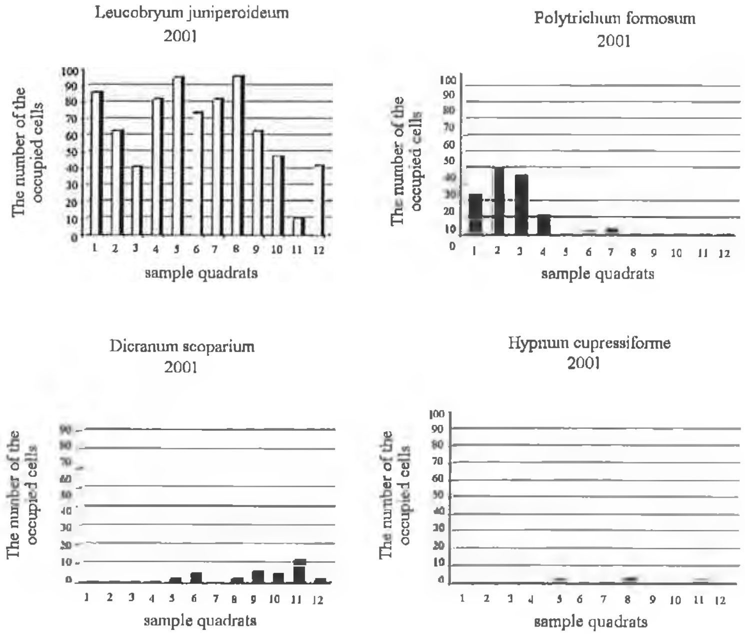


Fig.2c

Fig.2 a, b, c The results of the cover estimation of bryophyte species during three years in the permanent quadrats.

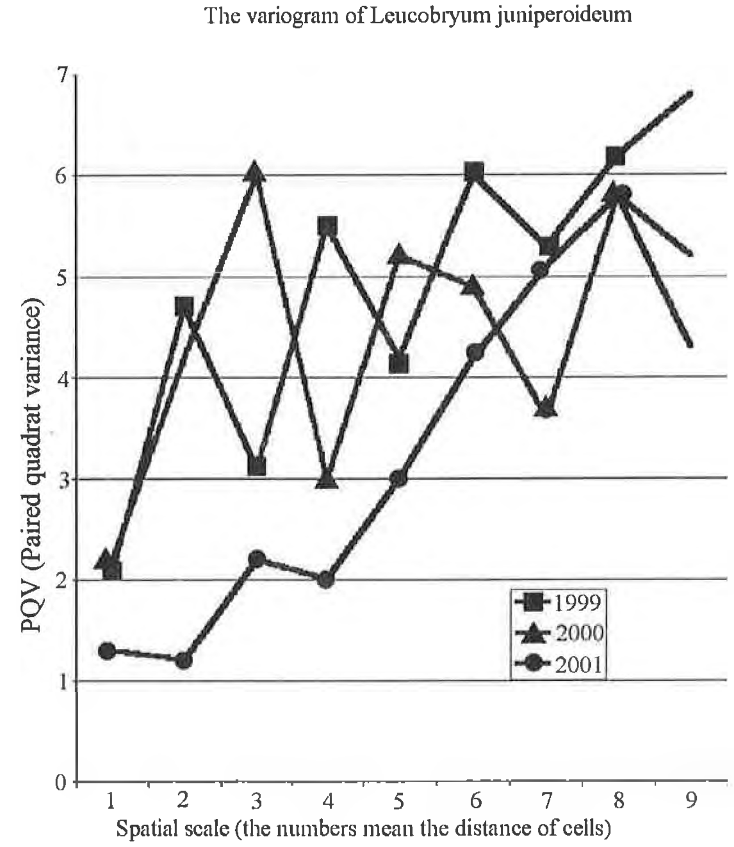


Fig.3 The result of the spatial pattern analysis (PQV) of *Leucobryum juniperoideum* in a permanent quadrat on the basis of three years.

Fig.4 The original top of the turned cushion of *Leucobryum juniperoideum* There are many rhizoids growing to the surface among the leaves in order to fix this side to the ground.

Fig.5 The original bottom of the turned cushion. New branchlets are growing up from the old, brownish leaves.

Fig.6 The rhizoids growing from the leaf apex of *L. juniperoideum*.

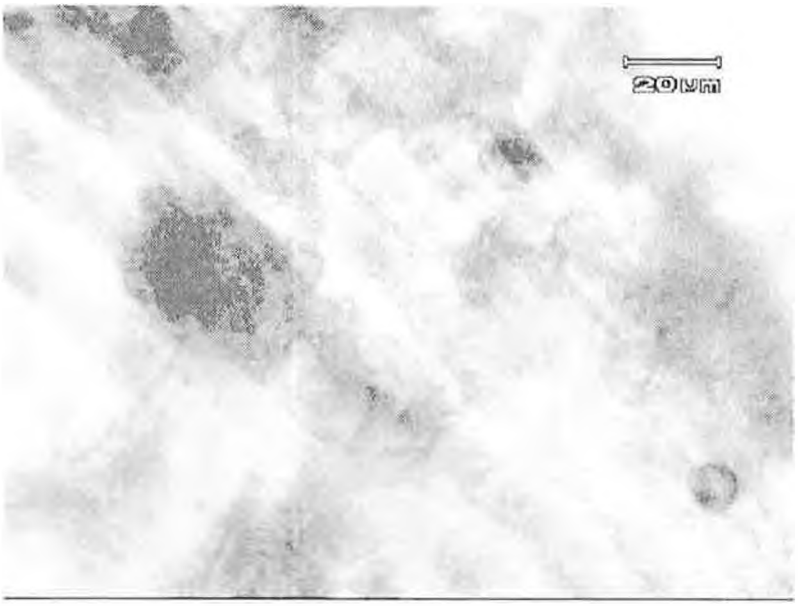


Fig.7 Protonema-like cell groups are developing in the leaf cells toward the upper side of the cushion. It can be probably the start of the development of caducous leaves.

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Photosynthetic Responses of Mastigophora diclados (Brid. ex Web.) Nees Ecotypes to Excess Light in Consequence of their Microhabitats in Reunion Island: a Fluorescence Induction Study

Molnár, I.[1], Orbán, S.[2], Pócs, T.[2], Sass-Gyarmati, A.[2], Lehoczki, E.[3] & Dulai, S.[1,4]
[1] Agricultural Research Institute of the Hungarian Academy of Sciences Martonvásár
[2] Departments of Plant Physiology and Botany, Eszterházy College H-3301 Eger, Hungary
[3] Department of Botany, University of Szeged, H-6701 Szeged, Hungary
[4] Corresponding author, `ds@ektf.hu`

Abstract. Three hours of high light treatment caused a 50% or 20% decrease in F_v/F_p in the shade and sun types of *Mastigophora diclados*, respectively. In the case of the shade type moss, the decrease in F_v/F_p was due to a decrease in F_v and an increase in the F_0 parameter indicating a pronounced inactivation of functional PS II reaction centres. This was associated with an increase in the F_i parameter. However, in the sun-type moss the F_0 parameter decreased and the F_i remained constant, suggesting that the non-radiative dissipation of excitation energy in the antenna pigment beds may play a more important role in the sun-type moss. This was associated with a higher R_{fd} parameter. At low light intensity the F_v/F_p of the sun type moss recovered completely after 1 h, while the recovery of the shade-type moss was partial (70%) even after 3 h.

Keywords: chlorophyll fluorescence, photosynthesis, photoinhibition, insular environment, light acclimation, Mastigophora diclados

Abbreviations used

Chl: chlorophyll; F_v/F_p: optimal quantum yield of photosystem II; F_v: variable fluorescence; F_0: initial level of fluorescence; F_i: intermediate level of fluorescence; F_p: plateau level of fluorescence; F_s: steady-state level of fluorescence; LHC II: light-harvesting chorophyll a/b protein complex; PS II: photosystem II; RCs: reaction centres; R_F: maximal rise in induced fluorescence; R_{fd}: fluorescence decrease ratio.

Introduction

Islands in the Pacific and Indian Ocean situated above "hot spots" have become special sites of plant evolution due to their distance from the continents. Some 80–90% of the flora on these islands consists of indigenous plants to be found nowhere else on Earth, whose conservation is of international importance for maintaining the diversity of the biosphere. In these high-rainfall areas soil erosion is very intensive. Under these circumstances, the moss flora of "moss forests" has a very significant ecological role. By storing and passing on great quantities of suddenly falling precipitation they protect the soil underneath from its erosive influence, thereby ensuring the maintenance of the conditions necessary for the settling of rare plant species. As a result of tropical windstorms or, not infrequently, human intervention, the closed tree stratum of these rain forests open up, changing the light conditions of the area. In such cases, the high light stress reactions of species in the various moss associations takes on ecological significance.

The ability of plants to adapt to the light conditions of their environment enables them to colonise different habitats, ranging from the arid, strongly lit deserts to the shady ground level of the tropical rain forests. It is well documented that the chloroplasts of shade plants living on the ground level of forests have a modified structure compared with that of sun plants. The grana of the larger shade-type chloroplasts have more thylakoid membranes, than the smaller sun-type chloroplasts (Lichtenthaler, 1981; Melis and Harvey, 1981). In addition, the quantity of light-harvesting chlorophyll a/b protein complex (LHC II) is also greater in the shade-type chloroplasts, compared to the PS II core, which is in accordance with the ratio of stacked/unstacked regions and with the greater chlorophyll a/b ratio (Simpson, 1981; Anderson et al. 1973). There is also a significant difference in the quantity of electron transport chain components. In the chloroplasts of shade plants there is less cytochrome b-559, cytochrome b-563, cytochrome f and plastoquinone relative to the quantity of chlorophyll (Boardman et al. 1972). These structural differences are also revealed in the functional differences of the thylakoid membrane: in shade plants, the PS II and PS I activity measured at saturation light intensity is lower, as is the photophosphorylation, which becomes saturated at very low light intensity. The CO_2 fixation measured at saturation light intensity also changes parallel with the functions of the electron transport chain (Boardman et al. 1972).

Under natural circumstances the light intensity is often significantly greater than is required for plant growth and the light energy absorbed by the leaves is more than the photosynthetic electron transport chain can utilise. Under these circumstances the long-lived triplet chlorophyll may generate reactive singlet oxygen, which may, among other things, cause irreversible damage to the D_1 protein (Aro et al. 1993). This may be reflected in a reduction in the quantum yield of CO_2 fixation and O_2 evolution (Powles, 1984). To avoid photooxidative damage these plants have developed several protective mechanisms, including the process known as the repair cycle of PS II (Aro et al. 1993). The protective role of zeaxanthin is also well documented (Demmig–Adams, 1990; Demmig–Adams and Adams, 1992), as is that of State I–State II transitions (Horton, 1989). At the level of water-soluble enzymes, various anti-oxidant enzyme systems may be of importance (Asada and Takahashi, 1987). In several cases, when the measure of light damage overtakes the efficiency of protective processes, photoinhibition causes a decrease in plant growth (Ögren, 1988; Ögren and Evans, 1992). The sensitivity of plants to photoinhibition at a given light intensity level greatly depends on genetic adaptation, the actual physiological conditions, and sun-shade acclimation. In addition, photoinhibition, as a physiological symptom, is also greatly dependent on other environmental factors. Photoinhibition is stronger when high light intensity is combined with other stress factors such as low or high temperature, lack of CO_2, or UV-b stress.

This paper investigates the reactions to intensive light stress of the shade and sun type species of *Mastigophora diclados*, a moss species which occurs in habitats with significantly different light conditions in Reunion Island part of the Mascarine Archipelago.

Materials and Methods

Plant Materials

The photosynthetic responses to excess light of the sun and shade types of *Mastigophora diclados* (Brid. ex Web) Nees were studied in a mountainous tropical rain forest. The sun and shade types of *M. diclados* to be investigated were selected from an *Acacia heterophylla*-dominated rain forest on the Belouve plateau (1400 m above sea level) on the island of Reunion. The sun and shade types of this moss species were collected from habitats subjected to high (800–1500 $\mu mol\,m^{-2}\,s^{-1}$ PPFD) and low (100–200 $\mu mol\,m^{-2}\,s^{-1}$ PPFD) light conditions 24 hours before the measurements. The light treatments and measurements were carried out on the upper photosynthetically active parts of the samples.

Light Treatment

The photoinhibition of photosynthesis in the moss types was induced by a 1200 μmol m^{-2} s^{-1} photosynthetic photon flux density (PPFD) of white light (Schott KL-1500, Germany) for three hours. During recovery the samples were transferred to low light conditions (40 μmol m^{-2} s^{-1}). The chlorophyll a fluorescence induction parameters were determined every hourly at 20 °C after a short (5 min) dark adaptation in the 90–100% water state.

Determination of Chlorophyll Fluorescence Parameters

The in vivo chlorophyll fluorescence measurements on intact moss segments were carried out with a computerised portable chlorophyll fluorometer after a 30-min (control samples) or 5-min (light treated samples) dark adaptation. The fluorescence was excited by a light-emitting diode (Stanley KR5004X) of 200 μmol m^{-2} s^{-1} PPFD and detected by a BPX-60 (Siemens) photodiode. The fast and slow fluorescence induction was excited for 1200 ms and for 5 min respectively.

Results

Fluorescence induction parameters of the control shade- and sun-type mosses

Kautsky and Hirsch (1931) observed changes in the time dependence of the fluorescence of chlorophyll a (*Chl* a) when the dark-adapted photosynthesising sample was exposed to light. Since then, the investigation of *Chl* a fluorescence transients (Kautsky effect or fluorescence induction) has been used as a sensitive, non-destructive tool for studying the different processes of photosynthesis (Papageorgiou, 1975). Fluorescence induction may be divided into two parts: (i) a fast initial stage from F_0 to F_p, characterised by an increase in the intensity of fluorescence, followed by (ii) a slow decrease in the intensity of fluorescence to the steady-state fluorescence level (F_s). This increase in fluorescence in the fast stage can be attributed to changes in the first stable electron acceptor (Q_A) of PS II in the redox state, thus the parameters of the fast stage provide a good insight into the electron transport processes of PS II. On the basis of the data in Table 1 it can generally be said that under stress-free conditions there is only a very slight (though significant) difference between the parameters of the shade-type and sun-type *M. diclados* plants. This indicates that acclimation to different light conditions is also revealed in the functional modification of PS II.

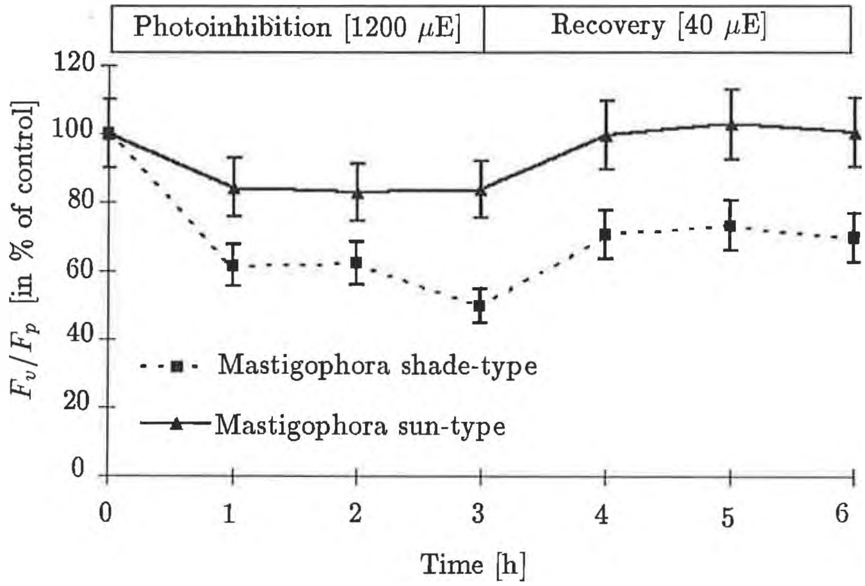

Fig. 1 Optimal quantum yield (F_v/F_p) of PS II during photoinhibition (at 1200 μmol^{-2} s^{-1}) and recovery (at 40 μmol^{-2} s^{-1}). Fluorescence was excited with 200 μE m^{-2} s^{-1} light intensity and the samples were dark-adapted (5 min) before the measurement.

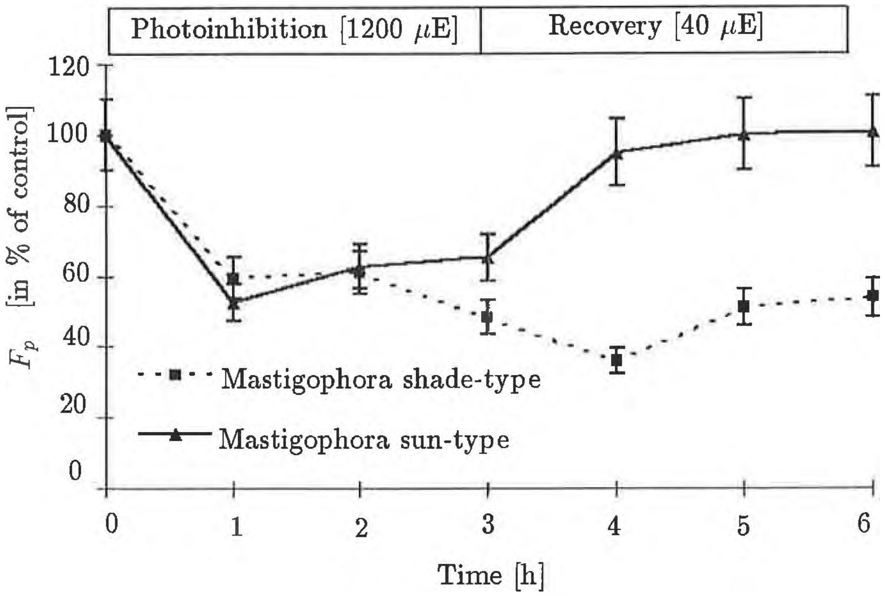

Fig. 2 Changes in maximal fluorescence level (F_p) at a measuring light intensity of 200 μmol^{-2} s^{-1}, during photoinhibition (at 1200 μmol^{-2} s^{-1}) and recovery (at 40 μE m^{-2} s^{-1}). Fluorescence was excited with 200 μmol^{-2} s^{-1} light intensity and the samples were dark-adapted (5 min) before measurement.

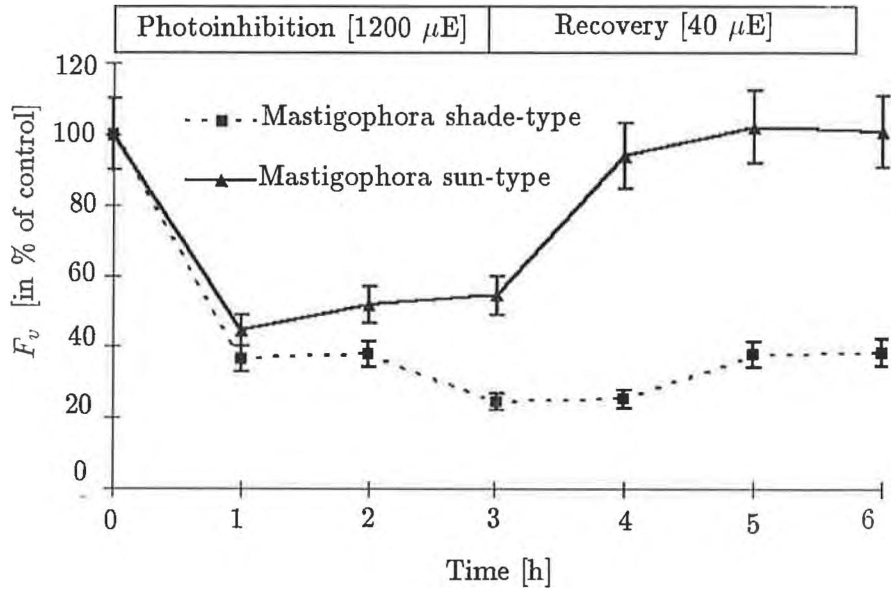

Fig. 3 Changes in variable fluorescence (F_v) during photoinhibition (at 1200 μmol^{-2} s^{-1}) and recovery (at 40 μE m^{-2} s^{-1}). Fluorescence was excited with 200 μE m^{-2} s^{-1} light intensity and the samples were dark-adapted (5 min) before measurement.

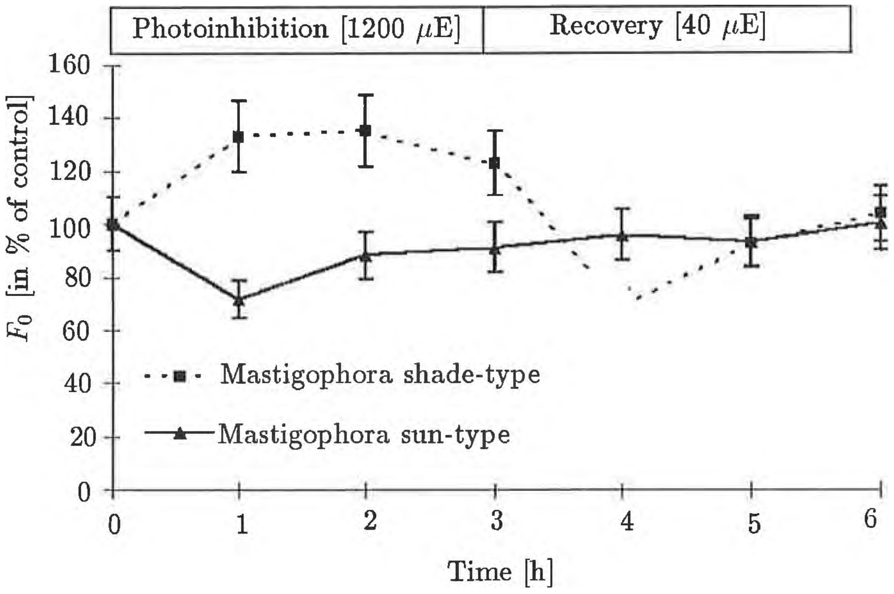

Fig. 4 Changes in initial fluorescence level (Fo) during photoinhibition (at 1200 μE m^{-2} s^{-1}) and recovery (at 40 μmol^{-2} s^{-1}). Fluorescence was excited with 200 μmol^{-2} s^{-1} light intensity and the samples were dark-adapted (5 min) before measurement.

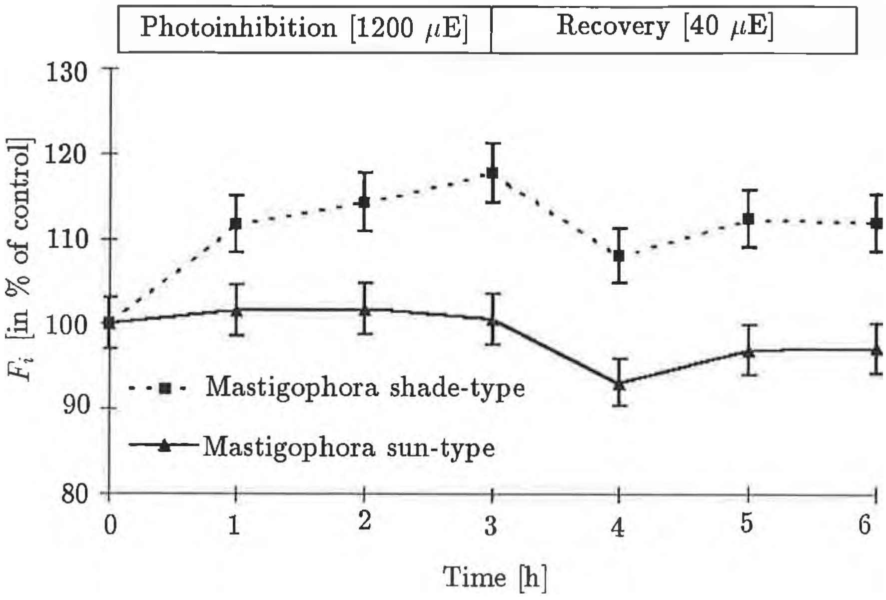

Fig. 5 Changes in intermediate fluorescence level (F_i) during photoinhibition (at 1200 μmol^{-2} s^{-1}) and recovery (at 40 μE m^{-2} s^{-1}). Fluorescence was excited with 200 μE m^{-2} s^{-1} light intensity and the samples were dark-adapted (5 min) before measurement.

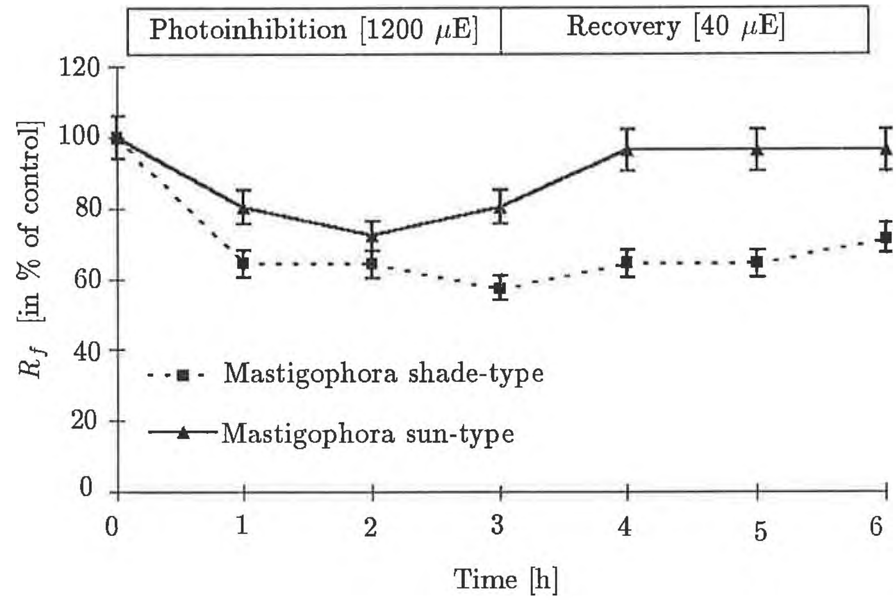

Fig. 6 Changes in the maximum rate of fluorescence rise $[(dF_v/dt)_{\max} = R_f]$ during photoinhibition (at 1200 μmol^{-2} s^{-1}) and recovery (at 40 μE m^{-2} s^{-1}). Fluorescence was excited with 200 μE m^{-2} s^{-1} light intensity and the samples were dark-adapted (5 min) before measurement.

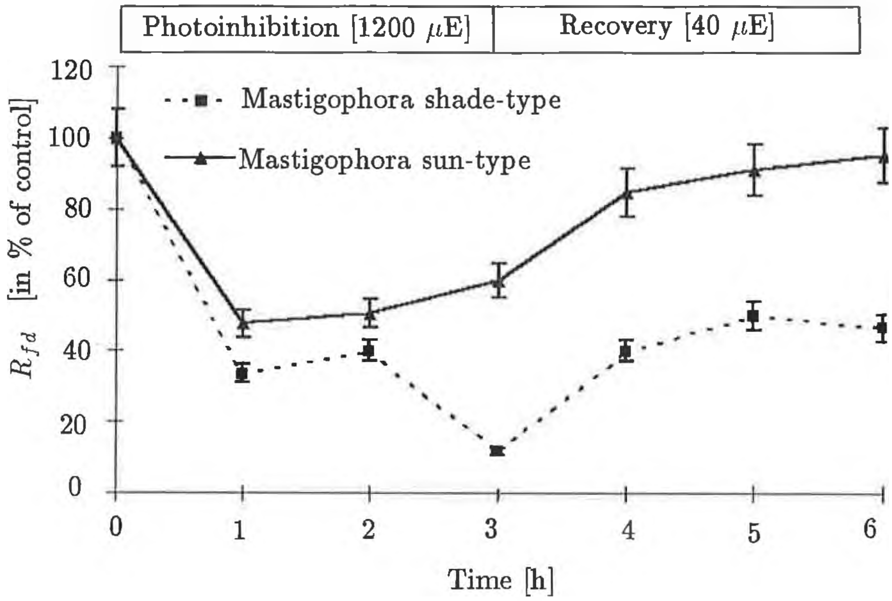

Fig. 7 Changes in the fluorescence decrease ratio (R_{fd}) during photoinhibition (at 1200 μmol^{-2} s^{-1}) and recovery (at 40 μmol^{-2} s^{-1}). Fluorescence was excited with 200 μmol^{-2} s^{-1} light intensity and the samples were dark-adapted (5 min) before measuring.

The F_v/F_p parameter, indicative of the optimal quantum efficiency of PS II, is significantly higher in the shade-type Mastigophora. This difference is even more striking for the $F_v(F_p - F_0)$ parameter and to a lesser degree for the F_0 parameter. Between the initial fluorescence level (F_0) and the maximum or plateau level (F_p) there is an intermediate level (F_i). This parameter is linked to the heterogeneity of PS II and the activity of the electron transport between Q_A and Q_B. In the present case the F_i expressed as a percentage of F_p is high in both plants, being higher in the sun-type than in the shade-type moss. Nevertheless, this difference in F_i is not significant. The maximal steepness of the increase in fluorescence intensity from F_i to F_p is indicated by the parameter R_f [$R_f = (dF_v/dt)_{\max}$]. This steepness is related to the capacity of PS II to reduce the PQ pool. At the low light intensity (200 μmol^{-2} s^{-1}) used for exciting fluorescence and photosynthesis, this parameter is also about 12% higher in the shade-type mosses.

For plant samples photosynthesising in a steady-state situation, the ratio of fluorescence decrease [$R_{fd} = (F_p - F_s)/F_s$] at a given light intensity signals the ratio of the quenched and non-quenched portions of fluorescence and correlates well with the potential photosynthetic capacity of the plant (Strasser et al. 1987). As can be seen in Table 1, under the present circumstances there was no significant difference between the shade- and sun-type mosses.

Ffluorescence induction parameters of shade- and sun-type mosses during photoinhibition and recovery

When plants are exposed to light intensity much higher than their growth conditions, the inhibition of photosynthesis can be observed. *Chl* a fluorescence has proved to be a suitable tool for detecting damage to the photosynthetic apparatus, including PS II (for review, see: Powles, 1984; Krause, 1988). As can be seen in Fig.1, the 1200 μmol^{-2} s^{-1} light intensity caused an approx. 40% decrease in the optimal quantum efficiency of PS II (F_v/F_p) after one hour in the shade-type *M. diclados*, decreasing further to 50% in the third hour of photoinhibition. In the sun-type *M. diclados* this decrease amounted to about 20% and this value did not change after a further 2 hours of light treatment. It can be seen in Fig. 2 that the maximal fluorescence level (F_p) induced by the given light intensity (200 μmol^{-2} s^{-1}), exhibited a decrease of about 40% after one hour in both types, compared to the non-photoinhibited control. In the shade-type mosses a further 10% decrease could be observed, while the sun-type mosses showed a slow, non-significant increase. A significant difference could not be observed between the two groups until the end of the third hour. After the 3-hour light treatment the decrease in variable fluorescence (F_v) revealed kinetics similar to the changes in the F_p level. Nevertheless, the decrease in F_v after 1-hour was more pronounced, (about 60%) in both types, later reaching 70–80% in the shade-type, while in the sun-type a slow increase occurred. As a result, by the end of the third hour the parameter linked with the electron transport processes of PS II showed an inhibition of about 80% in the shade-type mosses and only 50% inhibition in the sun-type. The initial fluorescence level (F_0) stems from the light-harvesting antenna pigments and is not connected to the electron transport processes of PS II. Its value is proportionate to the quantity of antenna pigments and at a given concentration its increase may signal the loss of functional connection between the PS II core and the LHCs. During photoinhibition, the F_0 level shifts in opposite directions in the shade-type and sun-type plants (Fig.3). The F_0 level of the shade-type *M. diclados* increased by 30% in the first hour and this value hardly changed during continued photoinhibition. The F_0 level of the sun-type *M. diclados*, however, decreased by 30%, which also revealed only a slight further decrease in the following two hours. During the recovery period the F_v/F_p parameter of sun-type mosses shifted back to the level of the control by the end of the first hour, which was also true of the F_p and F_v parameters. The situation was quite different for the shade type. The optimal quantum efficiency of PS II, which had suffered 50% inhibition, reached only 70% of the control after an hour, and qas still at this level after 3 hours. Figures 2, 3 and 4 show that this slight increase could be attributed to a decrease in the high F_0 level, since the F_v exhibited practically no recovery, being 30% of the control even in the third hour of recovery. It can thus be said that the 3-hour (1200 μmol^{-2} s^{-1}) light treatment caused slowly reversible damage to the primary processes of PS II, which did not relax even after 3 hours, in the shade-type mosses, and a quickly reversible inhibition, which relaxed in 1 hour, in the sun-type mosses. As Figure 5 shows, there was a significant difference in the F_i parameters, proportionate to the number of inactive PS II reaction centres in the different types of *M. diclados*, during photoinhibition and recovery. During the first two hours of inhibition, an increase in F_i was observable in the shade type. However, in the third hour a 20% increase occurred compared to the control. At low light intensity, this value was 10–15% higher than the control even after three hours. In the case of mosses grown at higher light intensity, the F_i did not change significantly during photoinhibition and only a slow decrease was observable during recovery.

As was mentioned above, the R_f parameter is proportionate to the maximum reduction of the plastoquinone pool by PS II. Figure 6 shows that the electron transport processes taking place within the active PS II prior to the reduction in the PQ pool lose some of their efficiency during photoinhibition in both groups. In the shade-type *Mastigophora* this decrease was about 40% by the end of photoinhibition and later, even after 3 hours at low light intensity, it was only 70% of the control. On the other hand, the R_f parameter of the sun-type *M. diclados*, which exhibited a less pronounced decrease, started to increase after the second hour of photoinhibition and reached the control level after the first hour of recovery.

The R_{fd} parameter signalling the potential photosynthetic capacity (Figure 7) decreased greatly during the first hour of photoinhibition in both groups and reached 90% in the shade type in the third hour. In the sun type the maximal decrease was about 50% and after the first hour a slow increase was observable, which became more intense when the high (1200 μmol^{-2} s^{-1}) light intensity ceased. By the end of the recovery period, the R_{fd} parameter of the sun-type *M. diclados* was the same as that of the control, while in the shade type it was only 40% of the control.

Discussion

The results of this investigation show that there are differences between the photosynthetic parameters of *M. diclados* growing in habitats with various light conditions, even in the default state. The functional parameters observed indicate that at the low light intensity level (200 μmol^{-2} s^{-1}) used in the measurements, photosynthesis in general and PS II in particular operated more efficiently in *M. diclados* grown at low light intensity. This is confirmed by the higher F_v/F_p value, which is associated with the functioning of the PS II reaction centres, the primary processes of photosynthesis. Previous studies (Chu and Anderson, 1984) indicate that a higher F_0 level may also indicate the presence of more extensive LHC linked to the reaction centres. At low light intensity, which may provide a more efficient excitation energy supply for the reaction centres. In these plants the PS II reaction centres can reduce the PQ pool within a short time as indicated by the greater R_f parameter (Table 1), which may also be due to the fact that in the shade-type plants the size of the PQ pool is generally smaller than in the sun type (Boardman et al. 1972). Both groups, however, are characterised by a high level of F_i. The increase in fluorescence from F_0 to the first inflectional point or intermediate peak (F_i) can be attributed entirely to the variable fluorescence yield from the PS II$_\beta$ centres (Cao and Govindjee, 1990). The PS II$_\beta$ centres are incapable of reducing the PQ pool and thus of oxidising water, nor do they take part in the operation of the linear electron transport chain. The question is, how these plants are able to reach a relatively high level of R_{fd} with such a large proportion of inactive PS II reaction centres. As is well known, at a given light intensity $R_{fd} = (F_p - F_s)/F_s$ (Strasser et al. 1987), that is, R_{fd} equals the ratio of quenched to non-quenched fluorescence. The responsibility for the decrease in fluorescence during the slow stage of fluorescence induction lies with the photochemical and the various types of non-photochemical quenching processes (Krause and Weis, 1991). The high R_{fd} value indicates that the quenching processes are intense, and at the low light intensity applied, can be expected to consist principally of photochemical quenching. The prerequisite of the greater part of photochemical and, at this low light intensity, non-photochemical quenching is the operation of the linear electron transport chain, which can only be generated by active PS II RCs. It is possible that the functionally inactive but physically intact PS II RCs take part in the elimination of excitation energy in the form of heat (Öquist et al. 1992).

As a result of adaptation to different light conditions, the functional parameters of the photosynthetic apparatus based on fluorescence induction were significantly different during photoinhibition and following recovery. The 3-hour, 1200 μmol^{-2} s^{-1} light intensity treatment reduced the efficiency of the primary processes, especially of charge separation, in PS II in both groups. This was manifest in the changes in F_v/F_p and, to an even greater extent, in the F_v parameter. However, the decrease in the optimal quantum efficiency of PS II was more vigorous in *M. diclados* grown at low light intensity. On the basis of the R_f parameter it can be said that there was a retardation not only in charge separation in the RCs but also in the reduction of the PQ pool by PS II. While the decrease in these processes in *M. diclados* grown at high light intensity seemed to be reversible during recovery following photoinhibition, the values equalling those of the control after 1 hour, in mosses grown at low light intensity these changes were irreversible or very slowly reversible. So what protective mechanisms have evolved against photoinhibition in *M. diclados* grown at high and low light intensity? The fact that as a result of high light intensity both the F_0 level and the number of inactive Q_B non-reducing RCs indicated by F_i increased suggests that the heterogeneity of PS II may have an important role in the process of photoinhibition and/or in the protective mechanism against photoinhibition in shade-type mosses. The literature mentions two main aspects of PS II heterogeneity: PS II antenna heterogeneity, also known as α, β, heterogeneity, and PS II reducing side heterogeneity. On the basis of PS II antenna heterogeneity there are two different PS II populations with different antenna sizes. The dominant form is PS II$_\alpha$, localised in the grana regions and responsible for water oxidation and plastoquinone reduction. PS II$_\beta$ is often localised in the intergrana or stroma thylakoids and only contains PS II Core and *Chl* a-b LHC II-inner components, with no LHC II-peripheral antenna (Melis, 1985; Greene et al. 1988; Guenther et al. 1988). Beside this, the PS II centres are incapable of electron transfer from Q_A to Q_B. These are the PS II Q_B-non-reducing centres (Greene et al. 1988; Guenther et al. 1988). These two labels often indicate the same inactive PS II RC. According to Guenther et al. (1990), the Q_B non-reducing centres are intermediate stages in the damage and repair processes of PS II. For theoretical reasons, however, although these centres are incapable of charge stabilisation, through charge separation and recombination. The ability to trap excitation energy and thus to non-photochemically dissipate the absorbed light energy is preserved (Cleland et al. 1986; Styring et al. 1990). Considering all this, it seems possible that by maintaining a large number of photoinhibited, functionally inactive but structurally intact reaction centres, mosses grown at low light intensity achieve the controlled dissipation of light energy.

Unlike the mosses grown at low light intensity, *Mastigophora* plants grown at high light intensity shoved no increase in F_i during photoinhibition suggesting that the inactive Q_B-non-reducing centres play a lesser role in protecting against photooxidative damage. At the same time, a decrease was recorded in both F_p and, to a smaller degree, in F_0. These symptoms are also known to be charateristic of the energy-dependent fluorescence quenching connected to the pH gradient through the thylakoid membrane, and to low lumen pH and the accumulation of zeaxanthin (Dau, 1994). It is also well documented that sun-type plants are characterised by a high xanthophyll/β carotene ratio (Aro et al. 1986). At the same time, the PS II repair cycle associated with the D_1 protein turnover also plays an important role in repairing photooxidative damage (Öquist et al. 1992). In addition, both processes are relaxed in the dark or at low light intensity within 0.5–1 hour, as observed during the dark relaxation of *M. diclados* grown at high light intensity.

All this seems to suggest that the protective strategies against high light stress in shade-type and sun-type *Mastigophora* are different, and that this could be related to the amount of light energy available in their given habitat. The sun-plant strategy appears at high light intensity. The high light intensity provides ample energy for the growth of the plant as well as for the energy-intensive *de novo* D_1 protein synthesis linked to the PS II repair cycle and for producing a greater pool of xanthophyll pigments. On the other hand, when the shade-type *M. diclados* is exposed to very high light intensity it apparently lacks the capacity to counterbalance oxidative damage with the help of a fast turnover repair cycle. Instead, photoinhibited, inactive PS II reaction centres are accumulated, because the turnover of the repair cycle is slow compared to the velocity of the photooxidative damage. Thus, with the help of heat dissipation by inactive RCs photoinhibition induces the stable regulation of PS II in the shade-type *M. diclados.* However, if the light intensity is too high compared to the capacity of these processes, the photosynthetic apparatus may suffer photooxidative damage, which is only slowly reversible, or irreversible, because of the slowness of the repair cycle.

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Contributions to the Lichen Flora of East Africa Pseudocyphellaria and Sticta

Farkas, E.
Institute of Ecology and Botany, Hungarian Academy of Sciences
Vácrátót, H-2163, Hungary
`efarkas@botanika.hu`

Abstract. A total of 91 specimens of *Pseudocyphellaria* and 135 specimens of *Sticta* were studied from various collections of T. Pócs and his colleagues. Six *Pseudocyphellaria* (*P. argyracea, P. aurata, P. clathrata, P. crocata, P. dozyana, P. intricata*) and 10 *Sticta species* (*S. ambavillaria, S. dichotoma, S. fuliginosa, S. limbata, S. macrophylla, S. orbicularis, S. sublimbata, S. tomentosa, S. variabilis, S. weigelii*) were identified from specimens collected in the 1970s, 1980s and early 1990s.

Keywords: East Africa, lichenised fungi, *Pseudocyphellaria, Sticta*

Introduction

Pseudocyphellaria and *Sticta* are relatively well-known genera among foliose lichens. They include very attractive species also in East Africa favoured by collectors. The key on East African macrolichens by SWINSCOW & KROG 1988), also the studies on *Pseudocyphellaria* of Southern Hemisphere (GALLOWAY 1988, 1992, 1994, GALLOWAY & ARVICSSON 1990) makes it easier to identify them. Useful notes on the nomenclature of *Sticta* were published by (GALLOWAY 1995). The most recent publication on this field is the treatment of the Australian representatives of these genera (GALLOWAY 2001, GALLOWAY et al. 2001).

Specimens of *Pseudocyphellaria* and *Sticta* collected in the 1970s, 1980s and early 1990s from various East African regions accumulated in the Lichen Herbarium VBI at Vácrátót. The bulk of the specimens were collected by T. Pócs (Eger) and myself in Tanzania. There were also specimens from Comoro Islands, Kenya, Madagascar, Rwanda, Uganda and Zaire. This material included specimens collected in the framework of the Usambara and Nguru Rain Forest Research Projects, the Eötvös L. University (Budapest) student expedition and the Bryotrop expedition in Zaire. Part of this material has already been identified by H. Krog (Oslo), 8 specimens by T. Pócs (Eger) 2 specimens by D. J. Galloway (London) and one specimen by L. Lőkös (Budapest). Specimens of O were kindly sent on loan for the sake of this treatment. A smaller Zaire collection by F. Müller (Halle) was also kindly provided. The Author during her Royal Society Postdoctoral Fellowship in the Natural History Museum London had an opportunity to study these valuable collections in 1992.

For a general characterisation of the investigated geographical areas (Fig. 1) a few papers can be suggested from the literature. The forest flora and vegetation in two of the old crystalline mountains was investigated from various aspects in the last decades. In the Uluguru mountains bioclimatic studies were also carried out with special attention to the amount of precipitation and water retention by epiphytic cover in mossy forests (Pócs 1974).

A comprehensive study has been prepared about the Usambara mountains, Tanzania (Iversen 1991a, 1991b). It treats the history of botanical research, geography, geology, pedology and climate of the Usambaras in details. Main vegetation types occurring in the Usambara mountains are those which can be found also in the whole currently lichenologically studied East African areas:

Forests: lowland evergreen forests, dry lowland evergreen forests, submontane evergreen forests, wet montane evergreen forests, dry montane evergreen forests, montane mist forests (cloud forests, mossy forests, elfin forests), ericaceous scrub forests, riverine forests; Woodlands: semi-deciduous woodlands ("savannas"), bushlands and thickets; Grasslands: grasslands and wooded grasslands, *Pteridium* heath, swamps, rocky outcrops; Induced vegetation: plantation forests, cultivated areas. Of course vegetation types for higher elevations (such as subalpine vegetation, paramo, alpine zone with rocks (lava rocks) and pebbles) must be added to the above vegetation types, characteristic for Kilimanjaro Mts., Ngorongoro Crater in Tanzania or Mt. Elgon in Kenya (Hedberg 1957). A chapter on lichen habitats is also found in Swinscow & Krog (1988).

The phytogeographical division of Africa is presented in the light of more than 100 years history (Iversen 1991a, 1991b). Phytogeographical analysis and affinities of the higher plant vegetation is discussed. Special attention is made to the human influence on the vegetation.

A part of the results on foliicolous lichens of the above collections has already been published (Farkas 1987, 1988, 1991).

The correlation between tropical African and Asian bryofloras was studied by (Pócs 1976). The Bryotrop project concentrates on several ecological factors important for the distribution of bryophytes. Papers has already been published on the result of this project contain useful information also on the ecological conditions for lichens (e.g. FRAHM 1990).

Preliminary results of the Mt. Elgon student expedition concerning to the epiphytic vegetation of *Senecio barbatipes* (giant groundsel) has been analysed by (PÓCS & SZABÓ 1992). Their analysis is based also on lichen specimens collected together with *Pseudocyphellaria* and *Sticta* species listed in this paper.

Recently a poster was presented on Lobariaceae of Mauritius and La Reunion mentioning interesting results based on c. 400 freshly collected specimens (HOLM et al. 2002).

Materials and methods

A total of 91 specimens of *Pseudocyphellaria* and 135 specimens of *Sticta* were studied from various collections mentioned in the introduction. All specimens found in VBI, EGR or HALLE, duplicates if any deposited in the following herbaria: BM, B, O, UPS, SUA. Detailed citation of locality data for each specimens is found under the characterisation (habitat data analysed concerning to geographical distribution, elevation and substrate features) of each species. For identification dissecting microscope and stereo research light microscope (Wilds) were used, handsections were prepared. The usual process of thin layer chromatography was applied following (WHITE & JAMES 1985). The number of specimens in our study is not enough for a comprehensive taxonomic treatment (e.g. solving problems suggested by (HOLM et al. 2002). So the "rather broad view of the limits of taxa" sensu (GALLOWAY 1994) is also applied here. For distributions in the Palaeotropics see also (GALLOWAY 1994).

Pseudocyphellaria

1. *Pseudocyphellaria argyracea* (Delise) Vainio, Hedwigia 37: 34 (1898).

P. argyracea is one of the most frequent species of the genus in the investigated localities in E-Africa. In Comoro Islands, Madagascar and Tanzania it was found in various forest types between 750 and 2300 m altitude, most frequently in submontane, montane or montane mossy forests. Usually it grows on bark of tree trunks, branches or twigs, seldom on decayed trunks. From higher elevations it was collected also on rocks, in lower elevation in Madagascar it was found on *Pandanus* leaves. Most of the records are originating from natural habitats of forest reserves, there are only two specimens collected in degraded forests.

Specimens (40) examined: COMORO. Ngazidja (Grande Comore) Island. Degraded rainforest on the W slope of Kartala volcano, at 700–860 m altitude, above Mvouni village. With many *Psidium cattleyanum* naturalised in the shrub layer. Corticolous, at 750 m alt. 16 March 1991, T. Pócs 9150/O, det. H. Krog (EGR). — Ngazidja (Grande Comore) Island. Ericaceous heath (*Philippia* forest and bush) on the W slope of Kartala summit at 1300–2300 m altitude, above the forest line, subalpine type. Corticolous. 19–20 March 1991, T. Pócs 9159/BW, det. H. Krog (EGR). — MADAGASCAR. Reserve Forestiere Andasibe, 100 km E of Antananarivo. Montane rainforest on granitic ground, at 920–990 m alt. E of the "Station de Pisciculture", with *Ocotea, Pandanus, Memecylon* spp. Corticolous. 15–16 March 1990, T. Pócs, with R. E. Magill & C. Lafarge-England 90103/W, det. H. Krog (EGR). — Reserve Forestiere Andasibe (Perinet) 100 km E of Antananarivo, 1.5 km W of the railway station. Degraded montane rainforest at 930–990 m alt. Foliicolous, on *Pandanus* leaves. 17 March 1990, T. Pócs, with R. E. Magill & C. Lafarge-England 90106/Y, det. H. Krog (EGR). — TANZANIA. Nguru Mts. in Morogoro District. Submontane rainforest in the S branch of Divue Valley: 1 km W of Mlaguzi village, at 1000–1300 m alt. Saxicolous. 23–24 September 1989, T. Pócs with D. Emmrich 89224/CW, det. E. Farkas (VBI). — Submontane evergreen forest in the valley below Maskati Mission. Wet, half-shady, rocky habitat, at 1400–1500 m alt. Saxicolous. 17–18 March 1988, S. & T. Pócs 88043/LA, det. E. Farkas (VBI). — Nguru Ya Ndege Hill NNW of Morogoro town. Dry evergreen forest, mist effected, rich in epiphytes, on the N ridge, at 1100 m alt. Corticolous. 22 October 1988, T. Pócs & E. Knox 88251/BB, det. E. Farkas (VBI), ramicolous, corticolous. 22 October 1988, T. Pócs & E. Knox 88251/D, det. T. Pócs (VBI, BM, B, UPS, SUA). — S-Pare Mts. in Same District. Montane evergreen forests at Chuva and on the plateau of Ranji, at 1740–1900 m alt. The forest patches are restricted to the valleys. Corticolous. 4 December 1989, T. Pócs with Helsinki University 89249/D, det. E. Farkas (VBI). — Uluguru Mts. Mwere Valley above Morogoro town. Submontane rainforest, at 1450–1550 m alt. Lignicolous, 28 November 1986, T. Pócs, E. Farkas, P. Geissler, S. T. Iversen, M. Steiner, R. P. C. Temu 86158/LB, det. E. Farkas (VBI, BM). — Tanga Region, East Usambara Mts. Amani. On (partly planted) trees of the Botanic Garden and experimental *Maesopsis* plantations S of the village, at 900–950 m alt. Corticolous. 20 February 1987, T. Pócs 87040/X, det. H. Krog (VBI, BM), det. E. Farkas (VBI). — Kwamkoro Forest Reserve. SE of Kwamkoro Tea Estate. Intermediate rain forest of *Ocotea usambarensis, Cephalosphaera* sp. at 900–1030 m alt. Corticolous. 28 October 1986, E. Farkas 86214/L, det. E. Farkas (VBI, BM, UPS, SUA). — Lutindi F. R. Wet, mossy submontane rainforest of the Nilo Peak area, at 1250–1450 m alt. Corticolous. 11 May 1987, S. T. Iversen, E. Persson & B. Petterson 87123/O, det. E. Farkas (VBI). — Former Marvera Forest Reserve E of Marvera Tea Estate, 6 km NE of Amani. Very degraded forest fragment with Cardamom and other plantations, at 1000–1180 m alt. Corticolous. 12 November 1986, E. Farkas, T. Pócs 86244/CG, det. E. Farkas (VBI).

— West Usambara Mts. E summit of Baga I. Forest Reserve. Microphyllous, dry evergreen forest, at 1800 m alt. Corticolous. 2 March 1984, T. Pócs 8419/IA, det. H. Krog (VBI). — Lushoto District. Montane evergreen forest 5 km E of Mgwashi village, on the W slopes of Gonja Hill, at 1600–1700 m alt. Corticolous. 17 October 1988, T. Pócs & H. Krog 88205/BD, det. H. Krog (VBI, BM, B, O, UPS, SUA), rupicolous (VBI, BM, B, O). — Mazumbai University Forest Reserve. Mossy elfin forest and *Philippia* heath on the rocky ridge of Sagara, at 1850–1980 m alt. Corticolous. 23 February 1982, T. Pócs 6960/U, det. H. Krog (VBI). — Mazumbai University Forest Reserve. Montane mossy forest, ericaceous heath and rock cliffs of Sagara Ridge, at 1800–1900 m alt. Rupicolous. 2 February 1985, T. Pócs 8531/F, det. H. Krog (VBI), T. Pócs 8531/EA, det. H. Krog (VBI, O). — Shagayu Forest Reserve. Intermediate rainforests on the S slopes of Kwashemhambu and riverine forest along the tributary of Umba river, at 1400–1750 m alt. Corticolous, 20 October 1986, E. Farkas 86201/M, det. E. Farkas (VBI).

2. *Pseudocyphellaria aurata* (Ach.) Vainio, Etude Lich. Brésil 1: 183 (1890).

P. aurata was found in Madagascar, Tanzania and Zaire. It was collected from 700 to 2650 m elevation, most frequently at about 1000 m. It prefers humid, mist effected woodlands, riverine forests. Corticolous, also ramicolous, seldom lignicolous on various phorophytes (e.g. on *Agauria, Euphorbia*). In Zaire it was found on leaves. It prefers natural circumstances, but tolerates conditions of a degraded forest, too.

Specimens (27) examined: MADAGASCAR. Reserve Forestiere Andasibe (Permet) 100 km E of Antananarivo. Montane rainforest 500 m E of the railway station, on the W slope of ridge, at 920–1010 m alt., near the aerial. Ramicolous. 17 March 1990, T. Pócs, with R. E. Magill & C. Lafarge-England 90108/T, det. H. Krog (EGR). — TANZANIA. NW Kilimanjaro, above Lerang Wa village, at the NW edge of Shira Plateau. Low canopy forest below the forest line dominated by *Podocarpus latifolius, Hagenia* and *Pittosporum viridiflorum*, at 2600–2650 m alt. Corticolous/lignicolous. 5 June 1990, T. Pócs & J. Linden 90124/D, det. E. Farkas (VBI). — N part of Marera Forest N of Karatu. Degraded dry semideciduous forest on the N leading ridge, at 1700–1800 m alt. Ramicolous. 25 January 1989, T. Pócs & S. Chuwa 89041/E, det. H. Krog (VBI, BM, B). — Mbulu Highlands and District. Marang Forest Reserve 7 km E of Daudi village. Mesic evergreen montane forest with *Casearia battiscombei, Xymalos* and *Olea capensis*, at 1900 m alt. Ramicolous. 30 May 1990, T. Pócs, H. Sjoholm, J. Linden & L. J. K. Ghula 90088/VB, det. E. Farkas (VBI). — Mindu Hill WSW of Morogoro town. Dry evergreen forest in the rocky ravine leading to the top on the E slope (N from the path), at 1000 m alt. Ramicolous. 21 September 1988, T. Pócs & D. Kayambazinthu 88187/L, det. T. Pócs (VBI, BM). — Mindu Hill WSW of Morogoro town. Mist effected miombo (*Brachystegia*) woodland on the SE slope, 900–1200 m alt. Corticolous. 5 June 1988, T.

Pócs, R. Ochyra & H. Bednarek 88101/B, det. E. Farkas (VBI, BM). — Ngorongoro Cons. Area. SE outer slopes of Ngorongoro Crater. Evergreen riverine forest with *Ilex mitis* and *Hagenia, Podocarpus milanjianus, Prunus africanus* in the valley leading to S from Rotian Glade, at 2000–2100 m alt. Ramicolous. 18 January 1989, T. Pócs & S. Chuwa 89027/Z, det. H. Krog (VBI, BM, B, O, UPS, SUA). — Nguru ya Ndege Hill NNW of Morogoro town. Mist effected miombo woodland on the N ridge near Mkundi village, at 900–1000 m alt. Corticolous. 22 October 1988, T. Pócs & E. Knox 88250/O, det. T. Pócs (VBI). — Nguru ya Ndege Hill NNW of Morogoro town. Dry evergreen forest, mist effected, rich in epiphytes, on the N ridge, at 1100 m alt. Corticolous. 22 October 1988, T. Pócs & E. Knox 88251/H, det. T. Pócs (VBI, B). — S-Pare Mts. in Same District. Montane evergreen forests at Chuva and on the plateau of Ranji, at 1700–1900 m alt. The forest patches are restricted to the valleys. Corticolous. 4 December 1989, T. Pócs 89249/M, det. E. Farkas (VBI). — Uluguru Mts, Kitulanghalo Forest Reserve ENE of Morogoro Rain dry evergreen forest on the E slopes below summit, at 700 m alt. (Corticolous/ramicolous?) 8 December 1985, T. Pócs 8562/E, det. E. Farkas (VBI). — Tanga Region, East Usambara Mts., Amani. Forest Reserve behind the "Forest Houses". Submontane rain forest at 950 m alt. On bark. 19 February 1982, T. Pócs 6946/LA, det. H. Krog (VBI). — East Usambara Mts. Lutindi F. R. Wet, mossy submontane rainforest of the Nilo Peak area at 1250–1450 m alt. Ramicolous. 11 May 1987, S. T. Iversen, E. Persson & B. Petterson 87123/ZA, det. H. Krog (VBI). — Tanga Region, West Usambara Mts. *Euphorbia nyikae* woodland with rock outcrops on the NE slopes below Baga I. F. R. SW of Mzinga village, at 1500 m alt. Corticolous on *Euphorbia nyikae*. 2 March 1984, T. Pócs 8418/N, det. H. Krog (VBI). — West Usambara Mts. On the isolated peak between Kwagoroto summit and Mazumbai village. Mosaic of grassland, *Philippia* heath and dry elfin forest (*Agauria and Myrica*), at 1850 m alt. Corticolous on *Agauria*. 23 February 1984, T. Pócs 8404/Q, det. H. Krog (VBI). — ZAIRE. Prov. Kivu Umgebung Goma Lac Vert 15 km NW Ort 1550 m NN. (Epiphytisch) 25 August 1991, F. Müller Z 107, det. E. Farkas (HALLE), F. Müller Z 109, det. E. Farkas (HALLE).

3. *Pseudocyphellaria clathrata* (de Not.) Malme, Ark. Bot. 26A(14): 9 (1935).

It was collected only from 3 localities of Tanzania (Image Mountains, Mbulu Highlands, Ngorongoro Crater). All from high elevation (1900–2100 m), from montane evergreen forests. Ramicolous.

Specimens (4) examined: TANZANIA. Image Mountains in Iringa Region. Montane mesic evergreen forest with many *Phoenix reclinata* on the sharp S ridge at 1900–2000 m alt. Ramicolous. 28 October 1988, B. & T. Pócs 88265/OA, det. E. Farkas (VBI). — Mbulu Highlands and District. Marang Forest Reserve 7 km E of Daudi village. Mesic evergreen montane forest with *Casearia battiscombei, Xymalos* and *Olea capensis*, at 1900 m alt. Ramicolous on *Olea*. 30 May 1990, T. Pócs, H. Sjoholm, J. Linden & L. J.

K. Ghula 90088/VA, det. E. Farkas (VBI). — SE outer slopes of Ngorongoro Crater. Evergreen riverine forest with *Ilex mitis* and *Hagenia, Podocarpus milanjianus, Prunus africanus* in the valley leading to S from Rotian Glade, at 2000–2100 m alt. Ramicolous. 18 January 1989, T. Pócs & A. Chuwa 89027/Z, det. H. Krog (VBI, BM).

4. *Pseudocyphellaria crocata* (L.) Vainio, Hedwigia 37: 34 (1898).

P. crocata was collected from Kenya, Rwanda, Tanzania and Zaire. It grows among humid conditions of elfin forests, mist effected miombo woodland and paramo vegetation. It was collected from 800 m to 3840 m (Mt. Elgon) altitude. Corticolous, also ramicolous.

Specimens (15) examined: KENYA. Mt. Elgon National Park in the E side of the caldera, at 3800–3900 m alt. *Giant Senecio barbatipes* paramo with dense *Alchemilla elgonensis* undergrowth and *Lobelia telekii, Euryops elgonensis.* On volcanic cliff at 3840 m alt. (Corticolous?) 15–17 January 1992, T. Pócs & A. Szabó 9218/EM, det. E. Farkas (VBI, EGR). — RWANDA, Nyungwe (former Rugege) Forest Reserve in Gikongoro Pref. *Erica rugegensis* heath with scattered *Hagenia* trees and *Andropogon shirensis* grassland patches at 2420 m, 02°31′34″ S, 29°21′21″ E. Ramicolous, on *Hagenia abyssinica.* 11–12 August 1991, E. Fischer & T. Pócs 91102/B, det. H. Krog (EGR). — TANZANIA. Mindu Hill WSW of Morogoro town. Dry evergreen forest in the rocky ravine leading to the top on the E slope (N from the path), at 1000 m alt. Ramicolous. 21 September 1988, T. Pócs & D. Kayambazinthu 88187/P, det. T. Pócs (VBI). — Nguru Ya Ndege Hill N of Morogoro town. Miombo woodland on the SW ridge dominated by *Brachystegia* spp. & *Julbernardia globiflora* at 800–1100 m alt. on quarzitic soil. Ramicolous. 20 April 1986, T. Pócs & J. B. Hall 8646/N, det. E. Farkas (VBI, BM). — Nguru Ya Ndege Hill NNW of Morogoro town. Dry evergreen forest, mist effected, rich in epiphytes, on the N ridge, at 1100 m alt. Corticolous. 22 October 1988, T. Pócs & E. Knox 88251/C, det. T. Pócs (VBI, BM, B, UPS, SUA). — East Usambara Mts. Amani. On (partly planted) trees of the Botanic Garden and experimental *Maesopsis* plantations S of the village, at 900–950 m alt. Corticolous. 15 February 1987, T. Pócs 87040/Y, det. E. Farkas (VBI). — West Usambara Mts., Shagayu F. R. Mossy cloud forest 2 km SW of the Shagein peak, on a summit at 2000–2150 m alt. Corticolous. 15 March 1984, A. Borhidi 8445/S, det. H. Krog (VBI, O). — ZAIRE. Prov. Kivu, Umgebung Goma, Lac Vert 15 km NW Ort 1550 mNN. (Epiphytisch) 25 August 1991, F. Müller Z 111, det. E. Farkas (HALLE).

5. *Pseudocyphellaria dozyana* (Mont. et v. d. Bosch) D. Galloway, Lichenologist 17: 304 (1985).

Two specimen were found in the Tanzanian collection of T. Pócs, one of them already published by (GALLOWAY 1994). It grows on bark in mist effected dry evergreen forests at 1100–1250 m altitude.

Specimens (2) examined: TANZANIA. Nguru Ya Ndege Hill NNW of Morogoro town. Dry evergreen forest, mist effected, rich in epiphytes, on the N ridge at 1100 m alt. Corticolous. 22 October 1988, T. Pócs & E. Knox 88251/BA, det. E. Farkas (VBI). — Uluguru Mts., Mindu Hill WSW of Morogoro town. Mist effected *Uapaca kirkii* woodland on the S end of the main ridge at 1250 m. Very rich in epiphytic and terricolous bryophytes. Corticolous. 5 June 1988, T. Pócs, R. Ochyra & H. Bednarek 88102/AO, det. D. J. Galloway (BM).

6. *Pseudocyphellaria intricata* (Delise) Vainio, Hedwigia 37: 36 (1989).

It was found in Tanzania and Zaire at 1100 m and 2100–2260 m altitude. Both are corticolous in montane and montane elfin forest.

Specimens (3) examined: TANZANIA. Ukaguru Mts. in Kilosa District. Elfin forest on the Mamwira summits at 2100–2260 m alt. Corticolous. 12 February 1988, T. Pócs, T. R. A. Minja, V. R. Nsolomo & A. Persson 88016/BL, det. E. Farkas (VBI, BM). — ZAIRE. Prov. Kivu, Pinga, 96 km NW Goma, Flusstal 4 km NNo Ort Bergregenwald, 1100 mNN on Brücken holz. 18–23 August 1991, F. Müller Z 66, det. E. Farkas (HALLE).

STICTA

1. *Sticta ambavillaria* (Bory) Ach., Lich. Univ., p. 455 (1810).

It is the most frequent *Sticta* species of the investigated localities of East Africa. It was collected frequently from high elevation (2000–3800 m) localities of Kenya, Tanzania and Zaire. It grows in montane elfin forest, subalpine paramo vegetation, in *Erica, Philippia* heath and *Podocarpus* forest, also in secondary grassland communities. Ramicolous or corticolous, also found on soil covered rocks.

Specimens (35) examined: KENYA. Mount Elgon National Park on the ESE slopes. Secondary grassland with scattered Ericaceae or open *Erica arborea* stand replacing evergreen mist forest after fires, on the SE slope of Chemwote, at 3200–3300 m alt. Corticolous. 11–27 January 1992, T. Pócs, M. S. Chuah, E. M. Kungu and students 9212/AGA, det. E. Farkas (EGR), on *Erica* bark. 11–27 January 1992, T. Pócs, M. S. Chuah, E. M. Kungu and students 9212/DB, det. T. Pócs (VBI). — Mount Elgon National Park on the ESE slopes. *Erica arborea* forest on the S slope of Mt. Chemwote, at 3250–3350 m. On *Erica arborea* bark. 12 January 1992, T. Pócs, M. S. Chuah, E. M. Kungu and students 9215/CA, det. E. Farkas (EGR). — Mount Elgon National Park on the ESE slopes. In a depression on the E slope of Chemwote, around a spring at 3250 m. Giant groundsel (*Se-*

necio johnstonii) and bamboo (*Arundinaria alpina*). On giant *Senecio* and on *Atrocrania* bark. 22 January 1992, T. Pócs & A. Szabó 9228/K, det. E. Farkas (EGR). — Mount Elgon National Park on the ESE slopes. Mossy mist forest in Kimothon valley on the SE slope of Chemwote, with *Rapanea melanophloeos, Prunus africana, Hagenia, Afrocrania, Dombeya goetzenii, Pittosporum viridiflorum*, at 3200 m alt. Corticolous. 11–27 January 1992, T. Pócs, M. S. Chuah, E. M. Kungu and students 9210/X, det. E. Farkas (EGR). — Mount Elgon National Park, in the E side of the caldera, at 3800–3900 m alt. Giant *Senecio barbatipes* paramo with dense *Alchemilla elgonensis* undergrowth and *Lobelia telekii, Euryops elgonensis*. On earth covered rocks. 15–17 January 1992, T. Pócs & A. Szabó 9218/EL, det. E. Farkas (VBI). — TANZANIA. Arusha National Park, Meru Crater. Subalpine *Erica(-Agauria)* stand around and above Kitito Camp, at 2480–2600 m. Ramicolous. 16–18 December 1988, T. Pócs & Helsinki Univ. Bot. Dept. 88301/K, det. H. Krog (VBI, BM, B). — Kilimanjaro Mts. Marangu Route. Subalpine *Erica arborea forest* around Mandara Hut, at 2600–2850 m. On *Erica arborea*. 19, 22 May 1989, T. Pócs & S. Orbán 89145/CB, det. H. Krog (VBI, BM, B, O, UPS, SUA). — Kilimanjaro Mts. Marangu Route. Gorge with *Senecios* below Horombo Hut, at 3750–3800 m alt. On *Erica arborea*. 20 May 1989, T. Pócs & S. Orbán 89149/AB, det. H. Krog (VBI, BM, O, UPS, SUA). — Kilimanjaro Mts. NE slope of Mawenzi. WSW of Tarakea village, N side of Nesikiria River. *Erica arborea* giant heath at 2580–2600 m alt. (4–6 m tall). Corticolous. 1 February 1990, T. Pócs with M. Jhatta & J. Linden 90022/AC, det. E. Farkas (VBI). — Kilimanjaro Mts. Mweka Route. Subalpine *Erica arborea* heath (2–3 m tall) around Mweka Base Hut, at 2900–3030 m alt. Ramicolous on *Erica arborea* at 3100 m. 9 June 1990, T. Pócs, with D. Harrison & J. M. Mushy 90130/PA, det. E. Farkas (VBI). — Kilimanjaro Mts. Mweka Route. Wet ericaceous heath with lava rocks near Mweka Base Hut in Charongo Valley, at 2900–3000 m alt. Corticolous on *Erica arborea*. 5–6 March 1985, T. Pócs 6995/D, det. H. Krog (VBI). — W slope of Mount Meru. Subalpine *Erica arborea-Stoebe kilimanjarica* bush with giant *Senecio* and *Lobelia deckenii* on S facing slope of a valley above Laikinoi, at 3210 m altitude (plot 11). Lignicolous. 15 December 1988, T. Pócs & Helsinki Univ. Bot. Dept. 88299/O, det. H. Krog (VBI, BM, B). — Ngorongoro Conservation Area. S crater rim. Glade with scattered trees near Rhino Lodge, at 2200 m alt. Corticolous. 29 November 1988, T. Pócs 88270/X, det. H. Krog (VBI). — Ngorongoro Conservation Area. Embagai Crater. E slopes of the main summit along the NW rim. Subalpine *Anthospermum-Stoebe-Artemisia* bush, at 2900–3100 m alt. Ramicolous. 3 December 1988, T. Pócs & S. Chuwa 88285/TB, det. H. Krog (VBI). — Mbeya Region. Poroto Mts. In montane rainforest on the way to Ngozi crater at the SE edge of Poroto Forest Reserve W of Isongole village, at 2000 m alt. Corticolous. 14 April 1989, E. Farkas, S. et T. Pócs 89128/LC, det. E. Farkas (VBI, BM, UPS, SUA). — Poroto Mts. On the N slope of Mt. Rungwe SE of Isongole village in Ericaceous heath just above the natural forest line at 2400 m alt. Lignicolous. 15 April 1989, E. Farkas 89130/LB, det. E. Farkas (VBI, BM). — ZAIRE. Kahuzi-Biega National Park NW from Bukavu town in Kivu Province. *Podocarpus* forest, bamboo thicket and *Philippia* heath on the small islet of "Lushanja" bog, SW from Camp Biega, at 2400 m alt. On bark of *Agauria* tree. 1 September 1991, T. Pócs 91142/AA, det. H. Krog (EGR).

Sticta cyphellulata (Müll. Arg.) Hue, Nouv. Archs Mus. Hist. nat., Paris, Sér. 4, 3: 99 (1901) — see under S. orbicularis

2. *Sticta dichotoma* (Bory) Delise, Mém. Soc. linn. Normandie 2: p. 107 (1825).

S. dichotoma has three records from Madagascar and one from Tanzania. It was collected from submontane, montane and elfin forests between 920 and 1400 m elevations. It grows on bark or tree trunks and branches.

Specimens (6) examined: MADAGASCAR. Prov. Antsiranana. Reserve Integrale Nationale de Marojezy. Closed, shady montane rainforest in the valleys around Camp II, at 1350–1400 m alt. Corticolous. 26–27 March 1990, T. Pócs, A. Randrianasolo, R. E. Magill & C. Lafarge-England 90115/A, det. D. J. Galloway (VBI, BM). — Prov. Antsiranana. Reserve Integrale Nationale de Marojezy. Elfin forest on the ridge between Camp II and III, at 1000–1400 (exceptionally to 1800) m. On bark at 1370 m alt. 26–28 March 1990, T. Pócs, C. Lafarge-England, R. E. Magill & A. Randrianasolo 90114/AU, det. H. Krog (EGR). — Reserve Forestiere Andasibe (Perinet) 100 km E of Antananarivo. Montane rainforest 500 m E of the railway station, on the W slope of ridge, at 920–1010 m alt., near the aerial. Ramicolous. 17 March 1990, T. Pócs, with R. E. Magill & C. Lafarge-England 90108/H, det. H. Krog (EGR). — TANZANIA. Tanga Region, SW from West Usambara Mts. Submontane rain forest on the plateau of Mafi Hill, near the headwaters of Kwalukonge stream, at 1000–1300 m alt. Ramicolous. 27–28 January 1985, T. Pócs 8522/D, det. H. Krog (VBI, O).

3. *Sticta fuliginosa* (Hoffm.) Ach., Meth. Lich., p. 280 (1803).

It was collected from high elevation (1900–3900 m) vegetation types (montane forest, subalpine bush, paramo) from Kenya and Tanzania. It was found mostly on twigs, also on lava rock and decayed trunks.

Specimens (11) examined: KENYA. Mount Elgon National Park, in the E side of the caldera, at 3800–3900 m alt. Giant *Senecio barbatipes* paramo with dense *Alchemilla elgonensis* undergrowth and *Lobelia telekii, Euryops elgonensis.* On twigs of *Euryops elgonensis.* 15–17 January 1992, T. Pócs & A. Szabó 9218/CW, det. E. Farkas (VBI). — Mount Elgon National Park on the ESE slopes. Streambed stones and boulders along Kimothon River at 3200 m altitude, accompanied by giant *Senecio johnstonii, Hypericum keniense, Conyza vernonioides.* On lava cliff. 11–27 January 1992, T. Pócs, M. S. Chuah, E. M. Kungu and students 9211/BD, det. E. Farkas (EGR), T. Pócs, M. S. Chuah, E. M. Kungu & students 9211/BZ, det. E. Farkas (EGR). — Mount Elgon National Park, ESE slope. Rocky gorge of Kimothon River between Koroborte and Chemwote summits, with subalpine ericaceous vegetation, at 3300–3360 m altitude. On rotting wood. 25 January 1992, T. Pócs, E. M. Kungu & A. Szabó 9230/H, det. E. Farkas (VBI). — TANZANIA. Arusha National Park, Meru Crater. Subalpine *Erica(-Agauria)* stand around and above Kitito Camp, at 2480–2600 m alt. Ramicolous. 16–18 December 1988, T. Pócs & Helsinki Univ. Bot. Dept. 88301/I, det. H. Krog (VBI). — Mbulu Highlands and District. Marang Forest Reserve, 7 km E of Daudi village. Mesic evergreen montane forest with *Casearia battiscombei, Xymalos* and *Olea capensis*. Alt. 1900 m. Ramicolous. 30 May 1990, T. Pócs, H. Sjoholm, J. Linden & L. J. K. Ghula 90088/U, det. E. Farkas (VBI). — Ngorongoro Conservation Area. Embagai Crater. E slopes of the main summit along the NW rim. Subalpine *Anthospermum-Stoebe-Artemisia* bush, at 2900–3100 m alt. Ramicolous. 3 December 1988, T. Pócs & S. Chuwa 88285/TA, det. H. Krog (VBI). — Ngorongoro Conservation Area. E side of the mean Oldeani summit. High altitude *Hagenia* forest at the timberline with *Agauria salicifolia* and *Pittosporum viridiflora*, at 3200 m alt. Ramicolous. 2 January 1989, T. Pócs 89005/KA, det. H. Krog (VBI), T. Pócs 89005/KBa, det. H. Krog (VBI). — Ngorongoro Conservation Area. SW edge of Ngorongoro Crater, inner slope. *Catha edulis* (Celastraceae) bush, xeric type, open. (Plot No. 892 just below Wildlife Lodge), at 2040 m alt. Rupicolous (ramicolous). 8 January 1989, T. Pócs 89010/AN, det. H. Krog (VBI).

4. *Sticta limbata* (Sm.) Ach., Meth. Lich., p. 280 (1803).

It was found in high elevations (2350–3600 m) in Kenya, Tanzania and Uganda. It occurred in the following vegetation types: evergreen forests, subalpine vegetation, *Erica, Philippia* heath and secondary grassland. Ramicolous, corticolous, also on volcanic rocks.

Specimens (19) examined: KENYA. Mount Elgon National Park on the ESE slopes. Secondary grassland with scattered Ericaceae or open *Erica arborea* stand replacing evergreen mist forest after fires, on the SE slope of Chemwote, at 3200–3300 m alt. (Corticolous?) 11–27 January 1992, T. Pócs, M. S. Chuah, E. M. Kungu and students 9212/AG, det. E. Farkas (EGR), T. Pócs, M. S. Chuah, E. M. Kungu and students 9212/C, det. E. Farkas (EGR), on *Erica* bark. 11–27 January 1992, T. Pócs, M. S. Chuah, E. M. Kungu and students 9212/DA, det. E. Farkas (VBI), T. Pócs, M. S. Chuah, E. M. Kungu and students 9212/DBB, det. E. Farkas (EGR). — Mount Elgon National Park on the ESE slopes. *Erica arborea* forest on the S slope of Mt. Chemwote at 3250–3350 m. On *Erica arborea* bark. 12 January 1992, T. Pócs, M. S. Chuah, E. M. Kungu and students 9215/CB, det. E. Farkas (EGR), T. Pócs, M. S. Chuah, E. M. Kungu and students 9215/M, det. E. Farkas (EGR). — TANZANIA. Kilimanjaro Mts., Umbwe Route, ericaceous heath with scattered giant *Senecio kilimanjari* trees at 3000–3300 m alt. Corticolous on *Erica arborea*. 2 March 1985, T. Pócs 6986/E, det. H. Krog (VBI, O). — Meru Mts. W slope, along Olkakola route. Subalpine, open *Hagenia abyssinica* forest intermixed with *Stoebe kilimandscharica* bush at 3100 m alt. Ramicolous, epiphyte on *Philippia*.

25 May 1986, T., S., A. & B. Pócs 8666/T, det. E. Farkas (VBI, BM). — W slope of Mount Meru. Subalpine *Erica arborea-Stoebe kilimanjarica* bush with giant Senecio and *Lobelia deckenii* on S facing slope of a valley above Laikinoi, at 3210 m altitude (plot 11). On *Erica arborea*. 15 December 1988, T. Pócs & Helsinki Univ. Bot. Dept. 88299/I, det. E. Farkas (VBI, BM, B, UPS, SUA). — Ngorongoro Conservation Area, E side of the mean Oldeani summit. High altitude *Hagenia* forest at the timberline with *Agauria salicifolia* and *Pittosporum viridiflora*, at 3200 m alt. Ramicolous. 2 January 1989, T. Pócs 89005/KBb, det. H. Krog (VBI). — North Pare Mts. in Mwanga District. Mesic evergreen forest with submontane character at the S end of Kindoroko Forest Res. dominated by *Newtonia buchananii* and *Albizia gummifera*. Corticolous. 27 January 1990, T. Pócs, with F. Mioga & P. Tetty 90017/L , det. E. Farkas (VBI). — S Uluguru Mts. in Morogoro District. E edge of Lukwangule Plateau. Open granitic rocks of the gorge at Mgeta River falls, at 2350–2380 m alt. Saxicolous. 8–9 June 1988, T. Pócs, R. Ochyra & H. Bednarek 88109/Q, det. E. Farkas (VBI). — UGANDA. Around the Hot Springs in the Suam Valley. NE part of the caldera of Mount Elgon. Humid gorge and cliffs effected by steam and surrounded by *Senecio johnstonii* moorland at 3600 m. On volcanic rocks. 16 January 1992, M. S. Chuah, E. M. Kungu, J. Adam & B. Pócs 9220/AD, det. L. Lőkös (VBI).

5. *Sticta macrophylla* Bory in Delise, Mém. Soc. linn. Normandie 2: 110 (1825).

It has a single collection from an elfin forest in Madagascar at 1300 m altitude. It was collected from tree bark.

Specimen (1) examined: MADAGASCAR. Prov. Antsiranana. Reserve Integrale Nationale de Marojezy. Elfin forest on the ridge between Camp II and III, at 1000–1400 (exceptionally to 1800) m. Corticolous, at 1300 m alt. 26–28 March 1990, T. Pócs, C. Lafarge-England, R. E. Magill & A. Randrianasolo 90114/AW, det. H. Krog (EGR).

6. *Sticta orbicularis* (Braun) Hue, Annls Jard. bot. Buitenz. 17: 193 (1901). (*S▷cyphellulata?*)

It has three collection from relatively high elevations (2200–2960 m) in Tanzania. It grows on rocks and twigs in montane evergreen and subalpine rocky vegetation.

Specimens (5) examined: TANZANIA. Kilimanjaro Mts. Subalpine streamside vegetation along the rocky side of Makoa River below Machame Hut, at 2960 m alt. Rupicolous. 5 April 1984, T. Pócs 6979/T, det. H. Krog (VBI, O). — Kilimanjaro Mts. NE slope of Mawenzi WSW of Tarakea village Nesikiria river gorge at 2600–2700 m alt. With *Senecio johnstonii* and *Lobelia deckenii*. Rupicolous. 31 January 1990, T. Pócs with K. Mjatta & J. Linden 90023/G, det. E. Farkas (VBI, BM). — Tanga Region, West

Usambara Mts. Mist effected, relatively dry evergreen forest on the rocky summit of Ndamanyiru range, 2200–2270 m. Ramicolous. 13 February 1985, T. Pócs 8547/KA, det. H. Krog (VBI).

7. *Sticta sublimbata* (Steiner) Swinscow et Krog, in Galloway, N. Z. J. Bot. 21: 198 (1983).

It was collected from one locality from Kenya and two localities from Tanzania between 1400 and 2300 m elevations. It grows on various substrates (corticolous, ramicolous, saxicolous) and in various vegetation types (montane rainforest with elfin forest patches, coffee-banana plantations, secondary grassland communities) tolerating also the human impact.

Specimens (6) examined: KENYA: Mount Elgon National Park on the ESE slopes. Secondary grassland with scattered Ericaceae or open *Erica arborea* stand replacing evergreen mist forest after fires, on the SE slope of Chemwote, at 3200–3300 m alt. (Corticolous?) 11–27 January 1992, T. Pócs, M. S. Chuah, E. M. Kungu and students 9212/AS, det. E. Farkas (VBI). — TANZANIA. S-Pare Mts. in Same District. Coffee-banana plantations with many avocado and other shade trees above Mbaga Manka village, at 1400–1600 m. Saxicolous. 4–5 December 1989, T. Pócs with Helsinki University 89247/H, det. E. Farkas (VBI). — West-Usambara Mts. Shagayu Forest Reserve. Upper part of the Mt. Kwashemhambu with montane rainforests and patches of elfin forest at 1750–1900 m alt. Corticolous. 20 October 1986, E. Farkas 86202/K, det. E. Farkas (VBI, BM, UPS, SUA).

8. *Sticta tomentosa* (Swartz) Ach., Meth. Lich., p. 279 (1803).

S. tomentosa was collected from 1 locality in Kenya and 2 localities in Tanzania. It lives in high elevations between 2000 and 3300 m. Found in montane rainforest, secondary grassland with *Erica arborea* on open granitic rocks and on bark.

Specimens (6) examined: KENYA. Mount Elgon National Park on the ESE slopes. Secondary grassland with scattered Ericaceae or open *Erica arborea* stand replacing evergreen mist forest after fires, on the SE slope of Chemwote, at 3200–3300 m alt. On *Erica* bark. 11–27 January 1992, T. Pócs, M. S. Chuah, E. M. Kungu and students 9212/DBA, det. E. Farkas (EGR). — TANZANIA. Mbeya Region. Poroto Mts. In montane rainforest on the way to Ngozi crater at the SE edge of Poroto Forest Reserve W of Isongole village, at 2000 m alt. Corticolous. 14 April 1989, E. Farkas, S. et T. Pócs 89128/LA, det. E. Farkas (VBI, BM, UPS, SUA). — S Uluguru Mts. in Morogoro District. E edge of Lukwangule Plateau. Open granitic rocks of the gorge at Mgeta River falls, at 2350–2380 m alt. On shady rocks. 8–9 June 1988, T. Pócs, R. Ochyra & H. Bednarek 88109/EB, det. E. Farkas (VBI).

9. ***Sticta variabilis*** **Ach., Lich. Univ., p. 455 (1810) (syn.** ***S. papyracea*** **Delise, Mém. Soc. linn. Normandie 2: 104 (1825).**

S. variabilis was found in several localities in Tanzania in rainforests, submontane, montane, montane mossy forest between 1550 and 2570 m altitude. It also occurred in paramo vegetation at 3800–3900 m on Mt. Elgon, Kenya. All records are corticolous or ramicolous.

Specimens (24) examined: KENYA. Mount Elgon National Park, in the E side of the caldera, at 3800–3900 m alt. Giant *Senecio barbatipes* paramo with dense *Alchemilla elgonensis* undergrowth and *Lobelia telekii, Euryops elgonensis.* On *Senecio* bark. 15–17 January 1992, T. Pócs & A. Szabó 9218/AF, det. E. Farkas (VBI). — TANZANIA. Arusha National Park, Meru Crater. Subalpine *Erica arborea* bush above Ngare Nanyuki Falls, at 2570 m alt. Corticolous on *Erica arborea.* 17 December 1988, T. Pócs & Helsinki Univ. Bot. Dept. 88305/O, det. E. Farkas (VBI). — North Pare Mts. in Mwanga District. Kindoroko Forest Reserve. E ridge, W of Ndorwe village. Montane mossy forest composed of relatively small trees (6–10 m) with tree ferns, at 2020 m alt. Corticolous. 4 May 1990, T. Pócs, with F. N. R. Mioga 90072/O, det. E. Farkas (VBI). — Uluguru Mts. Montane mossy forest on Palata Ridge between 1800–1900 m alt. Corticolous. 27 November 1986, E. Farkas 86157/A, det. E. Farkas (VBI, BM, O, UPS, SUA). — East Usambara Mts. Kwamkoro Forest Reserve. SE of Kwamkoro Tea Estate. Intermediate rain forest of *Ocotea usambarensis, Cephalosphaera* sp. at 900–1030 m alt. Corticolous. 28 October 1986, E. Farkas 86214/YA, det. E. Farkas (VBI). — Tanga Region, West Usambara Mts. in Lushoto District. Submontane rainforest with dominant *Newtonia buchananii* and *Aningeria adolfi-friderici* around Kambi Falls, SW of Mazumbai Station, at 1550–1650 m. Ramicolous. 21 May 1988, T. Pócs & Helsinki Univ. Bot. Dept. 88077/F, det. T. Pócs (VBI, BM). — West Usambara Mts. in Lushoto District. Montane evergreen forest 5 km E of Mgwashi village, on the W slopes of Gonja Hill, at 1600–1700 m alt. Corticolous. 17 October 1988, T. Pócs & H. Krog 88205/BB, det. H. Krog (VBI, BM, B). — West Usambara Mts. Mazumbai. Montane rainforest around Kambi Falls, at 1600–1750 m alt. Ramicolous. 8 December 1989, T. Pócs, with Helsinki University 89256/F, det. E. Farkas (VBI). — West Usambara Mts., Shagayu F. R. Mossy cloud forest 2 km SW of the Shagein peak, on a summit at 2000–2150 m alt. Corticolous. 15 March 1984, A. Borhidi 8445/G, det. H. Krog (VBI, O). — West Usambara Mts. Shagayu Forest Reserve. Road side and forest edge, SE range of Shagein at 1850–1950 m alt. Corticolous. 21–22 October 1986, E. Farkas 86204/G, det. E. Farkas (VBI). — West Usambara Mts. Shagayu Forest Reserve. SE range of Shagein. Montane evergreen forest at 1850–2050 m alt. Corticolous. 22 October 1986, T. Pócs 86205/D, det. E. Farkas (VBI). — West Usambara Mts. Shagayu Forest Reserve. Summit 2.5 km S of the main peak of Shagein, in elfin forest more or less mossy type with many epiphytes, at 2100 m alt. Corticolous. 22 October 1986, E. Farkas, T. Pócs 86206/GA, det. E. Farkas (VBI, BM, UPS, SUA).

10. *Sticta weigelii* (Ach.) Vainio, Acta Soc. Fauna Flora Fenn. 7(7): 189 (1890).

One of the most frequent *Sticta* species in this material. Found in Kenya, Tanzania and Zaire between 1250 and 3600 m elevations in various vegetation types from submontane, montane zones to subalpine paramo vegetation, *Erica, Philippia* heath, also in secondary grassland communities. It covers various substrate types, corticolous, ramicolous, also grows on rocks and decayed trunks.

Specimens (21) examined: KENYA. Mount Elgon National Park on the ESE slopes. Secondary grassland with scattered Ericaceae or open *Erica arborea* stand replacing evergreen mist forest after fires, on the SE slope of Chemwote, at 3200–3300 m alt. On *Erica* bark. 11–27 January 1992, T. Pócs, M. S. Chuah, E. M. Kungu and students 9212/BX, det. E. Farkas (VBI). — Mount Elgon National Park, in the E side of the caldera, at 3800–3900 m alt. *Giant Senecio barbatipes* paramo with dense *Alchemilla elgonensis* undergrowth and *Lobelia telekii, Euryops elgonensis.* On *Senecio* bark. 15–17 January 1992, T. Pócs & A. Szabó 9218/BH, det. E. Farkas (VBI). — TANZANIA. Arusha National Park, Meru Crater. Subalpine *Stoebe-Erica* bush with scattered *Agauria* and *Juniperus* trees on the crater floor, at 2570 m alt. Corticolous on *Agauria.* 17 December 1988, T. Pócs & Helsinki Univ. Bot. Dept. 88303/F, det. H. Krog (VBI, B, UPS, SUA). — Kilimanjaro Mts. Shira Route. Montane evergreen forest at 2600 m alt. near to the forestline, dominated by *Nuxia congesta, Podocarpus latifolius, P. falcatus, Juniperus excelsa, Hagenia.* Corticolous. 17 February 1990, T. Pócs, with J. Linden 90028/E, det. E. Farkas (VBI). — Kilimanjaro Mts. Mweka Route. Subalpine *Erica arborea* heath (2–3 m tall) around Mweka Base Hut, at 2900–3030 m alt. Ramicolous on *Erica arborea,* at 3100 m. 9 June 1990, T. Pócs, with D. Harrison & J. M. Mushy 90130/PB, det. E. Farkas (VBI). — Kilimanjaro Mts. Subalpine *Philippia* heath along Machame Route, near and above the hut, at 3000–3600 m alt. Corticolous on *Erica arborea.* 5–6 April 1984, T. Pócs 6978/W, det. H. Krog (VBI, O). — Kilimanjaro Mts. Ericaceous heath above the Machame Hut at 3050 m alt. Corticolous on *Erica arborea.* 8–9 August 1986, T. Pócs & B. O. van Zanten 86130/AE, det. E. Farkas (VBI, BM). — Mindu Hill WSW of Morogoro town. Mist effected *Uapaca kirkii* woodland on the S end of the main ridge at 1250 m. Very rich in epiphytic and terricolous bryophytes. Corticolous. 5 June 1988, T. Pócs, R. Ochyra & H. Bednarek 88102/AP, det. E. Farkas (VBI). — Nguru Mountains in Morogoro District. Submontane evergreen forest in the valley below Maskati Mission. Wet, half-shady, rocky habitat at 1400–1500 m alt. Saxicolous. 17–18 March 1988, S. & T. Pócs 88043/LB, det. E. Farkas (VBI). — Nguru Ya Ndege Hill NNW of Morogoro town. Submontane rainforest on 1300 m alt., dominated by *Newtonia buchananii.* Corticolous. 22 October 1988, T. Pócs & E. Knox 88252/Q, det. E. Farkas (VBI, BM). — Mbeya Region. Poroto Mts. In montane rainforest on the way to Ngozi crater at the SE edge of Poroto Forest Reserve W of Isongole village, at 2000 m alt. Corticolous. 14

April 1989, E. Farkas, S. & T. Pócs 89128/LB, det. E. Farkas (VBI). — Poroto Mts. On the N slope of Mt. Rungwe SE of Isongole village in Ericaceous heath just above the natural forest line at 2400 m alt. Lignicolous. 15 April 1989, E. Farkas 89130/LA, det. E. Farkas (VBI). — S Uluguru Mts. Montane forest on the W escarpment of Lukwangule Plateau near Ulindi rocks, at 2250–2300 m alt. (Corticolous/ramicolous?) 14 March 1986, T. Pócs 8628, det. E. Farkas (VBI). — S Uluguru Mts. in Morogoro District. E edge of Lukwangule Plateau. Open granitic rocks of the gorge at Mgeta River falls, at 2350–2380 m alt. On shady rocks. 8–9 June 1988, T. Pócs, R. Ochyra & H. Bednarek 88109/EA, det. E. Farkas (VBI). — ZAIRE. Kahuzi-Biega National Park NW from Bukavu town in Kivu Province. *Podocarpus* forest, bamboo thicket and *Philippia* heath on the small islet of "Lushanja" bog, SW from Camp Biega, at 2400 m alt. On bark of Agauria tree. 1 September 1991, T. Pócs 91142/AB, det. H. Krog (VBI).

***Sticta weigelii* var. *xanthotropa* (Krempelh.) Hue, Nouv. Archs Mus. Hist. nat., Paris, Sér. 4, 3: 96 (1901).**

S. weigelii var. xanthotropa lives in lower elevation than *S. weigelii*, at 900–1200 m. It was found in a Tanzanian dry evergreen forest on rocks.

Specimen (1) examined: TANZANIA. Tanga Region, SW from West Usambara Mts. Sclerophyllous, dry evergreen forest on the N ridge of Mafi Hill, at 900–1200 m alt. Saxicolous. 28 January 1985, T. Pócs 8523/F, det. H. Krog (VBI).

Remarks on distribution data

Six species of *Pseudocyphellaria* and 10 species of *Sticta* were identified in the presented collections.

Pseudocyphellaria grows in a relatively lower elevation range, in understorey of shady rainforests compared to *Sticta*. The latter more often was collected from elevations higher than 3000 m above see level where due to the more open subalpine or alpine, often rocky vegetation types lichens meet different light conditions and also often changing relative humidity. Figure 2 presenting the elevation range of each species of the two genera treated in this paper is in a good correlation with the one published by (GALLOWAY & ARVIDSSON 1990). *Pseudocyphellaria* species also occur in Ecuador found in comparable elevation range with the East African species.

It would be worth to investigate the correlation further between the photobiont content and the elevation range of the species. These records suggest that occurrence in higher altitudes than 3000 m might correlate with blue-green alga (cyanobacteria) as primary photobiont. *Sticta* species occurring in higher elevations containing cyanobacteria usually. Those *Sticta* species (*S. dichotoma, S. variabilis*) which have green alga as a primary photobiont were found also in lower elevations. Similarly *Pseudocyphellaria crocata* living with cyanobacteria in symbiosis grows also above 3000 m.

Concerning to the substrate a similar observation can be made. Species with cyanobacteria grow more often on rocks and decayed trunks, thin twigs of *Erica arborea* (found more typically in higher elevations) while other species with green alga photobiont grow usually on bark of tree trunks and thick branches and twigs.

There is a remarkable difference between the two genera in chemical contents too. While *Pseudocyphellaria* is rich in various chemical substances, pigments, triterpenoids, *Sticta* is almost entirely in lack of any chemicals. What can be the role of the various chemicals and the lack of substances in the various distribution patterns of the *Pseudocyphellaria* and *Sticta* species?

There are attempts to study the ecophysiology of these groups (e.g. (GREEN & LANGE 1991, GREEN et al. 1991). Still it needs further careful studies, precise experimental works, higher knowledge of biochemistry and ecophysiology of lichenized fungi.

One might think that both the taxonomic groups and the geographic area presented here are overcollected compared to others. However for the better knowledge of the infraspecific or infrageneric variation both the study of freshly collected specimens and the study of former herbarium materials with new methods (e.g. the application of the recently so popular molecular techniques) is necessary. Tropical rainforests are probably the most endangered of all natural vegetation types. Would it be possible to collect lichens presented in this paper today? This unanswered question helps us to understand the importance of the collecting activity of T. Pócs and others.

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Fig. 1. The investigated areas. Names of countries visited indicated on the map of Africa: Comoro Islands, Kenya, Madagascar, Rwanda (R), Tanzania, Uganda, Zaire.

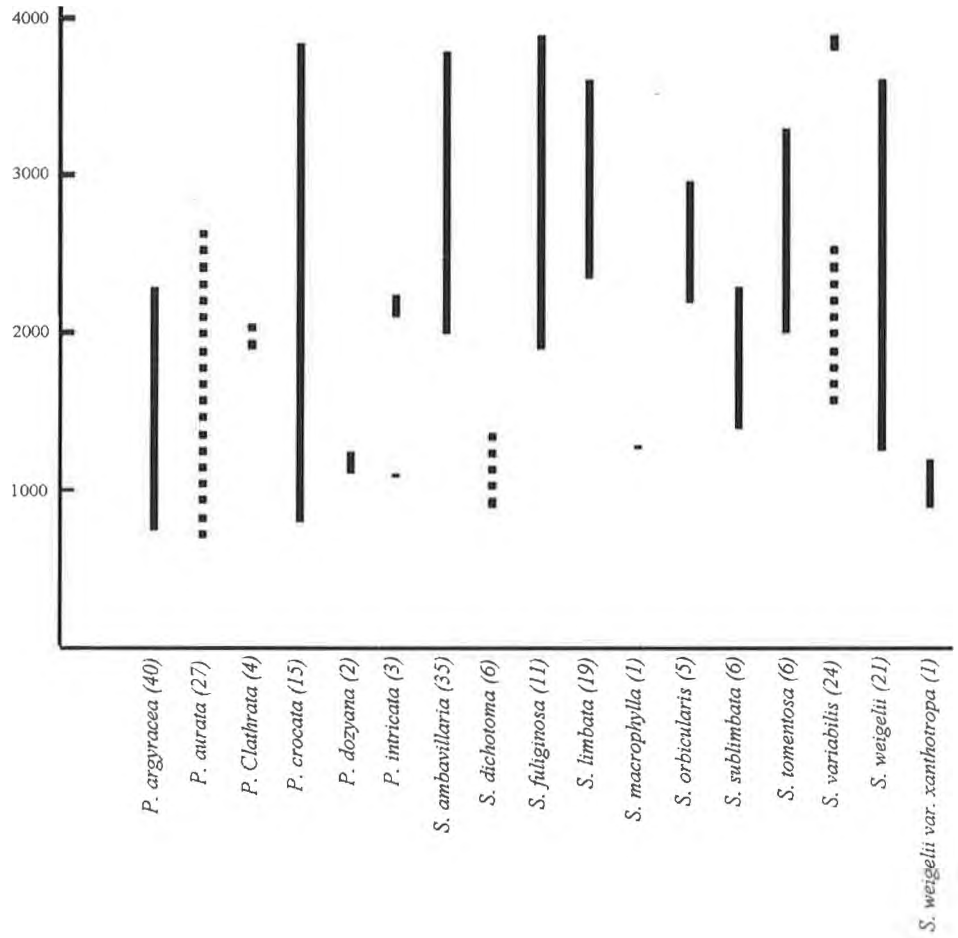

Fig. 2. Altitudinal distribution of species of *Pseudocyphellaria* (6) and *Sticta* (10) in East Africa, based on collections presented here. Number of specimens investigated given in brackets. Photobiont type is indicated: continuous line = cyanobacterium, dotted line = green alga.

Neorutenbergia **Biz.** & **Pócs**, 1974. Rev. Bryol. Lichénol. 40: 27.
Neorutenbergia usagarae (Dix.) **Biz.** & **Pócs**, 1974.
Acta Acad. Paed. Agriensis, Eger, n. s. 12: 444.
Tanzania, South Pare Mts.
Coll.: T. Pócs, D. Harrison, H. Győri & Y. S. Mialla 90084/G (EGR)

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Ecophysiological Screening of a Tropical Wet Evergreen Forest Vegetation in the Mishmi — Himalaya Range (Northeast India, Arunachal Pradesh): Preliminary Results

Czóbel, Sz.[2], Benkő, Zs.[2], Lakner, G.[2], Nagy, J.[2], Figeczky, G.[3] & Tuba, Z.[1,2]
[1] Plant Ecology Research Group of Hungarian Academy of Sciences
Szent István University, H-2100, Gödöllő, Páter K. u. 1.
[2] Department of Botany and Plant Physiologyences
Faculty of Agricultural and Environmental Sciences
Szent István University, H-2100, Gödöllő, Páter K. u. 1.
[3] WWF-Hungary, H-1124, Budapest, Németvölgyi út 78/B

Abstract. One of the main objectives of our study was to detect the actual ecophysiological state of species which use different habitats and life forms of the wet evergreen forest ecosystem within the boundary of Namdapha National Park (Arunachal Pradesh, India). The other goal was to test the usefulness of portable non-invasive chlorophyll fluorescence method for describing some ecophysiological processes in tropical rainforest. The measured plant species and their individuals grew either soliterly or in stand and there were stressed (high light-, heat- and water deficit stress) and non stressed speciesThe field chlorophyll fluorescence measurement can demonstrate the physiological differences of the various life forms of the tropical wet evergreen forest species and it is feasible to detect stress responses caused either by naturally occuring stress factors or anthropogenic perturbations in an early, non-visible state. Therefore the method can be very useful both for monitoring the status of the vegetation in the nature conservation areas of the tropical rainforest region and for managing a sustainable forestry and to follow the effects of tropical deforestation.

Keywords: chlorophyll fluorescence, ecophysiology, it in situ measurement, life forms, non-destructive, stress, tropical vegetation

Abbreviations: F_v/F_m: the maximal photochemical efficiency of PS II, R_{fd}: the variable chlorophyll fluorescence decrease ratio, NPQ: non photochemical quenching

Introduction

Many ecophysiological problems involving tropical ecophysiology and deforestation require some measure of the vitality or photosynthetic capacity of the plants. Concerning photosynthesis gas-exchange measurements in any case tend to be time-consuming, and are not always easy to carry out in the field. Uptake of $^{14}CO_2$ (e.g. Penny & Bayfield, 1982) is a very sensitive method and it can be used on even minute species, but scintillation counting is inherently destructive of the material. In recent years, chlorophyll fluorescence has become recognised as a powerful non-invasive technique in higher-plant physiology (Krause & Weis, 1991; Jones, 1992). It has been extensively used, both in fundamental studies of the photosynthetic mechanism in vivo, and in ecophysiology (Lichtenthaler, 1988). In particular, close relationships have been demonstrated between appropriate chlorophyll-fluorescence measurements and photosynthetic CO_2 uptake (Seaton & Walker, 1990). Seel, Baker & Lee (1992) used the ratio of variable to maximum fluorescence, F_v/F_m, in their analyses of photosynthesis (Tuba et al., 1997). The functioning of photosystem II (PS II) is the most sensitive indicator of the photosynthetic apparatus. Measurements of PS II activity provide a means of rapidly and non-destructively probing of photosynthetic characteristics in the field (Long et al., 1994; Ball et al., 1995; Dulay et al., 1998).

The majority of the field ecophysiological measurements are focused on the temperate vegetation while tropical areas are not widely represented in spite of possessing the highest species and vegetation diversity of the Earth. During the past 10 years, biodiversity has become a focal point of different natural and social sciences (Porembski & Barthlott, 2000). One of the major large scale disturbances to the worlds forest is timber harvesting and it is one of the most conspicuous aspects of contemporary global change. Deforestation occurs almost everywhere in the world but the highest rates (0.8–1.2 percent/year) can be observed in the tropical regions (Loreau et al., 2002). Trees are the dominant and essential elements of the forest ecosystems, especially in the wet evergreen forest where the trees consist the majority of the biomass and give habitats to thousands of species, but the diversity and abundance of mosses and liverworts (including epiphyllous liverworts) are also significant (Pócs, 1996). Because of the mentioned importance and there sensibility to any kind of disturbance wet evergreen forest trees are one of the best indicators of the tropical forest ecosystems. One of the most suitable method to detect the stress state of the plants in field “in situ” is the chlorophyll a fluorescence measurement (Hall et al., 1993; Lüttke, 1997).

In 1999 a botanical and ecophysiological expedition has been organized by the professor's assistants and PhD students of the Department of Botany and Plant Physiology of the Szent István University. Now we are presenting the ecophysiological part of the scientific results of this research trip. One of the main objectives of our study was to detect the actual ecophysiological state of species which occupy different habitats and use various life forms of the wet evergreen forest ecosystem like giant and medium size trees (indigenous, often endemic species), shrubs, perennials, epiphytes, lianas and even weeds. The other goal was to test the usefulness of portable non-invasive chlorophyll-a fluorescence method for describing ecophysiological processes in tropical rainforest.

Materials and methods

Site description

The area chosen is the richest one in species and habitats in Tropical Asia and situated in the Northeastern tip of India. Namdapha National Park and Tiger Reserve (Changlang district, Arunachal Pradesh) is spread in an area of 1,850 km^2 rugged terrain. Though located at 27 degrees north from the Equator hence being in the sub-tropical zone has tropical climate, the higher parts of the reserve, which are mountainous and rugged, experience cold and temperate conditions around the year. Concerning for the climatic characteristics the average minimum and maximum temperature is 17.7 °C and 29.5 °C in the tropical zone, while 2.4–21.4 °C in cold humid areas. Similarly, rainfall is very variable — excessive in the tropical part (3000 mm) and scanty (1900 mm) in the higher reaches. The park receives heavy rain almost throughout the year and practically without any dry months. Perhaps no other conservation area in the world has a wider altitudinal variation than the Namdapha National Park that rises from 200 m to 4,571 m in the snow-capped mountain. This variation rises the growth of diverse habitats of flora and fauna. Another unique feature of Namdapha is its location at the junction of the Indian sub-continental biogeographic region and the Indo-China biogeographic region. The vegetation can be broadly classified into tropical wet evergreen, temperate and alpine depends on the elevation (200–4571 a.s.l.), but the tropical and subtropical evergreen forest predominate the area. Among others the low-land tropical wet evergreen forests of Namdapha National Park holds the largest *Dipterocarpus* forests in India and give shelters to huge number of rare, endangered and threatened taxa as well as a rich gene pool of indigenous crop plants along with their wild relatives and ecological variants, such as the wild banana (*Musa sp.*), citrus (*Citrus sp.*) and mango (*Mangifera indica*) (Hajra et al., 1996a & b). Nomenclature follows "A Contribution to the Flora of Namdapha" (Hajra et al., 1996a).

Methods used

The 26 species were selected from a wet tropical forest in the territory of the national park, described above. The *in situ* field measurements were performed within two days (24th and 25th of November, 1999), in two different but close places (the distance is 20 kms) near Deban and Miao village. During the measurements climatic conditions (RH: 78–82%, temperature: 23–25 °C), elevation (250–260 m a.s.l.) and forest type (wet tropical evergreen forest) were similar. Ecophysiological measurement was carried out on species which occupy different life forms in the rainforest ecosystem like giant and medium size trees (indigenous, often endemic species), shrubs, perennials, epiphytes, lianas and even weeds. The observed plant individuals grew either soliterly or in stand and there were stressed and non stressed species.

The investigation was carried out by a portable chlorophyll-a fluorometer (PEA, Hansatech, UK), which could be used as an effective non-destructive, *in* vivo probe of photosynthetic performance in a wide range of species from the mosses to the flowering plants. All experiments were performed on intact leaves after a 20 minutes dark adaptation. At least three repetition have been done on the individuals' leaves selected for measurement with identical position and light environment. The maximal photochemical efficiency of PS II (F_v/F_m) and the variable fluorescence decrease ratio ($R_{fd} = (F_m - F_s)/F_s$) measured at 695 nm were calculated from the clorophyll-a fluorescence induction kinetics (Lichtentaler, 1988).

Results and conclusions

Generally accepted that the species those F_v/F_m values higher than 0.800 have optimal photosynthesis (e.g. Lichtentaler & Rinderle, 1988), but species below this value probably are stressed. As *Fig.1* shows there is a significant difference between the F_v/F_m values of the stressed and non stressed species. For example this stressed plant is the epiphyte *Asplenium nidus* whose neighbour trees was cutted (except its host tree). This disturbance increased irradiation, decreased its photosynthetic activity and simultaneously caused higher evaporation. This noticeable separation between the species can be seen in *Fig.2* too where $(F_s - F_0)/F_0$ values below zero indicate adaptation to the changing environment like *Pterospermum acerifolium* and *Alangium chinense.* The above-mentioned two medium sized tree growing in stand naturally were seriously effected by clearing around them recently and during our measurement were at the beginning of adaptation. Another group contains the moderately stressed species with F_v/F_m values between 0.75–0.8 and those $(F_s - F_0)/F_0$ values are also low, around zero. Nevertheless the two third of the measured plants had normally high these two characteristic photosynthetic chlorophyll fluorescence values (Schreiber & Bilger, 1993). This clearly demonstrates that primary charge separation is more efficient in those plants which are growing in stand compare with solitary species of the rainforest. Further, the higher Fi values (data not shown) of the stressed specimens indicate a deceleration of the $Q_A \longrightarrow Q_B$ electron transfer within the photosynthetic electron transport. Consequently, the elevated proportion of Q_A^- (higher F_i) in the stressed group results in a larger fraction of closed reaction centres incapable of stable charge separation, and thus in a decrease in the light-limited quantum efficiency of the PS II photochemistry ((Schreiber et al., 1995).

Although R_{fd} parameter was previously interpreted clearly as "vitality-index" (characterises the potential photosynthetic activity of the leaves (Lichtentaler, 1988; Lichtentaler & Rinderle, 1988)) according to the *Fig. 3.* there is not so significant correlation between the R_{fd} parameter and the physiological state of the plants. Based on the R_{fd} values less species seems to be stressed than using F_v/F_m values. Additionally until the *Nephrolepis cordifolia, Dipterocarpus retusus* and *Bauhinia purpurea* species were part of the groups with optimal photosynthesis on the basis of F_v/F_m, according to the R_{fd} these species belongs to the seriously stressed group. Probably the F_v/F_m values reflect more accurately the physiological status of the plants furthermore R_{fd} value is not vitality, rather isolated fragment of non photochemical quenching (NPQ) during stress like in the mosses during desiccation (Csintalan et al., 1999).

The difference between the R_{fd} and F_v/F_m parameters is well noticeable in *Fig. 4.a* and *4.b* too. Comparing the taxonomically created groups in both case the *Dicotyledon* trees have the lowest values because amongs them were the most stressed species (this caused the great deviation). The only difference can be observed in the group of *Pteridophytes* but they contain the least stressed species therefore both photosynthetic parameters belong to optimal non-stressed physiological range.

Because of the importance, diversity and complexity of the tropical evergreen trees we have analyzed them separately (Fig.5). The species growing soliterly (the neighbour trees were cutted) have lower F_v/F_m and R_{fd} values, because they are just attending to adaptate for this stress. Amongs the soliter species the *Bauhinia* and *Dillenia* are widely distributed (in another vegetation types, too) and have stronger ecological tolerance so they can be adapted better to this stress and this can be seen in the higher F_v/F_m values. From the species growing in stand the *Magnolia* and *Aesculus* have the lowest F_v/F_m values because they did not reach their maximal size and therefore they not obtained optimal irradiance. The dominant species of this forest like *Dipterocarpus* and *Terminalia* had the highest F_v/F_m values.

Our field chlorophyll fluorescence measurements were able to demonstrate the physiological differences of the various life forms of the tropical evergreen forest and it seems to be feasible to detect stress responses caused either by naturally occuring stress factors or anthropogenic perturbations in an early, non-visible state. Therefore the chlorophyll a fluorescence method can be very useful both for monitoring the status of the vegetation in the nature conservation areas of the tropical region and for managing a sustainable forestry and to follow the effects of tropical deforestation.

Acknowledgements

This study was supported by grants from the SOROS Foundation Hungary (194-198/222/1999), the Hungarian-Indian Bilateral Intergovermental S&T Cooperation (TÉT, IND-11/2001), the MTA/INSA project, the Department of Botany and Plant Physiology of Szent István University and the Plant Ecology Research Group of Hungarian Academy of Sciences, at the Department of Botany and Plant Physiology, SZIE, Gödöllő.

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List & acronyms of investigated species (authors listed in the "A Contribution to the Flora of Namdapha" [Hajra et al., 1996]):

Pteridophytes
Asplenium nidus, ASP (Aspleniaceae)
Cyathea spinulosa, CYA (Cyatheaceae)
Nephrolepis cordifolia, NEP (Nephrolepidaceae)
Tectaria polymorpha, TEC (Tectariaceae)
Selaginella hookeri, SEL (Selaginellaceae)

Dicot trees
Aesculus assamica, AES (Hippocastanaceae)
Alangium chinense, ALA (Alangiaceae)
Bauhinia purpurea, BAU (Caesalpiniaceae)
Dillenia indica, DIL (Dilleniaceae)
Dipterocarpus retusus, DIP (Dipterocarpaceae)
Magnolia hodgsonii, MAG (Magnoliaceae)
Pterospermum acerifolium, PTE (Bombacaceae)
Terminalia myriocarpa, TER (Combretaceae)

Dicots:
Ageratum conyzoides, AGE (Asteraceae)
Bidens pilosa, BID (Asteraceae)
Boehmeria glomerulifera, BOE (Urticaceae)

Clerodendrum colebrookianum, CLE (Verbenaceae)
Lantana camara, LAN (Verbenaceae)
Laportea terminalis, LAP (Urticaceae)
Mikania macrantha, MIK (Asteraceae)
Oxyspora paniculata, OXY (Melastomataceae)

Monocots
Bambusa tulda, BAM (Poaceae)
Colocasia fallax, COL (Araceae)
Commelina paludosa, COM (Commelinaceae)
Costus speciosus, COS (Costaceae)
Musa velutina, MUS (Musaceae)

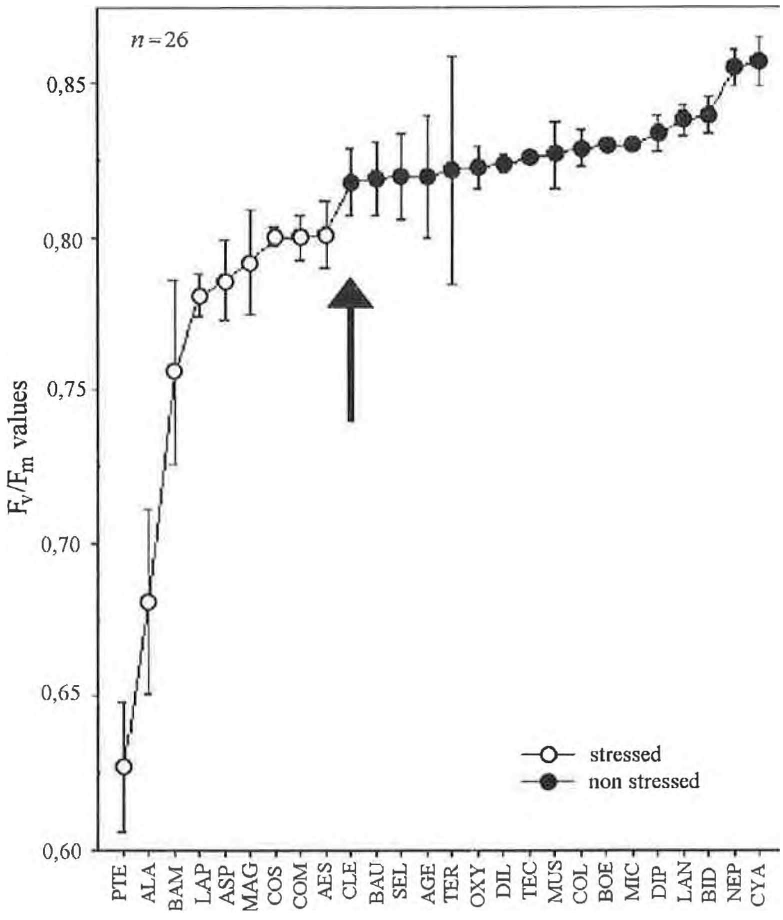

Fig.1 Chlorophyll fluorescence F_v/F_m ratios measured at 695 nm of the investigated species in the wet evergreen forest (24–25/11/1999; Deban & Miao, Arunachal Pradesh, India)

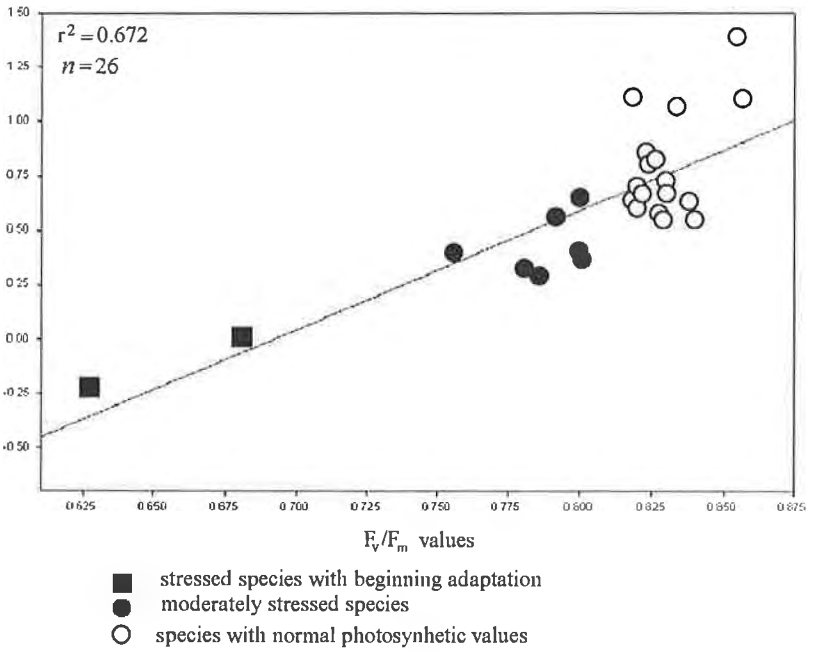

Fig.2 Correlation between the chlorophyll fluorescence F_v/F_m ratios and the chlorophyll fluorescence decrease ratio (R_{fd}) values measured at 695 nm of the investigated species in the wet evergreen forest (24–25/11/1999; Deban & Miao, Arunachal Pradesh, India)

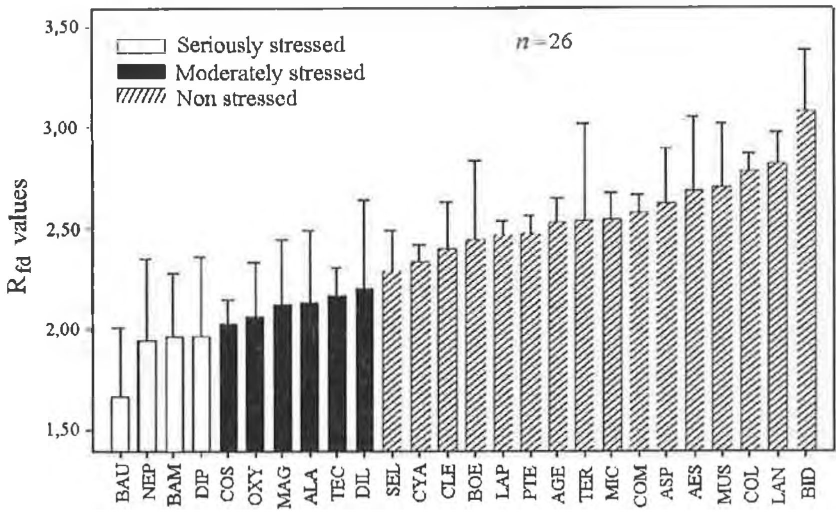

Fig.3 The average values of chlorophyll fluorescence decrease ratios measured at 695 nm (R_{fd}) of the investigated species in the wet evergreen forest (24–25/11/1999; Deban & Miao, Arunachal Pradesh, India)

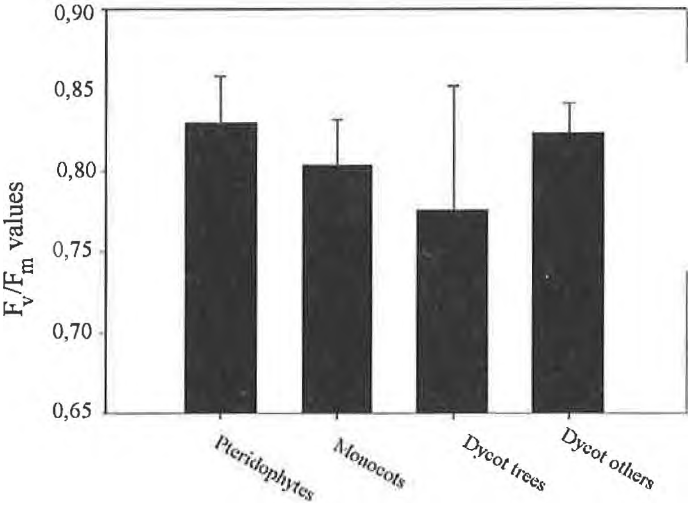

Fig.4.a The average values of chlorophyll fluorescence F_v/F_m ratios of various ecological groups of the measured species in the wet evergreen forest (24–25/11/1999; Deban & Miao, Arunachal Pradesh, India)

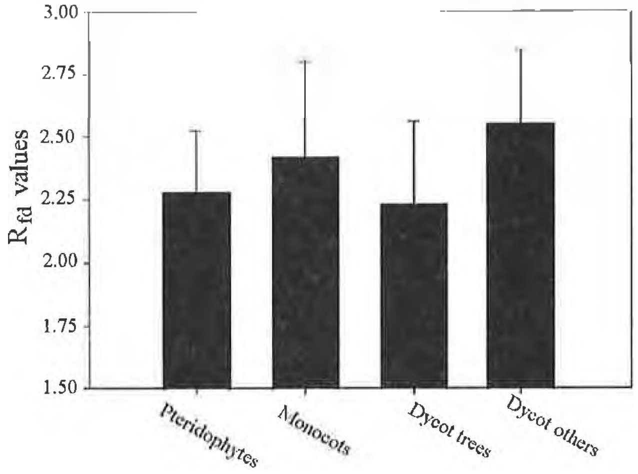

Fig. 4.b The average values of chlorophyll fluorescence decrease ratios measured at 695 nm (R_{fd}) of various ecological groups in the wet evergreen forest (24–25/11/1999; Deban & Miao, Arunachal Pradesh, India)

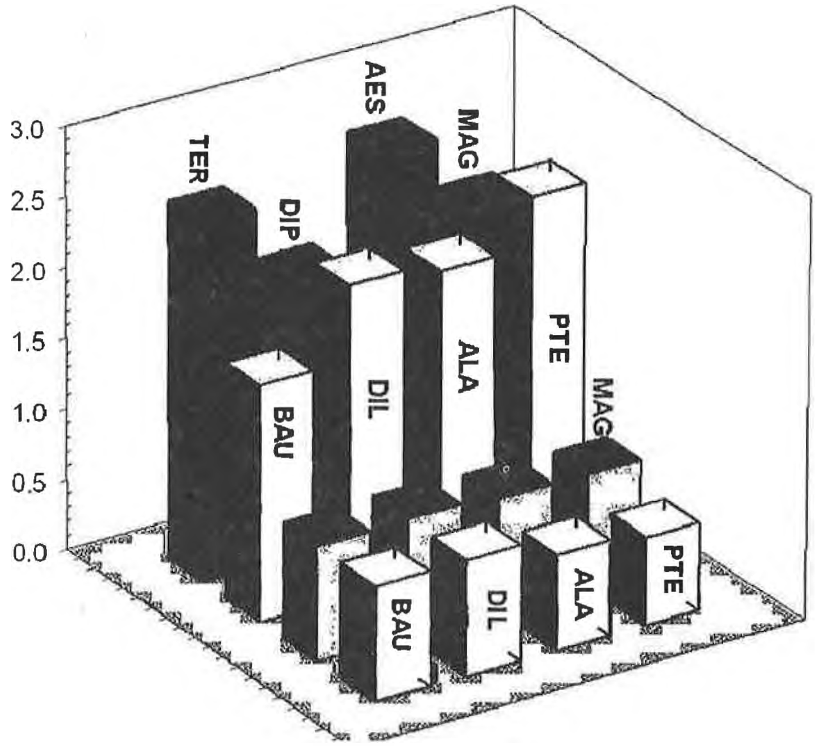

Fig.5 The average values of chlorophyll fluorescence F_v/F_m ratios and chlorophyll fluorescence decrease ratio (R_{fd}) values measured at 695 nm of the investigated tree species in the wet evergreen forest (24–25/11/1999; Deban & Miao, Arunachal Pradesh, India)

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Contribution to the Biology and the Vegetation Ecology of Heracleum mantegazzianum Populations in West Transdanubia (Hungary)

Kovács, J. A.
BDF, Növénytani Tanszék
`kja@deimos.bdtf.hu`

Abstract. The study dealing with the development, spreading, ecology and cenological relation of *Heracleum mantegazzianum* invasive stands distributed alongside the stream Borzó, West Transdanubia (Hungary). It was demonstrated that the spreading strategy is influenced by the phenology and structure of populations, distinguished a juvenile phase and an adult phase (flowering and fruiting only once before senesting). The regenerative growth is restricted to the vegetative (juvenile) phase. The original diaspore spreading is the passive autochory, completed occasionally by the hydrochoric and antropochoric spreading.

The *H. mantegazzianum* stands phytosociologically belong to the classes of *Galio-Urticetea, Artemisietea, Molinio-Arrhenatheretea.* The ceno-ecological role of the species and the *Heracleum mantegazzianum* derivate community are well expressed by the ecology of the species *Aegopodium podagraria* and *Urtica dioica.* In the studied area, the Giant Hogweed populations prefer fresh and moist sites, moist roadsides, riparian habitats with good nutrient level realized by the alliance of *Senecion fluviatilis.*

Introduction

During the years 1993–1994, when we explored and studied the flora and vegetation of Vas county, overviewed and summarised the ecology, floristic composition and the distribution of natural, seminatural and antropogenous plant communities in the area of western Hungary, our attention was attracted by some tall giantiform plant populations of *Apiaceae*, spreaded alongside the stream Borzó, in fresh and moist sites, damp places and waste ground, forming sometimes dominant riparian stands between the localities Vép and Bozzai (HU: 8766/3, 4). After futher investigation on the interesting plant material, it has been registrated to the *Heracleum mantegazzianum* agg. (Kovács 1996, Kovács–Takács 1997).

At the III. Conference of the "Actually Studies on the Flora and Vegetation in Hungary" (Szombathely, 1999) we presented our first observations and results about the floristical, ecological and phytosociological aspects regarding the Giant Hogweed population in West Transdanubia. The present paper continues to give other scientific aspects, regarding especially the taxonomy, development, communities and vegetation ecology of the Giant Hogweed invasive populations naturalized alongside the stream Borzó (West Hungary).

Heracleum mantegazzianum is a native herbaceous species of the subalpine zone (from 1,700 to 2,300 m) in the Caucasus Mountains and south-west Asia, which became naturalized in Central Russia and Europe in the nineteenth century (Hegi 1965, Tiley et al. 1996). It was introduced to Western and Central Europe around 1850 as an ornamental plant into gardens and parks, from which the escapes and colonization have been realized along the watercourses in many countries (Lundström 1984, Clegg, Grace 1974, Pysek 1991). In the last decades the general distribution has increased especially alongside the river-banks, streams, damp places and waste grounds. Secondary spread reflects strong antropogenic influences on the landscape and occurs in wet meadows, eutrofied forests, roadsides, railway tracks, refuse dumps, generally nitrophilous sites and vegetation, fresh to moist sites with high nutrient levels.

Nowadays Giant Hogweed is considered in Europe as an invasive alien herbaceous perennial, as a neophyta and ergasiophyta species with a continuous increasing distribution, being found and marked in most European countries: Austria, Belgium, British Isles, Czech Republic, Denmark, Finland, France, Germany, Hungary, Ireland, Italy, the Netherlands, Norway, Russia, Slovakia, Sweden, Switzerland, Ukraine (Andersen 1996, Clegg and Grace 1974, Ludström 1984, Oschmann 1996, Pysek 1991, Soó 1980, Tiley et al. 1996).

Taxonomical aspects

The type of species was described as *Heracleum mantegazzianum* by Sommier and Levier in 1895 (Brummitt 1968), nevertheless more descriptive names have been used: *H. giganteum* Fischer ex Hornem, *H. villosum* Fischer ex Sprengel, *H. speciosum* Weinm., *H. persicum* Desf. ex Fischer, *H. asperum* Bieb., *H. caucasicum* Steven, *H. stevenii* Manden., *H. pubescens* (Hoffm.) Bieb., *H. sibiricum* Sphalm etc. So, some confusions may exist in the earlier literature between similar related species. After Brummitt (1968) the taxonomy and nomenclature of naturalized Giant Hogweeds populations from south-western Asia are not uniform. Morphologically the populations can be very variable and the *H. mantegazzianum* group probably includes also the distinct but occasionally naturalized types like *H. lehmannianum* Bungle, H. persicum Desf. and H. wilhelmsii Fischer et Avé-Lall.

The typical *H. mantegazzianum* forms are biennial or perennial monocarpic herbs, the stem up to 10 cm thick at the base and 2-5 m tall, hollow, ridged. The leaves blades up to 250–300 cm, ternately or pinnately divided in varying degree, pinnately lobed. Flowers in compound umbels up to 50 cm in diameter, with 50–150 unequal rays, the terminal umbel is largest, petals are white or rarely pinkish, the fruits 9–14 mm are glabrous or villous dorsally compressed with two wigned mericaps. Some of the main characteristics of the related taxa are the following (Brummitt 1968, Stace 1992):

Characters	H. mantegazzianum	H. pubescens	H. persicum
Stem height [cm]	200–500	60–80	80–250
Umbels wide [cm]	20–50	10–12	20–50
Umbels rays [No]	50–150	15–20	50
Leaves form	pinnate, ternate or simple, ternately to pinnately lobed	ternate to pinnate, the segments pinnately lobed	pinnate or ternate, the segments more divided

The botanical literature related to the Giant Hogweed populations naturalized mostly in Northern, Western and Central-Europe indicates them to belong to one taxon only, *H. mantegazzianum* Sommier et Levier. Earlier names used in different countries probably refer also to this taxon. Hybrids described in England and recorded also in Germany: *H. sphondylium* × *H. mantegazzianum* (Stace 1992, Oschmann 1996). Several references point out the relationship between chemical composition and photodynamic properties of furanocumarins that produced phytodermatitis in man (Camm et al. 1976, Tiley et al. 1996).

In Hungary data about the subspontaneous spreading and the first naturalized records of Giant Hogweed were indicated by Soó (1966 without localities) and published with localities (Zirc, Szombathely, Szarvas) also by Soó (1980, apud Priszter), and Priszter (1978). The main Hungarian references to the *Heracleum mantegazzianum* group are the following:

- 1925: "Established once near Budapest also the *H. persicum* Desf." (Jávorka, S. 1925, p. 792.)
- 1951: "*H. mantegazzianum* Somm. et Lev.: the leave blades are ternately or pinnately divided on 3–5 lobes, very larges (mostly 1,5–3,0 m), fruits villous and prickled, giant ornamental plant. *H. persicum* Desf.: once adv. (Bpest +)" (Soó, R., Jávorka, S. 1951, I. 425.)

- 1966: "*Heracleum persicum* Desf. 1840 (*H. trichocarpum* Borb 1879). Originated from Persia H., once ornamental plant, running wild (Budapest +), ephemerophyta" [...] "*H. Mantegazzianum* Somm. et Lev. 1894. Caucasian species, tall stature ornamental plant sometimes escaped. H. July–August, 2n: 22" (Soó, R. 1966, II. p. 487.)
- 1980: "*H. Mantegazzianum.* Subspontaneous in localities: Zirc, Szombathely, Szarvas (Priszter, Sz.)" (Soó, R. 1980, VI. p. 69. Addenda et corrigenda ad tomus I–IV.)
- 1994: "*H. mantegazzianum* (*H. sosnovskyi* ?). Frequent in the floodplain area of the river Tisza between Tiszabecs and Tiszacsécse" (Fintha, I. 1994, p. 130.)
- 1995: "Spreading of subspontaneous *Heracleum* species in Europe" (Terpó, A. 1995, Summary, p. 41.)
- 1996: "*Heracleum mantegazzianum* Sommier et Levier., Őriszentpéter: near the river Zala. ap. Bálint et al. 1993" (Balogh, L. 1996, Savaria 23/2, p. 299.)
- 1996: "*Heracleum mantegazzianum* Somm. et Lev., Vép-Bozzai, Szombathely-Kámon: spreading invasive populations" (Kovács, J. A. 1996., incl. Molnár, Zs. 1996/1997 Diss. p. 49.)
- 1997: "*H. mantegazzianum* Somm. et Lev., Keszthely: spreading invasive populations" (Dancza, I. 1997, Kitaibelia 2 (2): p. 213.)
- 1997: "*H. mantegazzianum* Sommier et Levier, Vép-Bozzai: spreading invasive populations" (Kovács, J. A., Takács, B. 1997, Kitaibelia 2 (2): p. 222.)
- 2000: "*H. mantegazzianum* Somm. et Lev. (*H. sosnovskyi* Manden. ?). Subspontaneous in the floodplain area of the river Tisza between Tiszabecs and Tiszacsécse ap. Terpó, A. In: Fintha, I. 1994" (Simon, T. 2000, p. 290.)

After the year 2000, other new records have been indicated (Bauer 2001, Balogh et al. 2002). However, the main recent distribution patterns recorded in the Central European Mapping System are the following: 8766/3, 4 (Vép-Bozzai), 8773/1 (Zirc, Csesznek), 9269/1 (Keszthely), 8281/3 (Vácrátót), 8085/3 (Mátraszentistván), 7802/4 (Tiszabecs–Tiszacsécse). Terpó's opinion (1994, 1995) is interesting about the origin and registration of the records especially from the NE Hungary, alongside the river Tisza on the Hungarian–Ukrainian border region. It is possible that this plant material belongs to the *H. sosnowskyi* Mándenová. This species has been cultivated and used in Poland, Russia and Ukraine as forage silage for cattle. Subspontaneous populations have been also reported in Russia and Ukraine. The populations require further investigation. A summary about the Hungarian contributions is given by Dancza (2003).

Development and phenology

In order to have reliable and thorough documentation on the development and phenology of the Giant Hogweed plant individuals and stands, we organized field observation and laboratory studies on the plant material situated in the strictly floodplain area of the stream Borzó, between Vép and Bozzai with the field characteristics: altitude with 178–184 m, the mean annual temperature is 9.3 °C, the annual rainfall is 750 mm, wet, streamside riparian vegetation (West Transdanubia). The survey organized in the period of 1997 to 1999 mainly demonstrated that the populational structure shows a charecteristic composition because in every small population without the new annuals can be present biennal, triennal and also perennial plants (Kovács 1999). They differ morphologically and physiologically. One of the phenological characteristics of the perennial *H. mantegazzianum* plant individuals is that they have a vegetative, juvenile phase and another, adult phase (flowering and fruiting only once before senescing). The regenerative growth (after cutting etc.) is restricted only to the vegetative (juvenile) phase, the adult plants with leaves and flowers, after flowering and fruiting become senescence. This situation contributes to the realization of an own populational structure, which influences the strategy of spreading.

Our observation on the development and phenology has summarized the development of plant individuals from seeds, development of perennial individuals and the distribution of diaspore, the distribution of seedlings around the senesced mother plats (Figures 1–3).

The development of plant individuals from seeds, the seedlings and the juvenile phase establishment can be observed in Fig. 1. The initial growth from seeds, the seedling stage is generally slow, the seedlings emerge with cotyledons and the primary leaf in 7 to 8 weeks after a long winter frost period, the second leaf appearing after around 12 weeks (about 20 March), the juvenile phase finishes after 18 to 19 weeks (early May). The new true leaves and the leaves rosette develop from May to the end of June with a maximum vegetative development in the second part of June. The new (annual) plant individuals do not realize a generative phase. In the second and subsequent years, leaf growth becomes expansive, more competitive.

The development of perennial individuals (Fig. 2) in the vegetative phase (weeks 12 to 19, generally from 15th March to 30th April) is similar to the development of juvenile plants developed a year ago, but normally is followed by the generative phase (middle of June). Flowering depends on the plant vigour of previous vegetative growth, extends in the observed field from 10th to 25th June, the fruit ripening is realized during July and August, beginning with the main terminal umbel. The seed dispersal occurs from August to the first part of October. It is very important, that after flowering and seed spreading the whole plant becomes senescent and including the roots also, normally dies. The flowering plants cut above the roots or having different damages, may survive in the same year and in the next vegetative season. The plants removed at the first node, can develop secondary flowering shoots, or following further disturbance, many individuals were able to produce a third inflorescence, without seed development. This regenerative growth also permits the grazing possibilities in the field (Andersen, Calov 1996).

The spreading success of the *H. mantegazzianum* individuals, the species' competitive ability depends on the diaspora dispersal. An original way for seed dispersal is the passive autochory realized by the solitary old plants. We studied and demonstrated this by measuring the radial distribution of seedlings around the dead mother plants (Fig. 3). Counting the germinated seeds in the neighbourhood of old mother plants in an area of 900 cm^2, a great density of seedlings (80–92) has been found between 50–120 cm from the senesced stem of a mother plant. From this distance the number of seedlings decreases continuously especially after 200 cm. At 300 cm distance the percent of germinated seeds is very slow. The seedling production is influenced by the frost in winter period. In the studied area, the germination was very early in spring, during March, influenced by local temperature and light conditions. In a distance of 200 cm around the dead mother plant there was a high seedling density, able for new propagation.

The dying mother plants create favourable condition for the establishment of the new annuals. This "autochory", realized step by step, contributes to the slowly but efficient plant propagation and creates fragmentary populations in the disturbed field. The seeds are relatively heavy (12,000 g/1,000 mericarps), so after our observation the wind dispersal (the diaspore propagation in an anemochoric way) is less important. The long distance dispersal usually can be realized by "hydrochoric" and "antropochoric" form. The hydrochoric dispersal has a greater efficiency. The floating mericarps can be transported by water courses to long distance. This way occurs a central establishment of the popoulations in the Vép-Bozzai area. The antropochoric dispersal, realized by various human activities, like the use of cars, trucks, buildings, exchange of plant materials etc. plays an important role in the spread of populations. In the expansion of a population in the studied field, in a local area, all these dispersal types have been recognized. The realization of new populations starts usually by autochory. 5 to 6 dying mother plants ensure in cca 100 m^2 the development of a high density of seedlings, followed by new adults with high interspecific competition ability. The new plant group can remain dominant for few years, transforming the original habitat conditions. The giant plants with high covering, shade the land ensuring the progress of colonization. The large populations by watercourses and different human activities (hydrochoric and antropochoric spreading) contribute to the realization of other populational fragment and new stands. The high seed production (about 5,500 diaspores in a primary umbel), the particular dispersal strategies, the huge persistent seed bank increase the species' competitive abilities.

Vegetation ecology and cenological relations

In order to establish the ecological and phytocenological role of *H. mantegazzianum* invasive populations in West Transdanubia, our survey has regarded the vegetation structure alongside the stream Borzó and surroundings, an area situated between the localities Vép and Bozzai-Bárdos (Vas county). The stream Borzó (or Kozár-Borzó) coming from the North, springs from the Kőszeg area, but from this region to the locality Vép, no plant of Giant Hogweed was found. The first plant individuals start to appear only after the Arboretum in Vép, after behind the small bridge and continuing their distribution to the Bozzai (see Vegetation map). In this section of the stream Borzó, about 19 plant communities have been mapped (Fig. 4) belonging to the freshwater aquatic vegetation, swamps, mesic meadows, moist and wet eutrophic grassland, roadside ruderal vegetation, antropogenous moist fringe vegetation, willow woodlands, temperate woodlands etc (see Vegetation map).

The populations of *Heracleum mantegazzianum* alongside the stream Borzó are the most frequent colonizers in disturbed habitats, open areas, occupated riparian sites and also invade the closed semi-natural and ruderal communities like: *Phragminetum communis, Filipendulo-Geranietum palustris, Tanaceto-Artemisietum, Urtico-Convolvuletum, Sambucetum ebuli, Salicetum albae-fragilis, Aegopodio-Alnetum* and uncultivated lands (Fig. 4, Vegetation map). The size of Giant Hogweed populations is variable in different plant communities, covering from 10–15% to 75–80%, realizing also stands for the own derivate community (DC: *Heracleum mantegazzianum*) (Tab. 1). It is interesting to note, that the populations from Vép to the bridge of Tanakajd can be considered the smallest, while others, especially those situated in the shaded, moist habitats, in northern exposition of the Bozzai section, the largest and very expressive. The highest density and covering are realized in the DC-community (75–90%) (Tab. 1).

The stands with *H. mantegazzianum* alongside the stream Borzó belong to the phytosociological Classes of *Galio-Urticetea, Artemisietea* and

Molinio-Arrhenatheretea. They are characterized by the dominance of *H. mantegazzianum* followed by *Urtica dioica, Aegopodium podagraria, Glechoma hederacea, Galium aparine, Anthriscus sylvestris, Calystegia sepium, Rubus caesius* (Tab. 1). The typical stands have been incadrated in the Class of *Galio-Urticetea*, but some of them realize facies in the communities: *Urtico-Convolvuletum, Filipendulo-Geranietum palustris, Sambucetum ebuli* etc. Within the recorded samples, a small difference can be observed. In the samples 1–8, the Giant Hogweed A–D values are very high (75–90%), while in the samples 9–10, the A–D values arrive only to the 50%. The ecological role of *H. mantegazzianum* is well expressed by the constancy of the species: *Aegopodium podagraria* and *Urtica dioica.* They are useful ecological and cenological indicators for the derivate community. It means that the Giant Hogweed populations in the studied area prefer fresh and moist sites, moist roadside, riparian habitats with a good nutrient level (Kovács 1994, 1999), while eutrophication has occured by antropogenic influences realized mainly by the alliances *Senecion fluviatilis, Aegopodion podagrariae, Deschampsion* (degraded stands), *Arrhenatherion* (degraded stands).

Approaching ecological and cenological relations have been demonstrated in the British Isles, Germany and Czech Republic (Dierschke 1984, Oschmann 1996, Pysek 1994, Tiley et al. 1996), the invasive populations of *H. mantegazzianum* being included generally in the Classes of *Artemisietea* or *Galio-Urticetea.* We may also mention the work of Klauck (1988) from Germany, who proposed and described a new nitratophytic plant community, spreaded near settlements: *Urtico-Heracleetum mantegazzianii*, which are related to *Urtico-Aegopodietum* and have been included in the Ord. *Glechometalia hederaceae.* To accept this community in our case is questionable, because in the given rélevées there are separate different species.

Instead of this situation, in the original habitats of *H. mantegazzianum* in West Caucasian Mountains the cenological relations are totally different. The species belong to the Class *Betulo-Adenostyletea* spread with other mountain species like: *Vaccinium arctostaphylos, Rhododendron caucasicum, R. ponticum, Lilium caucasicum* etc.

Conclusions

The presence of subspontaneous *Heracleum mantegazzianum* populations from ornamental garden plants in Hungary has been recorded by Soó ap. Priszter (1966, 1980). The first escapes were related to the neighbourhood of Arboretums. Other escaped and naturalized populations originate from forage introductions. Therefore the plant materials taxonomically can be different.

The survey realized about the West-Transdanubian *H. mantegazzianum* stands near Vép-Bozzai, distributed alongside the stream Borzó, demonstrated interesting features of development, spreading, ecology and cenological relations. It was pointed out that the phenology of populations developed from seeds and perennial sources, distinguished juvenile, vegetative, generative, fruiting and dispersal phases. An original diaspore spreading is the passive autochory. 5 to 6 dying mother plants ensure on cca 100 m^2 the development of a high density of seedling. The dispersal especially for long distance is completed occasionally by hydrochoric and antropochoric spreading.

The stands with *H. mantegazzianum* along the stream Borzó phytosociologically belong to the Classes of *Galio-Urticetea, Artemisietea* and *Molinio-Arrhenathereatea*. The derivate community of *H. Mantegazzianum* mainly is characterized by the species: *H. mantegazzianum, Urtica dioica, Aegopodium podagraria, Glechoma hederacea, Galium aparine, Anthriscus sylvestris*. The ceno-ecological role of *H. mantegazzianum* is well expressed by the constancy of the species *Aegopodium podagraria* and *Urtica dioica*. The Giant Hogweed populations in the studied area prefer fresh and moist sites, moist roadsides, riparian habitats with good nutrient levels, realized especially by the alliance of *Senecion fluviatilis* and *Deschampsion* (degraded stands).

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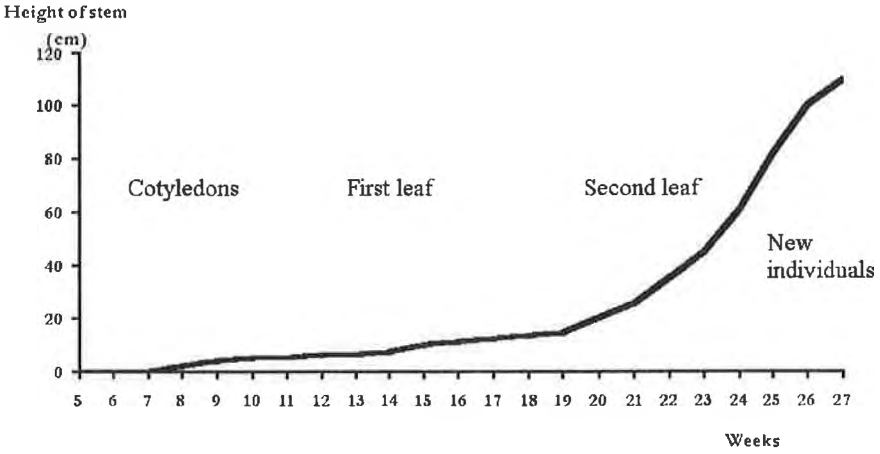


Fig.1 Development of plant individuals from seeds (10.03.–15.06. 1999)

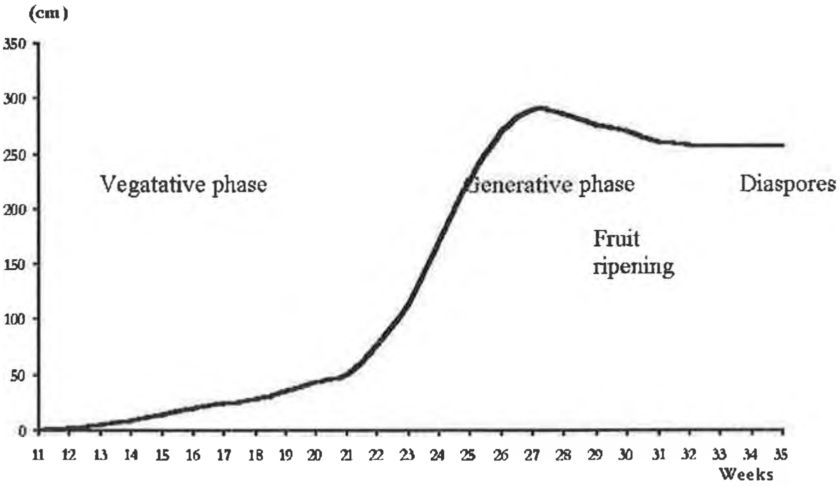


Fig.2 Development of perennial individuals (15.03.–31.08. 1999)

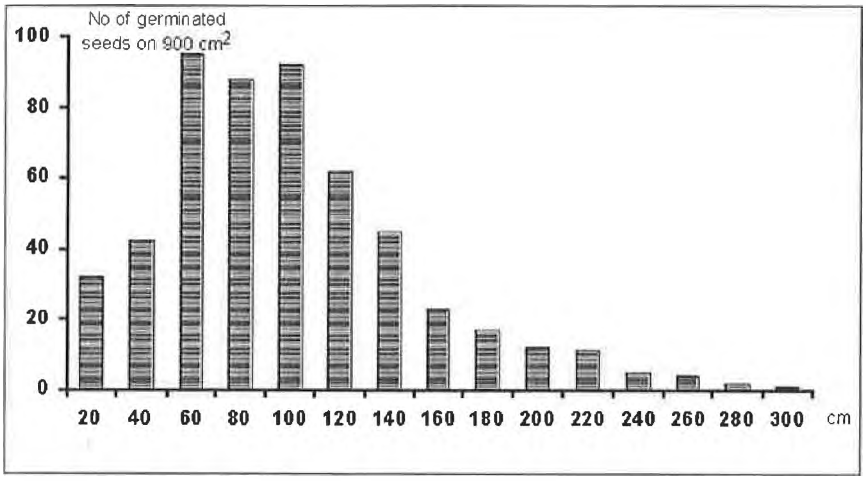


Fig.3 The distribution and distance of seedlings around the senesced mother plant

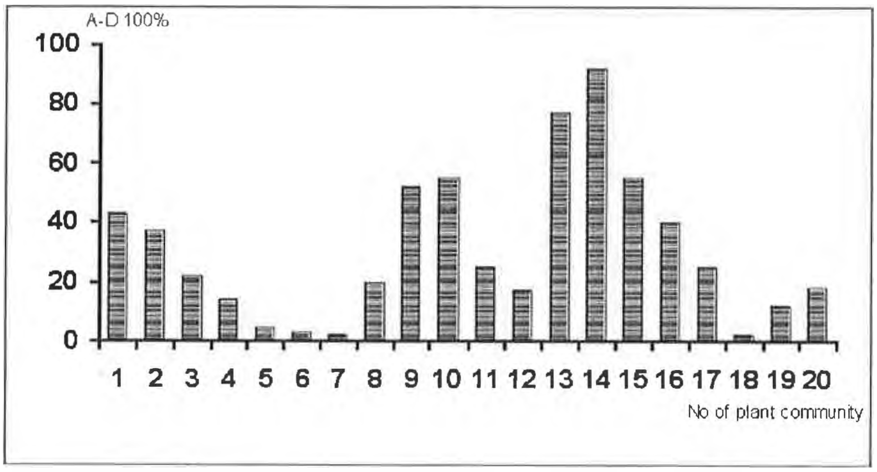
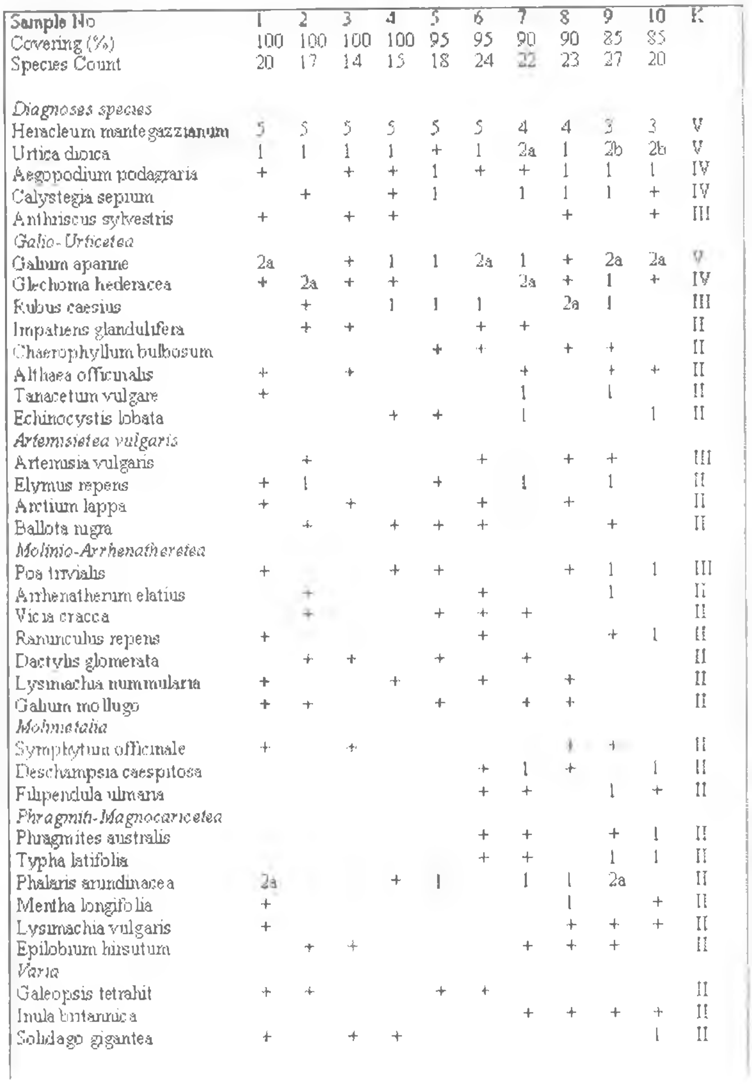


Fig.4 Cenological relations of Heracleum mantegazzianum populations alongside the stream Borzó

Table 1. The *Heracleum mantegazzianum* Galio-Urticetea derivate community alongside the stream Borzó between Vép-Bozzai (West Transdanubia, Hungary, 06–07. 1999).



Sample No	1	2	3	4	5	6	7	8	9	10	K
Covering (%)	100	100	100	100	95	95	90	90	85	85	
Species Count	20	17	14	15	18	24	22	23	27	20	
Diagnoses species											
Heracleum mantegazzianum	5	5	5	5	5	5	4	4	3	3	V
Urtica dioica	1	1	1	1	+	1	2a	1	2b	2b	V
Aegopodium podagraria	+		+	+	1	+	+	1	1	1	IV
Calystegia sepium		+		+	1		1	1	1	+	IV
Anthriscus sylvestris	+		+	+				+		+	III
Galio-Urticetea											
Galium aparine	2a		+	1	1	2a	1	+	2a	2a	V
Glechoma hederacea	+	2a	+	+			2a	+	1	+	IV
Rubus caesius		+		1	1	1		2a	1		III
Impatiens glandulifera		+	+			+	+				II
Chaerophyllum bulbosum					+	+		+	+		II
Althaea officinalis	+		+				+		+	+	II
Tanacetum vulgare	+						1		1		II
Echinocystis lobata				+	+		1			1	II
Artemisietea vulgaris											
Artemisia vulgaris		+				+		+	+		III
Elymus repens	+	1			+		1		1		II
Arctium lappa	+		+			+		+			II
Ballota nigra		+		+	+	+			+		II
Molinio-Arrhenatheretea											
Poa trivialis	+			+	+			+	1	1	III
Arrhenatherum elatius		+				+			1		II
Vicia cracca		+			+	+	+				II
Ranunculus repens	+					+			+	1	II
Dactylis glomerata		+	+		+		+				II
Lysimachia nummularia	+			+		+		+			II
Galium mollugo	+	+			+		+	+			II
Molinietalia											
Symphytum officinale	+		+					+	+		II
Deschampsia caespitosa						+	1	+		1	II
Filipendula ulmaria						+	+		1	+	II
Phragmiti-Magnocaricetea											
Phragmites australis						+	+		+	1	II
Typha latifolia						+	+		1	1	II
Phalaris arundinacea	2a			+	1		1	1	2a		II
Mentha longifolia	+							1		+	II
Lysimachia vulgaris	+							+	+	+	II
Epilobium hirsutum		+	+				+	+	+		II
Varia											
Galeopsis tetrahit	+	+			+	+					II
Inula britannica							+	+	+	+	II
Solidago gigantea	+		+	+						1	II

Conium maculatum		+	.	.	+	+					II
Scrophularia umbrosa	.	.	.	.	.	+		+			II
Equisetum sylvaticum				+	+	+			+	+	II
Persicaria hydropiper						+		I	+		II
Lamium maculatum		+	+	.	.	+	+	.	+		II

Species present only in one-two samples: Poa pratensis + (1), Caltha palustris + (9), Ranunculus ficaria + (2), Poa annua + (8), Heracleum sphondylium + (5), Cichorium intybus 3 (4), Lamium album + (3), Galium verum + (2), Taraxacum officinale + (4), Humulus lupulus + (8), Cirsium vulgare + (3), Saponaria officinalis + (7), Angelica sylvestris + (6), Calamagrostis epigeios + (6), Humulus lupulus + (10)

Vegetation map

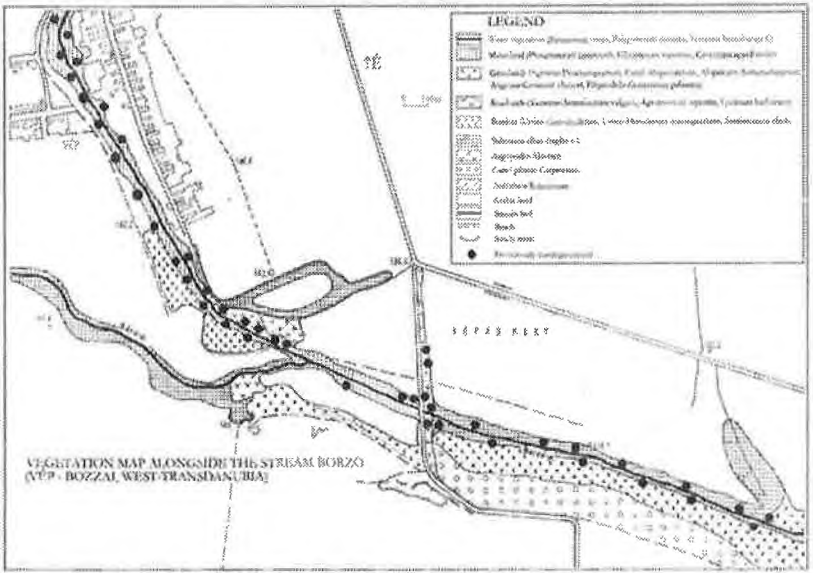

LEGEND
VEGETATION MAP ALONGSIDE THE STREAM BORZÓ
(VEP - BOZZAI, WEST-TRANSDANUBIA)

Photo: *Heracleum mantegazzianum* Sommier et Levier giant plant individual alongside the stream Borzó (Vép-Bozzai)

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Electronic botany in research and teaching (Case studies)

Szabó, A. T.
University of Veszprém, Institute of Biology, Hungary
`szta@almos.vein.hu`

Abstract. Electronic botany (E-botany) is a new phenomenon in the history of botany. It is a new approach, different from previous botanical information processing, storage and transmission possibilities. E-botany has influence on data management in taxonomy (nomenclature, systematics), plant genetics, phylogenetics and evolution, study of plant biodiversity, plant genetic resources, conservation, plant physiology, palynology, paleoclimatology global ecology, agrobotany, history of botany etc.

The paper reviews the main trends in E-botany by case studies focused on three high ranked journals: one of general international scientific information (*Science*), one of dealing with specific information in plant taxonomy (*Taxon*) and a Hungarian botanical periodical (*Acta Botanica Hungarica*), as well as presenting a case used by a graduate student writing her essay in systematic botany on *Lilium*.

The journal *Science* reviewed regularly relevant scientific websites, but was relevant for E-botany especially from an interdisciplinary point of view.

E-botany presented in the journal *Taxon* was focused on specific topics and practiced only by a restricted groups of authors.

In *Acta Botanica Hungarica* the new trends were reflected by a home page presenting the content of the journal on the Web.

The high possibilities of the E-botany was illustrated with the case of selected homepages dealing with *Lilium* cytology, anatomy, taxonomy, nomenclature, systematics, genetics, evolution and cultivation.

Introduction

Taxonomy represent the beginnings of biological informatics. But a taxonomical information is not just biological, it also a "legal" one: an official taxon name is a document of an official act ruled by international codes of nomenclature. Taxonomic papers may loose their biological content, but never will lose their formal, "legal" content as such documents. This is one of the main differences between a conventional research paper and a taxonomical one and the main reason to adopt electronic methods in "taxonomical bioinformatics" (Gradstein et al. 2001, Minelli 2003, Wilson 2001).

Electronic botany (E-botany) is a new phenomenon in the history of botany (Szabó 1990, Szabó et Biró 2000, Tóthmérész 1999/2001, Townsend 2002). It is not just a new method, but it is a new approach, a new way of thinking, which is quite different from previous information processing, storage and transmission possibilities. Influences international research cooperation (eg. in access to scientific literature cf. Weston 2002), in computerised bryophyte collections, cf. Annon. 2003), plant molecular systematics (Crafword 2000), botanical documentation e.g. the Global Taxonomy Initiative (Creswell et Bridgwater 2000), omega taxonomy (Winsor 2000), E-publication (Ceska 1995–, Gewin 2002, Schmid 2003) , data management (Wolpert 2002), traditional and distance teaching and learning (Wilson et Manhart 2001).

E-botany has influence on data management in taxonomy (nomenclature, systematics), plant genetics, phylogenetics and evolution (Hey 2001), study of plant biodiversity (Wilson 2000), plant genetic resources, conservation, plant physiology, palynology

`www.geo.arizona.edu/palynology`,

paleoclimatology and global ecology (Adams 2001,

`www.sciencemag.org/cgu/content/full/`),

agrobotany (The Mansfeld Database:

`http://mansfeld.ipk-gatersleben.de`),

plant phenology (Fitter et Fitter 2002), history of botany (Szabó 2003a,b) etc.,

`www.esd.ornl.gov/projects/qen/`.

The first prognoses for the advent of E-botany started around 1990, but the preparatory phase for this developments has been initiated earlier by starting the periodical BioTár (1988), which developed later on *BioTár Electronic (BTE)*. E-monitoring of the Web started around 1992 with a preparatory phase in the GOPHER system. This was continued first in 1995/1996 within BTE edited in Szombathely (`http://genetics.bdtf.hu`), transferred later to Veszprém (Szabó 1983, 1988–, 1996–, 2002–).

The aim of this paper is to review the main trends in of E-botany in plant taxonomy around the turn of millennium in a case study focused on three high ranked journals: one of general international scientific information, one of dealing with specific information in plant taxonomy and a Hungarian botanical periodical of great traditions. The traditions of this periodical is derived from a period of Hungarian science history important even for world science (Smil 2001). From our point of view is worth to note now just the 100^{th} anniversary of the birth of the founder of the modern computer theory, that of John von Neumann (1903–1965?).

Materials and methods

Materials: The following journals have been used for the case study:

1. *The NetWatch* series of the leading scientific journal Science published in Washington D.C., USA by the American Association for the Advancement of science *Science*, focused on general international scientific information (Kaiser 1998–2001, Leslie M. 2002–)

`www.sciencemag.org/cgu/content/full/`

2. *Taxon* published in Vienna by the International Association for Plant Taxonomy focused on to systematic and evolutionary biology with emphasis on botany (Editor-in-Chief T.F. Stuessy, Associate editors E. Hörandl, V. Mayer)

`http://www.botanik.univie.ac.at/iapt/taxon/index.htm`

3. *Acta Botanica Hungarica*, a Hungarian botanical periodical of great traditions, a leading Hungarian botanical periodical (Editor-in-chief A. Borhidi, Managing Editors: L. Lőkös, L. Peregovits 1999–2003)

`http://www.akkrt.hu/journals/abot.`

4. The methodology was that adopted earlier, completed recently during the editorial work of *BioTár Electronic. Science NetWatch* was monitored weekly beginning with 1998, *Taxon and Acta Botanica Hungarica* were monitored for E-botany quarterly beginning with 2000.

The URL addresses of botanical importance identified in peer reviewed scientific periodicals have been included in a database, monitored periodically for accessibility (including constancy and up to date actualisation), author and web master's names, as well as scientific character (high science, scientific training/teaching, popular science etc.) and content reflected by key words. Some sites have been monitored also during graduate and postgraduate teaching process jointly with our students writing their essays on plant anatomy, morphology and systematics.

Beginning with 2001 botanical E-documentation has been introduced also for our environmental science students in Veszprém among the requirements in the botanical curricula. The result was a steady raise in the level of botanical essays written by the most talented students (cf.

`http://binet-biotar.vein.hu`

BioTár Electronic – BTE, Graduate Students Works, eg. Bartl 2002, Horváth and Szabó 2003, see a sample page of the later reference also in Annexe 3.).

Students were guided to the most effective Web sites using a kind of "Internet guided tours" available at the Botanical Department of the Veszprém University, as well as searching for the scientific plant names mostly on *Yahooo* (Science ⟶ Biology ⟶ Botany ⟶ Images), or *Google* search engines (Szabó and Siki 1998–, 2003–, Lampinen et al. 2001).

In some cases comparative tables have been compiled from search results performed in Hungarian and different EU languages (cf. for example Bartl 2002, in Annexe 2.).

Results

A large number of electronic references and botanical URL addresses have been identified both in guided botanical Internet tours, as well as in the examined items of the leading international periodicals in botany (eg. Taxon, cf. Stuessy et al. 2000–2001), or in leading science journals (eg. *Science*, cf. Kaiser 1998–2001). A leading Hungarian botanical journal (*Acta Botanica Hungarica* cf. Borhidi et al. 1999–2002) has been also reviewed.

In *Taxon* URL references have been included mostly by North American and by some European authors. So for example a new Euro-Mediterranean initiative in plant systematics has been started
`http://www.euromed.org.uk`,
an Internet directory for botany has been compiled
`http://www.botany.net/IDB`
(cf. Wilson 2001), with pitfalls-specimens and databases, intellectual property and copyright (in Digitising biological collections: The 2000 meeting of the Taxonomic Database Working Group, Frankfurt,
`http://www.tdwg.org/tdwg2000/ipr.htm`,
cf. Owens et Prior 2000). E-courses were made available on the Internet by Reveal (1996, 2001), Willson et Manhart (2001) (cf. Reveal:
`http://www.inform.umd.edu/PBIO/pb450/intr.html`,
Willson et Manhart:
`http://www.csdl.tamu.edu/FLORA/tfp/tfphome1.html`).

American taxonomists initiated a series of floristic E-projects, eg. *The Flora of North America Association*, (2001), The Flora of North America
(`http://hua.huh.harvard.edu/FNA/`),
Wundelrin et Hansen (2001) The "*Atlas of Florida Vascular Plants*"
(`http://www.plantatlas.usf.edu/`,
Watson et Dalwitz 2001), the *Flora of Texas*, an Internet homepage with information on California, another for Florida plants (Wunderlin and Hansen 2001) for education, research and conservation is also available via Internet

(`http://www.texasflora.org`, `http://www.calflora.org/`).

A checklist of the vascular flora of the United States, Puerto Rico, and the Virgin Islands was published on the Net, too

(`http://www.csdl.tamu.edu/FLORA/b98/check98.htm`).

There is a trend to publish high ranking botanical illustrations on the web, as well

`http://hua.huh.harvard.edu/HuCards/`.

Valuable E-monographs have been compiled regarding the families of vascular and/or flowering plants, representing a real Flowering Plant Gateway (cf. eg. Carr 2003, Texas A&M Bioinformatics Working Group, 2000:
`http://biodiversity.uno.edu/delta/angio/index.htm`,
`http://www.botany.hawaii.edu/faculty/carr/pfamilies.htm`,
`http://www.csdl.tamu.edu/FLORA/b98/check98.htm`,
`http://www.csdl.tamu.edu/FLORA/cgi/gateway_family?fam=familyname`),

Beside plant systematics (eg. Watson et Dalwitz 2001), plant ecology and the E-presentation of North American biota is also on move

(`http://www.bonap.org/`).

The International Working Group on Taxonomic Databases (TDWG) acting beside the International Union of Biological Sciences (IUBS) also developed an international forum for biological data projects in order to promote the use of standards and facilitate international exchange of taxonomic data

(`http://www.tdwg.org`,
`http://www.bgbm.fu-berlin.de/tdwg/2000/Presentations.htm`).

The botanical URL addresses and references identified in the journal Science (Kaiser 3rd April 1998–2001, Leslie 15 June 2001–) were included in the Table 1. It is worth to note that the NetWatch edited by Kaiser was much more balanced toward plant sciences and environmental sciences as compared to the series edited by M. Leslie but both were quite irrelevant for botanical taxonomy (Szabó et Siki 2002, 2003c, cf. Annexe 1., Table 1.)

Discussions

There are signs of E-communication penetrating in the botany, but the degree of acceptance varies greatly in form and content among the journals and authors examined.

Among the authors of the journal Taxon (Stuessy et al. l.c.) those examining the changes and the progress of botanical systematics around the turn of millennium could generally not avoid completely the new phenomenon of E-botany, but only Wilson (2001) focuses strongly on E-botany (this will be discussed later). Generally E-botany is mentioned just sparsely by different authors. Stevens (2000) talking about electronic processing of taxonomic descriptors and about interactive keys cites the works of Dalwitz et al. (1993–, 2000–). Mishler (2000) in his table summarising the historical periods in biological systematics beginning with folk classifications (phase 1) up to cladistics (phase 6) considers the numerical phenetics (phase 5) and the arrival of computers having just a week and superficial effect on plant systematics. Even *The Tree of Life* (Maddison 1998–, Sogin and Patterson 1998–) is cited only in a figure, but not in references. Chase et al. (2000) have no E-references in their paper dealing with the effect of DNA sequence data on higher level classification of the Angiosperms.

In the first part of the "Jubilee Series" of the journal Taxon ("*New and renewed sources of comparative data from plants*", Editorial Part I. and following papers) practically no URL references are cited. Talking for example about progress in techniques and methods (Endress et al. 2000) — computer technique is considered just one of the many possible new methods for cladistics (and it is not even mentioned as an important tool for molecular systematics) with no E-references cited among the almost 500 titles referred in the paper. Similarly no E-databases on plant secondary substances are cited by Harborne (2000) among the 50 references cited in the subject.

Stace (2000), talking about plant chromosome counts, genome size, chromosome morphology, chromosome staining characteristics, chromosome and genome disposition in the cell, chromosome behaviour and homology states that classical and molecular cytogenetics produced an enormous amount of data which needs to be integrated. But no E-references are cited regarding the E-possibilities of such an integration.

Plant macromolecular systematics is traditionally focused on secondary compounds (cf. Harborne 2000), more recently on proteins and quite newly on DNA. Crawford (2000) reviewing the trends between 1950–2000 on the field stated that amino acid sequencing had little lasting impact on taxonomy and phylogeny (Maddison 1998–, Mishler 2000). Enzyme electrophoresis has been used more in microevolutionary studies with little or no effect on taxonomy.

Analysis on DNA level affected and will further affect all levels of botany: the next five decades will witness a melding of the old and new to continue the "unending synthesis" in plant sciences. There is a marked discrepancy between this statement, the E-boom of plant genomics and the lack of this perspective in the reference lists of the most botanical papers.

This discrepancy is explained perhaps by a traditional separation of classical taxonomy from molecular biology... even on DNA level.

One of the new E-methods in the study of plant biodiversity is the Geographic Information System (GIS), the tool used by plant biologists to collect and process electronically spatial data in order to gain biologically relevant information. Skov (2000) reviewed the hardware, software and other tools, but without a reference on the possible use of GIS in a networked botanical E-(e)nvironment.

However Hagedorn (1997–), Hagedorn and Rambold (2000) in their account on a method on use of descriptive plant data available via Internet, presented a successful synthesis of traditional (printed) and modern E-references: in 9 references (out of 18) the URL addresses have been also included. The following E-contacts are mentioned:

`http://pnp.huh.harvard.edu`

(The plant names project. Access denied on 26th May 2003, szta), Cross (1998, but E-reference no more accessible in 2003!), Dalwitz et Zurcher (1995–1999), Findling (1998), Green (1997), Hagedorn (1997–2000), Hagedorn et Rambold (2000), Jacobs et al. (1996), using direct URL references even in the text of the paper.

The nomenclature *ipso facto* is a "conservative" field of botany. Even so McNeill (2000) in his paper dealing with the new trends in developing a stable and efficient plant nomenclature refers frequently on E-sources, citing Benton's work (in E-preprint) on rank-free lists and the fate of Linnean taxonomy, that of Cantino et de Queiroz (2000), de Queiroz (1996) on Phyllocode, McNeill (1996), Redhead (2000) on BioCode and/or Raveal (1996), Greuter et al. (1993, 1998), Withgott (2000) on biological nomenclature and the (sometimes quite aggressive) controversy regarding the "sunset of the Linnean nomenclature".

E-references are completely lacking from the extensive reference list of Bachman (2001) comprising about 350 titles on "*Evolution and genetic analysis of populations: 1950–2000*", as well as from the paper of Reiseberg and Burke (2001) on "*The biological reality of species: gene flow, selection, and collective evolution.*" (no E-sources in about 150 references!), that of Levine (2001) dealing with the literature of the last 50 years of plant speciation (more than 200 references), or from the paper of Arnold et al. (2001) on "*Natural hybridisation and fitness*" (no E-titles among 52 references).

Writing about "*Discovering the plant world*" at the turn of century and millennium Gh. T. Prance (2001) also avoids to cite E-references. However Heywood (2001) refers on electronic sources when writing about new electronic keys used for plant identification (PANKEY —

`http://www.rbge.org.uk/pankey.html`.

Note: address not found in 26th May 2003, szta), on CD-Rom keys (CABIKEY), on taxonomic databases (TDWG) and on progress in taxonomy (Blackmore 2002), on Euro+Med Plant Base Project (cf. Carine et al. 2000), on Flora of China (cf. Al-Shehbaz n.p., etc.), the ESFEDS database (Heywood et al. 1984, cf. Idem 1998, 2001), on *Flora of North America* (*l.c.*), ILDIS (Bisby 1994), *Species 2000* (cf. Bisby 2000, 2002), the ALL Species Project (Smith 2003), the Index of the world herbaria (Holmgren et Holmgren 2001), the use of herbaria (Metsger 1999, Miller 1999), *The Virtual Australian Herbarium* (Barker 1998), but the URL addresses of the *PhylloCode* are referred only through Cantinbo et al. (2000) and others, with a comment that this Code "[...] would drastically affect the accessibility of the units of taxonomy to a large number of non-specialist users".

Among the authors of the "*Jubilee Review Series*" of the journal Taxon Wilson (2001) received the task to review the role of informatics in the systematics of the 21st century. His main statements may be summarised by the following quotation: "*The international community of systematic botany is in the process of entering a networked, digital environment that, after initial development [...] will dominate [...] scientific activity in the future. [...] The products of systematic botany, previously generated locally as static, hardcopy documents, can now be presented as collaborative enterprises [...] as [...] dynamic data resources [...] made available to a global user community [...] The emerging Internet standard of "usage equals value" could place the products of systematic botany in a position to draw public interest and [...] support. However [...] the digital transition" will be not realised, if [...] traditional publication and "ownership" are retained /but/ [...] via interaction and content review by professionals, that information available to the public is of the highest scientific quality.*" It is worth to note that the "reference list" of this paper cites only URL addresses (websites).

The optimism of Wilson is not really supported by our analysis. It is true that plant germplasm science is heavily represented on the web, but genetic resource items are not treated in this paper. Websites in botany are well represented on the Internet, with many URL address's with images (eg.

`http://www.csdl.tamu.edu/FLORA/`,

`http://www.helsinki.fi/kmus/botpics.html`.

Note: a search on for this site in 26th May 2003 gave the following result: The *Internet Directory for Botany – Subject Category List* and the Helsinki mirror site of the *Internet Directory for Botany – Alphabetical List* have been closed. The main page of the Internet Directory for Botany in Canada is still accessible), with images on persons, with herbals and herbal remedies (eg.

`http://www.amfoundation.org/herbmed.htm`),

practical conservation and natural heritage (eg.
http://splash.metroke.gov/wlr/pi/salvage.htm.
Note: access denied on 26th May 2003,
http://infoweb.magi.com/ẽhaber/main.html),
dendrology and tree ring studies (eg.
http://www.valdosta.edu/g̃rissino).

Conclusions

1. Our case study demonstrates that scientific botany still avoids E-publication and E-citation both on truly international and on national/regional level (Stuessey et al. 2001–2001, Borhidi et al. 1999–2000).

2. There is an renewing trend of "new-", "bio-", "phylo-" systematics trying to shake and weaken the positions of the traditional, Linnean taxonomy, making use of (mostly uncontrolled) E-communication.

3. "Enthusiast" and visionary botanists promote E-communication in botany, but the main problem in taxonomy is the lack of constancy in E-publication vs. traditional printed publication.

4. Even so, the global accessibility of E-botany, especially E-images, E-teaching, new phylogenetic systems and taxon lists find their way toward students, teachers and research scientists.

5. Popular science, and university seminars are well supported by English E-botany at the turn of millennia. This is not the case with smaller national languages.

6. Conservative attitude (among professionals) and language barriers (among non-English students) still represent a narrow gate in E-communication among botanists.

7. There are promising signs, that botanical knowledge is growing also by translations, by passing the language barriers in E-botany (Crystal 2001, Montgomery 2001).

8. The journal *Science* reviewed regularly relevant scientific websites, but was relevant for E-botany especially from an interdisciplinary point of view.

9. E-botany presented in the journal Taxon was focused on specific topics and practiced only by a restricted groups of authors.

10. In *Acta Botanica Hungarica* the new trends were reflected by a home page presenting the content of the journal beginning with 2000.

11. The high possibilities of the E-botany was illustrated with the case of selected homepages dealing with *Lilium* cytology, anatomy, taxonomy, nomenclature, systematics, genetics, evolution and cultivation

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Note: the "Hungarian System" in the citation of the family names and given name abbreviations of the authors of papers was deliberately used in this section, because this is one to be preferred in E-botany. The editor is kindly requested to respect this advise at last in this single case (A. T. Szabó).

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(no access on 26th May, 2003) `www.vulpia.ncsu.edu`

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Annexe 1.

Table 1.

Guided Internet Tours in Plant Sciences (1) using

Science Watching the Net

Scientific Websites presented by NetWatch (Science, Washington DC.)
Recommended for Hungarian students of environmental biology
Vol. I.: 1998-2002, Vol. II: 2002-

Compiled by:
A.T. Szabó (reviewer)
A. Siki (techical assistant)

BioTár Electronic Neumannia

BTN: 1015/2003

URL addresses of botanical relevance reviewed in Science

(Kaiser 3rd April 1998-2001, Leslie 15 June 2001-,
excerpts from Szabó and Siki 2002, 2003c)

Table 1a: Excerpts from a title selection

Title and key words	Y	M	D	www.	Web – Master	Notes
Mapping Israel's Biodiversity: Databases Israel biodiversity, database, chorology, floristics R. Kadmon	01	01	26.4	www.biogis.huji.ac.il		Accessible: 030506szta
Tree Decoders: Databases Genematics, biotechnology, dendrome, U. S. Forest Service, dendrology, Tree Genes, global warming, paleoclimate	00	11	17.5	http://dendrome.ucdavis.edu	Dr. David Neale	Accessible: 030506szta
The Green Scene: Databases U.S. Dept. Agriculture's Plants cultivated plants, botany, horticulture, botanical illustration, evolution, food, taxonomy	00	11	03.4	http://plants.usda.gov/plants/index.html		030526szta: No access
Crust of Life: Resources Lychens, mosses, fungi, bacteria, ldessert, nitrogen fixation, soil, invasion	00	10	27.1	www.id.blm.gov/soils www.soilcrust.org		A: 030526szta: No access
Book of plants	00	07	14	www.ipni.org		Accessible: 030506szta
California Blooming	00	07	07	http://elib.cs.berkeley.edu/photos		Accessible: 030506szta
California Blooming	00	07	07	http://elib.cs.berkeley.edu/photos		Accessible: 030506szta
Algae That Kill	00	04	28	www.redtide.whoi.edu/hab/default.html	Dr. Donald M Anderson	030526szta: Not valid
Herb garden: Index Herbariorum	00	02	11	www.nybg.org/bsci/ih		Accessible: 030506szta
Green thumbing through history: history of botany	99	09	10	www.huntington.org/BotanicalDiv/Timeline.html		Accessible: 030506szta
Plants in Glass Houses: Diatomae	99	05	07	www.BGSU.edu/departments/biology/algae/index.html		Accessible: 030506szta
Mushroom of The Month Club	99	02	05	www.wisc.edu/botany/fungi/volkmyco.html		030526szta: No access
Nurturing a Digital Tree of Life: phylogeny, taxonomy, evolution	99	01	29	http://Phylogeny.arizona.edu/tree/phylogeny.html		Accessible: 030506szta
Digital Blossoms Bioinformatics Group: plant Art Gallery Vascular plants, iconography, images	99	01	15	www.csdl.tamu.edu/FLORA/gallery.htm		Accessible: 030506szta
Flower power: history of botany, rare botanical books	98	04	10	www.mobot.org/MOBOT/research/library/kohler/welcome.html		Accessible: 030506szta

Table 1b:
Excerpts from a Keyword Search Key words used in searching: titles in bold lines

Botany:

A Garden of Links: Links	01	08	17.2	www.ou.edu/cas/botany-micro/bot-linx		Dr. Scott Russel	Notes
Mushroom of The Month Club	99	02	03	www.wisc.edu/botany/fungi/volkmuzo.html			No access 030526/szta
Plants of Paradise: Resources	03	01	31.5	http://rathbun.si.edu/botany/pacificislandbiodiversity/hawaiianflora/index.htm http://rathbun.si.edu/botany/pacificislandbiodiversity/marquesasflora/index.htm			Accessible: 030506szta

Plant:

Getting Hip to Plant Hormones	01	03	16.4	www.plant-hormones.bbsrc.ac.uk		Steve Croker	Notes
The Science of Sick Plants	98	06	12	www.ifgb.uni-hannover.de/extern/ppigb/ppigb.htm			Accessible: 030506szta
Garden of Vanishing Plants: Database Veszélyeztetett növény fajok, USA, természetvédelem	02	11	01.3	http://plants.usda.gov/cgi_bin/topics.cgi?earl=threat.html	021106 030107/szta		Accessible: 030506szta
Dissecting the Cell's Power Plant: Database Mitokondrium, energia, gén, betegség, egér, élesztő, muslica, sejt	02	09	13.2	http://mips.gsf.de/proj/medgen/mitop	030108sztal		Accessible: 030506szta
Gateways to the Plant Cell: Database	02	06	14.4	http://plantsl.sdsc.edu			Accessible: 030506szta
Plant Versus Plant: Resources	02	05	24.4	www.science.siu.edu/parasitic-plants	020608	Dan Nickrent	Slow 030526szta
Plant's family Tree: Resources	02	04	03.1	www.mobot.org/MOBOT/Research/APweb/welcome.html	020302nem!		Accessible: 030506szta
Stressed-Out Plants: Resources Feszültségelvezető növények: Források feszültség, terméselőállítás, növényzet	01	09	21.5	www.plantstress.com			Accessible: 030506szta
Peek-a-Boo Leaves: Images Cleared leaves, Paleobotany, Levélszerkezet	03	02	14.5	www.ucmp.berkeley.edu/collections/plants/clearedleaf.html			Accessible: 030506szta
Plants of Paradise: Resources	03	01	31.5	http://rathbun.si.edu/botany/pacificislandbiodiversity/hawaiianflora/index.htm http://rathbun.si.edu/botany/pacificislandbiodiversity/marquesasflora/index.htm			Repeated ! Accessible: 030506szta

Flower:

Watch the Grass Grow: Images Plants in motion, növényi mozgások	02	01	18.1	http://sunflower.bio.indiana.edu/~rhangart www.plantsci.cam.ac.uk/Haseloff/MOVIES/IndexMOVs.html			Accessible: 030506szta B: not found 030526szta

Pollen:–
Angiosperm: –
Gymnosperm: –

Biodiversity

Tour the Strongholds of Biodiversity: Resources Biodiverzitás, forró pontok, természetvédelem, endemizmusok	02	10	11.4	www.biodiversityhotspots.org/xp/Hotspots	030108 szta		Accessible: 030506szta
The Business of Conservation: Resources	02	03	15.2	http://biodiversityeconomics.org	020425		Accessible 030506szta
Plants of Paradise: Resources	03	01	31.5	http://rathbun.si.edu/botany/pacificislandbiodiversity/hawaiianflora/index.htm http://rathbun.si.edu/botany/pacificislandbiodiversity/marquesasflora/index.htm			Repeated !

Chorology: –
Floristics: –

Forest: –

Phylogeny Forest: Resources **Evolution, evolúció, törzsfejlődés**	**02**	**03**	**01.1**	**www.treebase.org/treebase**			**Accessible: 030506szta**
Forest Gallery: Images **Esőerdő képtár: Képek ostrom alatt, dögvész, fertőzés, edzés** **invazív fajok, gyomok stb.**	**01**	**09**	**07.3**	**www.forestryimages.org** **www.bugwood.org**	**2001.06.26** **2001.05.28**		**Accessible: 030506szta**
Network to Log World Forest Loss **Renewable resources, természeti erőforrások, erdők,**	**00**	**03**	**10**	**www.globalforestwatch.org**			**Accessible: 030506szta**

Dendrology: –
Cultivated plants: –
Horticulture: –
Botanical illustration: –

Taxonomy

Taxonomists at Play: Fun **Taxonomiai, nevezéktani furcsaságok**	**03**	**01**	**31.1**	**http://home.earthlink.net/~misaak/taxonomy.html**	**030310**	**Mark Isaak**	**Accessible: 030506szta**

***Lychens:* –**
***Mosses:* –**

Fungi:

Mushroom of The Month Club	99	02	05	www.wisc.edu/botany/fungi/volkmyco.html				No access 030526szta

***Bacteria:* –**
***Nitrogen fixation:* –**
***Soil:* –**
***Invasion:* –**

Alga:

Ont he Trail of Rogue Algae: Education Toxinok, vörösmoszat, alga, vízvirágzás	02	10	18.1	www.bigelow.org/hab/index.html	030108 szta	Dr. Maureen Keller	Accessible: 030506szta
Algal Bloom: Resources	**02**	**05**	**17.2**	http://seaweed.ucg.ie	020704	**Michael D. Guiry**	No access 030526szta

Algal Bloom: Resources	02	05	17.2	http://seaweed.ucg.ie	020704	Michael D. Guiry	No access 030526szta
Plants in Glass Houses	99	05	07	www.BGSU.edu/departments/biology/algae/index.html	Repeated site		Accessible: 030506szta

Garden:

Garden of Vanishing Plants: Database Veszélyeztetett növény fajok, USA, természetvédelem	02	11	01.3	http://plants.usda.gov/cgi_bin/topics.cgi?earl=threat.html	021106 030107/szta		Repeated !
A Garden of Links: Links	01	08	17.2	www.ou.edu/cas/botany-micro/bot-linx		Dr. Scott Russel	Repeated !
Botanical Garden: Resources Botanikuskertek: Adatforrás Online botanika, P v. zengbus evolúció, botanikaleckék	01	02	02.4	www.rrz.uni-hamburg.de/biologie/b_online/e00/contens.htm	010322 nem!		No access Szta030526

BioInformatics:

Bioinformatics Workshop: Tools Bioinformaciós muhely: Eszközök szabad eszközök, visszacsatolás	01	09	21.4	www.bioinformatics.org	Accessible: 030506 szta		Low botanical relevance
Bioinformatics cornucopia	00	08	11	http://genome.cornell.edu/index.html			Decomissioned on 15 April 2002 !!!
MEDLINE robot	99	08	27	www.bioinformatics.weizmann.ac.il/cms			Access denied

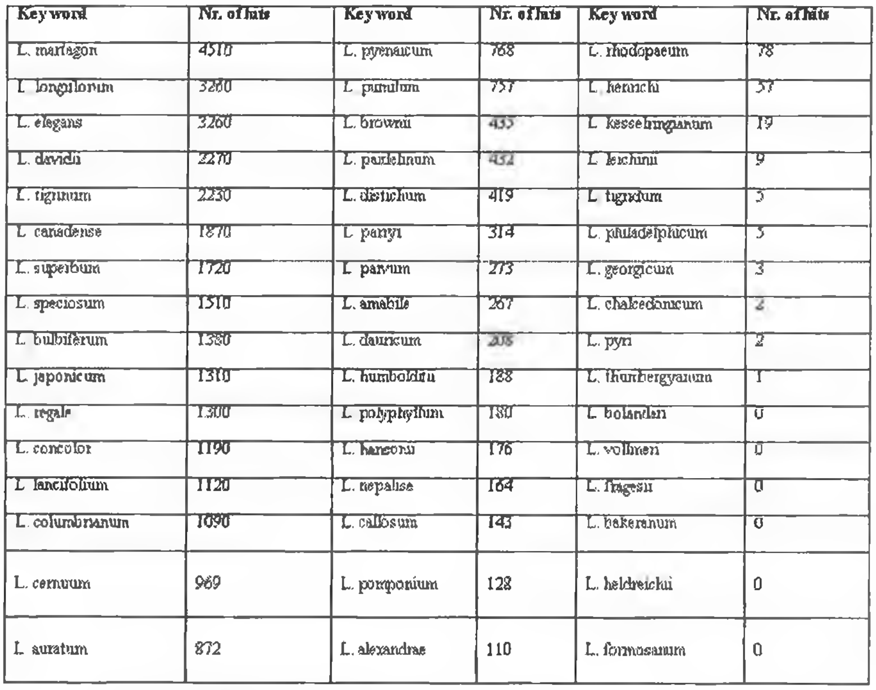
Annexe 2.

Lilium on the Internet
according to search results of Bartl (graduate student) and Szabó (tutor)
2002

Total number of hits: 59900

Evaluated web sites: first 40 (Note: some taxa were searched also separately)

1. **Search results for *Lilium* (Yahoo, Science, Botany)**



Key word	Nr. of hits	Key word	Nr. of hits	Key word	Nr. of hits
L. martagon	4510	L. pyrenaicum	768	L. rhodopaeum	78
L. longiflorum	3280	L. pumilum	757	L. henrichi	57
L. elegans	3260	L. brownii	435	L. kesselringianum	19
L. davidii	2270	L. pardalinum	432	L. leichtlinii	9
L. tigrinum	2230	L. distichum	419	L. tigridum	5
L. canadense	1870	L. parryi	314	L. philadelphicum	5
L. superbum	1720	L. parvum	273	L. georgicum	3
L. speciosum	1510	L. amabile	267	L. chalcedonicum	2
L. bulbiferum	1380	L. dauricum	208	L. pyri	2
L. japonicum	1310	L. humboldtii	188	L. thunbergyanum	1
L. regale	1300	L. polyphyllum	180	L. bolanderi	0
L. concolor	1190	L. hansonii	176	L. vollmeri	0
L. lancifolium	1120	L. nepalise	164	L. fargesii	0
L. columbianum	1090	L. callosum	143	L. bakerianum	0
L. cernuum	969	L. pomponium	128	L. heldreichii	0
L. auratum	872	L. alexandrae	110	L. formosanum	0

2. Yahoo results for Lilium (excerpts from the URL addresses of the first 32 hits)

(Bartl and Szabó 2002)

	URL address	Notes
2.	http://groups.yahoo.com/group/**Lilium**/	Gardening association
3.	http://rareplants.co.uk/**lilium**/gallery.htm	Pictures and short descriptions
4.	http://www.botany.com/**lilium**.html	Idem, a botanical gateway
5.	http://images.aspnr.org/lily/male.html	Meiosis in the Lilium microspore
7.	http://www.veseys.com/store.cfm?product=2039	Cataloge of a garden
8.	http://www.plants-magazine.com/newplants/newplant34.shtml	Plants-magazine
10.	http://www.[illegible]keep.ca/bulbs%20lilium.htm	Detailed descriptions
11.	http://www.lillafiskaregatanstradgardsbutik.se/grupp4/**lilium**.htm	Swedish, gardening
13.	http://www.prideon.com/	A large database on cultivated Lilium
14.	[illegible].htm	Virus infections in Tulipa and Lilium
21.	http://www.ungarden.com/egroepen/enliliumindex.html	Detailed description of five Lilium taxa
22.	http://hortplex.gardenweb.com/plants/p1/gw2002614.html	Good botanical links (Plants Database, Plants For A Future, Plants Viruses Online stb.)
25.	http://www.infoagro.com/flores/flores/**lilium**.asp	Portugál nyelvű részletes fajleírások képek nélkül.
26.	http://botit.botany.wisc.edu/images/130/Angiosperm/**Lilium**/	Lilium macro- and micromorphology, anatomy (pictures)
31.	http://www.nargs.org/seed00/pages18.html	Pictures of many Lilium taxa

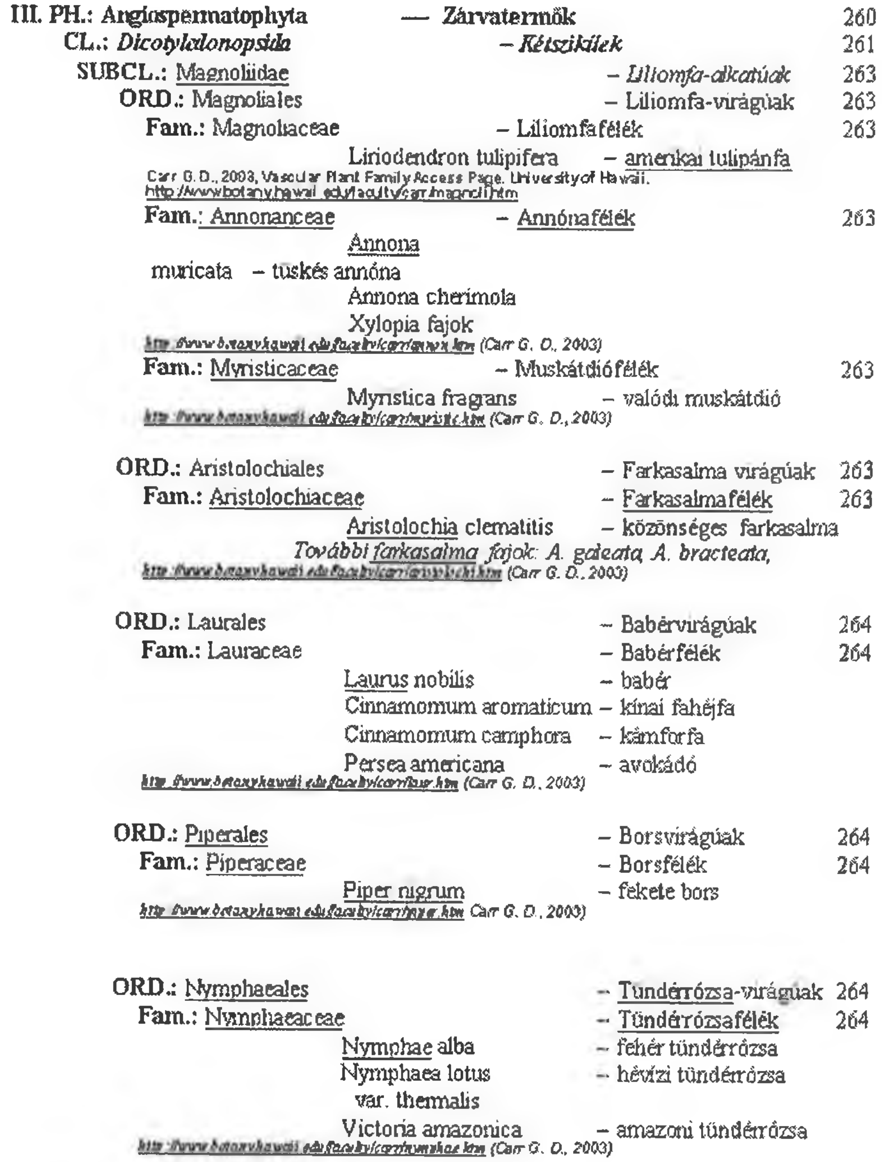
Best sites for Lillium.

- http://images.aspnr.org/lily/male.html

- http://botit.botany.wisc.edu/images/130/Angiosperm/**Lilium**/
- http://www.bulb.com/summerguide98/**lilium**/index.asp
- http://www.ungarden.com/egroepen/enliliumindex.html
- http://www.prideon.com/

Annexe 3.

A sample page from the essay of E. Horvath (2003) on E-learning in systematic botany using the standard Hungarian botanical textbook edited by G. Turcsányi (2001)



III. PH.: **Angiospermatophyta** — **Zárvatermők** 260
CL.: ***Dicotyledonopsida*** – ***Kétszikűek*** 261
SUBCL.: Magnoliidae – *Liliomfa-alkatúak* 263
ORD.: Magnoliales – Liliomfa-virágúak 263
Fam.: Magnoliaceae – Liliomfafélék 263
Liriodendron tulipifera – amerikai tulipánfa
Carr G. D., 2003, Vascular Plant Family Access Page. University of Hawaii.
http://www.botany.hawaii.edu/faculty/carr/magnoli.htm
Fam.: Annonanceae – Annónafélék 263
Annona
muricata – tüskés annóna
Annona cherimola
Xylopia fajok
[illegible] *(Carr G. D., 2003)*
Fam.: Myristicaceae – Muskátdiófélék 263
Myristica fragrans – valódi muskátdió
[illegible] *(Carr G. D., 2003)*

ORD.: Aristolochiales – Farkasalma virágúak 263
Fam.: Aristolochiaceae – Farkasalmafélék 263
Aristolochia clematitis – közönséges farkasalma
További farkasalma fajok: A. galeata, A. bracteata,
[illegible] *(Carr G. D., 2003)*

ORD.: Laurales – Babérvirágúak 264
Fam.: Lauraceae – Babérfélék 264
Laurus nobilis – babér
Cinnamomum aromaticum – kínai fahéjfa
Cinnamomum camphora – kámforfa
Persea americana – avokádó
[illegible] *(Carr G. D., 2003)*

ORD.: Piperales – Borsvirágúak 264
Fam.: Piperaceae – Borsfélék 264
Piper nigrum – fekete bors
[illegible] *Carr G. D., 2003)*

ORD.: Nymphaeales – Tündérrózsa-virágúak 264
Fam.: Nymphaeaceae – Tündérrózsafélék 264
Nymphae alba – fehér tündérrózsa
Nymphaea lotus – hévízi tündérrózsa
var. thermalis
Victoria amazonica – amazoni tündérrózsa
[illegible] *(Carr G. D., 2003)*