Arctoa (2001) **10**: *97-102*

ENTOSTHODON HUNGARICUS (BOROS) LOESKE (FUNARIACEAE, MUSCI) IN ALTAISKY TERRITORY, SOUTH SIBERIA

ENTOSTHODON HUNGARICUS (BOROS) LOESKE (FUNARIACEAE, MUSCI) В АЛТАЙСКОМ КРАЕ, ЮЖНАЯ СИБИРЬ

O.YU.PISARENKO[1], E.A.IGNATOVA[2], M.S.IGNATOV[3]

О.Ю.ПИСАРЕНКО[1], Е.А.ИГНАТОВА[2], М.С.ИГНАТОВ[3]

Abstract

Entosthodon hungaricus (Boros) Loeske is reported for the first time in Asian Russia. It was collected in solonchak steppe on terrace of Kulunda Lake (Altaisky Territory). Descri ption, illustrations and ecological characteristics are provided.

Резюме

Entosthodon hungaricus (Boros) Loeske впервые обнаружен в Азиатской части России, в солонцеватой степи на террасе Кулундинского озера (Алтайский край). Приводятся описание, рисунки, экологическая характеристика вида.

Entosthodon hungaricus (Boros) Loeske has been described from Hungary (as *Funaria hungarica*; Boros, 1924). The earliest known collection from this country has been made in 1912 (Boros, 1945). Later this specis was found in many other localities in Hungary (Boros, 1943*, 1945)[* – publications with maps; + - with list of localities], Ukraine (Boros, 1928; Lazarenko, 1955; Bachurina & Melnichuk, 1988+), Lower Volga area (Gams, 1934*), Austria (Baumgartner, Exs. 3090; Grims, 1986), Romania (Stefureac, 1969*), Slovakia (Stefureac, 1969*), Serbia (Boros, 1970), Spain (Casas & Brugues, 1978; Garcia Gomez & Fuertes Lasala, 1980; Fuertes Lasala & Garcia Gomez, 1981; Casas & al., 1985*), Israel (Herrnstadt & al., 1991), Germany (Ahrens, 1996), Kazakhstan Altai (Mamatkulov & al., 1998).

Cano & al. (1999) recently synonymized *Entosthodon maroccanum* (Meyl.) Hebr. & Lo Guidice with *E. hungaricus*, which add to the range of this species also Morocco (Meylan, 1937) and Sicily (Hebrard & Lo Guidice, 1996).

Savicz-Ljubitskaya & Smirnova (1970) reported this species from Kirgizia, without any details of locality. Abramov & al. (1989) noted that this record is a doubtful one. We also could not find any proof on the occurrence of *E. hungaricus* in this country.

In the course of studies of steppes in lowland of Altaisky Territory in 1995 the first author collected *E. hungaricus*, which also is the first certain record for Asian Russia, and also the most north-eastern locality of this species.

Entosthodon hungaricus (Boros) Loeske, Repert. Spec. Nov. Regni Veg. Sonderbeih. 3(2): 115. 1929. Figs. 2&3

Funaria hungarica Boros, Magyar Bot. Lapok 23 73. 1924.

Plants pale green to greyish-green; small, to 6-7 mm tall (with sporophyte). Stems short, 1-1,5 mm, simple, erect. Lower leaves smaller, 1-1.5 mm long, ovate-lanceolate. Upper leaves few, soft, erect when wet, slightly curved when dry, 3-3.5 mm, ovate to obovate, shortly acute, and with narrow attenuate apiculus, slightly narrowed toward base, not decurrent, concave; margin plane, unbordered, in upper part slightly crenulate by upper cell angles, costa stout, ending below apex; lamina cells smooth, thin-walled,

1 – Central Siberian Botanical Garden, Zolotodolinskaya 101, Novosibirsk 630090 Russia – Россия 119899 Новосибирск, Золотодолинская, 101, Центральный Сибирский ботанический сад

2 – Moscow State University, Biological Faculty, Moscow 119899 Russia – Россия 119899 Москва, Московский государственный университ, Биологический факультет

3 – Main Botanical Garden of Russian Academy of Sciences, Botanicheskaya 4, Moscow 127276 Russia – Россия 127276 Москва, Ботаническая 4, Главный ботанический сад Российской Академии Наук

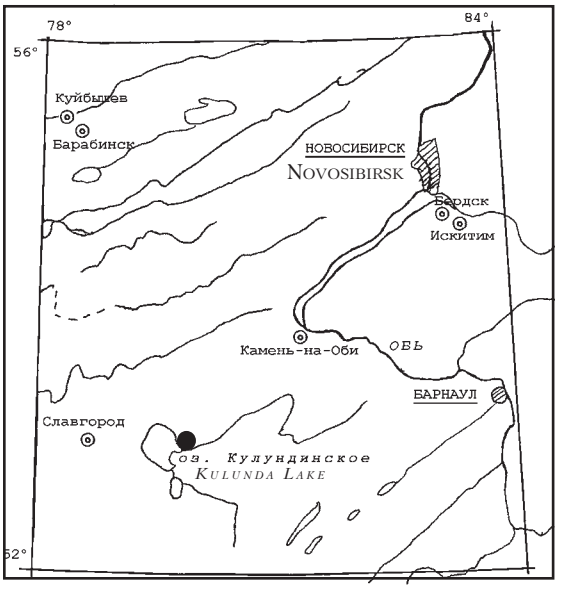

Fig.1. Locality of *Entosthodon hungaricus* in Altaiskij Territory.

poor in chloroplasts, pellucid, in mid-leaf rectangular to short-rectangular, 20-30 x 40-65 (80) μm; at margins shorter, almost quadrate, below apex rhomboidal, towards base longer; in leaf base corners enlarged, 25-40 x 40-60 μm, forming small group. Sporophytes solitary. Seta stout, ca. 4 mm long, slightly twisted when dry. Lid small, almost plane, with short beak. Capsule brown, 1.5-2 mm long; erect, symmetric, oblong-clavate, when open and dry contracted below wide mouth; neck narrow, slightly shorter than urn. Exothecium cells with very thick (12-14 μm) cell walls, almost equal in width to lumen; below mouth transverse-rectangular in 3-5 rows; further below irregularly rounded and then elongate rectangular. Peristome lacking or rarely observed as irregular easily decomposing fragments. Spores brownish, papillose, 28-30 μm. Calyptra large, in lower part swollen and lobed.

Cano & al. (1999) published SEM micrographs showing the great variation in spore ornamentation in *E. hungaricus.* In our material papillae of spore surface are higher than in most of European collections (Fig. 3), but approaching however to those in one specimen from Spain.

Entosthodon hungaris has been found in Altaisky Territory, Blagoveshchensk Distr., 5 km from north-east shore of Kulunda Lake, solonez dry steppe, on soil (53°05' N; 79°50'E, about 110 m altitude). Coll. Pisarenko 9.VI.1995 (Fig. 1). Specimens in herbarium of the laboratory of population ecology of plants of Central Siberian Botanical Garden, duplicates in MHA, LE.

This locality belongs to the central part of Kulunda lowland, an extensive accumulative lowland in south-east part of West-Siberian plane, within the Ob-Irtysh watershed. Altitude of the lowland is 100-140 m. In the Late and Middle Pleistocene the area had been flooded by fluvioglacial waters, so, its territory is covered by thick layer (to 50-60 m) of alluvial sediments. Central part of Kulunda lowland is weakly concave bowl with a system of shallow internal-drainage mineralised lakes (Nikolaev, 1970, 1988; Nikolaev & al., 1982).

The territory is located within a steppe zone (Ilina & al., 1985; Vandakurova, 1950).

The climate is continental, with long, cold and little-snowy winter, and with short, hot and dry summer. Due to its open position, the Kulunda lowland is often affected by cold air masses from Karskoye Sea, and warm and dry ones from Kazakhstan steppes and Middle Asian deserts. Thus, the temperature is highly variable, May and September often have night frost, in late autumn temperature can drop to lower than -20°C without snow, spring sometimes has very dry periods, and dry winds are common throughout the year. Mean annual temperature is about 0°C, mean temperature of January (the coldest month) is -19°C, absolute minimum -47°C, mean temperature of July (the warmest month) is + 19°C, absolute maximum + 40°C. Frostless period is 112-120 days - from 15-25 of May till 10-15 of September. Annual precipitation 250-300 mm. Duration of a stable snow cover - 140-150 days (from 10-15 of November till 5-10 of April). Mean depth of snow cover is 15 cm (absolute maximum - 35-38 cm), so thin snow cover does not protect the soil from frost very much and soil freezes in winter to more than 2 meter. The precipitation in April-October period is about 200 mm. The amount of solar heat is 2-3 times more, than it is required on evaporation of this amount of rainfall (Chernikova, 1971; Altaisky Territory, 1978).

Investigated plot is situated on ancient terrace of Kulunda Lake. Vegetation is mosaic, re-

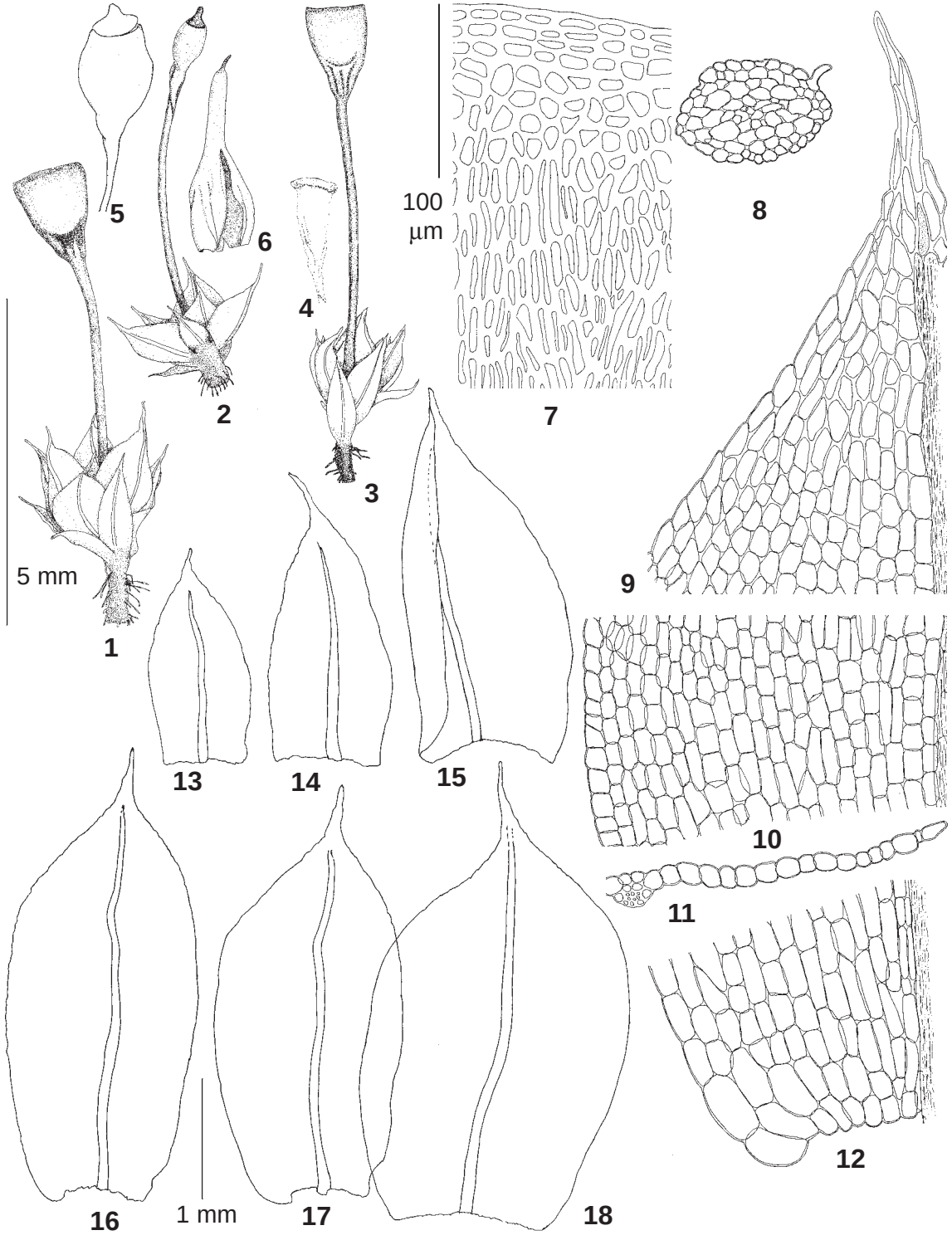

Fig. 2. *Entosthodon hungaricus* Boros (from Pisarenko, coll. 9.VI.1995). 1-3 – habit, from wet plants; 4-5 – dry capsules; 6 – calyptra; 7 – exothecium cells; 8 – transversal stem section; 9 – upper leaf cells; 10 – mid-leaf cells; 11 – transversal leaf section; 12 – lower leaf cells; 13-18 – leaves. Scale bars: 5 mm for 1-6; 1 mm for 13-18; 100 µm for 7-12.

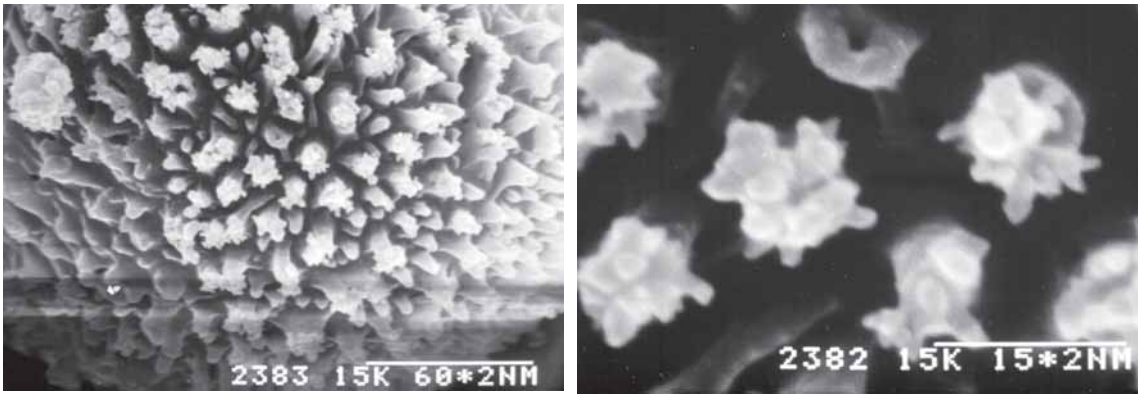

Fig. 3. Spore ornamentation of *Entostodon hungaricus* Boros (from Pisarenko, coll. 9.VI.1995). Scale bars: 6 μm (left) and 1.5 μm (right).

flecting the differences in microrelief and soils; three main types are as follow (arranged by the increase of salinization):

(1) Communities of forb meadow steppe. They occupy not large area. Herbage about 60 cm tall, rich, with more than 50 species on 100 m^2. Upper layer is composed by tall bunch steppe grasses (*Stipa zalesskii* Wilensky, *Helictotrichon desertorum* (Less.) Nevski - dominate) and meadow forbs (*Centaurea scabiosa* L., *Peucedanum morisonii* Bess.). Beneath there are small steppe grasses (*Festuca valesiaca* Gaud., *Agropyron cristatum* (L.) Beauv., *Hierochloe glabra* Trin.), sedges (*Carex praecox* Schreb., *C. supina* Wahlenb., *C. duriuscula* C.A.Mey.) steppe and meadow forbs (*Filipendula vulgaris* Moench, *Veronica spicata* L., *Thymus marschallianus* Willd., *Verbascum phoeniceum* L., *Galium verum* L., *Pulsatilla patens* (L.) Mill., *Achillea millefolium* L., *Campanula sibirica* L.) and legumens (*Vicia cracca* L., *Lathyrus tuberosus* L.). Cover 80-90%. Soil is covered by old dry leaves, mosses almost absent.

(2) Communities of solonez dry steppe. They are most spread. The steppes are characterized by rarefied (cover is 40-50%) and few-species (about 20 species on 100 m^2) herbage. Dominants are xerophyte (*Koeleria cristata* (L.) Pers., *Festuca valesiaca*) and halophyte (*Puccinellia tenuissima* Litv. ex V.Krecz.) grasses. Permanent presence of *Artemisia* species is characteristic (*Artemisia nitrosa* Web. ex Stechm., *A. rupestris* L., *A. austriaca* Jacq., etc.). The first species sometimes can be a codominant of the community. Other species of the communities are steppe xerophytes (*Seseli ledebourii* G.Don fil., *Glycyrrhiza uralensis* Fisch., *Goniolimon speciosum* (L.) Boiss., *Orostachys spinosa* (L.) C.A. Mey.) and halophytes (*Saussurea amara* (L.) DC., *Limonium gmelinii* (Willd.) O. Kuntze, *Plantago maritima* L.). Mosses are abundant.

(3) Halophyte communities. They are dated for salt medallions and take little places (about 5-7 m in diameter) among of solonchak dry steppes. Herbage is extremely poor, consists from 4-6 species: *Puccinellia tenuissima, Artemisia nitrosa* and some halophytes (*Suaeda* sp., *Petrosimonia* sp.). Cover not more than 30%. On the surface of the ground there is slender whitish salt powder. Mosses are absent.

Entosthodon hungaricus was collected in the second described component of mosaic, in solonez dry steppe, where soil salts are concentrated not in the upper part of soil profile, but in several centimetres under soil surface. So, plants with superficial roots system and mosses suffer mainly not from toxility, but from the xeric condition of habitat. The most graphic illustration of xeric condition is presence in solonez communities of *Orostachys spinosa*. This species is typical for well-drained Altai dry steppes and exceptional for plain Siberian steppes. Moss cover in solonez dry steppe is 20-30(-40)%. Dominant is *Bryum caespiticium* Hedw., very common is also *Jaffueliobryum latifolium* (Lindb. et H.Arnell) Ther. In some sites *J. latifolium* covers to 10%. Other species are: *Bryum argenteum* Hedw., *Pterygoneurum subsessile* (Brid.) Jur., *Phascum cuspidatum* Hedw., *Pleuridium subulatum* (Hedw.) Rabenh., and among them *Entosthodon hungaricus*. They occur sporadically and grow in loose groops.

Ecology of *E. hungaricus* attracted much attention and has been described in details in a number of publications. Despite of the occurrence in regions with the different climate, it grows almost everywhere in rather similar habitats: halophytic steppes of Ukraine, Lower Volga area, Hungary, and Romania (Gams, 1934; Stefureac, 1969); in dry periferial parts of saltmarshes in Spain (Garcia Gomez & Fuertes Lasala, 1980). In Sicily, Morocco and , and Germany *E. hungaricus* was reported on basic calcicolous soils (Hebrard & Lo Giudice, 1996; Cano & al., 1999; Ahrens, 1996). According to Gams (1934) and Stefureac (1969), in halophytic steppes of Central Europe *E. hungaricus* occurs in wide amplitude of habitats, from moist and poison-saline communities in depressions, to dry steppes on slightly raising places; at the same time it is the most abundant in intermediate habitats of solonetz steppes.

Growing in the regions with very hot and dry climate, *E. hungaricus* avoids the most extreme conditions due to rapid developement during floods and rain period (Hebrard & Lo Giudice, 1996). Apparently due to this ephemeral strategy, *E. hungaricus* can survive in Kulunda lowland, where it may escape the cold winter and hot dry summer by the rapid growth and maturation during warm and relatively moist period of May and June.

So, the habitat of *E. hungaricus* in Kulunda is typical for this species. Also it is not especially peculiar for the region: similar saline steppes are quite widespread in lowlands of Altaiskj Territory and Kazakhstan. Therefore we can speculate, that *E. hungaricus* will be found in more places in this area.

It is interesting that *Jaffueliobryum latifolium* also occurs in this habitat – in Altai Mountains (Ignatov & Cao, 1994) and other parts of South Siberia (Bardunov, 1989) it grows only on rocks or thin soil layer covering rocks. In Kulunda Lake area rocks are absent: bedrocks are covered by many-meter layer of sandy or loamy deposits. However Churchill (1987) reported *J. wrigthii* (Sull.) Ther. (which he considered to be confspecific with *J. latifolium*), as rarely occurring on soil in North America. The Kulunda locality of *J. latifolium* is the westernmost in Eurasia.

Literature Cited

[ABRAMOV, I.I., A. L. ABRAMOVA & I.V.SIROTINA] АБРАМОВ И.И., А. Л. АБРАМОВА, И.В. СИРОТИНА 1989. О видах рода Entosthodon Schwaegr. (сем. Funariaceae) из Средней Азии. – [About species of Entosthodon Schwaegr. (Funariaceae) from Middle Asia] *Новости сист.низш.раст.* [*Novosti Sist. Nizsh. Rast.*] **26**: *124-132*.

[ALTAISKY TERRITORY. ATLAS.] АЛТАЙСКИЙ КРАЙ. АТЛАС 1978. *М.-Барнаул, ГУГК* [*Moscow-Barnaul, Izd. glavnogo upravlenia geodezii i kartografii*] (I), *222*.

AHRENS, M. 1996. Entosthodon hungaricus in Suedwestdeutschland. – *Herzogia* **12**: *199-206*.

[BACHURINA, G. F. & V. M. MELNICHUK] БАЧУРИНА, Г. Ф., В. М. МЕЛЬНИЧУК 1988. Флора мохів Українськоі РСР. 2. – [Moss flora of Ukrainian SSR. 2] *Київ, Наукова Думка* [*Kiev, Naukova Dumka*], *179*.

[BARDUNOV, L. V.] БАРДУНОВ, Л.В. 1989. Аридные виды во флоре мхов Южной Сибири. – [Arid species in moss flora of South Siberia] *В кн.:Проблемы бриологии в СССР (ред. Абрамов, И. И.), Ленинград, Наука* [*In: Abramov, I. I. (ed.) Problemy briologii v SSSR, Leningrad, Nauka*]: *30-36*.

BOROS, A. 1924. Funaria hungarica, nov. spec. – *Magyar Batanikai Lapok* **23**: *73-75*.

BOROS, A. 1928. Das Vorkommen von Funaria hungarica in der Ukraine. – *Ukr. Bot. Zhurn.* **4**: *33-35*.

BOROS, A. 1943. A Funaria hungarica toertenete es foeldrajzi elterjedese. – *Acta Geobot. Hung.* **5**: *280-289*.

BOROS, A. 1945. Ueber Funaria hungarica. – *Rev. Bryol. Lichenol.* **15**: *74-78*.

BOROS, A. 1968 Bryogeographie und Bryoflora Ungarns. – *Budapest, Akad. Kiado, 466*.

CANO, M. J., R. M. ROS, J. GUERRA & J. GONZALEZ 1999. The identity of Entosthodon hungaricus (Boros) Loeske and E. maroccanus (Meyl.) Hebr. & Lo Giudice (=Physcomitrium maroccanum Meyl.). – *J. Bryol.* **21**: *67-70*.

CASAS, C. & M. BRUGUES 1978. Nova aportacio al coneixement de la brioflora dels Monegros. – *Anales Inst. Bot. Cavanilles* **35**: *103-114*.

CASAS, C., M. BRUGUES, R. CROS & C. SERGIO 1985. Cartografia de briophyts; Peninsula Iberica i les Illes Balears, Canaries, Acores i Madeira, 1. – *Inst. d'Estudis Catalans, Barcelona, 154*.

[CHERNIKOVA, M.I. (ED)] ЧЕРНИКОВА, М.И. (ред.) 1971. Агроклиматические ресурсы Алтайского края. – [Agroclimatic resource of Altai territory] *Л., Гидрометеоиздат* [*Leningrad, Gidrometeoizdat*], *156*.

CHURCHILL, S. P. 1987. Systematics and biogeography of Jaffueliobryum (Grimmiaceae). – *Mem. New York Bot. Gard.* **45**: *691-708*.

FUERTES LASALA, E. & R. GARCIA GOMEZ 1981. Funaria hungarica Boros in the Iberian Peninsula. – *Herzogia* **5**: *609-612*.

GAMS, H. 1934. Beitraege zur Kenntniss der Steppenmoose. – *Annals bryol.* **7**: *37-56*.

GARCIA GOMEZ, R. & E. FUERTES LASALA 1980. Comunidades muscinales de los saladares y espartales de Navarra (España). – *Crypt. Bryol. Lichenol.* **1**(3): *289-304*.

GRIMS, F. 1986. Rote Liste gefaehrdeter Laubmoose (Musci) Oesterreich. – *In: Niklfeld, H. (Hrsg.), Rote Listen gefaehrdeter Pflanzen Oesterreich. Gruene Reiche Bundesministerium Gesundheit Umweltschutz* **5**: *138-151*.

HEBRARD, J. P. & R. LO GIUDICE 1996: Physcomitrium maroccanum Meylan in Sicily, new to European bryoflora. – *J. Bryol.* **19**: *325-332*.

HERRNSTADT, I., C. C. HEYN & M. R. CROSBY 1991. A checklist of the mosses of Israel. – *Bryologist* **94**(2): *168-178*.

IGNATOV, M.S. & CAO TONG. 1994. Bryophyte flora of Altai Mountains. IV. Grimmiaceae – *Arctoa* **3**: *67-122*.

[ILINA, I. S. & AL.] ИЛЬИНА, И. С. & ДР. 1985. Растительный покров Западно-Сибирской равнины. – [Plant cover of West-Siberian plain] *Новосибирск, Наука* [*Novosibirsk, Nauka*], *251*.

[LAZARENKO, A.S.] ЛАЗАРЕНКО, А. С. 1955. Определитель лиственных мхов Украины. – [Handbook of mosses of Ukraine] *Киев, изд. АН УССР* [*Kiev, Izd. Akad. Nauk Ukr. SSR*]: *468*.

[MAMATKULOV, U.K., I.O.BAITULIN & S. G. NESTEROVA] МАМАТКУЛОВ, У.К., И.О. БАЙТУЛИН, С.Г.НЕСТЕРОВА 1998. Мохообразные Средней Азии и Казахстана. – [Bryophyta of Middle Asia and Kazakhstan] *Алматы, изд. ин-та ботаники и фитоинтродукции МН-АН РК* [*Almaty, Izd. Inst. Botaniki of botany and phytointrodukzii Min. Nauk. & Akad. Nauk Respubl. kazakhstan*]: *232*.

[MELNICHUK, V.M.] МЕЛЬНИЧУК, В.М. 1970. Определитель лиственных мхов Средней полосы и Юга европейской части СССР. – [Handbook of mosses of the middle and south parts of European USSR] *Киев, Наукова Думка* [*Kiev, Naukova Dumka*]: *444*.

MEYLAN, C. 1937. Note sur la nouvelle especе ed Physcomitrium. – *Bull. Soc. Hist. Nat. l'Afr. Nord* **28**: *426-427*.

[NIKOLAEV, V.A.] НИКОЛАЕВ, В.А. 1970. Геоморфологическое районирование Западно-Сибирской равнины - [Geomorphological zonation of West-Siberian plain] *История развития рельефа Сибири и Дальнего Востока. Западно-Сибирская равнина, М., Наука* [*Istoriya razvitiya reliefa Sibiri i Dalnego Vostoka. Zapadno-Sibirskaya Ravnina, Moscow, Nauka*]: *226-255*.

[NIKOLAEV, V.A.] НИКОЛАЕВ, В.А. 1988. Геоморфологическое районирование сельско-хозяйственной зоны Западно-Сибирской равнины. – [Geomorphological zoning of agricultural zone of West-Siberian plain] *Рельеф Западно-Сибирской равнины* [*Relief of West-Siberian plain*] *Новосибирск, Наука* [*Novosibirsk, Nauka*]:*139-145*.

[NIKOLAEV, V.A.& AL.] НИКОЛАЕВ, В. А. & ДР. 1982. Рельеф южных равнин Западной Сибири. – [Relief of south plains of West-Siberia] *Закономерности развития рельефа Северной Азии, Новосибирск, Наука* [*Zakonomernosti razvitiya reliefa Severnoi Azii, Novosibirsk, Nauka*]: *11-47*.

[SAVICZ-LYUBITSKAYA, L.I. & Z.N. SNIRNOVA] САВИЧ-ЛЮБИЦКАЯ, Л.И., З.Н. СМИРНОВА. 1970. Определитель листостебельных мхов СССР. Верхоплодные мхи. – [The Handbook of mossesof the USSR. The acrocarpous mosses] *Л., Наука* [*Leningrad, Nauka*], *826 pp*.

STEFUREAC, T. I. 1969. Studii briologice in unele formatiuni de vegetatie on Romania. Saraturi, sfagnete, paduri. – *Acad. Rep. Soc. Romania, Bucuresti, 163*.

[VANDAKUROVA, E.V.] ВАНДАКУРОВА Е.В. 1950. Растительность Кулундинской степи – [Vegetation of Kulunda steppe] *Новосибирск* [*Novosibirsk*], 128.