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Contribution to the knowledge of the Flora of the Mongolian Altai

With one Map and 2 Tables

Summary

During a German-Mongolian expedition to the Mongolian Altai in July/August 2000, 404 specimens of vascular plants were collected. They are deposited in the Herbarium of the University of Osnabrück (OSBU). 381 specimens could be determined conclusively. The collected material comprises 300 species, 156 genera, and 44 families. Six of these species were first records for Mongolia, six species had not been recorded so far for the region Mongolian Altai, five are new for the region Khobdo, and 19 species new records for both regions, Mongolian Altai and Khobdo, Western Mongolia. A list of the collected plants with accession numbers and provenances is presented.

Introduction

The main work on the vascular flora of Mongolia (formerly Peoples Republic of Mongolia, Outer Mongolia) has been (and still is) the “Key to the vascular plants of Mongolia (with an atlas)” by GRUBOV (1982). In 1996, GUBANOV published a “Conspectus of flora of Outer Mongolia (vascular plants)” intended to be an early stage of a critically revised “Flora of Outer Mongolia”. The conspectus (GUBANOV 1996) sums up new data on the floristic composition of Mongolia and on the distribution of certain taxa in the territory of Outer Mongolia. These data were mainly gathered by the Soviet – Mongolian Integrated Biological Expeditions 1971–1991 organised by the So-

Zusammenfassung

Beitrag zur Kenntnis der Flora des Mongolischen Altais

Auf einer deutsch-mongolischen Expedition in den Mongolischen Altai im Juli/August 2000 konnten wir 404 Herbarbelege von Gefäßpflanzen sammeln. Diese werden im Herbarium der Universität Osnabrück (OSBU) aufbewahrt. 381 Belege konnten endgültig bestimmt werden. Das gesammelte Material umfasst 300 Arten aus 156 Gattungen und 44 Familien. Sechs Arten sind neu für die Mongolei, sechs Arten sind neu für die Region Mongolischer Altai, fünf für die Region Khobdo und 19 für beide Provinzen, Mongolischer Altai und Khobdo der westlichen Mongolei. Die gesammelten Belege werden in alphabetischer Reihenfolge mit Angabe der Akzessionsnummern und Herkünfte tabellarisch aufgelistet.

viet and Mongolian Academies of Sciences, and by German botanists working together with botanists from the Mongolian National University of Ulaanbaatar. A brief history of botanical research in Mongolia is given in HILBIG (1995) and GUBANOV (1996). Since then, interest in the flora of Mongolia has been further stimulated by the “Flora of China” project (published by Science Press Beijing, China, and Missouri Botanical Garden Press, U.S.A., 1994, on-going) and by the planned “Flora of the Altai” (A. I. SCHMAKOV, Barnaul, and R.V. KAMELIN, St. Petersburg, eds., in preparation). Knowledge of the floristic composition of Mongolia is important for biogeographic and florogenetic reasons.

Biogeographic significance of the Altai

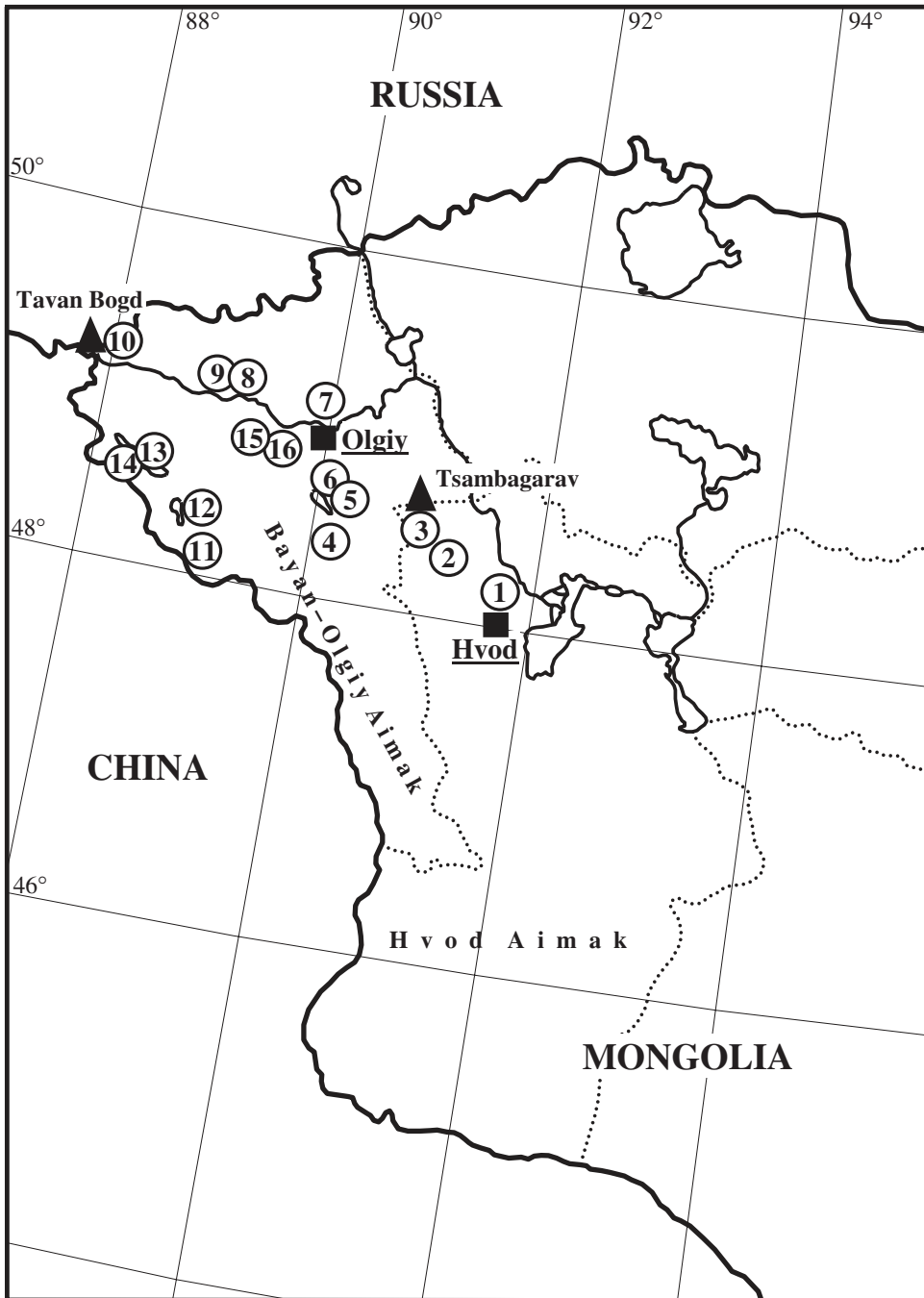
The Altai extends westwards from the upper courses of the rivers Jenissej, Ob and Irtysh in southern Siberia (Russia) to the autonomous regions Xinjiang Uygur in China, to Kazakhstan and Mongolia. In the more moist westerly regions of the Altai, the slopes in the montane and sub-alpine belts are wooded, whereas in the eastern parts the climate becomes increasingly dryer. If the precipitation drops down to 200 mm a year, dry steppe or semi-deserts form the vegetation. However, steppe and semi-deserts in the Altai are not only the consequence of low precipitation but also of low temperatures. In the basins, temperature inversions in winter time are significant and lead to a cold climate in the bottom of the basins which prevents forest growth.

Glaciation during the last ice age depressed the snow line in the Altai by approximately 1000 to 1200 m below that of today. The loss of biodiversity, however, has been less dramatic than in Europe. For many regions in the Altai, studies on the flora proved their autochthonous character, which is interpreted as an old boreal flora of preglacial origin with relicts of nemoral forests (MALYSHEV & PESHKOVA 1984). The steppe zones of the southern Altai have since long been regarded as a centre of origin and evolution of the modern Eurosiberian steppe flora (cf. MEUSEL et al. 1965). This has been recently corroborated by florogenetic analyses particularly for the steppe islands in the southern Siberian mountains (NAMSALOV 1994; PESHKOVA 2001) where relicts of pleistocenous forest steppe are preserved. KAMELIN (1998) assumes the origin of these forest steppe relicts already in the cold periods towards the end of the Pliocene. Eastern Europe and Siberia are of high biogeographic significance for the postglacial history of the European flora. The relationship between the European alpine flora with the central Asiatic mountain flora is striking. In her classic study, JEROSCH (1903) pointed out that 30% of the 420 alpine species examined in Switzerland are of arctic-alpine distribution, and 22% hereof show an arctic-alpine-altai distribution pattern. To explain this distribution pattern TOLMACHEV (1971) hypothesised that the species concerned evolved in a formerly coherent cold steppe plain of

Siberian origin. This idea is related to the view that during the ice ages floristic components of different geographic regions mixed in the cold steppe plains, and following the retreating glaciers became separated. A recent spatial analysis of the Siberian flora points to the Altai mountains as one of the most diverse regions of Siberia (MALYSHEV et al. 1999; MALYSHEV 2000). Proportion of the number of genera to the number of species of the southern Siberian high mountains argues in favour of many autochthonous floristic elements of these regions, and it would appear that the existing mountain flora evolved from an older autochthonous flora. Thus, the periglacial steppe regions should be considered as both, a centre of conservation for a preglacial and a centre of evolution for a postglacial mountain flora (MALYSHEV et al. 1999).

Expedition route and collected material

Compared to other parts of the Altai mountains, knowledge of the flora of the Mongolian Altai (Bayan-Olgii) is still limited. This most western part of Mongolia was for a longer time a military prohibited area and only hardly or not at all accessible for botanists. Within the framework of a scientific partnership between the University of Osnabrück and the Mongolian National University Ulaanbaatar financed by the DAAD (Deutscher Akademischer Austauschdienst) and the Ministry of Science and Culture of Lower Saxony (MWK), a botanical expedition to the most western part of Mongolia has been carried out in July/August 2000, organised by Prof. SCHAMSRAN from the Botany Department of the Mongolian National University, Ulaanbaatar. The expedition started from Hovd to the Tsambagarav Mountain massif, Tavan Bogd and Tsengel National Parks and back to Olgii (see Map 1). Following GRUBOV (1982), the expedition area is located in the regions Khobdo (6) and Mongolian Altai (7). Each expedition point marked by a number in Map 1, may include several localities labelled with a, b, c, d and specified in Table 1. In the presented short contribution we provide the list of collected plants. Some records were new for the flora of Mongolia, others were first records for the region covered by the expedi-



Map 1

Map of Western Mongolia giving collecting sites (numbers). Each collecting site may include several localities labelled with a, b, c, d, which are described in Table 1. For the spelling of geographical names, see legend to Table 1

Table 1

Characterisation of collecting sites. Each collecting site given in Map 1 may include several localities labelled a, b, c, or d. Spelling of geographical names (settlements, rivers, lakes, mountains) follows the “Physical Map of Mongolia”, ed. by the Cartographic Enterprise of the State Administration of Geodesy and Cartography, Ulaanbaatar (2000). In the last column, regions according to GRUBOV (1982) and their corresponding numbers (in brackets) are given

| Collecting Site No. (Date) | Provenance | Coordinates; Elevation | Habitat | Region (GRUBOV 1982) |
|-------------------------------|--|---------------------------------|---|--------------------------------------|
| 1a (19.07.2000) | Hovd Aimak, Hovd City | 48°05'N/91°30'E; 1300 m | ruderal sites in Hovd | Depression of Great Lakes (10) |
| 1b (19.07.2000) | Hovd Aimak, Erdeneburen Sum; 10 km north of Hovd | 48°11'N/91°25'E; 1500 m | mountain steppe | Mongolian Altai (7) |
| 1c (20.07.2000) | Hovd Aimak, Erdeneburen Sum | 48°15'N/91°22'E; 1400 m | mountain steppe | Mongolian Altai (7) |
| 2b (20.07.2000) | Hovd Aimak, Erdeneburen Sum | 48°31'N/90°52'E; 2300 m | mountain steppe to mountain desert, along mountain stream | Mongolian Altai (7) |
| 2c (20.07.2000) | Hovd Aimak, Erdeneburen Sum | 48°19'N/91°19'E; 1400 m | river gravel | Mongolian Altai (7) |
| 3a (20.07.2000) | Hovd Aimak, Erdeneburen Sum; Tsambagarav Mts. | 48°37'N/90°43'E; 3000 m | alpine meadow, partly with shallow peat | Khobdo (6) |
| 3b (20.07.2000) | Hovd Aimak, Erdeneburen Sum; Tsambagarav Mts. | 48°37'N/90°43'E; 3000–3500 m | high alpine meadow, scree and rock communities, spring horizons | Khobdo (6) |
| 3c (21.07.2000) | Hovd Aimak, Erdeneburen Sum; Tsambagarav Mts. | 48°37'N/90°43'E; 2900–3100 m | alpine meadow, moraine screes and river gravel near dead glacier ice | Khobdo (6) |
| 4a (21.07.2000) | Bayan – Olgii Aimak, Altantsogts Sum | 48°27'N/90°25'E; 2800 m | high mountain steppe | Khobdo (6) |
| 4b (26.07.2000) | Bayan – Olgii Aimak, Bugat Sum | 48°58'N/89°52'E; 1900 m | mountain steppe | Khobdo (6) |
| 5 (21.07.2000) | Bayan – Olgii Aimak, Tolbo Sum | 48°28'N/90°11'E; 2200 m | wet meadow along tributary to Tolbo Nuur | Khobdo (6) |
| 6a (21.07.2000) | Bayan – Olgii Aimak, Tolbo Sum | 48°39'N/90°03'E; 2300 m | mountain steppe – mountain desert above Tolbo Nuur | Khobdo (6) |
| 6b (22.07.2000) | Bayan – Olgii Aimak, Tolbo Sum | 48°39'N/90°00'E; 2400 m | mountain steppe near Tolbo Nuur | Khobdo (6) |
| 7a (23.07.2000) | Bayan – Olgii Aimak, Bugat Sum | 48°59'N/89°57'E; 1800 m | alluvial plains near Olgi | Khobdo (6) |
| 7b (22.07.2000) | Bayan – Olgii Aimak, Bugat Sum | 48°58'N/89°56'E; 2000 m | mountain steppe near Olgi | Khobdo (6) |
| 7c (27.07.2000) | Bayan – Olgii Aimag, Olgii City | 48°59'N/89°56'E; 1800 m | ruderal sites in Olgi | Khobdo (6) |
| 8 (23.07.2000) | Bayan – Olgi Aymak, Tsengel Sum | 49°03'N/89°44'E; 2200 m | mountain steppe, partly stony and rocky | Khobdo (6) |
| 9 (23.07.2000) | Bayan – Olgii Aimak, Tsengel Sum | 49°15'N/89°04'E; 2100 m | mountain desert on alluvial fan | Khobdo (6) |
| 10a (24.07.2000) | Bayan – Olgii Aimak, Tsengel Sum; Tavan Bogd National Park | 49°11'N/88°05'E; 2800 m | alpine meadow, river gravel, shallow peat | Khobdo (6) |

Table 1 (Fortsetzung)

| Collecting Site No. (Date) | Provenance | Coordinates; Elevation | Habitat | Region (GRUBOV 1982) |
|-------------------------------|---|----------------------------------|---|-------------------------|
| 10b (24.07.2000) | Bayan – Olgii Aimak, Tsengel Sum; Tavan Bogd National Park | 49°09'N/88°01'E; 3100 m | alpine spring horizons and wet meadows | Khobdo (6) |
| 10c (24.07.2000) | Bayan – Olgii Aimak, Tsengel Sum; Tavan Bogd National Park | 49°09'N/88°00'E; 3100–3500 m | high alpine meadows, alpine tundra, spring horizons, scree | Khobdo (6) |
| 10d (25.07.2000) | Bayan – Olgii Aimak, Tsengel Sum; Tavan Bogd National Park | 49°11'N/88°05'E ; 2800–3500 m | mountain steppe, alpine meadows, boulder and scree | Khobdo (6) |
| 11 (28./29.07.2000) | Bayan – Olgii Aimak, Sagsay Sum; Tsengel Nat. Park, Songino River Valley | 48°09'N/89°00'E; 2000–2750 m | <i>Larix sibirica</i> forest on northern slopes and in sheltered places on south slopes; tall herb communities in the bottom of the valley along river; mountain steppe, partly stony and rocky, on southern slopes and on mountain peaks | Mongolian Altai (7) |
| 12 (30.07.2000) | Bayan – Olgii Aimak, Sagsay Sum; Tsengel Nat. Park; along Dayan Nuur | 48°24'N/88°51'E; 2300 m | mountain steppe | Mongolian Altai (7) |
| 13a (31.07.2000) | Bayan – Olgii Aimak, Tsengel Sum; Tsengel Nat. Park; between Hoton Nuur and Hurgan Nuur | 48°35'N/88°27'E; 2200 m | sea shore along Lake Hoton Nuur; ruderal sites near military camp | Mongolian Altai (7) |
| 13b (01.08.2000) | Bayan – Olgii Aimak, Tsengel; Tsengel Nat. Park; between Hoton Nuur and Hurgan Nuur | 48°35'N/88°27'E; 2200–2500 m | mountain steppe, granite rocks and boulder, scree | Mongolian Altai (7) |
| 13c (30.07.2000) | Bayan – Olgii Aimak, Sagsay Sum; Tsengel Nat. Park | 48°36'N/88°27'E; 2200 m | moraine landscape, mountain steppe and meadows, wet meadows along creeks | Mongolian Altai (7) |
| 14 (31.07.2000) | Bayan – Olgii Aimak, Tsengel Sum; Tsengel Nat. Park | 48°29'N/88°28'E; 2300–3100 m | <i>Larix sibirica</i> forest; <i>Betula rotundifolia</i> shrub; alpine meadows and alpine tundra; scree and boulder | Mongolian Altai (7) |
| 15 (02.08.2000) | Bayan – Olgii Aimak, Sagsay Sum | 48°53'N/89°28'E; 2100 m | mountain steppe and -desert | Khobdo (6) |
| 16 (02.08.2000) | Bayan – Olgii Aimak, Bugat Sum; near Olgii | 48°56'N/89°48'E; 2100–2500 m | mountain steppe, scree and sand | Khobdo (6) |

Table 2

Alphabetical list of families of vascular plants and species within them collected in the regions Khobdo and Mongolian Altai (GRUBOV 1982). Numbers are accession numbers of the Herbarium of Systematic Botany of the University of Osnabrück, OSBU; in brackets the collecting sites of the specimens according to Table 1; ^M species new for Mongolia, ^{MA} species new for the region Mongolian Altai; ^K species new for the region Khobdo; ^{K+MA} species new for both regions Mongolian Altai and Khobdo

| Family | Species | Herbarium numbers (collecting sites according to Table 1) |
|-------------------|---|---|
| Apiaceae | | |
| | <i>Bupleurum bicaule</i> HELM | 10230 (1c), 10254 (2b), 10333 (6a) |
| | <i>Pachypleurum alpinum</i> LEDEB. | 10286 (3b) |
| | <i>Peucedanum falcaria</i> TURCZ. | 10363 (8) |
| | <i>Phlojodicarpus sibiricus</i> (STEPH. ex SPRENG.) KOSO-POL. | 10477 (11) |
| | <i>Schultzia crinita</i> (PALL.) SPRENG. | 10427 (10c), 10439 (10d) |
| Asteraceae | | |
| | ^{K+MA} <i>Ajania trifida</i> (TURCZ.) TZVEL. | 10375 (9), 10599 (15) |
| | <i>Ancathia igniaria</i> (SPRENG.) DC. | 10595 (13b) |
| | <i>Antennaria dioica</i> (L.) GAERTN. | 10512 (11) |
| | <i>Artemisia borealis</i> PALL. | 10283 (3b) |
| | <i>Artemisia dracunculus</i> L. | 10342 (6b), 10546 (11) |
| | <i>Artemisia frigida</i> WILLD. | 10223 (1b) |
| | <i>Artemisia laciniata</i> WILLD. | 10487 (11) |
| | <i>Artemisia macrocephala</i> JACQ. ex BESS. | 10205 (1a), 10353 (7a) |
| | <i>Artemisia palustris</i> L. | 10211 (1c), 10607 (16) |
| | <i>Artemisia pectinata</i> PALL. | 10225 (1b) |
| | <i>Artemisia rupestris</i> L. | 10253 (2b) |
| | <i>Artemisia rutifolia</i> STEPH. ex SPRENG. | 10605 (16) |
| | <i>Artemisia santolinifolia</i> TURCZ. ex BESS. | 10596 (13b) |
| | <i>Artemisia schrenkiana</i> LEDEB. | 10559 (15) |
| | ^{nfm} <i>Artemisia succulenta</i> LEDEB. | 10252 (2b), 10343 (6b) |
| | <i>Artemisia vulgaris</i> L. | 10473 (11) |
| | <i>Artemisia xerophytica</i> KRASCH. | 10464 (4b) |
| | <i>Aster alpinus</i> L. | 10317 (3c), 10328 (4a) |
| | <i>Chrysanthemum sinuatum</i> LEDEB. | 10481 (11) |
| | <i>Cicerbita azurea</i> (LEDEB.) BEAUVERD | 10585 (14) |
| | <i>Cirsium esculentum</i> L. | 10560 (12) |
| | <i>Crepis chrysantha</i> (LEDEB.) TURCZ. | 10326 (4a), 10415 (10c), 10431 (10d), 10537 (11), 10537 (11) |
| | <i>Erigeron eriocalyx</i> (LEDEB.) VIERH. | 10384 (10a) |
| | <i>Erigeron lonchophyllus</i> HOOK. | 10484 (11) |
| | <i>Heteropappus altaicus</i> (WILLD.) NOVOPOKR. | 10218 (1c), 10524 (11) |
| | <i>Heteropappus hispidus</i> (THUNB.) LESS. | 10247 (1c) |
| | ^{K+MA} <i>Lactuca sibirica</i> (L.) BENTH. ex MAXIM. | 10260 (1c) |
| | <i>Leontopodium ochroleucum</i> BEAUVERD | 10267 (3a) |
| | <i>Ptarmica ledebourii</i> (HEIMERL) SERG. | 10562 (14) |
| | <i>Pyrethrum changaicum</i> KRASCH. ex GRUBOV | 10426 (10c), 10430 (10d) |
| | ^{nfm} <i>Pyrethrum pyrethroides</i> (KAR. & KIR.) B.FEDTSCH. ex KRASCH. | 10284 (3b) |
| | <i>Saussurea alata</i> DC. | 10603 (16) |
| | <i>Saussurea amara</i> (L.) DC. | 10425 (10c), 10563(14), 10567(14) |
| | <i>Saussurea baicalensis</i> (ADAMS) ROBINS | 10529 (11) |
| | <i>Saussurea glacialis</i> HERD | 10341 (6b) |
| | <i>Saussurea leucophylla</i> SCHRENK | 10273 (3b), 10319 (3c), 10429 (10c) |
| | <i>Saussurea parviflora</i> (POIR.) DC. | 10503 (11) |
| | ^{K+MA} <i>Saussurea salicifolia</i> (L.) DC. | 10369 (8) |

Table 2 (Fortsetzung)

| Family Species | Herbarium numbers (collecting sites according to Table 1) |
|---|--|
| <i>Saussurea subacaulis</i> (LEDEB.) SERG. | 10434 (10d) |
| <i>Scorzonera curvata</i> (POPL.) LIPSCH. | 10237 (1c) |
| <i>Scorzonera radiata</i> FISCH. ex LEDEB. | 10535 (11) |
| <i>Senecio erucifolius</i> L. | 10547 (11) |
| <i>Senecio pricei</i> SIMPSON | 10453 (10d) |
| <i>Senecio resedifolius</i> LESS. | 10392 (10b), 10419 (10c) |
| <i>Senecio subdentatus</i> LEDEB. | 10808 (14) |
| <i>Solidago dahurica</i> KITAG. | 10495 (11), 10527 (11) |
| <i>Tanacetum tanacetoides</i> (DC.) TZVEL. | 10516 (11), 10591 (13b) |
| ^K <i>Taraxacum eriopodium</i> (D.DON.) DC. | 10303 (3c) |
| <i>Taraxacum lyratum</i> (LEDEB.) DC. | 10300 (3c) |
| <i>Tragopogon songoricus</i> S.A.NIKITIN | 10493 (11) |
| <i>Waldheimia tridactylites</i> KAR. & KIR. | 10310 (3c) |
| <i>Youngia tenuifolia</i> (WILLD.) BABC. & STEBBING | 10240 (1c), 10593 (13b) |
| Athyriaceae | |
| <i>Cystopteris fragilis</i> (L.) BERNH. | 10545 (11) |
| Berberidaceae | |
| <i>Berberis sibirica</i> PALL. | 10530 (11) |
| Betulaceae | |
| <i>Betula rotundifolia</i> SPACH | 10455 (10d), 10586 (14) |
| Boraginaceae | |
| <i>Lappula consanguinea</i> (FISCH. & C.A.MEY.) Guerke | 10309 (3c) |
| <i>Lappula marginata</i> (M.BIEB.) GUERKE | 10234 (1c) |
| <i>Lappula microcarpa</i> (LEDEB.) GUERKE | 10443 (10d) |
| ^{nM} <i>Myosotis austrosibirica</i> O.NIKIF. | 10420 (10c) (10c) |
| ^{nM} <i>Myosotis stricta</i> LINK ex ROEM. & SCHULT. | 10329 (4a) |
| Brassicaceae | |
| <i>Capsella bursa-pastoris</i> (L.) MEDIK. | 10587 (13a) |
| <i>Cardamine bellidifolia</i> L. | 10409 (10c), 10574 (14) |
| <i>Cardamine macrophylla</i> WILLD. | 10494 (11), 10582 (14) |
| <i>Dontostemon elegans</i> MAXIM. | 10461 (4b) |
| <i>Dontostemon integrifolius</i> (L.) C.A.MEY. | 10217 (1c), 10228 (1c), 10233 (1c), 10324 (4a), 10231 (1c), 10336 (6b), 10337 (6b), 10352 (7a) |
| <i>Dontostemon senilis</i> MAXIM. | 10099 (6b), 10366 (8) |
| <i>Draba altaica</i> (C.A.MEY.) BUNGE | 10433 (10d) |
| <i>Draba fladnizensis</i> WULFEN | 10313 (3c), 10376 (10a) |
| ^K <i>Draba lanceolata</i> ROYLE | 10306 (3c) |
| <i>Draba mongolica</i> TURCZ. | 10287(3b), 10288 (3b), 10294 (3c), 10422(10c), 10565 (14) |
| ^{K+MA} <i>Draba multiceps</i> KITAG. | 10262 (3a) |
| <i>Draba nemorosa</i> L. | 10261 (1c), 10269 (3b) |
| <i>Draba ochroleuca</i> BUNGE | 10572 (14) |
| <i>Draba oreades</i> SCHRENK | 10416 (10d) |
| <i>Draba sibirica</i> (PALL.) THELL. | 10568 (14) |
| <i>Draba turczaninovi</i> POHLE & N.BUSCH | 10571 (14) |
| <i>Erysimum hieracifolium</i> L. | 10502 (11), 10513 (11) |

Table 2 (Fortsetzung)

| Family | Species | Herbarium numbers (collecting sites according to Table 1) |
|------------------------|--|--|
| | <i>Eutrema edwardsii</i> R.BR. | 10401 (10c), 10405 (10c), 10576 (14) |
| | ^{K+MA} <i>Goldbachia laevigata</i> (M.BIEB.) DC. | 10601 (16) |
| | ^{K+MA} <i>Lepidium crassifolium</i> WALDST. & KIT. | 10467 (7b) |
| | <i>Lepidium latifolium</i> L. | 10255 (2c) |
| | <i>Lepidium obtusum</i> BASINGER | 10207 (1a) |
| | <i>Macropodium nivale</i> (PALL.) R.BR. | 10581 (14) |
| | ^{K+MA} <i>Microstigma junatovii</i> GRUBOV | 10809 (10a) |
| | <i>Parrya excapa</i> C.A.MEY. | 10410 (10c) |
| | <i>Ptilotrichum canescens</i> C.A.MEY. | 10219 (1c), 10465 (4b) |
| | <i>Rorippa islandica</i> (OEDER) BORBÁS ex MURR. | 10557 (12) |
| | <i>Smelowskia alba</i> (PALL.) REGEL | 10293 (3c), 10659 (2b) |
| | <i>Smelowskia calycina</i> (STEPH.) C.A.MEY. | 10403 (10c) |
| | ^K <i>Smelowski a mongolica</i> KORNIL. | 10301 (3c), 10413 (10c) |
| | <i>Stevenia cheiranthoides</i> DC. | 10589 (13b) |
| | ^{K+MA} <i>Taphrospermum altaicum</i> C.A.MEY. | 10597 (13b) |
| | ^{K+MA} <i>Thellungiella salsuginea</i> (PALL.) O.E.SCHULZ | 10379 (10a) |
| Campanulaceae | | |
| | <i>Campanula altaica</i> LEDEB. | 10491 (11) |
| | <i>Campanula glomerata</i> L. | 10498 (11), 10519 (11) |
| Caprifoliaceae | | |
| | <i>Lonicera altaica</i> PALL. | 10501 (11) |
| | <i>Lonicera hispida</i> PALL. ex SCHULT. | 10517 (11) |
| | <i>Lonicera microphylla</i> WILLD. ex SCHULT. | 10515 (11) |
| Caryophyllaceae | | |
| | <i>Arenaria capillaris</i> POIR. | 10277 (3b), 10564 (14) |
| | <i>Cerastium arvense</i> L. | 10575 (14) |
| | <i>Cerastium cerastioides</i> (L.) BRITTON | 10275 (3b), 10417 (10c) |
| | <i>Cerastium lithospermifolium</i> FISCH. | 10302 (3c) |
| | <i>Cerastium pusillum</i> SER. | 10349 (7a) |
| | <i>Dianthus hoeltzeri</i> WINKL. | 10456 (10d) |
| | <i>Dianthus superbus</i> L. | 10505 (11) |
| | <i>Dianthus versicolor</i> FISCH. ex LINK | 10488 (11) |
| | ^K <i>Gastrolychnis apetala</i> (L.) TOLM. & KOZHAN. | 10279 (3b) ^K , 10421 (10c) |
| | <i>Minuartia biflora</i> (L.) SCHINZ & THELL. | 10396 (10b), 10264 (3a), 10321 (3c) |
| | <i>Minuartia verna</i> (L.) HIERN | 10345 (6b) |
| | <i>Silene chamarensis</i> TURCZ. | 10314 (3c) |
| | <i>Silene jenisseensis</i> WILLD. | 10528 (11) |
| | <i>Silene repens</i> PATRIN ex PERS. | 10331 (4a), 10543 (11) |
| | <i>Stellaria dichotoma</i> L. | 10213 (1c), 10506 (11) |
| | ^x <i>Stellaria gypsophiloides</i> FENZL | 10239 (1c) |
| | <i>Stellaria peduncularis</i> BUNGE | 10570 (14) |
| Chenopodiaceae | | |
| | <i>Anabasis brevifolia</i> C.A.MEY. | 10338 (6b) |
| | <i>Axyris prostrata</i> L. | 10311 (3c) |
| | <i>Bassia dasyphylla</i> (FISCH. & C.A.MEY.) O.KUNTZE | 10356 (7a) |
| | <i>Chenopodium acuminatum</i> WILLD. | 10220 (1c) |
| | <i>Chenopodium frutescens</i> C.A.MEY. | 10463 (4b), 10609 (15) |
| | <i>Krascheninnikovia ceratoides</i> (L.) GUELLENST. | 10243 (1c), 10359 (8), 10608 (16) |
| | <i>Salsola collina</i> PALL. | 10208 (1a), 10370 (10a), 10606 (16) |

Table 2 (Fortsetzung)

| Family | Species | Herbarium numbers (collecting sites according to Table 1) |
|-----------------------|---|--|
| Convolvulaceae | | |
| | <i>Convolvulus ammannii</i> DESR. | 10245 (1c) |
| Crassulaceae | | |
| | <i>Orostachys spinosa</i> (L.) C.A.MEY. | 10249 (2b), 10344 (6b) |
| | <i>Rhodiola algida</i> (LEDEB.) FISCH. & C.A.MEY. | 10428 (10c) |
| | <i>Rhodiola quadrifida</i> (PALL.) FISCH. & C.A.MEY. | 10270 (3b) |
| | <i>Rhodiola rosea</i> L. | 10298 (3c) |
| | <i>Sedum ewersii</i> LEDEB. | 10521 (11) |
| | <i>Sedum hybridum</i> L. | 10523 (11) |
| Cupressaceae | | |
| | <i>Juniperus sabina</i> L. | 10478 (11), 10549 (11) |
| | <i>Juniperus sibirica</i> BURGSD. | 10479 (11), 10550 (11) |
| Cyperaceae | | |
| | ^{MA} <i>Carex microglochis</i> WAHLENB. | 10382 (10a) |
| | ^{K+MA} <i>Eriophorum brachyantherum</i> TRAUTV. & C.A.MEY. | 10394 (10b) |
| | <i>Kobresia bellardii</i> (ALL.) DEGEL. | 10436 (10d) |
| Ephedraceae | | |
| | <i>Ephedra sinica</i> STAPF var. <i>pumila</i> FLORIN | 10242 (1c) |
| Fabaceae | | |
| | <i>Astragalus adsurgens</i> PALL. | 10206 (1a) |
| | <i>Astragalus altaicus</i> BUNGE | 10437 (10d) |
| | <i>Astragalus laguroides</i> PALL. | 10232 (1c) |
| | <i>Astragalus monophyllus</i> BUNGE | 10350 (7a), 10351 (7a) |
| | <i>Caragana bungei</i> LEDEB. | 10238 (1c) |
| | <i>Caragana leucophloea</i> POJARK. | 10221 (1c), 10354 (7a) |
| | <i>Caragana spinosa</i> (L.) DC. | 10256 (2c) |
| | <i>Gueldenstaedtia monophylla</i> FISCH. | 10246 (1c) |
| | ^{MA} <i>Hedysarum alpinum</i> L. | 10438 (10d) |
| | ^{nFM} <i>Hedysarum consanguineum</i> DC. | 10323 (3c) |
| | <i>Hedysarum gmelinii</i> LEDEB. | 10327 (4a) |
| | <i>Oxytropis aciphylla</i> LEDEB. | 10373 (9) |
| | <i>Oxytropis gorbunovii</i> BORISS. | 10272 (3b) |
| | <i>Oxytropis lapponica</i> (WAHLENB.) J.GAY | 10285 (3b) |
| | <i>Trifolium eximium</i> STEPH. ex DC. | 10290 (3c) |
| | <i>Trifolium lupinaster</i> L. | 10485 (11) |
| | <i>Vicia costata</i> LEDEB. | 10362 (8) |
| Gentianaceae | | |
| | <i>Gentiana acuta</i> MICHX. | 10486 (11) |
| | <i>Gentiana algida</i> PALL. | 10291 (3c) |
| | <i>Gentiana barbata</i> FROEL. | 10380 (10a), 10462 (4b) |
| | <i>Gentiana decumbens</i> L. | 10372 (9), 10475 (11) |
| | <i>Gentiana squarrosa</i> LEDEB. | 10263 (3a), 10423 (10c) |
| | <i>Gentiana uniflora</i> GEORGI | 10457 (10f), 10532 (11) |
| | <i>Swertia marginata</i> SCHRENK | 10400 (10c), 10442 (10d) |
| Geraniaceae | | |
| | <i>Biebersteinia odora</i> STEPH. | 10454 (10d) |
| | <i>Erodium tibetanum</i> EDGEW. | 10347 (7a) |

Table 2 (Fortsetzung)

| Family | Species | Herbarium numbers (collecting sites according to Table 1) |
|-----------------------|--|--|
| | <i>Geranium albiflorum</i> LEDEB. | 10472 (11) |
| | <i>Geranium pseudosibiricum</i> J.MAYER | 10518 (11) |
| | <i>Geranium sibiricum</i> L. | 10258 (2c) |
| Haloragaceae | | |
| | <i>Myriophyllum verticillatum</i> L. | 10553 (12) |
| Juncaceae | | |
| | <i>Luzula parviflora</i> (EHRH.) DESV. | 10569 (14) |
| Lamiaceae | | |
| | <i>Dracocephalum bungeanum</i> SCHISCHK. & SERG. | 10325 (4a) |
| | <i>Dracocephalum discolor</i> BUNGE | 10404 (10c) |
| | <i>Dracocephalum foetidum</i> BUNGE | 10358 (8), 10602 (16) |
| | ^{K+MA} <i>Dracocephalum fragile</i> TURCZ. ex BENTH. | 10447 (10d) |
| | <i>Dracocephalum grandiflorum</i> L. | 10241 (1c), 10444 (10d) |
| | <i>Dracocephalum imberbe</i> BUNGE | 10292 (3c) |
| | <i>Dracocephalum origanoides</i> STEPH. ex WILLD. | 10308 (3c), 10458 (10d), 10578 (14c) |
| | <i>Hyssopus cuspidatus</i> BORISS. | 10482 (11) |
| | <i>Lagopsis marrubiastrum</i> (STEPH.) IKONN.-GAL. | 10282 (3b), 10588 (13a) |
| | ^{K+MA} <i>Leonurus mongolicus</i> KREZ. & KUPRIAN. | 10474 (11) |
| | <i>Nepeta sibirica</i> L. | 10466 (7b) |
| | <i>Panzeria lanata</i> (L.) SOJÁK | 10229 (1c) |
| | <i>Phlomis oreophila</i> KAR. & KIR. | 10522 (11) |
| | <i>Schizonepeta annua</i> (PALL.) SCHISCHK. | 10224 (1b), 10371 (8) |
| | <i>Scutellaria grandiflora</i> SIMS | 10210 (1c) |
| | ^{K+MA} <i>Scutellaria scordifolia</i> FISCH. ex SCHRANK | 10600 (16) |
| | <i>Thymus mongolicus</i> (RONNIGER) RONNIGER | 10592 (13b) |
| | <i>Ziziphora pamiroalaica</i> JUZ. | 10489 (11) |
| Liliaceae | | |
| | <i>Allium altaicum</i> PALL. | 10551 (11) |
| | <i>Allium anisopodium</i> LEDEB. | 10222 (1c) |
| | <i>Allium bogdoicolum</i> REGEL | 10432 (10d) |
| | <i>Allium mongolicum</i> REGEL | 10215 (1c) |
| | <i>Allium pumilum</i> VVED. | 10296 (3c) |
| | <i>Allium strictum</i> SCHRAD. | 10548 (11) |
| | <i>Allium tuvinicum</i> (FRIESEN) FRIESEN | 10250 (2b) |
| Onagraceae | | |
| | <i>Chamaenerion latifolium</i> (L.) TH.FRIES & LANGE | 10378 (10a) |
| Papaveraceae | | |
| | <i>Chiazospermum lactiflorum</i> KAR. & KIR. | 10257 (2c) |
| | <i>Papaver pseudocanescens</i> POPOV | 10268 (3a), 10398 (10b), 10580 (14) |
| Plantaginaceae | | |
| | <i>Plantago komarovii</i> PAVL. | 10460 (10d) |
| | <i>Plantago minuta</i> PALL. | 10355 (7a) |
| Plumbaginaceae | | |
| | <i>Goniolimon eximium</i> (SCHRENK) BOISS. | 10509 (11) |
| | <i>Goniolimon speciosum</i> (L.) BOISS. | 10365 (8) |

Table 2 (Fortsetzung)

| Family | Species | Herbarium numbers (collecting sites according to Table 1) |
|----------------------|---|--|
| Poaceae | | |
| | <i>Agropyron cristatum</i> (L.) BEAUVERD | 10226 (1b) |
| | ^{K+MA} <i>Agropyron desertorum</i> (FISCH. ex. LINK) SCHULT. | 10214 (1c) |
| | <i>Alopecurus alpinus</i> SMITH | 10508 (11) |
| | <i>Alopecurus brachystachyus</i> M.BIEB. | 10315 (3c) |
| | <i>Beckmannia syzigachne</i> (STEUD.) FERN. | 10555 (12) |
| | <i>Bromus japonicus</i> THUNB. | 10544 (11) |
| | <i>Eragrostis minor</i> HOST | 10348 (7a) |
| | <i>Poa attenuata</i> TRIN. | 10332 (4a) |
| | <i>Ptilagrostis mongholica</i> (TURCZ. ex TRIN.) GRISEB. | 10435 (10d) |
| | <i>Stipa glareosa</i> P.A.SMIRN. | 10335 (6b) |
| | ^x <i>Stipa krylovii</i> ROSHEVITZ | 10209 (1c) |
| Polemoniaceae | | |
| | <i>Polemonium racemosum</i> (REGEL) KITAM. | 10497 (11) |
| Polygalaceae | | |
| | <i>Polygala hybrida</i> DC. | 10480 (11) |
| Polygonaceae | | |
| | <i>Atraphaxis frutescens</i> (L.) K.KOCH | 10364 (8), 10590 (13b) |
| | <i>Oxyria digyna</i> (L.) HILL | 10579 (14) |
| | <i>Rheum undulatum</i> L. | 10526 (11) |
| Portulacaceae | | |
| | <i>Claytonia joanneana</i> SCHULT. | 10389 (10b) |
| Primulaceae | | |
| | <i>Androsace chamaejasme</i> HOST | 10312 (3c) |
| | <i>Androsace dasyphylla</i> BUNGE | 10276 (3b) |
| | <i>Androsace maxima</i> L. | 10368 (8) |
| | <i>Androsace septentrionalis</i> L. | 10307 (3c) |
| | <i>Primula algida</i> ADAMS | 10271 (3b), 10304 (3c) |
| | <i>Primula farinosa</i> L. | 10278 (3b) |
| | <i>Primula nivalis</i> PALL. | 10406 (10c) |
| Pyrolaceae | | |
| | <i>Pyrola incarnata</i> (DC.) FREYN | 10451 (10d) |
| | <i>Pyrola rotundifolia</i> L. | 10500 (11) |
| | <i>Pyrola secunda</i> L. | 10499 (11) |
| Ranunculaceae | | |
| | ^{K+MA} <i>Aconitum septentrionale</i> KOELLE | 10496 (11) |
| | <i>Aquilegia sibirica</i> LAM. | 10504 (11) |
| | <i>Atragene sibirica</i> L. | 10542 (11) |
| | <i>Atragene speciosa</i> WEINM. | 10540 (11) |
| | ^{K+MA} <i>Batrachium mongolicum</i> (KRYLOV) V.I.KREZC. | 10385 (10a) |
| | <i>Callianthemum sajanense</i> (REGEL) WITASEK | 10511 (11) |
| | ^{MA} <i>Delphinium ukokense</i> SERG. | 10471 (11) |
| | <i>Halerpestes salsuginosa</i> (PALL. ex GEORGI) GREENE | 10577 (14) |
| | <i>Halerpestes sarmentosa</i> (ADAMS) KOM. | 10383 (10a) |
| | <i>Oxygraphis glacialis</i> (FISCH.) BUNGE | 10408 (10c) |
| | <i>Pulsatilla bungeana</i> C.A.MEY. | 10216 (1c), 10227 (1c) |
| | var. <i>astragalifolia</i> (POBED.) GRUBOV | |

Table 2 (Fortsetzung)

| Family | Species | Herbarium numbers (collecting sites according to Table 1) |
|-------------------------|--|--|
| | <i>Pulsatilla multifida</i> (TURCZ.) JUZ. | 10459 (10d) |
| | <i>Ranunculus altaicus</i> LAXM. | 10411 (10c) |
| | <i>Ranunculus pseudohirculus</i> SCHRENK | 10391 (10b), 10418 (10c) |
| | <i>Ranunculus pulchellus</i> C.A.MEY. | 10274 (3b) |
| | <i>Thalictrum alpinum</i> L. | 10289 (3c), 10448 (10d) |
| | <i>Thalictrum foetidum</i> L. | 10360 (8) |
| | <i>Thalictrum schischkinii</i> FRIESEN | 10468 (11) |
| Rosaceae | | |
| | <i>Amygdalus pedunculata</i> PALL. | 10248 (1c) |
| | <i>Chamaerhodos erecta</i> (L.) BUNGE | 10235 (1c) |
| | <i>Cotoneaster uniflora</i> BUNGE | 10525 (11) |
| | <i>Dasiphora fruticosa</i> (L.) RYDB. | 10412 (10c) |
| | <i>Dryas oxyodonta</i> JUZ. | 10295 (3c) |
| | <i>Potentilla astragalifolia</i> BUNGE | 10212 (1c) |
| | <i>Potentilla bifurca</i> L. | 10346 (6b), 10554 (12) |
| | <i>Potentilla chrysantha</i> TREVIR. | 10534 (11) |
| | <i>Potentilla evestita</i> TH.WOLF | 10566 (14) |
| | <i>Potentilla gelida</i> C.A.MEY. | 10424 (10c) |
| | <i>Potentilla multifida</i> L. | 10297 (3c) |
| | <i>Potentilla sericea</i> L. | 10251 (2b) |
| | <i>Potentilla strigosa</i> PALL. ex PURSH | 10340 (6b) |
| | ^{K+MA} <i>Potentilla tanacetifolia</i> WILLD. ex SCHLTDL. | 10367 (8) |
| | ^{MA} <i>Rosa acicularis</i> LINDL. | 10538 (11) |
| | <i>Rosa kokanica</i> (REGEL) JUZ. | 10533 (11) |
| | <i>Sanguisorba alpina</i> BUNGE | 10483 (11) |
| | <i>Spiraea alpina</i> PALL. | 10381 (10a) |
| | <i>Spiraea media</i> F.SCHMIDT | 10507 (11) |
| Salicaceae | | |
| | <i>Salix arctica</i> PALL. | 10397 (10b) |
| | <i>Salix bebbiana</i> SARG. | 10584 (14) |
| | <i>Salix caesia</i> VILL. subsp. <i>tschenensis</i> BOLSCH. | 10470 (11) |
| | <i>Salix nummularia</i> ANDERSSON | 10390 (10b), 10402 (10c) |
| | <i>Salix pyrolifolia</i> LEDEB. | 10583 (14) |
| | <i>Salix reticulata</i> L. | 10446 (10d) |
| | <i>Salix taraikensis</i> KIMURA | 10476 (11) |
| | <i>Salix turczaninowii</i> LAKSCH. | 10573 (14) |
| Saxifragaceae | | |
| | <i>Saxifraga hieracifolia</i> WALDST. & KIT. | 10318 (3c) |
| | <i>Saxifraga hirculus</i> L. | 10265 (3a) |
| | <i>Saxifraga macrocalyx</i> TOLM. | 10299 (3c) |
| | <i>Saxifraga oppositifolia</i> L. | 10305 (3c) |
| | <i>Saxifraga sibirica</i> L. | 10259 (1c), 10281 (3b), 10322 (3b), 10399 (10b) |
| Scheuchzeriaceae | | |
| | <i>Triglochin palustre</i> L. | 10552 (12) |
| Scrophulariaceae | | |
| | ^{MA} <i>Euphrasia tatarica</i> FISCH. ex SPRENG. | 10492 (11) |
| | <i>Lagotis integrifolia</i> (WILLD.) SCHISCHK. | 10280 (3b) |

Table 2 (Fortsetzung)

| Family Species | Herbarium numbers (collecting sites according to Table 1) |
|---|--|
| <i>Linaria acutiloba</i> FISCH. ex RCHB. | 10514 (11) |
| <i>Linaria buriatica</i> TURCZ. ex LEDEB. | 10361 (8) |
| <i>Linaria pedicellata</i> KUPRIAN. | 10594 (13b) |
| ^K <i>Pedicularis dasystachys</i> SCHRENK | 10266 (3a) |
| <i>Pedicularis lasiostachys</i> BUNGE | 10334 (5) |
| <i>Pedicularis longiflora</i> RUDOLPH | 10561 (13c) |
| <i>Pedicularis oederi</i> VAHL | 10393 (10b) |
| <i>Pedicularis tristis</i> L. | 10445 (10d) |
| <i>Veronica densiflora</i> LEDEB. | 10449 (10d) |
| <i>Veronica porphyriana</i> PAVL. | 10452 (10d) |
| ^M <i>Veronica sajanensis</i> PRINTZ | 10469 (11) |
| ^{K+MA} <i>Veronica sibirica</i> L. | 10598 (13b) |
| Tamaricaceae | |
| <i>Reaumuria songorica</i> (PALL.) MAXIM. | 10098 (15) |
| Valerianaceae | |
| ^{MA} <i>Patrinia sibirica</i> (L.) JUSS. | 10541 (11) |
| <i>Valeriana petrophila</i> BUNGE | 10450 (10d) |
| Violaceae | |
| <i>Viola altaica</i> KER-GAWL. | 10520 (11) |
| Zygophyllaceae | |
| ^{K+MA} <i>Zygophyllum potaninii</i> MAXIM. | 10490 (4b) |

tion, and might therefore be a valuable contribution to the knowledge of the flora of the Mongolian Altai.

All collected herbarium specimens of vascular plants are listed in Table 2. They are deposited in the Herbarium of the University of Osnabrück (OSBU). Families and within them specimens are listed alphabetically, and the accession numbers of OSBU are given. With reference to HILBIG & SCHAMSRAN (1976 and 1980), HILBIG et al. (1989), GRUBOV (1982), GUBANOV (1996), six of the species were first records for Mongolia (marked with ^M), six species had not been recorded for the region Mongolian Altai (marked with ^{MA}), five are new for the region Khobdo (marked with ^K), and 19 for both regions, Mongolian Altai and Khobdo in Western Mongolia (marked with ^{K+MA}). Regions are defined according to GRUBOV (1982). Some species could not be conclusively determined (*Sedum* one specimen, *Carex* six specimens, *Eleocharis* one, *Astragalus*

two, *Oxytropis* two, Lamiaceae one specimen, *Poa* one, *Trisetum* one, Poaceae four, *Polygonum* one). Determination followed mainly GRUBOV (1982) and the Flora Sibiriae (MALYSHEV 1987–1997). Nomenclature is given according to Flora Sibiriae and CZEREPANOV (1995).

Within the scope of our own research, special attention was given to the Alliaceae and the Brassicaceae. The Brassicaceae are one of the ten most diverse families of the Altai, and include many endemic taxa (EBEL 2000). Phylogenetic and phylogeographic studies within the Brassicaceae are of high interest for analyses of the age and history of the Altai flora. Taxa currently under molecular systematic investigations include *Clausia* KORN.-TR., *Cardamine* L., *Dontostemon* ANDRZ. ex DC. and others. We are collaborating with the group of Prof. A. I. SCHMAKOV from the Altai State University and South-Siberian Botanical Garden, Barnaul, Russia.

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