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Bomarea edulis (TUSSAC) HERB. a nearly forgotten pre-Columbian cultivated plant and its closest relatives (Alstroemeriaceae)

Mit 18 Abbildungen

Summary

The morphological variability, distribution, tuber anatomy, use and taxonomy of *Bomarea edulis* are discussed. *Bomarea edulis* is distributed from Mexico to Argentina. Its wide distribution may be caused by the fact that the root tubers have been used as food. A well developed plant can bear more than 20 root tubers with 5 cm in diameter. The tubers are named with a number of local names, best known as "white Jerusalem artichoke" or in German as "Bomarie", respectively. *Bomarea edulis* is morphologically variable, this and the wide distribution have caused 23 synonyms, the very similar and also edible *B. ovata* has seven synonyms. *Bomarea edulis* is compared to its closest similar species and a key is given to determine them.

Zusammenfassung

Bomarea edulis (TUSSAC) HERB., eine nahezu vergessene prä-kolumbianische Kultur-Pflanze und ihre nächsten Verwandten (Alstroemeriaceae)

Die morphologische Variabilität, die Verbreitung, die Knollenanatomie, die Verwendung und die Taxonomie von *Bomarea edulis* werden diskutiert. *Bomarea edulis* kommt von Mexiko, den großen und kleinen Antillen über Brasilien bis Argentinien vor. Diese weite Verbreitung ist unter Umständen dadurch verursacht, dass die Wurzelknollen essbar sind. Eine gut entwickelte Pflanze trägt mehr als 20 Wurzelknollen mit ca. 5 cm Durchmesser. Die Knollen werden z. B. als „white Jerusalem artichoke" (deutsch: Bomarie) verkauft. *Bomarea edulis* erweist sich morphologisch als sehr variabel. Dies und die weite Verbreitung haben zu 23 Synonymen geführt. Die ebenfalls essbare *B. ovata* hat sieben Synonyme. *Bomarea edulis* wird mit ihren nächsten Verwandten verglichen.

1. Introduction

The Andes are one of the so-called VAVILOV centres for the origin of cultivated plants, and thus have provided the world with several useful plants among which the potato (*Solanum tuberosum* L.) and the tomato (*Lycopersicon esculentum* L.) are most well known (VAVILOV 1992). But, thousands of other species were used by the prehispanic cultures, and the edible *B. edulis* (Figs. 1–6) proves that *Bomarea* was no exception.

Alstroemeriaceae recently comprise two genera: *Alstroemeria* L. (ca. 70–80 species) (AKER & HEALY 1990; ASSIS 2002; BAYER 1987; MUÑOZ & MOREIRA 2003) and *Bomarea* MIRB. (ca. 120 species).

Bomarea is distributed from Mexico in the north to Argentina/Chile in the south (Fig. 7). The genus is nearly restricted to the American Cordillera. The only exception is *B. edulis* (Fig. 7). The genus *Bomarea* is subdivided in four subgenera: *Baccata* (5 species), *Bomarea* s.str. (ca. 70), *Sphaerine* (12) and *Wichuraea* (18) (HOFREITER & TILLICH 2002, 2003; HOFREITER 2005). All species so far known with edible root tubers fall within *Bomarea* s.str. *Bomarea edulis* was cultivated in pre-Colum-

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bian times at least in Mexico and Guatemala (DRESSLER 1953). *Bomarea edulis* is known by different names, e.g. in German "Bomarie", English "white Jerusalem artichoke", in Mexico "coyolxóchitl" and on Cuba "gloriosa del pais" (HANELT & IPK 2001). The second Mexican species, *B. acutifolia* (LINK & OTTO) HERB. was also used, in Peru the tubers of *B. ovata* (CAV.) MIRB. were eaten. Also the sweet red sarcotesta of several species is eaten in the Andes. Other species are thought to be poisonous by the local people. As an example, *B. involucrosa* (HERB.) BAKER often grows in large populations near villages. The huge root tubers up to 6 cm in diameter are filled with starch, but are never used by the local people. Most species of the genus *Bomarea* are very variable; therefore they are often misidentified in herbaria and have a lot of synonyms. The root tubers of some species of the closely related genus *Alstroemeria* (Fig. 9) were used in Chile to produce flour.

2. Taxonomic treatment and comments on *B. edulis* and its closest relatives

***Bomarea edulis* (TUSSAC) HERB., Amaryllidaceae 111. 1837**

Figs. 1–6, 10; distribution: Fig. 7

Basionym: *Alstroemeria edulis* TUSSAC, Flora Antillarum 1: 109–112. 1808.
Type: TUSSAC, loc. cit.: pl. 14, figs. 1–6.
= *B. affinis* (MARTINS & GALEOTTI) KUNTH, Enum. pl. 5: 796. 1850.
Basionym *Alstroemeria affinis* MARTINS & GALEOTTI, Bull. Acad. Roy. Sci. Bruxelles 10: 116. 1843. Type: Mexico, Morelia, Cerro de Quinzeo, *Galeotti 5395* (BR).
= *B. bakeriana* KRAENZL., Bot. Jahrb. Syst. 11: 235. 1908. Type: Colombia, east of the central Andes of Popayan, near San Francisco and Inga, 1400–1600 m, *Lehmann 4545* (K!).
= *B. brauniana* SCHENK, In: Mart. Fl. bras. 3(1): 168. 1855. Type: Brazil, Minas Gerias, *Ackermann s.n.* (B!).
= *B. caraccensis* HERB., Amaryllidaceae 111. 1837. Type: Venezuela, Caracas, *Fanning s.n.* (BM).
– *B. furcata* KLOTZSCH ex KUNTH, Enum. pl. 5: 792. 1850. Type: Guiana, *Schomburgk, M. R. 688* (B).
– *B. fuscata* KLOTZSCH, in: Ri. Schomb. Fauna & Fl. Guy. 1120. 1848. Type: Britisch-Guiana, Pirara, *Schomburgk, R. H. 430* (BM).
= *B. gloriosa* (SCHLTDL. & CHAM.) M. ROEM., Fam. nat. syn. monogr. 4: 1847.
Basionym: *Alstroemeria gloriosa* SCHLTDL. & CHAM. Linnaea 6: 51. 1831. Type: Mexico, Julapensibus, *Schiede & Deppe s.n.* (B).
= *B. grandifolia* (KUNTH) HERB. Amaryllidaceae 113. 1837.
Basionym: *Alstroemeria grandifolia* KUNTH in HUMBOLDT, BONPLAND & KUNTH, Nov. gen. sp. 1 (4): 285. 1816. Type: Jaen de Bracamoros Amazonas, San Filipe, *Humboldt & Bonpland s. n.* (P).
= *B. guianensis* KRAENZL., Ann. K. K. Naturhist. Hofmus. 27: 153. 1913. Type: Britisch-Guiana, Pirara, *Schomburgk, R. H. 430* (BM).
= *B. hirta* SCHENK, in: Mart. Fl. bras. 3(1): 168. 1855. Type: Brazil, Prov. Goyaz, prope Villa Boa, *Pohl s.n.* (M, photo GH!).
= *B. hirtella* (KUNTH) HERB. Amaryllidaceae 112. 1837.
Basionym: *Alstroemeria hirtella* KUNTH in HUMBOLDT, BONPLAND & KUNTH, Nov. gen. sp. 1 (4): 284. 1816. Type: Mexico, Tiangillo, Toluccensi, *Humboldt & Bonpland s.n.* (B-WILLD).
= *B. jacquesiana* (LEM.) KUNTH, Enum. pl. 5: 800. 1850.
Basionym *Alstroemeria jacquesiana* LEM., Fl. Serres Jard. Eur. 2: 12. 1846. Iconotype: Brazil, Fig. 10 in LEM. loc. cit.
= *B. janeirensis* M. ROEM., Fam. nat. syn. monogr. 4: 267. 1847.
Basionym *Alstroemeria salsilla* VELL. non L., Fl. flumin. 3: 131. 1829. Iconotype: Brazil, Rio de Janeiro, t. 120. loc. cit.
= *B. maakiana* KLOTZSCH, OTTO & DIETR. Allg. Gartenz. 20: 337. 1852. Type: Venezuela, Caracas, cultivated specimen (B).
= *B. maranensis* HERB., Amaryllidaceae 422. 1837. Type: Brazil, Maranhao, *Hesketh s.n.* (K).
= *B. martiana* SCHENK, In: Mart. Fl. bras. 3(1): 170. 1855. Type: Brazil, *Sellow 143 & 144* (B probably destroyed).
= *B. miniata* (MARTINS & GALEOTTI) KUNTH, Enum. pl. 5: 792. 1850.
Basionym: *Alstroemeria miniata* MARTINS & GALEOTTI, Bull. Acad. Roy. Sci. Bruxelles 10: 116. 1843. Type: Mexico, Totutla, colonia de Mirador, *Galeotti 5390* (BR).
= *B. mooreana* KRAENZL., Bull. Misc. Inf. Kew 190. 1913. Type: Cultivated specimen from the Botanical Garden of Glasnevin, Dublin. Ireland (K!).
= *B. petiolata* RUSBY, Mem. N. Y. Bot. Gard. 7: 216. 1927. Type: Bolivia, 270 m, *Cardenas 2071* (NY, B!, GH!, K!, US!).
= *B. perlongipes* KILLIP, J. Wash. Acad. Sci. 25: 375. 1935. Type: Colombia, Dept. Norte de Santander, Prov. Ocana, 1525 m, *Schlim 718* (US!, P, G!).
= *B. salsilloides* (MART.) M.ROEMER, Fam. Nat. Syn. 4: 264. 1847.

Basionym *Alstroemeria salsilloides* MART., in: SCHULT. & SCHULT., Syst. veg. 7(1): 748. 1829. Type: probably Brazil, Rio de Janeiro, 1768, *Banks & Solander s.n.* (BM!).
= *B. spectabilis* SCHENK, in: Mart. Fl. bras. 3(1): 170. 1855. Type: Brazil, prope Corumba, *Pohl 1218* (W destroyed, Photo MO!).
= *B. sororia* N.E.BR., Ill. Hort. 39: 19. 1892. Iconotype*: N. E. Br., Pl. 545*. loc. cit.
= *B. edulis* var. *grandis* HERB., Amaryllidaceae 111. 1837. Type: Brazil, near Rio de Janeiro, *BOOZ s.n.* (K!).

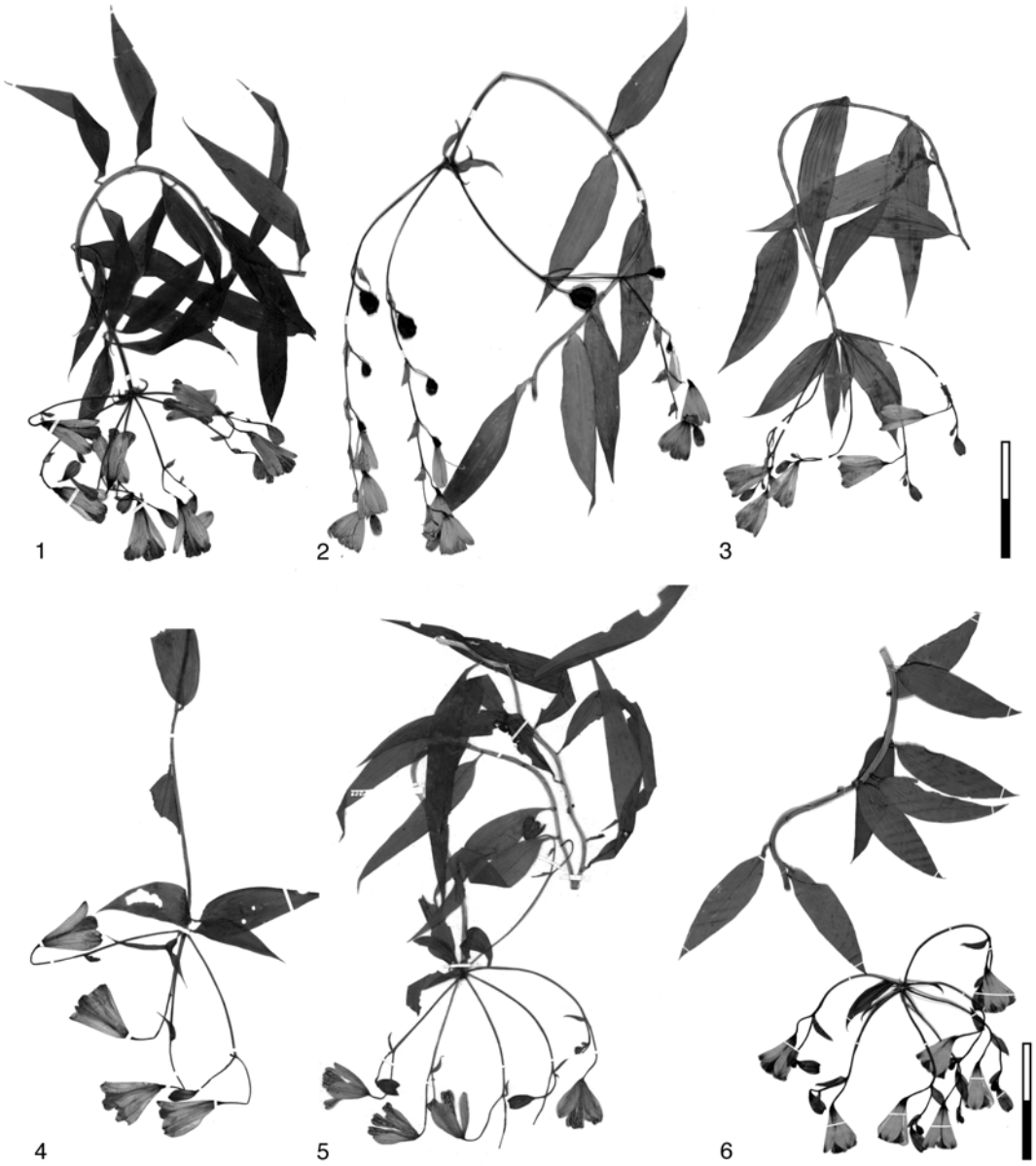
Morphology: Plant twining (1) 2–6 (8) m long or rarely erect (up to 0.6 m high), stem robust, glabrous or rarely weakly pubescent with increasing density towards the top, 0.2–0.8 cm in diameter, perennial, rhizomatous with root tubers. Leaves lanceolate or linear-lanceolate, 4–20 × 1–3 cm, adaxial side glabrous or poorly pubescent, abaxial side glabrous. Inflorescence pendant, laxiflorous, hypopodium of primary flowers 2–15 cm long, epipodium 1.5–3 cm long. Bracts of primary flowers frondose, 2–6 × 0.5–1.5 cm, bracts of secondary flowers frondose or bracteose, 1–2.5 × 0.2–0.7 cm, 3–20 (ca. 30) flowers per inflorescence. Flowers actinomorphic, pendulous, ca. 2.5–3.5 cm long, all tepals free to base, inner tepals equalling outer ones in length, outer tepals oblong, at outer side pink with green tip, pale yellow at inner side. Inner tepals subdivided in blade and claw, claw pale yellow or whitish with a pink stroke on outer side, blade whitish and pink, with a green tip and dark spots. Filaments straight, whitish, several millimetre shorter than tepals, ovary inferior, glabrous, or rarely weakly pubescent, capsule turbinate, loculicidally dehiscent, seeds spherical with a fleshy red sarcotesta, 3–4 mm in diameter.

Tuber anatomy: the tubers are developed at the end of fibrous roots (Fig. 8); they are mostly 3–5 cm in diameter. The number of tubers per plant and ~~in~~to a lesser degree their sizes vary generally with the size of the plant. More than half of the tuber diameter is made up by the enlarged central cylinder. The starch is stored in the cells of the cortex as well as in the central cylinder. This is typical for the whole genus. On the other hand, the tubers of *Alstroemeria* contain starch only in the cortex, the central cylinder is not enlarged. The cell walls of the endodermis are not thickened in contrast to the fibrous part of the root.

Distribution: *Bomarea edulis* occurs from 24° N in Mexico to 23° S in Argentina (Fig. 7). This species can also be found on the Greater and Lesser Antilles, in the Guianas and in many areas of Brazil. In the central Andes it seems to be rare. The species is not cited in the Flora of Ecuador. Its occurrence in Peru is also doubtful. *Bomarea edulis* grows in small shrubs, hedges and mostly semi-deciduous forests at altitudes between 10 m and 1800 m. It seems to prefer drier habitats in contrast to most of *Bomarea* s.str. species. This habitat preference is somewhat shared with *B. ovata* (Fig. 16), the second species widely eaten. But, *B. ovata* occurs in Peru, Bolivia and northern Argentina mostly above 2500 m or in the very dry costal desert in Peru between 100 m and 500 m. The Peruvian costal desert is cool, due to the frequent fog.

Use and cultivation: *B. edulis* was used as an edible and medical plant in pre-Columbian times. In Mexico and Guatemala it is still eaten in some areas. DRESSLER (1953) lists it under the pre-Columbian cultivated plants of Mexico. The tubers are eaten like roasted potatoes and also a white cream is produced from them. They are mostly called "white Jerusalem artichoke" (HEDRICK 1919). *Bomarea edulis* was called "Karamboroty" by the Guarani and used as a medical plant for diuretic and diaphoretic effects (SILVA-NOELLI 1998). *Bomarea edulis* can be cultivated in a wide range of soil types, but it is sensitive against stagnant moisture. It occurs in the tropics and subtropics in a wide range of habitats. The temperature should not fall below +15 °C and if adapted they can grow in full sun. The species can be propagated by seeds and rhizome parts.

Taxonomic note: *B. edulis* is the only *Bomarea* species which occurs in the Antilles, the Guianas and Brazil, probably it can also be found in Paraguay. All *Bomarea* species, which are based on material from this region, have to be synonymized under *B. edulis.* The collections *Schomburgk 430* and *Schomburgk 688* are identical (VAN DAM 2002). The wide distribution and the high variability (see Figs. 1–6) led to 23 synonyms and much taxonomical confusion (see HANELT & IPK 2001). Within one population one can find erect and twining individuals with 3 to 20 flowers per inflorescence. The erect habit seems to be very rare, and was so far only found on freshly burned sites, where



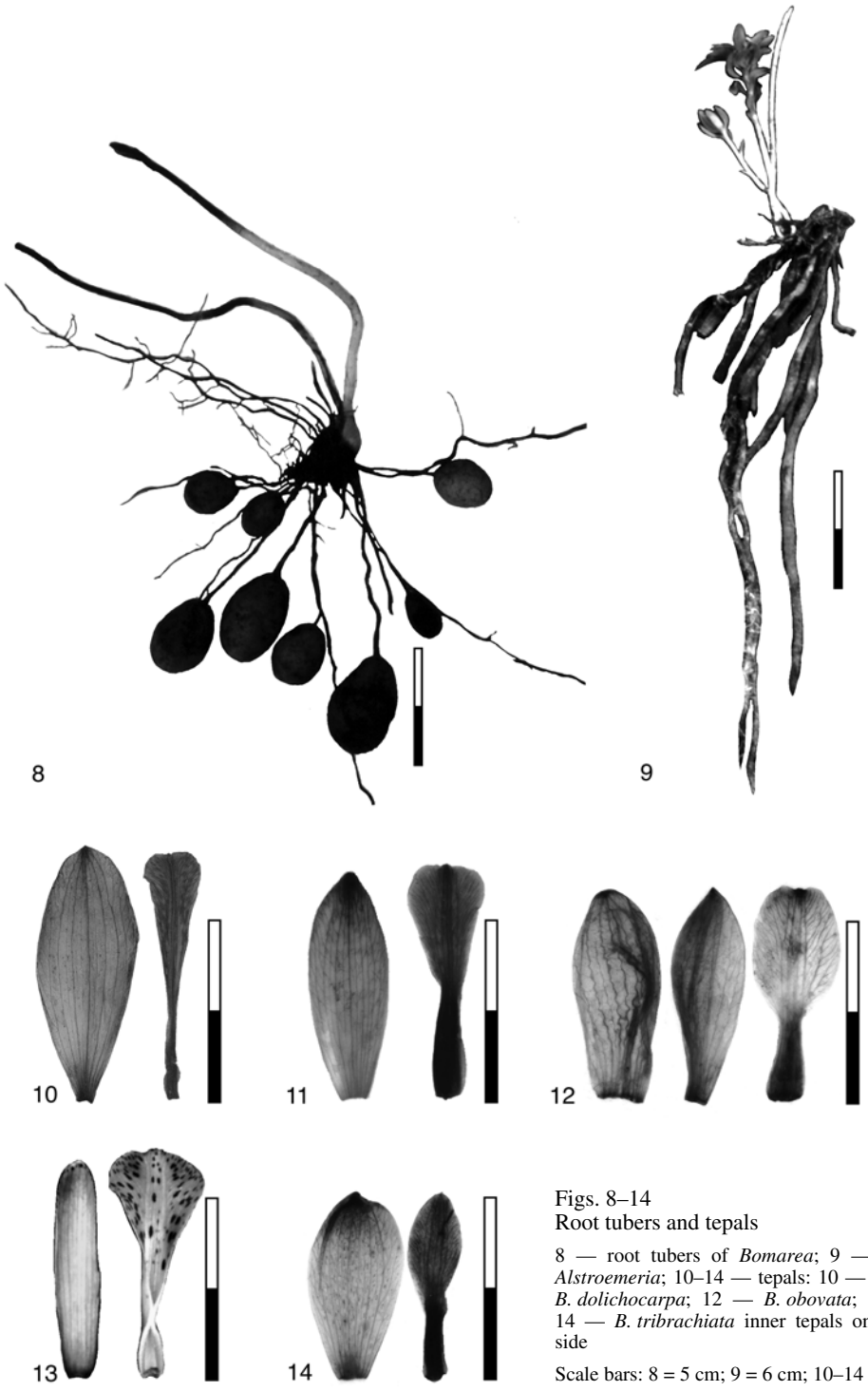
Figs. 1–6
B. edulis specimen from diverse origins

1 — Mexico; 2 — Cuba; 3 — Colombia; 4 — Guiana; 5 — Brazil; 6 — Bolivia
Scale bars = 5 cm

all the shrubs were destroyed. Sometimes also plants with an umbel rather than a thyrse can be found, but these are always weak individuals with only a few flowers. Many *Bomarea* species flower when they are still very small, this explains a great deal of the variability. Not surprisingly, the shape of the foliage leaves depends a lot on the amount of sun they receive. *Bomarea edulis* is often confused with *B. ovata*. The shape of the outer tepals distin-

Fig. 7
Genus area of *Bomarea*
Grey — distribution of *Bomarea* excl. *B. edulis*; x — distribution of *B. edulis*

guishes the species: broadly ovate in *B. edulis* (Fig. 10), narrowly ovate in *B. ovata* (Fig. 13). The species also differ in the inflorescence, the habitat and the amount of pubescence. The figure 6 in SANSO & XIFREDA (1995) is *B. ovata* and not *B. edulis.* In Argentina *B. edulis* and *B. ovata* grow sympatrically. *Bomarea dolichocarpa* KILLIP (Fig. 15) is an other very similar species. It can be distinguished by the more heavily spotted inner tepals and the elongated ovary. It cannot be confused when it bears fruits. The fruit is elongated in *B. doli-*



Figs. 8–14
Root tubers and tepals

8 — root tubers of *Bomarea*; 9 — root tubers of *Alstroemeria*; 10–14 — tepals: 10 — *B. edulis*; 11 — *B. dolichocarpa*; 12 — *B. obovata*; 13 — *B. ovata*; 14 — *B. tribrachiata* inner tepals on the right hand side

Scale bars: 8 = 5 cm; 9 = 6 cm; 10–14 = 2 cm

chocarpa and turbinate in *B. edulis. Bomarea dolichocarpa* occurs in similar altitudes but generally wetter habitats from Ecuador to Peru, it does not occur sympatrically with *B. edulis*. *Bomarea obovata* HERB. (Fig. 17) has also been confused with *B. edulis* (BAKER 1888). The two species can be distinguished very easily in the field because of the different shape of the flowers, funnel shaped in *B. edulis,* nearly closed, cucullate in *B. obovata.* This character is partly lost in herbarium specimens, but the difference in the shape of the outer tepals remains. *Bomarea obovata* is found from Nicaragua to Ecuador. It grows in Central America sympatrically with *B. edulis.* It is unknown whether the tubers of *B. dolichocarpa* and *B. obovata* are also edible.

BAKER (1888) lists 17 names as synonyms under *B. edulis.* In the present paper, seven of these species are excluded as synonyms. For instance, *B. bracteata* (RUIZ & PAVÓN) HERB. belongs in subgen. *Wichuraea* with semi-inferior ovary and spatulate inner tepals, *B. obovata* is very similar to *B. edulis* only as dried herbarium specimen but can be easily distinguished in the field.

The subgenus *Bomarea* s.str. is subdivided in five informal groups in the Flora of Ecuador (HARLING & NEUENDORF 2003). Among them is the Edulis group with seven species: *B. dolichocarpa, B. obovata, B. tribrachiata* KRAENZL. (Fig. 18), furthermore two species with cornute outer tepals (*B. cornuta* HERB. from Peru and Ecuador, *B. moritziana* KUNTH from Venezuela, Colombia and Ecuador), *B. spissiflora* HARLING & NEUENDORF from Ecuador, and *B. campanularia* HARLING & NEUENDORF, which is very similar to *B. obovata* in the shape of the flowers (HARLING & NEUENDORF 2003). *Bomarea cornuta, B. moritziana, B. spissiflora* and *B. campanularia* are not included in the present paper, since they are clearly distinguished from *B. edulis*. For instance, *B. cornuta* is superficially similar to *B. edulis*, but this species as well as *B. moritziana* are easily distinguished by their cornute outer tepals, and the flowers are more red than pink in colour. *Bomarea moritziana* differs even stronger from *B. edulis* with its open, red flowers without green tepal tips, and the large fruits.

Bomarea cornigera, which is not mentioned in HARLING & NEUENDORF (2003) is a furthermore similar cornute species from Peru.

Additional material examined:

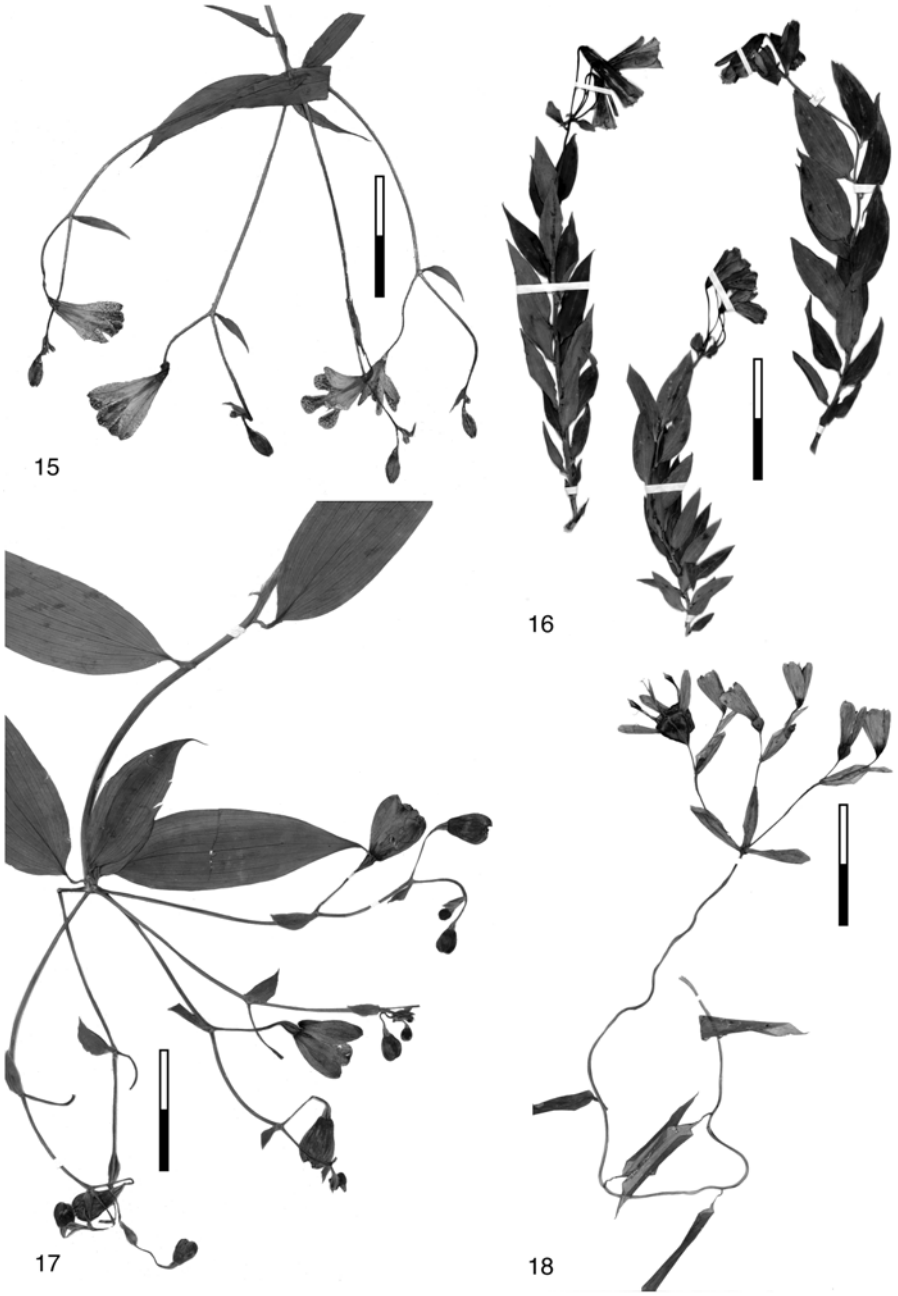
MEXICO: San Luis Potosi: Las Canoas, banks of streams, *PRINGLE 3188* (BM, ED, G, MA); Veracruz: *PURPUS 2035* (ED). GUATEMALA: Petén, NW-Ufer des Lago Petén Itzá, 200 m, *WALLNÖFER & TUTTESUCUN 9665* (M); Alta Verapaz, San Juan Chamelco, Montana Caquipec, 1700–1900 m, *FÖRTHER et al. 10405* (MSB); Santa Domingo: Barahona: Noche Buena, 1800 m, *FUERTES 1495* (BM, ED, G); CUBA: Santa Clara: Guabairo, *JACK s.n.* (GH); Pinar del Río: north of Vinales, Rio Cuajuani, *SCHULTES et al. 59* (GH), HONDURAS: Octepeque: Cordillera Merendón, 1800 m, *MOLINA 22142* (G). PANAMA: Chirique: road Boquete – Cerro Horqueta, *DUKE A13712* (MO). BELIZE: Cayo, Guacamallo road, 650 m, *WHITEFOORD 2252* (BM). GUIANAS: U. Takutu-U, Essequibo, SE-Kanuku Mts, 500–700 m, *GOPAUL & PETERSON 1890* (US). TRINIDAD: St. George: Morne Catherine road, 300 m, *WEBSTER & MILLER 9949* (GH). ARGENTINA: Jujuy: 5 km west of Jujuy on road to Reyes, *Q 6114* (GH, MO); Ledesma: Parque Nacional Calilegua, 850–1000 m, *MULGURA et al. 1419* (MO); Misiones: Dep. Iguazú, Parque Nacional Misiones, *VANNI et al. 3002* (GH); Tucuman: Cumbre, 1800 m, *VENTURI 5978* (MO). BOLIVIA: Pando: Manuripi, entornos de Conquista, 160 m, *FERNÁNDEZ CASAS 53* (G, MA); Santa Cruz: Prov. Nuflo de Chavez, 450 m, *MAMANI & SAUCEDO 823* (MO); Velasco: *GUILLEN et al. 250* (MO). BRAZIL: Mato Grosso: Mun. de Barra do Garcas, Serra do Roncador, *EITEN & EITEN 9877* (US); Minas Gerais: Vicosa, Fazenda do Deserto, 690 m, *MEXIA 5484* (BM, UC); Paraná: Araucaria, Campina dos Martins, *CARRIAO & SIVA 2359* (G); Rio de Janeiro: Recreio dos Bandeirantes, *ALSTON-LUTZ 109* (BM); Santa Catarina: Ponte Alta do Sul, 900 m, *REITZ & KLEIN 11.333* (US); Sao Paulo: Mun. de Ubatuba, *FONTELLA & MOURAN 101* (US).

***Bomarea dolichocarpa* KILLIP, J. Wash. Acad. Sci. 22: 62. 1932**

Figs. 11, 15
Type: Peru, Dept. Junín, Puerto Yessup, 400 m, *Killip & Smith 26306* (US, F, NY!).
= *B. klugii* KILLIP, Publ. Field Mus. Nat. Hist. Bot. 8: 648. 1936.
Type: Peru, Dept. San Martin, Moyobamba, Zepelacio, 1600 m, *Klug 3410* (US!).
= *B. killipii* VARGAS, Bol. Mus. Hist. Nat. Javier Prado 8: 216. 1944.
Type: Peru, Dept. Cusco, Prov. Convecion, Pintobamba, 2800 m, *Vargas 3493* (CUZ!).

Additional material examined:

ECUADOR: Prov. Morona-Santiago, Gualaquiza, 900–950 m, *HARLING & ANDERSSON* (GB); Prov.



Figs. 15–18
Specimen of the Edulis group

15 — *B. dolichocarpa*: 16 — *B. ovata*; 17 — *B. obovata*; 18 — *B. tribrachiata*
Scale bars: 15 = 3 cm; 16, 17 = 4 cm; 18 = 6 cm

Napo, Satzayacu, *LUGO 1048* (GB); PERU: Dept. Huánuco: Prov. Tingo Maria, Santa Rosa-Shapanguilla, *ALDAVE & FERNANDEZ 5588* (MSB); Dept. Junin: Satipo, Rio Negro, 800 m, *WOYTKOWSKI 5803* (MO); Dept. Ucayali: Stromgebiet des Ucayali, *TESSMANN 3102* (G); Rio Abajao, Quebrada Shesha, 250 m, *GENTRY & DIAZ 58567* (MO); Bosque Nacional Humboldt, Km 88 Pucallpa – Tingo Maria, 270 m, *GENTRY et al. 36386* (MO). Dept. Cuzco: Prov. Cuzco, Camisea, 467 m, *ACEVEDO 8614b* (NY, US); Dept. Madre de Dios, Prov. Tambopata, near Puerto Maldonado, 200 m, *GENTRY & REVILLA 16237* (F, MO); Prov. Tambopata, 30 km from Puerto Maldonado, 260 m, *BARBOUR 5069* (F, MO).

***Bomarea obovata* HERB., Amaryllidaceae 112. 1837**

Figs. 12, 17

Type: Ecuador, road to Angus, *Hall 7* (K!).
= *B. chontalensis* SEEMANN, Gard. Chron. 479. 1871.
Type: Nicaragua, Chontales mountains, 700–850 m, *Seemann s.n.* (BM!).
= *B. sternbergiiflora* KRAENZL., Ann. K. K. Naturhist. Hofmus. 27: 156. 1913.
Type: Ecuador, *Lobb s.n.* (W probably destroyed).
= *B. subtriflora* SODIRO, Sert. Fl. Ecuad., Ser 2: 59. 1908.
Type: Ecuador, Prov. Imbabura, *Sodiro s.n.* (QPLS, US fragm.).

Additional specimen examined:

ECUADOR: Prov. Los Rios, Rio Palenque, 200 m, *GENTRY et al. 54749* (MO); Quevedo Canton, Cerro Centinala, 650 m, *TIPAZ & QUELLA 661* (MO); Prov. Pichincha, Santa Domingo, Puerto Limón road, 100 m, *KVIST 40651* (AAU); Prov. Cotopaxi, Tenefuerte, km 55 Quevedo – Latacunga, 850–1000 m, *Dodson et al. 14391* (MO); Prov. Esmeraldas, Rio Zapallo, 200 m, *BARFOD 41039* (MO). COSTA RICA: Prov. Limon, Bonilla Lake, 380 m, *DODGE et al. 5873* (MO); Prov. Alejuela, Reserva Biológica Monteverde, Rio Penas Blancas, 700 m, *BELLO 1630* (MO); Prov. Heredia, Finca La Selva, Rio Puerto Viejo, 100 m, *CHACON 467* (MO); Prov. Guanacaste, Cantón de La Cruz, Parque Nacional Guanacaste, 700 m, *RÍOS 70* (MO). NICARAGUA: Dept. Zelaya, Río Punta Gorda, Loma San Jorge, 160 m, *MORENO & SANDINO 13056* (MO). NUEVA GUINEA, Salto de Lajas, *LAGUNA 14* (MO); Dept. Boaco, San José de los Remates, *MORENO 24859* (MO).

***Bomarea ovata* (CAV.) MIRB., Hist. Nat. 72. 1804**

Figs. 13, 16

Basionym: *Alstroemeria ovata* Cav., Icon. Pl. 1 54. 1791.
Type: habit. Peru. h R M (MA, photo BM!, F!).
= *B. amoena* (HERB.) M. ROEM., Syn. Ensat. 274, 1847.
Basionym: *B. purpuraea* var. *amoena* HERB. Amaryllidaceae 399, 1837.
Type: Peru, Chachapoyas, 1835, *Matthews 874* (K!).
= *B. marcocarpa* (RUIZ & PAVÓN) HERB., Amaryllidaceae 114. 1837.
Basionym: *Alstroemeria marcocarpa* RUIZ & PAVÓN, Fl. Peruv. Chil. 3: 62. 1802.
Type: Peru, Dept. Huánuco, Pillao, *Ruiz & Pavón s.n.* (MA!).
= *B. polyphylla* KRÄNZL., Ann. K. K. Naturhist. Hofmus. 27: 158. 1913.
Type: Bolivia, Yungas, *Bang 593* (BM!, ED!, GH!, MO!).
= *B. simplex* HERB. Amaryllidaceae 119. 1837.
Type: Peru, *Matthews 786* (K!, E!, NY!).
= *B. subsessilis* KILLIP, J. Wash. Acad. Sci. 25: 373. 1935.
Type: Bolivia, Dept. Cochabamba, near Cochabamba, 3400 m, *Troll 1630* (B!, M!).
= *B. tomentosa* (RUIZ & PAVÓN) HERB., Amaryllidaceae 117. 1837.
Basionym: *Alstroemeria tomentosa* RUIZ & PAVÓN, Fl. Peruv. Chil. 3: 62. 1802.
Type: Peru, Dept. Huánuco, Muna, *Ruiz & Pavón s.n.* (BM!, MA!).
= *B. variabilis* HERB., Bot. Reg. Lindl. P. 66,67. 1842.
Type: Peru, *Matthews 866* (K!).

Additional material examined

ARGENTINA: Prov. Tucuman: Dept. Trancas, San Pedro de Colalao, 1750 m, *SCHREITER 9753* (GH, U); BOLIVIA: Dept. Cochabamba: Carrasco, road Espinozana-Santa Cruz, 3100 m, *FERNÁNDEZ CASAS 7789* (MO); Prov. Chapare, Locotal, 1600 m, *STEINBACH 9312* (BM, E); between Vila Vila and Cochabamba, 3500 m, *BROOKE 6236* (BM); Dept. La Paz: Prov. Larecaja, Sorata, 2600–2700 m, *MANDON 1201* (BM, G); Prov. Larecaja, Sorata, 2850 m, *CASAS & MOLERO FC6524* (MA); Prov. Inquisivi, Rio Chichipata, *Lewis 882035* (LPB). PERU: Dept. Huancavelica: Prov. Huancavelica, Ayán, 3300 m, *TOVAR 152* (USM); entre Colcabamba y Surcabamba, 2800–2900 m, *TOVAR 1815* (USM); Dept. Huánuco: Acomayo, 2100 m, *WOYTKOWSKI 34007* (F, MO); Pillao, 2700 m, *WOYTKOWSKI 34133* (F); Prov. Huánuco, Acomayo, *RIDOUTT s.n.* (USM); Dept. Pasco: entre Salcachupán y Cerro de Pasco, 3300–3400 m, *FERREYRA 6613* (USM).

***Bomarea tribrachiata* KRAENZL., Bot. Jahrb. Syst. 40: 235. 1908**

Figs. 14, 18

Type: Peru, Dept. Ancash, Cajatamb, between Tallanga and Piscapaccha, 3600–3800 m, *Weberbauer 2884* (B!).

= *B. ayavacensis* KRAENZL., Bot. Jahrb. Syst. 54, Beibl. 117: 2. 1916.
Type: Peru, Dept. Piura, above Ayavaca, 2900 m, *Weberbauer 6373* (B!).
Figs. 14, 18

Additional material examined

PERU: Dept. Cajamarca: Prov. Contumazá, Guzmango, 2900 m, *SAGÚSTEGI 3931* (MSB); Prov. Contumazá, Bosque Cachil, 2400 m, *DILLON et al. 6510* (F, MO); Prov. San Miguel, Lives-Payac, 1850 m, *SAGÁSTEGUI et al. 8790* (F); Dept. La Libertad, Prov. Otuzco, Huaranchal, 2750 m, *LÓPEZ et al. 2654* (MSB); Prov. Ayabaca, Yacupampa-Cuyas, 2500 m, *LÓPEZ et al. 7755* (NY).

3. Key to distuingish *B. edulis* and its closest relatives from the rest of *Bomarea* species

(For the determination very weak specimen can not be used, because important characters may be missing)

1 ovary semi-inferior; flowers pendulous, actinomorphic; tepals retained at the ripe fruit; fruit dehiscent; Ecuador to Argentina . . . . . subgen. *Wichuraea*
1* ovary inferior; flowers pendulous, horizontally or erect, actinomorphic or zygomorphic, tepals mostly deciduous; fruit dehiscent or indehiscent; Mexico to Argentina 2
2 fruit indehiscent, fleshy 3
2* fruit dehiscent, leathery (subgen. *Bomarea* s.str.) 4
3 big twining lowland rain forest plants; flowers pendulous, actinomorphic; Panama to north-western Ecuador . . . . . subgen. *Baccata*
3* small, erect fog-forest or páramo plants; flowers erect and actinomorphic or horizontally orientated and zygomorphic; Colombia to Bolivia . . . . . subgen. *Sphaerine*
4 inflorescence a thyrse; Mexico to Argentina 5
4* inflorescence an umbel; Mexico to Bolivia, American cordillera . . . . . *Multiflora* group and related species
5 inflorescence lax, hypopodium of primary flowers at least 2 cm, but mostly about 10–15 cm 6
5* inflorescence dense, hypopodium of primary flowers mostly about 0.2–0.5 cm long, rarely more than 2 cm; from Colombia to Peru . . . . . *Goniocaulon* group, *Pardina* group
6 flowers pink, tepals with a green tip, without a horn on the outer tepals, inner tepals never longer than outer tepals, flowers always actinomorphic. 7
6* flowers never pink with a green tip and without a horn, but red, orange or otherwise coloured, some species with a horn on outer tepals, inner tepals of same length as outer tepals, or in some cases longer than outer ones, flowers actinomorphic or zygomorphic; the American Cordillera from Costa Rica to Chile. . . *Dispar* group and various other species
7 fruit turbinate, inner tepals sparsely spotted, outer tepals never spotted 8
7* fruit elongated, inner tepals heavily spotted, mostly outer tepals also spotted; Ecuador, Peru . . . . . *B. dolichocarpa*
8 flowers funnel-shaped, open, outer tepals oblong 9
8* flowers campanulate, nearly closed, outer tepals cucullate; from Nicaragua to Ecuador . . . . . *B. obovata*
9 bracts of secondary flowers small, 0.2–2 × 0.1–0.5 cm, inner and outer tepals of equal length. 10
9* bracts of secondary flowers large, green, 1.5–6 × 0.5–4 cm, inner tepals mostly slightly shorter than outer ones; south Ecuador to north Peru . . . . . *B. tribrachiata*
10 outer tepals narrowly ovate, ovary densely pubescent; Peru, Bolivia, northern Argentina . . . . . *B. ovata*
10* outer tepals broadly ovate, ovary glabrous or nearly glabrous; Mexico to Argentina, not in the central Andes. . . . . *B. edulis*

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