

THE FAMILIES AIZOACEAE AND MOLLUGINACEAE (CARYOPHYLLALES) IN SONORA, MEXICO

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ABSTRACT

The families Aizoaceae and Molluginaceae are distributed in tropical and subtropical areas around the world. In Mexico, these families have been studied for Aguascalientes, Guerrero, Veracruz, the Bajío region, Mexico Valley, and Tehuacán-Cuicatlán Valley. This work aimed to develop morphological descriptions and dichotomous keys for the taxa of the families Aizoaceae and Molluginaceae present in the state of Sonora. The material collected in the state of Sonora and deposited in the University of Sonora herbarium and the Mexico National Herbarium was reviewed, and the identity of the specimens was corroborated using specialized bibliography. In addition, the specimens deposited in the Herbarium of the Arizona State University Vascular Plant Herbarium, University of Arizona Herbarium, and Desert Botanical Garden were consulted online via Red de Herbarios del Noroeste de México. In Sonora, the family Aizoaceae is represented by three genera and five species, while the family Molluginaceae is represented by three genera and three species, mostly distributed in the Sonoran biogeographic province, in sandy soils. All the taxa of Aizoaceae present in the state are part of the flora of beaches and coastal dunes, and the three genera on the family Molluginaceae reported to the country are also found in Sonora.

KEY WORDS: coastal dunes flora, *Hypertelis*, *Mesembryanthemum*, Sonoran Desert flora

RESUMEN

Las familias Aizoaceae y Molluginaceae se distribuyen en áreas tropicales y subtropicales de todo el mundo. En México, estas familias han sido estudiadas en para Aguascalientes, Guerrero, Veracruz, la región del Bajío, el Valle de México y el Valle de Tehuacán-Cuicatlán. Este trabajo tuvo como objetivo desarrollar descripciones morfológicas y claves dicotómicas para los taxones de las familias Aizoaceae y Molluginaceae presentes en el estado de Sonora. Se revisó el material colectado en el estado de Sonora y depositado en el herbario de la Universidad de Sonora y en el Herbario Nacional de México y se corroboró la identidad de los ejemplares mediante bibliografía especializada. Además, los especímenes depositados en el Herbario del Herbario de Plantas Vasculares de la Universidad Estatal de Arizona, el Herbario de la Universidad de Arizona y el Jardín Botánico del Desierto fueron consultados en línea a través de la Red de Herbarios del Noroeste de México. En Sonora, la familia Aizoaceae está representada por tres géneros y cinco especies, mientras que la familia Molluginaceae está representada por tres géneros y tres especies, distribuidas en su mayoría en la provincia biogeográfica de Sonora, en suelos arenosos. Todos los taxones de Aizoaceae presentes en el estado forman parte de la flora de playas y dunas costeras y los tres géneros de la familia Molluginaceae reportados para el país también se encuentran en Sonora.

INTRODUCTION

In the past, the genera of Molluginaceae were included in Aizoaceae, however, chemical, and molecular evidence supports these families as separated groups (Stevens 2001). Some members of Molluginaceae do not have betalains as Aizoaceae and have instead anthocyanins as Caryophyllaceae (Thulin et al. 2016). Phylogenetic analyzes show Molluginaceae to be closely related to Portulacineae, while Aizoaceae is related to the families Kewaceae, Gisekiaceae, Phytolaccaceae, Petiveriaceae, and Nyctaginaceae (Walker et al. 2018; Yao et al. 2019).

Aizoaceae is integrated by 125 genera and 1800–1900 species, distributed in tropical and subtropical areas around the world, its species mainly inhabit sandy coastal environments or arid zones (Hernández-Ledesma et al. 2015; Stevens 2001). The largest genera are *Conophytum* N.E. Br., with 290 species and *Delosperma* N.E. Br., with 150 (Stevens 2001). The family also contains numerous ornamental genera such as *Lampranthus* N.E. Br., *Dorotheanthus* Schwantes, *Mesembryanthemum* L., *Ruschia* Schwantes, *Carpobrotus* N.E. Br., and *Lithops* N.E. Br., which are cultivated for their appearance (Judd et al. 2016).

For a long time, Molluginaceae has been a refuge for anomalous genera (Ronse de Craene 2013). Currently, eleven genera and about 90 species are recognized for this group (Stevens 2001; Thulin et al. 2016), distributed in tropical regions, mostly in southern Africa (Stevens 2001). The largest genera are *Pharnaceum* L. with 25 species and *Mollugo* L. with 15 (Thulin et al. 2016).

In Mexico, these families have been only studied for Aguascalientes (Sandoval-Ortega & Siqueiros-Delgado 2018), Guerrero (Vigosa-Mercado 2015), Veracruz (Rico-Gray 1979; Nee 1985), the Bajío region (Ocampo-Acosta 2002a, 2002b), Mexico Valley (Calderón 2005) and Tehuacán-Cuicatlán Valley (Medina-Lemos 2007). The aim of this work was to develop morphological descriptions and dichotomous keys for the taxa of the families Aizoaceae and Molluginaceae present in the state of Sonora, Mexico.

MATERIALS AND METHODS

Study area.—Sonora is located in northwestern Mexico and is the second largest state in the country, it is made up of 72 municipalities and includes a total area of 184,934 km² that represents the 9.1% of the national surface (INEGI 2017). In its territory converge four biogeographic provinces: the Sonoran province, which is the most extended, the Pacific Lowlands, the Chihuahuan Desert, and the Sierra Madre Occidental (Morrone et al. 2017). The state has a wide variety of climates (Brito-Castillo et al. 2010; INEGI 2017), especially dry (BWh, BSh, BSo^h, BSk, BW[h']), semidry (BSlk, BS1h, BS1[h']), temperate subhumid (C[w]), semi-warm subhumid (Acw), and warm sub-humid (A[w]); average annual temperatures between 18 to 25°C and average annual precipitation ranges between 231 to 464 mm (INEGI 2017). In general, the vegetation is arid, and most of the state surface is covered by xerophytic shrub, but there are also subtropical communities at the south-central part of the state, and temperate vegetation such as *Quercus-Pinus* forest on highlands of Sierra Madre Occidental (Brito-Castillo et al. 2010).

Material identification and data collection.—The material collected in the state of Sonora and deposited in the University of Sonora herbarium (USON) and Mexico National Herbarium (MEXU) was reviewed (herbaria acronyms follow Thiers 2021), and plant identification was corroborated using specialized bibliography (Boetsch 2002; Bohley et al. 2017; Sandoval-Ortega & Siqueiros-Delgado 2018; Thulin et al. 2016; Vivrette et al. 2003). In addition, the specimens deposited in the Arizona State University Vascular Plant Herbarium (ASU), University of Arizona Herbarium (ARIZ) and Desert Botanical Garden (DES), were consulted using the portal Red de Herbarios del Noroeste de México (Sánchez-Escalante & Gilbert 2018), as well as the online collections: Kew Royal Botanic Gardens (Kew 2022), Missouri Botanical Garden (TROPICOS 2022), Muséum national d'Histoire Naturelle (P 2022), New York Botanical Garden (NY 2022), Smithsonian Institution (US 2022) and the Global Plants platform (JSTOR 2022).

Taxonomic treatment.—Morphological descriptions of the families, genera, and species, as well as dichotomous keys were elaborated based on the sequence used by Sandoval-Ortega and Siqueiros-Delgado (2018). Regarding the accepted names and their synonymy, the proposals of Thulin et al. (2016) and Bohley et al. (2017) were considered. Distribution maps for the species were prepared using QGIS v. 2.28.4 (QGIS 2017), using the coordinates from the herbarium specimens, those that did not have this information were assigned coordinates according to the collection locality with the Google Earth Pro program (Google Earth 2021).

RESULTS

In Sonora the family Aizoaceae is represented by three genera and five species, two of which are introduced, most taxa are distributed along the coast, on sandy soils, while the family Molluginaceae is represented by three genera and three species, one introduced, mostly found in disturbed areas and sandy soils.

Aizoaceae Martinov

Herbs annual or perennial or subshrub, usually succulent, smooth or covered by hyaline papillae, glabrous or pubescent; stems creeping, prostrate or ascending; leaves sessile or petiolate, opposite or alternate, stipules present or absent, leaf blades simple, flattened to terete; inflorescences axillary or terminal, solitary flowers to cymes; flowers actinomorphic, pedicellate or sessile, bisexual rarely unisexual, actinomorphic, perianth uniseriate, calyx with 4–5 sepals fused in a tube, lobes petaloid or foliaceous, unequal; petaloid staminodes present or absent; stamens numerous, adnate or not to the calyx; ovary superior, inferior or semi-inferior, locules 1–many, stigmas same number as locules, free or fused at base, filiform; fruit usually a pyxidium, sometimes a loculicidal capsule or rarely an indehiscent berry; seeds 1–many per locule, aril usually present.

Only the genera *Sesuvium* and *Trianthena* are native and genera such as *Tetragonia* L., *Galenia* L., *Mesembryanthemum* L., *Carpobrotus* N.E. Br., and *Lampranthus* N.E. Br. are introduced in Mexico (Villaseñor 2016; Sandoval-Ortega & Siqueiros-Delgado 2018). In Sonora, the family Aizoaceae is represented by three genera and five species.

KEY TO THE GENERA OF AIZOACEAE PRESENT IN SONORA

1. Stipules absent; petaloid staminodes present _____ **Mesembryanthemum** L.
 1. Stipules present; petaloid staminodes absent.
 2. Ovary 1 locule; stigma 1 _____ **Trianthena** L.
 2. Ovary 2–5 locules; stigmas 2–5 _____ **Sesuvium** L.

Mesembryanthemum L., Sp. Pl. 1:480. 1753. nom. cons. TYPE: *Mesembryanthemum nodiflorum* L. typ. cons. (Klak & Bruyns 2013).

Herbs annual or perennial, succulent, usually covered by hyaline papillae, glabrous; stems prostrate to ascending; leaves sessile or petiolate, basal and cauline, alternate or opposite, stipules absent, leaf blades flat or terete; inflorescences axillary or terminal, solitary flowers to cymes; flowers sessile to subsessile, bisexual, calyx lobes (4–)5, foliaceous; petaloid staminodes 20–40(–150), free or fused in a short tube, linear; stamens 10–30(–120), not adnate to the calyx; ovary semi-inferior, locules (4–)5, stigmas (4–)5, filiform; fruit capsule, ovoid to subglobose, opening by (4–)5 persistent valves; seeds 100–200, compressed or globose, smooth to rough with minute tubercles, aril absent.

Genus with 103 species (Klak & Bruyns 2013), only two in Mexico, both present in Sonora, introduced (Villaseñor & Espinosa-García 2004).

KEY TO THE SPECIES OF MESEMBRYANTHEMUM PRESENT IN SONORA

1. Leaf blades flat, ovate to spatulate; stamens 30 _____ **M. crystallinum** L.
 1. Leaf blades terete, linear; stamens 10 _____ **M. nodiflorum** L.

Mesembryanthemum crystallinum L., Sp. Pl. 1:480–481. 1753. TYPE: Hortus elthamensis, t. 180 f. 211. Dillenius 1732 (LECTOTYPE designated by Gerbault 2001). ≡ *Cryophytum crystallinum* (L.) N.E. Br., Gen. S. Afr. Fl. Pl. 245. 1926.

= *Mesembryanthemum glaciale* Haw., Suppl. Pl. Succ. 92. 1819. TYPE: SOUTH AFRICA, Railway banks, 3-Anchors Bay and Sea Point, Dec 1922, M.M. Page 17307 (NEOTYPE designated by Gerbault 2001: BOL barcode BOL128739 [digital image!]).

Herbs annual to biennial, covered by hyaline papillae; stems prostrate to procumbent, 10–40 cm long, green to reddish; lower leaves opposite, petiolate, upper leaves alternate, sessile, reduced; petiole up to 30 mm long; leaf blades flat, ovate to spatulate, 20–120(–150) × 10–100 mm, base truncate, attenuate or cordate margins undulate, apex acute to acuminate or obtuse; inflorescences axillar or terminal, cymes or solitary flowers; calyx lobes 5, ovate, 4–8 mm long, unequal, reflexed at maturity, green to yellowish with red tips; petaloid staminodes 20–40, connate into tube, white to pink; stamens 30; capsule subglobose, 6–10 × 5–8 mm, coarsely papillate; seeds abundant, D-shaped, 0.8–1.2 mm long, rough with minute tubercles.

Native to southern and western Africa, introduced in America, Australia, and Europe (Vivrette et al. 2003). In Mexico, it has been reported for Baja California and Sonora (Vivrette et al. 2003, Van Devender et al. 2009). In Sonora, *M. crystallinum* is distributed in Sonoran biogeographic province (Fig. 1), in Pitiquito,

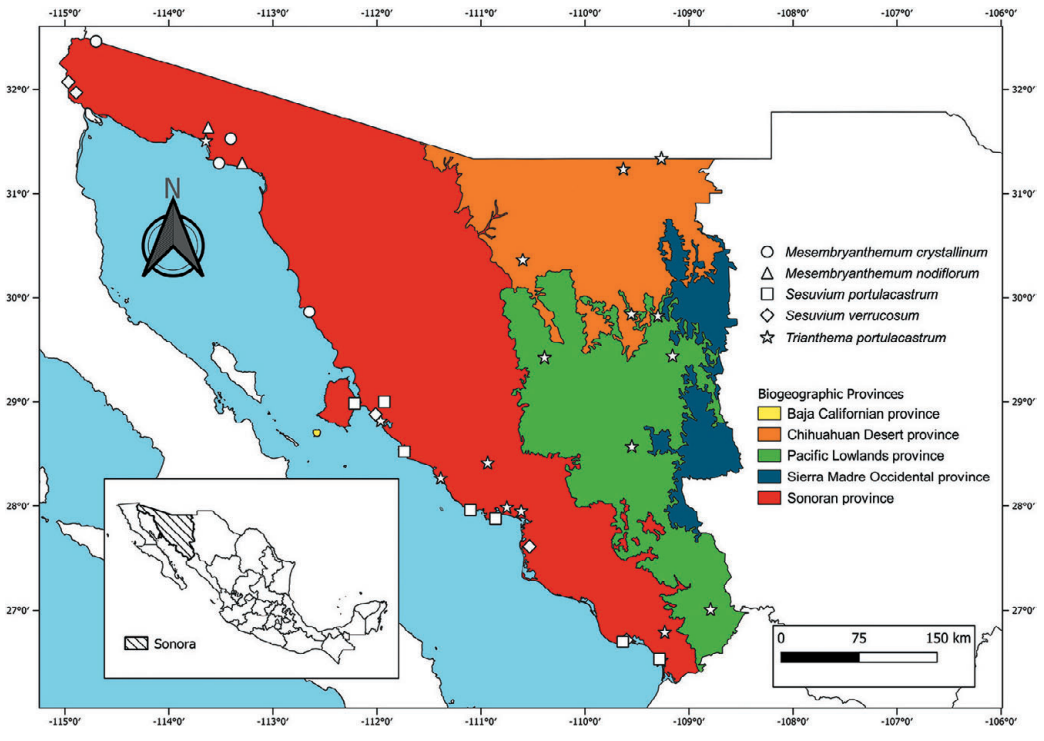


FIG. 1. Distribution of the family Aizoaceae in the state of Sonora, Mexico.

Puerto Peñasco, and San Luis Río Colorado municipalities, in beach dunes and sandy places near seashore, at 2–80 m a.s.l. (Fig. 2).

Specimens examined: **MEXICO. SONORA. Pitiquito:** Duna costera entre Puerto Libertad y Punta Cirio, a 5.4 Km (línea recta) al SE de Puerto Libertad, 29.864889 -112.650167, 20 m, 23 Mar 2011, *Sánchez-Escalante 2011-099* (USON). **Puerto Peñasco:** Las Conchas subdivision in Puerto Peñasco, 31.293167 -113.518007, 2 m, 10 Mar 2015, *L. Makings 4616* (ASU, RSA); E of Playa de Oro at abandoned Universidad Sonora facility, 31.296917 -113.53525, 3m, 29 Apr 2017, *J.F. Wiens 271* (ASDM); Km 8 70.5 carr. Mex 8 Sonoyta-Puerto Peñasco, 31.528611 -113.405556, 80 m, 10 Apr 2002, *Sánchez-Escalante NF-286* (USON). **San Luis Río Colorado:** 5.4 Km E of San Luis Río Colorado on Mex. 2, 32.459444 -114.700556, 49 m, 26 Apr 1997, *A.L. Reina G. 97-512* (USON).

Mesembryanthemum nodiflorum L., Sp. Pl. 1:480. 1753. TYPE: EGYPT: Neapoli (LECTOTYPE designated by Hedge & Lamond 1975: LINN-649.1[digital image!]).

Herbs annual, covered by hyaline papillae, stems prostrate to procumbent, 10–20 cm long, green to reddish; lower leaves opposite, sessile, upper leaves alternate, sessile, reduced; leaf blade terete, linear, (5–)10–20(–30) × 1–2 mm, apex obtuse; flowers solitary; calyx lobes 5, linear, 2–5 mm long, unequal, almost erect at maturity, green to yellowish with red tips; petaloid staminodes 20, connate into tube, white, often pinkish near tips; stamens 10; capsule obconic, 5–8 × 3–5 mm, minutely papillate; seeds abundant, D-shaped, 0.8–1 mm long, rough with minute tubercles.

Its native range is southern Africa, Macaronesia, the Mediterranean to Sahara, and Arabian Peninsula, introduced in America and Australia (POWO 2022). In Mexico, it has been reported for Baja California, Baja California Sur, and Sonora (Vivrette et al. 2003; Van Devender et al. 2009). In Sonora, it is distributed in the Sonoran biogeographic province (Fig. 1), in Puerto Peñasco municipality, in sandy places and near seashore, at 2–87 m a.s.l. (Fig. 3).



FIG. 2. *Mesembryanthemum crystallinum* L. Photo by José Jesús Sánchez Escalante.



FIG. 3. *Mesembryanthemum nodiflorum* L. Photo by José Jesús Sánchez Escalante.

Specimens examined: **MEXICO. SONORA. Puerto Peñasco:** ca. 14 km NE of Puerto Peñasco on SON 8, Lower Colorado River Valley, 31.6361 -113.622, 87 m, 10 Apr 2002, A.L. Reina G. 1752 (ASU); Puerto Peñasco E of Playa de Oro, 31.295778 -113.295778, 2m, 29 Apr 2017, J.F. Wiens 278 (ASDM).

Sesuvium L., Syst. Nat. ed. 10, 2:1058. 1759. TYPE: *S. portulacastrum* (L.) L.

Herbs annual or perennial, succulent, smooth or covered with hyaline papillae, glabrous; stems procumbent, prostrate to erect or creeping; leaves petiolate or sessile, opposite; stipules present; leaf blades lanceolate, elliptic, obovate, oblong or linear; inflorescences absent; flowers solitary, axillary, bisexual, usually pedicellate; calyx lobes 5, petaloid; petaloid staminodes absent; stamens 3–many, attached to perianth tube; ovary semi-inferior, locules 2–5, stigmas 2–5, filiform; fruit pyxidium, ovoid to conic or subglobose, without apical ornaments; seeds up to 60, smooth or ornamented, aril present.

Genus with 14 species distributed throughout the world (Bohley et al. 2017), four of them present in Mexico (Villaseñor 2016, Sandoval-Ortega & Siqueiros-Delgado 2018), two in Sonora.

KEY TO THE SPECIES OF *SESUVIUM* PRESENT IN SONORA

1. Plants smooth, not covered with hyaline papillae; flower pedicellate, pedicels 3–10(15) mm long _____ ***S. portulacastrum*** (L.) L.
1. Plants covered with hyaline papillae; flowers sessile to subsessile, pedicels < 2(3) mm long _____ ***S. verrucosum*** Raf.

Sesuvium portulacastrum (L.) L., Syst. Nat. ed. 10, 2: 1058. 1759. ≡ *Halimus portulacastrum* (L.) Kuntze, Rev. Gen. Pl. 1:263. 1891. ≡ *Portulaca portulacastrum* L., Sp. Pl. 1:446. 1753. TYPE: KINGDOM OF THE NETHERLANDS: Curaçao, illustration of “*Portulaca curassavica angusto longo lucidoque folio*” in Hermann (1698), Paradisus Batavus: 212. (LECTOTYPE designated by Wijnands 1983).

= *Sesuvium spathulatum* Kunth, Nov. Gen. Sp. 6:87.1823. TYPE: CUBA: near Havana, *Bonpland & Humboldt 1372 4524* (HOLOTYPE: P barcode P00679547 [digital image!]).

= *Sesuvium distylum* Ridl., J. Linn. Soc., Bot. 27:38. 1890. TYPE: BRAZIL: Rat Island, *Ridley 61* (HOLOTYPE: BM barcode BM001008537 [digital image!], ISOTYPE: K barcode K000531509 [digital image!]).

= *Sesuvium ayresii* Marais, Kew Bull. 32(2):483. 1978. TYPE: MAURITIUS: Fort William, on sand surrounding saltwater pools, Sep 1860, *Ayres s.n.* (HOLOTYPE: K barcode K000076290 [digital image!]).

Herbs perennial, smooth, not covered with hyaline papillae; stems erect, procumbent or creeping up to 100 cm long, green to reddish brown; petioles 2–3 mm long, broader and with scarious margins at base; leaf blades elliptic to oblanceolate, 10–50(70) × (2)3–7(10) mm, base attenuate, margin entire, apex obtuse to acute; flowers with pedicels 3–10(15) mm long; calyx lobes obovate to lanceolate, 5–7(10) × 2–4 mm, pink to white adaxially; stamens 30; pyxidium conic, 8–10 × 4–7 mm; seeds 30–60, rounded-reniform, ca. 1.5 mm diameter, black, smooth, lustrous.

Distributed worldwide in tropical and subtropical zones between approximately 35°N and 42°S (Bohley et al. 2017). In Mexico it has been reported for Campeche, Chiapas, Ciudad de México, Coahuila, Colima, Durango, Estado de México, Guerrero, Hidalgo, Jalisco, Michoacán, Nayarit, Oaxaca, Querétaro, Quintana Roo, San Luis Potosí, Sinaloa, Sonora, Tabasco, Tamaulipas, Veracruz and Yucatán (Villaseñor 2016). In Sonora it is distributed in Sonoran biogeographic province (Fig. 1), and has been collected in Guaymas, Hermosillo, Huatabampo and Pitiquito municipalities, including insular territory (Islands: San Vicente, Almagre Grande, Pájaros, Tiburón and Alcatraz), in beach dunes and sandy places near seashore, at 1–12 m a.s.l (Fig. 4).

Note.—many names have been proposed for this polymorphic species through the time, for more synonyms see Bohley et al. (2017).

Examined specimens: **Guaymas:** San Carlos, duna costera en la Playa Los Algodones, 27.963097 -111.100992, 12 m, 15 Mar 2011, *Sánchez-Escalante 2011-073* (USON); Isla San Vicente, 28.879223 -110.860231, 6 m, 3 May 1964, *R.S. Felger 10043* (ARIZ); Isla: Almagre Grande, 27.910380 -110.869770, 10 m, 28 Sep 2006, *C.G. Suarez Gracida 2006-152-CGSG* (ARIZ); Isla: Pájaros, 27.895359 -110.840707, 6 m, 7 Nov 2006, *A. Burquez-Montijo 2006-41-ABM* (ARIZ). **Hermosillo:** Playa de Punta Baja, costa de Hermosillo a 3.3 Km (por el camino de terracería) al Sur de El Sahuímaro, 28.523694 -111.736333, 6 m, 27 Oct 2010, *Sánchez-Escalante 2010-716* (USON); Bahía de Kino, Punta Hueso de Ballena, a 6 Km (línea recta) al S de Kino Viejo, 28.76275 -111.944861, 10 m, 26 Oct 2011, *Sánchez-Escalante 2011-692* (USON); Isla Tiburón, E side island, on beach ca. 1 km N of Estero de San Milguel, 28.98389 -112.21541, 1 m, 1 Jan 2001, *B.T. Wilder 41796* (USON); Isla Alcatraz, eastern point of flat, 28.81521 -111.96411, 2 m, 16 Sep 2007, *B.T. Wilder 07-388* (USON). **Huatabampo:** On beach area, at mouth of Arroyo



FIG. 4. *Sesuvium portulacastrum* (L.) L. Photo by Francisco Alejandro Rodríguez Salas.

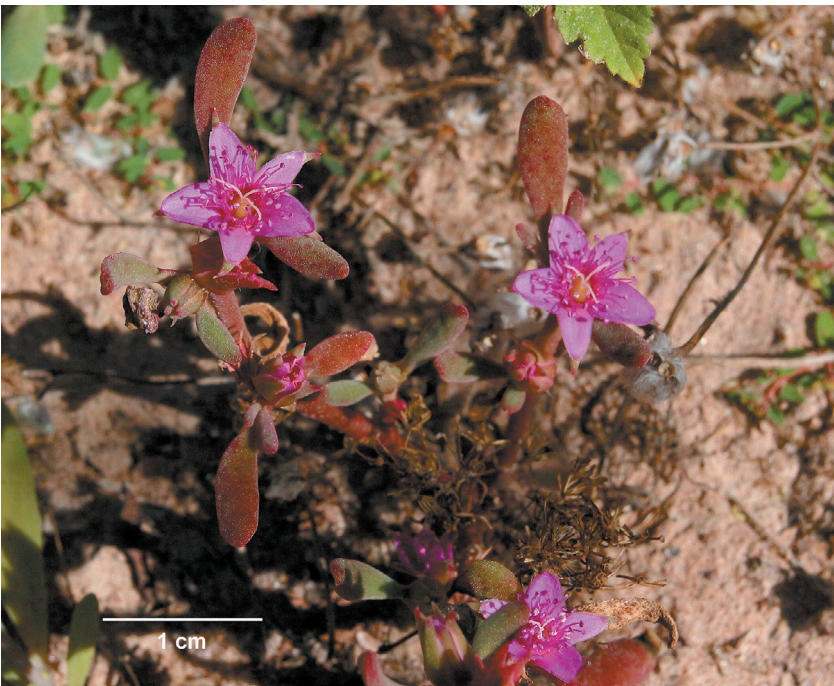


FIG. 5. *Sesuvium verrucosum* Raf. Photo by José Jesús Sánchez Escalante.

Muerto, 600 m W (by air) Camahuíroa, 26.533333 -109.283333, 4 m, 20 Jul 1993, S.L. Friedman 198 (BCMEX); Estero El Tecucure, playa entre Santa Bárbara y Acuicola Camarón Dorado, a 5 Km (línea recta) siguiendo la línea de costa al W de Huatabampito, 26.696694 -109.636833, 3 m, 23 Oct 2010, Sánchez-Escalante 2010-655 (USON). **Pitiquito:** Campo Dolar, shore of Infiernillo Channel, opposite Tiburón Island, 29.333333 -112.366667, 12 m, 21 Mar 1963, R.S. Felger 6877 (ARIZ).

Sesuvium verrucosum Raf., New Fl. 4, 16. 1836. TYPE: U.S.A.: Salt River, Arkansas, *Nuttall s.n.* (NEOTYPE designated by Bohley et al. 2017: P barcode P00680440 [digital image!]). U.S.A. CALIFORNIA: Riverside, Mystic (San Jacinto) Lake, 1 mi W of Jackrabbit Trail on Gilman Springs Rd, 0.4 mi W of Quail Lake Golf C. entrance, 2 mi WNW of Eden Hot Spr., San Jacinto Valley, 33.9 -117.1, 436m, 15 Oct 1999, A.C. Sanders 23186 (EPITYPE designated by Bohley et al. 2017: BRIT, ISOEPTYPE: UTC barcode UTC00230499 [digital image!], SD, DAV, UCR barcode UCR0101079 [digital image!]).

=*Sesuvium erectum* Correll, Rhodora 68:421. 1966. TYPE: U.S.A. TEXAS: Kenedy Co.: 40 km S of Sarita along U.S. St. 77, 12 Jul 1957, Correll & Johnston 17868 (HOLOTYPE: LL barcode LL00370731 [digital image!], ISOEPTYPE: F barcode F0047560F [digital image!], BRIT barcode BRIT24054 [digital image!], US barcode US01050060 [digital image!]).

Herbs perennial, covered with hyaline papillae; stems prostrate to procumbent, up to 100 cm long, green to reddish brown; petioles 2–6 mm long, broader and with scarious margins at base; leaf blades oblong to oblanceolate or linear, 5–30 × 2–10 mm, base attenuate, margin entire, apex obtuse to acute; flowers sessile or subsessile, pedicels < 2(3) mm long; calyx lobes obovate to lanceolate, 5–7 × 3–4 mm, pink to violet adaxially; stamens 30; pyxidium ovoid to subglobose, 4–6 × 3–5 mm; seeds 20–40, rounded-reniform, ca. 1 mm diameter, black, smooth, lustrous.

Native to Mexico and United States of America, introduced in South America, Canary Islands, Cape Verde, Hawaii, Iran, Arab States of the Persian Gulf, Lebanon-Syria, Saudi Arabia, and Vietnam (POWO 2022). In Mexico it has been reported for Baja California, Baja California Sur, Chihuahua, Ciudad de México, Coahuila, Colima, Durango, Guanajuato, Jalisco, Michoacán, Nuevo León, San Luis Potosí, Sinaloa, Sonora and Tamaulipas (Villaseñor 2016). In Sonora, it is distributed in Sonoran biogeographic province (Fig. 1), and has been collected in Guaymas, Hermosillo, Huatabampo and San Luis Río Colorado municipalities, near seashore, at 3–15 m a.s.l. (Fig. 5)

Specimens examined: **MEXICO. SONORA. Guaymas:** 4.2 mi by dirt road inland (eastward) from shore at Chiinim (=Algodones) on road to Pótam, 27.611111 -110.533333, 3 m, 13 Dec 1988, R.S. Felger 55-578 (USON). **Hermosillo:** Hermosillo- Kino Highway, 10.5 mi E of the shore at Bahía Kino, 28.829722 -111.849722, 15 m, 10 Apr 2007, R.S. Felger 41705 (USON); Bahía de Kino Nuevo, 28.856389 -112.005556, 15 m, 1 Jun 1996, A.L. Reina G. 96-242 (USON); Extremo Norte de playa San Bartolo, a 91 km al E de Hermosillo, 29.110256 -111.957, 10 m, 30 Jan 2020, Sánchez-Escalante 2020-025 (USON). **Huatabampo:** 1.25 km N of Huatabampito on the road to Moroncarit, c. 13 km (airline) SSE of Huatabampo, Rio Mayo region, 26.71667 -109.6, 5m, 4 Sep 1989, A.C. Sanders 9221 (UCR). **San Luis Río Colorado:** Delta of the Rio Colorado, 8 Km SW Mesa Rica, Ejido Luis Encinas Johnson, 32.072778 -114.966111, 10 m, 9 Apr 1993, Ortiz-Reina s.n. (USON); Ciénega de Santa Clara, N end of ciénega, ca. 0.5 km N of hunter's camp, 32.046111 -114.905, 5 m, 21 Nov 1992, R.S. Felger 92-993 (USON).

Trianthema L. Sp. Pl. 1:223. 1753. TYPE: *Trianthema portulacastrum* L.

Herbs annual or perennial, usually succulent, smooth or papillose, glabrous to pubescent; stems prostrate or ascending; leaves petiolate, opposite; stipules present; leaf blades usually flat, linear to orbicular; inflorescences axillary, solitary flowers to cymes; flowers sessile or subsessile, bisexual; calyx lobes 5, petaloid; petaloid staminodes absent; stamens 5–10, inserted near the apex of calyx tube; ovary upper, locules 1–2, stigmas 1–2, filiform; fruit pyxidium, subglobose, ovate or turbinate, sometimes with apical ornamentations; seeds 2–4, triangular, globose or reniform, smooth, rough or papillose, aril present.

A genus with 28 species distributed in the tropical and subtropical regions of both hemispheres, with important centers of distribution in Africa and Australia (Hernández-Ledesma et al. 2015; Ocampo-Acosta 2002a). Only one species reported for Mexico.

Trianthema portulacastrum L. Sp. Pl. 1:223. 1753. TYPE: THE NETHERLANDS: Curaçao, illustration of "*Portulaca curassavica capparidis folio*", in *Paradisus Batavus*: 213, Hermann 1698 (LECTOTYPE designated by Jeffrey 1960).

Herbs annual or perennial, glabrous to minutely pubescent; stems ascending or procumbent, 5–40(–60) cm long, reddish, green to yellowish or brown; stipules deltoid 1.3–3(–3.5) × 1–2 mm, membranous, connate in a basal ring, margins entire, apex aristate, whitish, petioles (5–)8–12(–20) mm long; leaf blades variable in size



Fig. 6. *Trianthesma portulacastrum* L. Photo by José Jesús Sánchez Escalante.

and shape, generally obovate to orbicular, (7–)12–29(–50) × (5–)10–22(–30) mm, base usually cuneate, apex obtuse, emarginate or shortly cuspidate; flowers solitary, axilar, sessile; calyx lobes ovate to lanceolate, (2–)3–5 mm, pinkish to reddish adaxially; stamens 5(–10); pyxidium turbinate, 3–4 mm long, base membranous and hidden by the stipules, apex with a pair of apical ridges; seeds 4, reniform, 1–2 mm diameter, dark, covered by a loose, membranous aril.

It is a widely distributed weed in Mexico, reported for Aguascalientes, Baja California, Baja California Sur, Campeche, Chiapas, Chihuahua, Ciudad de México, Coahuila, Colima, Durango, Estado de Mexico, Guanajuato, Guerrero, Hidalgo, Jalisco, Michoacán, Nayarit, Nuevo León, Oaxaca, Puebla, Querétaro, Quintana Roo, San Luis Potosí, Sinaloa, Sonora, Tabasco, Tamaulipas, Veracruz, Yucatán, and Zacatecas (Villaseñor 2016; Sandoval-Ortega & Siqueiros-Delgado 2018). In Sonora it has been registered in Chihuahuan Desert, Pacific Lowlands, and Sonoran biogeographic provinces (Fig. 1), in Agua Prieta, Álamos, Cucurpe, Empalme, Granados, Guaymas, Hermosillo, Huatabampo, Moctezuma, Navojoa, Puerto Peñasco, Sahuaripa, Soyopa and Ures municipalities, on roadsides, urban areas, crop margins, and other disturbed soils, also on beach dunes and near seashore, at 2–550 m a.s.l. (Fig. 6).

Specimens examined: **MEXICO. SONORA. Agua Prieta:** 30 km E of Agua Prieta Hwy. 2 & Rio San Bernardino, 31.333333 -109.265278, 1138 m, 27 Aug 2000, A. Búrquez M. SBV201978 (USON); Isolated hill NE of Sierra Anibacachi, Rancho La Calera, ca. 10 km (by air) SW of Agua Prieta, 31.233056 -109.631389, 1287 m, 12 Aug 2006, A.L. Reina G. 2006-439 (USON). **Álamos:** upper crossing of the Rio Cuchujaqui, 12 mi by road E of Alamos, 1.5 mi E of Sabinito Sur, Rio Mayo, 27.00556 -108.79306, 400 m, 6 Sep 1989, A.C. Sanders 9336 (UCR). **Cucurpe:**

Ciénega de Saracachi, Rancho Agua Fría, Río Saracachi, 10.6 km (by air) ENE of Cucurpe, 30.359722 -110.598056, 946 m, 6 Oct 2010, *Van Devender 2010-1111* (USON). **Empalme**: Ejido San Fernando, Valle de Guaymas, 27.983611 -110.751389, 12 m, 30 Jul 1984, *R. López E. s.n.* (USON). **Granados**: Granados, 29.823611 -109.298611, 550 m, 31 Jul 1986, *Meling s.n.* (USON). **Guaymas**: 4 Km al W de San Rafael, Sierra Libre, talud de exposición E, 28.410556 -110.935556, 260 m, 19 Aug 1997, *A. Flores M. 5326* (USON); Isla Jama, 27.941322 -111.052170, 2 m, 28 Jul 1999, *Suárez-Gracida s.n.* (USON). **Hermosillo**: Vado del Río en Hermosillo, 29.085556 -110.894167, 220 m, 3 Aug 1986, *Meling s.n.* (USON); Playa San Agustín, a 4 Km (siguiendo la línea de costa) al SE del campo pesquero El Colorado, 28.264611 -111.386583, 1 m, 19 Oct 2010, *Sánchez-Escalante 2010-624* (USON); Playa de Punta Baja, costa de Hermosillo a 3.3Km (por el camino de terracería) al Sur de El Sahumaro, 28.523694 -111.736333, 6 m, 27 Oct 2010, *Sánchez-Escalante 2010-719* (USON); Isla Alcatraz, eastern point of flat, 28.81521 -111.96411, 1 m, 16 Sep 2007, *B.T. Wilder 07-389* (USON). **Huatabampo**: Camahuíroa, on the coast, 27 air km SE of Yavaros, Coastal Plain, 26.51667 -109.26667, 2 m, 8 Oct 1992, *A.C. Sanders 12746* (UCR). **Moctezuma**: Tonibabi, a 12.8 Km (línea recta) al ENE de Moctezuma, 29.84 -109.554722, 779 m, 8 Aug 2011, *Valenzuela-Yanes 2011-072* (USON). **Navojoa**: Teachive de Masica, Arroyo Masiaca, 26.786111 -109.233333, 75 m, 29 Sep 1995, *Van Devender 95-1084* (USON). **Puerto Peñasco**: NE corner of Reserva Alto Golfo y Delta del Río Colorado, NW of Puerto Peñasco, 1.2-mile (odometer) on dirt road paralleling (N side of) RR W of SE boundary of El Pinacate Reserva de la Biosfera (along road and RR to Estación Gustavo Sotelo), then ca. 100 m southward from RR tracks, 31.504444 -113.644167, 7 m, 20 Oct 2003, *R.S. Felger 03-507* (USON). **Sahuaripa**: Rancho Dubaral, Arroyo Dubaral, 42.9 km (by air) N of Sahuaripa, Reserva Jaguar del Norte, 29.44 -109.158611, 584 m, 5 Sep 2009, *Van Devender 2009-963* (USON). **Soyopa**: Arroyo Los Garambullos, 0.5 Km SE of Río Yaqui bridge on Mex. 16, 3.3 Km S, 1.5 Km E of Tonichi, 28.569444 -109.55, 180 m, 9 Sep 1999, *A.L. Reina G. 99-403* (USON). **Ures**: Ures, 29.425 -110.389167, 285 m, 15 Aug 1986, *Meling s.n.* (USON).

MOLLUGINACEAE Bartling

Herbs annual or perennial, rarely shrubs or subshrubs, glabrous or pubescent; stems prostrate to erect; leaves simple, sessile or petiolate, alternate, opposite, usually appearing whorled, basal rosette sometimes present, stipules usually present, leaf blades, simple, flat; inflorescences axillary or terminal, cymes resembling an umbel, fascicle or flowers solitary; flowers actinomorphic, pedicellate, bisexual or unisexual, perianth uniseriate, calyx with 4–5 sepals, free or connate, petaloid, unequal; petaloid staminodes present or absent; stamens 3–5(–30), not adnate to de calyx; ovary superior, carpels 1–5, stigmas 1–5, free or fused at base; fruit capsule or achene; seeds 1–many, reniform or orbicular, smooth, minutely reticulate, tuberculate or ribbed, sometimes with caruncle.

Family with 11 genera and about 90 species distributed mainly in tropical and subtropical regions, more diverse in southern Africa (Thulin et al. 2016). Three genera in Mexico, all present in Sonora.

KEY TO THE GENERA OF MOLLUGINACEAE PRESENT IN SONORA

1. Plants tomentose; caruncle present _____ **Glinus** L.
1. Plants glabrous to sparsely puberulent; caruncle absent.
 2. Stipules present; seeds minutely reticulate _____ **Hypertelis** E. Mey. ex Fenzl
 2. Stipules absent; seeds ribbed, tuberculate or smooth _____ **Mollugo** L.

Glinus L., Sp. Pl. 1:463. 1753. TYPE: *G. lotoides* L.

Herbs annual or perennial, tomentose; stems prostrate to procumbent, rarely erect; leaves petiolate to subsessile, opposite, appearing whorled, basal rosette sometimes present, short-lived, stipules absent, leaf blades spatulate, obovate or elliptic; inflorescences axillary, short cymes resembling fascicles; flowers sessile to subsessile, bisexual; calyx with 5 free sepals, ovate, oblong or elliptic, white, pinkish or yellowish adaxially; stamens 3–20(–30); ovary superior, carpels 3–5; stigmas 3–5; fruit a capsule, ovoid to subglobose, opening by 3–5 valves; seeds usually more than 50, reniform, smooth or tuberculate, caruncle present.

Genus with ca. 10 species, some pantropical and others spreading to temperate areas as weeds (Thulin et al. 2016). Only two species reported for Mexico (Sandoval-Ortega & Siqueiros-Delgado 2018) and only one in Sonora.

Glinus radiatus (Ruiz & Pav.) Rohrb., Fl. Bras. 14(2):238. 1872. ≡ *Mollugo radiata* Ruiz & Pav., Fl. Peruv. 1:48. 1798. TYPE: MEXICO, SONORA: municipio Hermosillo, 3 km al NE de San José de Gracia, a orilla del río Sonora, 29.310836 -110.590627, 315 m, 12 Mar 2022, Sandoval-Ortega 1083 (USON). (NEOTYPE, **designated here**: USON!).

Note.—Original collection was CHILE: habitat in inundatis locis Conceptionis Chile ad Mochita et Carcamo terminum; (Type: no type designated).

Herbs annual, tomentose with stellate trichomes; stems prostrate, up to 30 cm long, brown to reddish; petioles 1–7 mm, leaf blades spatulate to obovate, 4–23 × 2–14 mm, base cuneate to attenuate, margin entire, apex rounded, mucronulate or acute; flowers subsessile, pedicels up to 2 mm long; sepals ovate to elliptic, 4–5 × 1.2–2 mm, unequal, apex attenuate to acuminate; petaloid staminodes 5, alternating with stamens, bifid, shorter than sepals; stamens 5; capsule ovate, 3–3.5 × 1.7–2 mm, shorter than sepals at maturity; seeds ca. 50, reniforms, 0.4–0.5 mm diameter, reddish to light brown, shiny, weakly reticulated, caruncle white.

Native to tropical America (Boetsch 2002). In Mexico it is reported for Aguascalientes, Baja California, Baja California Sur, Campeche, Chiapas, Chihuahua, Coahuila, Colima, Durango, Guerrero, Jalisco, Morelos, San Luis Potosí, Sinaloa, Sonora, Tamaulipas and Veracruz (Villaseñor 2016; Sandoval-Ortega & Siqueiros-Delgado 2018). In Sonora it is distributed in Chihuahuan Desert, Pacific Lowlands, and Sonoran biogeographic provinces (Fig. 7), and has been collected in Agua Prieta, Guaymas, Huatabampo, Opodepe, Ures and Yécora municipalities, usually at the edge of ponds and dams, on muddy soils, at 15–1200 m a.s.l. (Fig. 8).

Specimens examined: MEXICO. Sonora. **Agua Prieta:** Arroyo Guadalupe, Rancho Puerta Blanca (Cuenca Los Ojos Reserve), ca. 40 km E of Agua Prieta, 31.3125 -109.110278, 1239 m, 2 May 2008, A.L. Reina G. 2008-132 (USON). **Guaymas:** coastal flats, 26 mi S of Empalme along Hwy 15, just N of Pitahaya., 27.793582 -110.43462, 15 m, 2 Apr 1982, A.C. Sanders 2525 (ASU); ca. 2 km SE of Rancho San Alfonso on road to Bahía San Pedro, 28.099444 -111.221389, 49.2 m, 11 Mar 1985, R.S. Felger 85-590 (USON). **Hermosillo:** 3km al NE de San José de Gracia, a orilla del río Sonora, agregar altitud y fecha, *Sandoval-Ortega 1083* (USON). **Huatabampo:** dried pools 6 km (3.6 mi) SW of Hwy 15 on the road to Camahuira, c. 2 km SW of Ejido Tierra & Libertad, 8 km (4.8 mi) E of Camahuira; Rio Mayo region/coastal plain, 26.55 -109.20833, 30m, 21 Mar 1993, A.C. Sanders 13528 (UCR). **Opodepe:** Represo del Burro, Rancho El Carrizal, 21.3 km (by air) ESE of Benjamin Hill., 30.145833 -110.896111, 737m, 30 Jul 2009, *Van Devender & A.L. Reina-G. 2009-414* (ARIZ). **Ures:** Los Llanos del Rancho los Novillos, Sierra Huérfana (Mazatán), 9.1 km (by air) SSW of Pueblo de Álamos, 29.142222 -110.166667, 1100 m, 28 Apr 2014, A.L. Reina-G. 2014-251 (ARIZ). **Yécora:** El Llano de Curea, 28.299444 -109.281111, 514 m, 19 Mar 2004, *Van Devender 2004-158* (USON)

Hypertelis E. Mey. ex Fenzl, in Ann. Wiener Mus. Naturgesch. 1:352. 1836. TYPE: *H. spergulacea* E. Mey ex Fenzl.

Herbs annual or perennial, glabrous; stems erect to scandent; leaves sessile or petiolate, opposite, appearing whorled, basal rosette present, short-lived; stipules present; inflorescences axillary or terminal, umbel-like cymes; flowers bisexual, pedicelate; calyx with 5 free sepals; petaloid staminodes absent; stamens 5–25; ovary of 3 carpels, stigmas 3; fruit a capsule dehiscent by 3 valves; seeds up to 40, very finely reticulate to almost smooth, caruncle absent.

A genus with five species, two widespread and three restricted to southern Africa (Thulin et al. 2016), and one in Mexico.

Hypertelis umbellata (Forssk.) Thulin, Taxon 65(4):787. ≡ *Mollugo umbellata* (Forssk.) Ser. in Candolle, Prodr. 1:393. 1824. ≡ *Pharnaceum umbellatum* Forssk., Fl. Aegypt. Arab. 58. 1775. TYPE: YEMEN: Lohajac, Jan 1763, *Forsskål s.n.*, Herb. Forsskål 1567 (LECTOTYPE designated by Thulin et al. 2016: C barcode C10002759 [digital image!]; ISOLECTOTYPE: S 05-5455 [digital image!]).

≡ *Mollugo spathulifolia* (Fenzl) Dinter in Repert. Spec. Nov. Regni Veg. 19:236. 1923. ≡ *Mollugo cerviana* var. *spathulifolia* Fenzl in Ann. Wiener Mus. Naturgesch. 1:379. 1836. TYPE: Not found.

Herbs annual, glabrous; stems erect, 3–30 cm long, glaucous; stipules linear, petioles 0.8–1.1 mm long; leaf blades linear to spatulate, 3–15 × 1–5 mm, base cuneate, margin entire, apex acute to obtuse, glaucous; inflorescences axillary and terminal, cymes resembling umbels; flowers with pedicels 3–11 mm long; sepals elliptic to obovate, 1–1.5 × 1–1.6 mm, unequal, white adaxially, apex acute; stamens 5; capsule subglobose, 1.5–1.8 × 1.5–1.9 mm; seeds 20–30(–40), reniform, ca. 0.4 mm diameter, finely reticulate, brown.

Widespread in south-western Asia, India, Africa, and America (Thulin 2016). In Mexico it was reported as *Mollugo cerviana* (L.) Ser. to Baja California, Baja California Sur, Chihuahua, Guerrero, Oaxaca and Sonora. In Sonora it is distributed in Sonoran biogeographic province (Fig. 7), in Guaymas, Hermosillo, Pitiquito and Puerto Peñasco municipalities, usually in sandy places like stream banks and dunes, at 3–130 m a.s.l.

Specimens examined: MEXICO. Sonora. **Guaymas:** Nacapule Canyon N of Guaymas near Bahía San Carlos, just N of Cerro Navarro and S of Cerro las Pinolas. NE of Tetas de Cabra. 6.3 mi W of hwy 15 on rd to San Carlos and 4.4 mi N on dirt road, deep canyon in old volcanic range, 28.01667 -111.05, 130 m, 4 Jan 1983, D. Keil 16598-1 (OBI). **Hermosillo:** Isla Tiburón, Zozni Cmiipla, 28.9687 -112.21409, 3m, 26 Sep 2008, R.S. Felger 08-117 (ARIZ). **Pitiquito:** NW side of Cerro Tepopa, ca. 10 mi E of El Desemboque San Ignacio, 29.366667 -112.400000, 324 m, 9 Oct 1966, R.S. Felger 15011 (MEXU). **Puerto Peñasco:** NW of Puerto Peñasco, 1.2-mile (odometer) on dirt road paralleling (N side

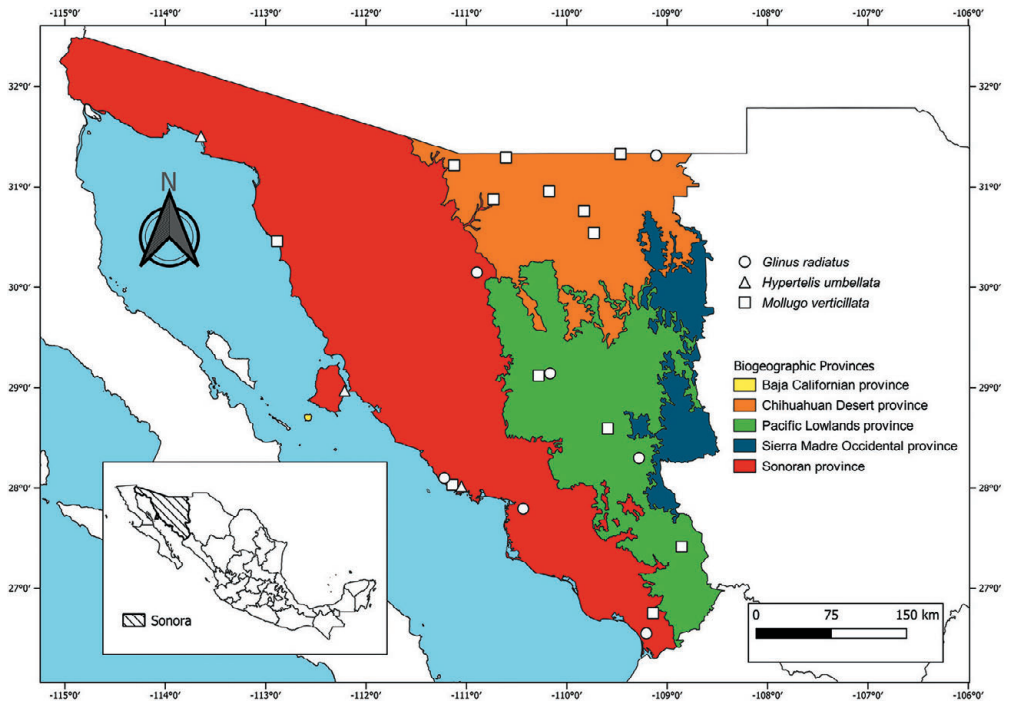


FIG. 7. Distribution of the family Molluginaceae in the state of Sonora, Mexico.



FIG. 8. *Glinus radiatus* (Ruiz & Pav.) Rohrb. Photo by Manuel Higinio Sandoval Ortega.

of) RR W of SE boundary of El Pinacate Reserva de la Biósfera (along road and RR to Estación Gustavo Sotelo), then ca. 100 m southward from RR tracks, 31.5045 -113.6443, 7 m, 20 Oct 2003, R.S. Felger 03-494 (ARIZ); 1 km de la estación de ferrocarril López Collada, 31.705679 -113.984475, 24 Mar 1989, E. Ezcurra s.n. (MEXU).

Mollugo L., Sp. Pl. 1:89. 1753. TYPE: *Mollugo verticillata* L.

Herbs annual or perennial, rarely small shrubs or subshrubs, glabrous or sparsely pubescent; stems prostrate to ascending; leaves sessile or petiolate, opposite, appearing whorled, basal rosette present, short-lived; stipules absent; leaf blades linear to spatulate; inflorescences axillary or terminal, solitary flowers to cymes resembling umbels or fascicles; flowers bisexual, sepals free; stamens 3–9; staminodes absent; ovary of 3 carpels, stigmas 3; fruit capsule, opening by 3 valves; seeds 3–35 reniform to orbicular, caruncle absent, surface ribbed, reticulated or smooth, shiny.

Genus with about 15 species, native to tropical and warm regions of North and South America and a single species restricted to India, introduced in Europe, Africa, and Asia (Thulin et al., 2016). One species in Mexico.

Mollugo verticillata L., Sp. Pl. 1:89. 1753. TYPE: Origin unknown (LECTOTYPE designated by Reveal et al. 1987: LINN-112.4 [digital image!]).

=*Mollugo arenaria* Kunth, Nov. Gen. Sp. 6:20. 1823. TYPE: VENEZUELA: Crescit in insula arenosa fluminis Apures, prope El Diamante, *Bonpland & Humboldt 806* (HOLOTYPE: P barcode P00679591 [digital image!]).

Herbs annual, glabrous or sparsely pubescent with minute simple or glandular hairs; stems prostrate to ascending, up to 50 cm long, green; leaves sessile to subsessile, petioles 1–3 mm long; leaf blades spatulate, oblanceolate or linear, 5–37 × 0.5–8 mm, base attenuate, margin entire, apex obtuse to acute; inflorescences axillary, short cymes resembling umbels; flowers with pedicels (2–)4–10 mm long; sepals obovate, elliptic or oblong, 2–2.5(–3) × 1–1.5 mm, apex acute to obtuse, whitish adaxially; stamens 3; capsule elliptic, 3–3.5 × 1.5–2 mm; seeds (15–)20–30, reniform, 0.5–0.6 mm diameter, with 3 or more curved and parallel ribs on the surface, reddish brown to dark brown, shiny.

Native to tropical America, currently distributed throughout the continent, also Eurasia and Africa (Boetsch 2002). Reported to almost all states of Mexico (Villaseñor 2016; Sandoval-Ortega & Siqueiros-Delgado 2018). In Sonora, it is distributed in the Chihuahuan Desert, Pacific Lowlands, and Sonoran biogeographic provinces (Fig. 7), and has been collected in Agua Prieta, Álamos, Cananea, Fronteras, Guaymas, Huatabampo, Imuris, Nacoziari de García, Navojoa, Santa Cruz, Soyopa, Ures and Nogales municipalities, is a common weed in disturbed areas of xerophytic and subtropical scrub, grasslands and *Quercus* forest like roadsides, also in stream banks and other open sandy places, at 2–1450 m a.s.l. (Fig. 9).

Specimens examined: **MEXICO. Sonora. Agua Prieta:** Arrollo Gallardo, 8 km E of Agua Prieta on MEX 2, 31.326476 -109.465779, 1319 m, 10 Sep 2002, S. Doan 1291 (ASU, USON). **Álamos:** ca. 27.9 mi NE. Álamos, 27.413454 -108.856266, 206m, 9 Aug 1980, E. Lehto 24745 (ASU). **Cananea:** 3 Km. Sur, Ojo de Agua de Arbayo, 30.956944 -110.176389, 1250 m, 27 Aug 1991, R. López E. s.n. (USON). **Fronteras:** Sierra Buenos Aires, just W of Rancho El Capulin; 50.5 km ESE (by air) of Cananea, 30.75932 -109.82893, 1457 m, 15 Aug 2016, S. Carnahan 1834 (ARIZ). **Guaymas:** Sobre el Arroyo, rumbo al Cañón Los Anegados, Ejido Francisco Villa, 28.030278 -111.140833, 50 m, 24 Aug 1999, Moreno-Moreno 99-32 (USON); 27.4 km S of Restaurant Los Arrieros, 4.4 Km N of Pemex El Caballo (toll road turnoff N Guaymas) km 143 on Mex 15, 28.081667 -110.955, 47 m, 9 Jan 1998, A.L. Reina G. 93-08 (USON); Aguaje de Robinson, 28.03751388 -111.1099333, 215 m, 1 Feb 2001, R.S. Felger 01-106 (USON). **Huatabampo:** Bamocha Vertice vicinity, Estero Bamocha coastal flats, 13 km W on dirt road from Estación Luis, 9 km S on dirt road parallel coast, 10 km SW (by air) Melchor Ocampo, 26.469872 -109.242095, 2 m, 23 Nov 1993, S.L. Friedman 339-93 (ASU). **Imuris:** 17.1 km NE of Imuris on MEX 2, 30.8747 -110.731, 1315m, 9 Sep 2002, S. Doan 1224 (ASU). **Nacoziari de García:** Sierra La Púrica, Municipio de Nacoziari, Sonora. Rancho Viejo, a 17.8 Km (línea recta) al NNW de Nacoziari, 30.540322 -109.729467, 1833 m, 8 Sep 2013, Sánchez-Escalante 2013-138 (USON). **Navojoa:** 9.3 Km. E of Masiaca on road to Yocogigua, 26.751389 -109.141667, 160 m, 20 Sep 1993, Van Devender 93-833 (USON). **Nogales:** Cañón Planchas de Plata, upstream (N) from Rancho Esmeralda (=Rancho Las Borregas), SE end of Sierra La Esmeralda, 31.2142 -111.1225, 1090 m, 6 Sep 2005, Van Devender 2005-1205 (NMC). **Santa Cruz:** Santa Cruz River, 5.5 N of Santa Cruz on road to Nogales, ca. 1 km E of Rio Santa Cruz, 31.2925 -110.606389, 1410 m, 16 Aug 2001, Van Devender 2001-697 (USON). **Soyopa:** Arroyo los Conejos, 3.4 Km N of MEX 16 on road to San Antonio de la Huerta (across Rio Yaqui from Tomichi), 28.594167 -109.5925, 2010 m, 16 Aug 2006, A.L. Reina-G. 2006-603 (ARIZ). **Ures:** Sierra de Mazatán, municipio de Ures, Sorora. A 3.28 Km. en línea recta al ESE del poblado de Rancho Viejo, sobre el camino que conduce a la cima de la sierra, 29.1175 -110.281111, 487 m, 16 Mar 2004, Sánchez-Escalante 04-055 (USON).



FIG. 9. *Mollugo verticillata* L. Photo by Manuel Higinio Sandoval Ortega.

DISCUSSION

All the taxa of the family Aizoaceae present in Sonora are part of the flora of beaches and coastal dunes in the state (Espejel et al 2017), like *Mesembryanthemum crystallinum* and *M. nodiflorum*, two species introduced in Mexico (Villaseñor & Espinosa-García 2004), that have been reported in coastal dunes in other states like Baja California and Baja California Sur (Jiménez-Orocio et al. 2015; Sánchez-Escalante & Gilbert 2018).

Sesuvium verrucosum and *S. portulacastrum* are two taxa that may also occur inland, on saline soils close to lakes (Ocampo-Acosta 2002a; Calderón 2005), but in the state of Sonora, they have only been collected near the seashore.

Sesuvium portulacastrum is widely distributed in the country (Villaseñor 2016), considered native to the tropics and subtropics around the world (Lonard & Judd 1997; POWO 2022) that habits in coastal areas where it grows on beaches and adjacent dunes, but it also occurs in disturbed areas (Bohley et al. 2017); in Mexico, this species is part of the coastal dune flora of other states like Baja California, Baja California Sur, Campeche, Chiapas, Quintana Roo, Sinaloa, Tamaulipas, Veracruz and Yucatán (Jiménez-Orocio et al. 2015). This important pioneer species traps sand and tolerates salt sprays and has been proposed to be used in the stabilization of coastal dunes (Lonard & Judd 1997; Tavares-Corrêa & Sabogal-de Alegría 2003).

Trianthema portulacastrum is the most collected and widely distributed species of Aizoaceae in Sonora. This species is also one of the most frequent elements in the beach dune flora of the republic (Espejel et al. 2017) and other countries of America (Tejada & Ayasta 2016). In Mexico it is also a common weed inland, that can be found in saline soils and disturbed sites like roadsides and farmland edges (Ocampo-Acosta 2002a; Sandoval-Ortega & Siqueiros-Delgado 2018; Villaseñor & Espinoza-García 1998). In Sonora, the seeds of this plant are used as food by the Seri people (Felger 1991).

As for the family Molluginaceae, two species of the genus *Mollugo* were reported to Mexico: *M. cerviana* (L.) Ser. and *M. verticillata* (Sandoval-Ortega & Siqueiros-Delgado 2018; Vincent 2003). The main difference

between these two species is found in the seeds and sepals (Sandoval-Ortega & Siqueiros-Delgado 2018), the seeds of *M. verticillata* are ornamented with parallel curved ribs, while *M. cerviana* the seeds are weakly reticulate; the sepals of *M. verticillata* have three easily visible green veins, while in *M. cerviana* they are absent. However, *Mollugo* was a polyphyletic group (Christin et al. 2011; Hernández-Ledesma et al. 2015), and many taxa were segregated from it, including *M. cerviana*, which was a polyphyletic species, now splitted in *Hypertelis cerviana* (L.) Thulin and *H. umbellata*, the first one distributed in Africa, Asia and Australia and the second one in Asia, Africa and America (Thulin et al. 2016).

Regarding the genus *Glinus*, only two species are reported for Mexico, *Glinus lotoides* L. and *G. radiatus* (Ruiz & Pav.) Rohrb., the first is introduced, native to the old world, and the second native to tropical America (Bogle 1970; Boetsch 2002), the main distinguishing feature between these two species is the morphology of the seed, the seed surface of *G. lotoides* is papillose, while that of *G. radiatus* is shiny and weakly reticulated (Sandoval-Ortega & Siqueiros-Delgado 2018).

Some sources mention that the type of *Mollugo radiata* was probably deposited in the Royal Botanic Garden of Madrid Herbarium (MA), adding a question mark after the acronym (TROPICOS 2022; Vigosa-Mercado 2015). The main collection of specimens from the “Botanical Expedition to the Viceroyalty of Peru and Chile” (1777–1788) is in the MA Herbarium and some others in the Botanical Institute of Barcelona Herbarium (IBB) (Nualart & Ibáñez 2015). However, in the protologue (Ruiz & Pavón 1798), there is no citation of collection number and only the habitat is mentioned (*Habitat in inundatis locis Conceptionis Chile ad Mochita et Carcamo terminum*). After consulting the IBB and MA data bases (CSIC-RJB 2021, IBB 2022, JSTOR 2022; Nualart & Ibáñez 2015) and the MA herbarium staff, it was confirmed that there is no material of *M. radiata* or any other Molluginaceae collected by Ruiz & Pavón in MA or IBB. As no illustration or other original material exists, a specimen collected during the present study was here designated as neotype.

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