

On *Opuntia spinulifera* and *O. streptacantha* (Cactaceae), new to Spain, and the status of *O. huajuapensis* in that country

Filip Verloove¹ , Enrique Sánchez Gullón² & Alessandro Guiggi³

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Abstract. *Opuntia spinulifera* and *O. streptacantha* are reported for the first time from Spain. Both are more or less naturalized in scattered localities in Ayamonte (province of Huelva, SW Spain) where they were previously confused with *O. huajuapensis*. Claims of the latter from other Spanish regions are shown to be also erroneous. These three species, as well as *O. leucotricha*, have apparently been confused. Distinguishing features useful for their separation are discussed and the species that are present in Spain are illustrated.

Keywords. *Opuntia*; Spain; Identification Key

Sobre *Opuntia spinulifera* y *O. streptacantha* (Cactaceae), especies nuevas para España, y estado de *O. huajuapensis*

Resumen. *Opuntia spinulifera* y *O. streptacantha* son citadas por primera vez para España. Ambas especies están más o menos naturalizadas en localidades dispersas de Ayamonte (provincia de Huelva, SW España) donde se confundieron previamente con *O. huajuapensis*. Las referencias de esta última de otras regiones españolas se muestran también erróneas. Estas tres especies, así como *O. leucotricha*, aparentemente han sido confundidas. Se discuten las características diferenciales útiles para su separación y se ilustran las especies presentes en España.

Palabras clave. *Opuntia*; España; clave de identificación.

Introduction

Opuntia huajuapensis Bravo is a species endemic to Mexico (Puebla, Oaxaca, Tecamachalco), described from Huajuapán de León (Bravo-Hollis, 1954, 1978). It is probably not widely cultivated as ornamental, if at all; at least it is not cited as such in standard works such as Huxley (1999), Sánchez de Lorenzo Cáceres (2000) or Hunt (2011). Nonetheless, it has been reported on several occasions as an escape from cultivation in various parts of Spain. Sanz-Elorza *et al.* (2004) reported about a small population in the Alforja riverlet basin in Cambrils (province of Tarragona). Subsequently, Pyke (2008) cited two populations from Collserola (province of Barcelona). Finally, Sánchez Gullón *et al.* (2014; erroneously as '*huajapensis*') reported about the finding of this species in Ayamonte (province of Huelva). Based on these records *O. huajuapensis* was included in a worldwide list of invasive cacti (Novoa *et al.*, 2015), albeit only from Spain.

In September 2018 the first author did fieldwork in dried out riverbeds in the Cambrils area where

O. huajuapensis had been reported for the first time in Spain. This area is considered to host the highest diversity of cacti on the European continent (Sanz-Elorza *et al.*, 2004, 2006) and several additional species were recorded during our own fieldwork, including potentially or genuinely invasive species (Verloove & Guiggi, 2019). However, *O. huajuapensis* was not recorded on that occasion. Instead, the morphologically similar *O. leucotricha* was regularly seen in rather numerous localities. Despite being fairly frequent this species was not mentioned by Sanz-Elorza *et al.* (2004, 2006). On closer examination the species depicted in Figure 1i in Sanz-Elorza *et al.* (2004) indeed shows *O. leucotricha*, not *O. huajuapensis*. Similarly, Gómez Bellver *et al.* (2019) reached the same conclusion for claims of the latter from Barcelona province. Therefore, it seemed appropriate to also re-assess the identity of Andalusian claims of *O. huajuapensis*. Critical examination now demonstrates that these plants in fact refer to yet two other Mexican species, *O. spinulifera* Salm-Dyck. and *O. streptacantha* Lem. Like *O. leucotricha* both are declared noxious weeds in Australia and/or South Africa

¹ Meise Botanic Garden, Nieuwelaan 38, B-1860 Meise, Belgium. Email: filip.verloove@botanicgardenmeise.be. Corresponding author

² Paraje Natural Marismas del Odiel (Huelva). Ctra. del Dique Juan Carlos I Km 3, Apdo. 720, E-21071 Huelva, Spain. Email: enrique.sanchez.gullon@juntadeandalucia.es

³ DISTAV, Polo Botanico, Università degli Studi di Genova, International Cactaceae Research Center (ICRC). Corso Dogali, 1M - 16136 Genova, Italy. Email: alex.guiggi@libero.it

(Walters *et al.*, 2011; Novoa *et al.*, 2015; Sheehan *et al.*, 2017). Apparently neither has been recorded before from Spain. They were thought to be also absent from the rest of Europe and the Mediterranean area (Korotkova & Raab-Straube, 2017). However, both are known as local escapes from cultivation in Italy (Guiggi, 2008; Galasso *et al.*, 2018).

In this paper distinguishing characters useful for the separation of *Opuntia huajuapensis*, *O. leucotricha*, *O. spinulifera* and *O. streptacantha* are discussed and the latter three species are illustrated. A key for the identification of these species is presented. An overview of the known localities of *O. spinulifera* and *O. streptacantha* in Spain is provided. The different application of some of these binomials in the native and invaded area is also explained.

Morphological characters useful for the separation of *Opuntia huajuapensis*, *O. leucotricha*, *O. spinulifera* and *O. streptacantha*

Opuntia huajuapensis, *O. leucotricha*, *O. spinulifera* and—to a much lesser extent—*O. streptacantha* are very similar in general appearance. All are large shrubs with

broadly oblong to orbicular, (greyish) green cladodes with fairly closely spaced areoles and yellow flowers. As a result, they have often been confused or their names misapplied. Yet, these species belong to different series, respectively series *Criniferae* Pfeiff. (*O. huajuapensis*), series *Leucotrichae* DC. (*O. leucotricha*) and series *Streptacanthae* Britton & Rose (*O. spinulifera* and *O. streptacantha*) (Bravo-Hollis, 1978). Backeberg (1982) accommodated *O. spinulifera* in series *Piliferae* Backeb.

Out of these four species, *Opuntia streptacantha* (Figure 1) is the most easily separated. It is tree-like (up to 5 m tall at maturity) with greenish (not glaucous-green) obovate cladodes with a glabrous epidermis. Areoles are less closely spaced than in the other species (ca. 30 mm apart). Fruits are nearly always dark red (Bravo-Hollis, 1978; Scheinvar *et al.*, 2010).

Opuntia leucotricha (Figure 2 A-C) is readily distinguished based on the following characters: plant tree-like (3–5 m tall at maturity) with a definite trunk that is covered in up to 8 cm long, white-greyish hair-like spines, cladodes are greyish-green, oblong ca. 14–28 × 11–15 cm, with a distinctly velvety indumentum and areoles are not impressed, fruits are usually yellowish white (rarely purplish red) (Scheinvar, 1974; Bravo-Hollis, 1978; Walters *et al.*, 2011).



Figure 1. *Opuntia streptacantha*. Ayamonte, November 2018, E. Sánchez Gullón. A) Habit; B) Detail of stem segments; C) Detail of spination; D) Detail of fruit.

The application of the binomials *O. leucotricha* and *O. spinulifera* is somewhat controversial. In Mexico Scheinvar *et al.* (2009) only apply the name *O. leucotricha* to plants lacking the long, bristly ‘vestiture’

on fruit and trunk, whereas the others are treated as *O. spinulifera*. In the introduced area, however, for instance in southern Europe and South Africa, intermediate plants are found that do not fit that distinction (Walters *et al.*,

2011). Therefore the name *O. leucotricha* is now applied in a broader concept outside of its native range.

Opuntia spinulifera (as here delimited) (Figure 2 D-E) is a non-arborescent species rarely exceeding 1.5–2 m in height, with glaucous-green and glabrous, nearly orbicular cladodes that are often slightly retuse

at apex, 20–25 (or up to 40) cm in diameter. Areoles are distinctly sunken and dense (8–20 mm apart). Spines 1–2(–9), up to c. 15–20 mm long, thin, rigid, reflexed, whitish. Fruits are widely barrel-shaped or globose, c. 3 cm in diameter, yellow (Bravo-Hollis, 1978; Walters *et al.*, 2011).

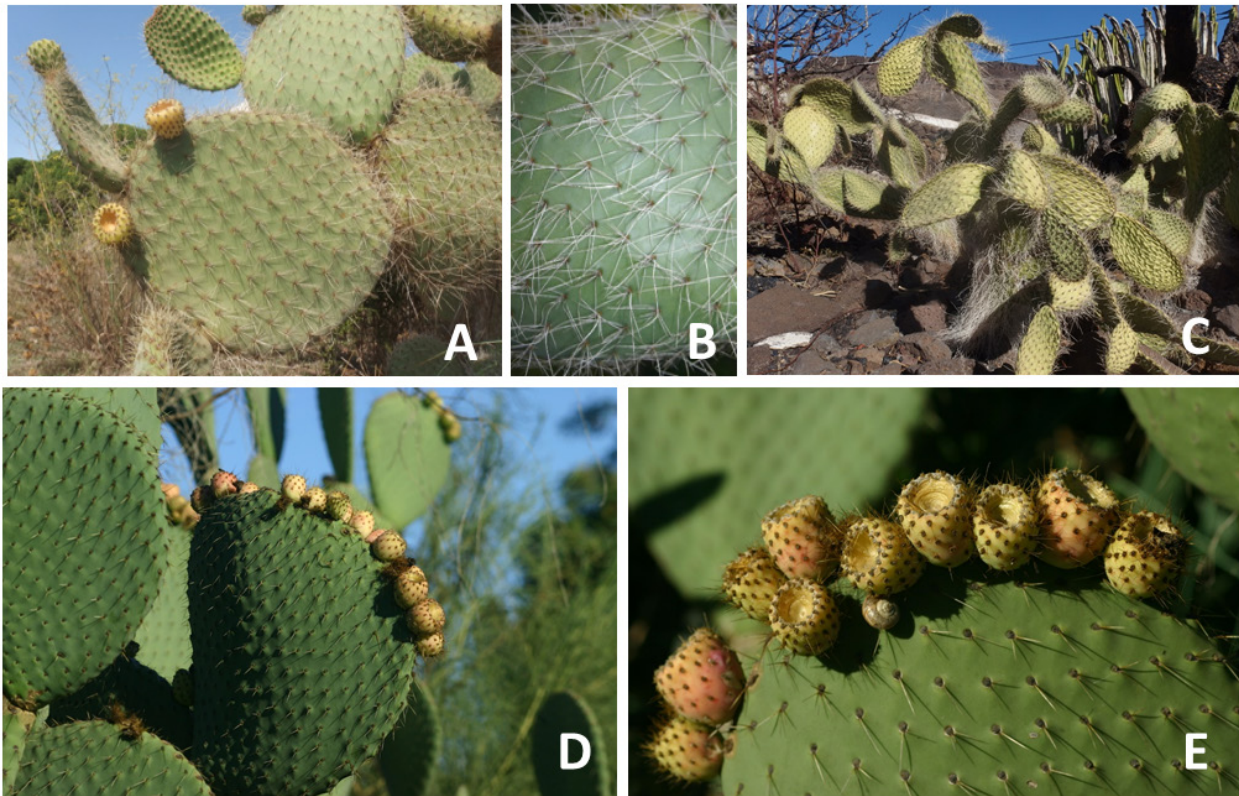


Figure 2. A-C) *Opuntia leucotricha*. D-E) *O. spinulifera*. Ayamonte, November 2018, E. Sánchez Gullón. A) Details of fruit and stem segments. Cambrils, September 2018, F. Verloove; B) Detail of spination. Huelva, April 2013, E. Sánchez Gullón; C) Characteristic long-bearded old stem. Santa Lucía de Tirajana, December 2017, F. Verloove; D) Detail of stem segments with characteristic almost orbicular pads; E) Detail of spination and fruits with typical depressed areoles.

Impressed areoles and nearly orbicular cladodes are very characteristic features of *O. spinulifera*. In the density of the areoles this species resembles *O. leucotricha*, but it has much wider cladodes, and lacks the velvety stem epidermis, as well as the trunk with long and flexuose, filiform spines.

The classification of Bravo-Hollis (1978) and Britton & Rose (1919–1923) is followed here in the application of this binomial. Some Mexican authors apply the name *O. spinulifera* for *O. leucotricha* plants with long, hair-like spines on fruit and trunk (Scheinvar, 1982; Scheinvar *et al.*, 2009). Scheinvar (1974) described *O. heliabravoana* Scheinvar this appears to be the same entity as *O. spinulifera*; and it is here treated as a synonym.

Opuntia huajuapensis is shrub- to almost tree-like (up to 2 m tall) with a more or less distinct trunk. Cladodes are obovate to orbicular, glaucous-green with slightly papillose epidermis. Areoles are ca. 20–30 mm apart, with long and abundant hairs. Spines are subulate, ascending

to reflexed and bright or dark yellow, 6–14 in number. Fruits are yellow (Bravo-Hollis, 1978, Arias *et al.*, 2012, Arreola-Nava *et al.*, 2017). A good photo of this species was presented by Bravo-Hollis l.c. (p. 318, figure 172). It has been suggested that perhaps this is just a yellow-flowered form of *O. pilifera* (Hunt *et al.*, 2006).

Key to the species

1. Plant arborescent, > 2 m high, normally with acrotonic branching; epidermis pubescent or glabrous; areoles not sunken; spines covering the entire cladode2
- 1.' Plant shrubby, < 2 m high, usually with basiton-ic branching; epidermis glabrous; areoles sunken, ca. 1–2 cm apart; spines absent or more numerous in the upper half of the cladode, sub-rigid, to 1.3 cm long; flowers with a yellowish to rose style, stigma lobes green *Opuntia spinulifera*
2. Epidermis pubescent3

- 2.' Epidermis not pubescent; cladodes 20-30 × 12-23 cm; areoles 3-3.5 cm apart with 1-2, short, bristle hairs; spines stiff, divergent, flattened at the base, whitish, 1-4, 1-3 cm long; flower with a white style, stigma lobes green *O. streptacantha*
3. Cladodes 14-28 × 11-15 cm; areoles to 1 cm apart; spines thin, very flexible, white, 1-3, to 3 cm long; flowers with a red style, stigma lobes green *O. leucotricha*
- 3.' Cladodes 35 × 28 cm; areoles 2-3 cm apart; spines subulate, somewhat flattened, white to yellowish, 3-5, to 4 cm long; flowers with a white style, stigma lobes whitish..... *O. huajuapensis*

Wild and introduced distribution of *Opuntia spinulifera* and *O. streptacantha*

Opuntia spinulifera was described from unsourced sterile material and long thought to be absent in the wild (Walters *et al.*, 2011). A type is missing and the species was considered to be of uncertain taxonomic status by Hunt *et al.* (2006). However, *O. heliabravoana* Scheinvar was described from wild populations in the northeastern part of Valle de Mexico (with type from Hidalgo) (Scheinvar, 1974) and this is now often believed to be conspecific with *O. spinulifera*. At present, it is known to occur naturally (or partly naturalized?) in Valle de Mexico in the states of Hidalgo, Mexico, Puebla and Tlaxcala (Scheinvar *et al.*, 2009).

It was introduced as ornamental to climatologically suitable areas elsewhere in the world, including Spain (Sánchez de Lorenzo Cáceres, 2000). Like many other opuntoids it was able to escape and naturalize. In South Africa it is a declared weed and a potential transformer species that invades savanna and grassland. It was first reported from Katrivier basin and more recently also from Bergville and Pietermaritzburg districts in Kwazulu-Natal (Walters *et al.*, 2011). In similar conditions it is known from Australia (Novoa *et al.*, 2015) and it is in the early stage of invasion in Namibia where it is spreading in the Windhoek townlands (Environmental Information Service Namibia, 2018). It also occurs as alien in Argentina and Brazil (Kiesling, 2005). In Europe it was introduced a long time ago already in the Hanbury Gardens on the Italian Riviera (Backeberg, 1982) from where it was able to escape. At present it is naturalized in scattered localities there, e.g. in Capo Nero, La Mortola and Bordighera (Guiggi, 2008; Galasso *et al.*, 2018). To

our knowledge and to date these were the only known feral populations in Europe.

Since 1989 its scattered presence was detected in coastal dune systems that are dominated by *Retama monosperma* Boiss. between Ayamonte and Punta del Moral (province of Huelva, Spain) (Sánchez Gullón *et al.*, 2014; sub *O. huajuapensis*). In this area *O. spinulifera* apparently was formerly planted as hedge plant for dividing private farms. As such it extends for about four kilometers next to the road H-9021. In this area individuals were able to escape and now form scattered wild populations in psammophilous vegetation. At present the species is considered a naturalized but non-invasive species in the following localities:

SPAIN, province of Huelva, Ayamonte, Avenida de la Playa at Isla Canela Golf, 37°11'41.62"N, 7°23'47.29"W, 6 m asl, several individuals over two kilometers, E. Sánchez Gullón obs.;

SPAIN, province of Huelva, Ayamonte, Avenida del Real, 37°11'20.71"N, 7°20'47.33"W, 4 m asl, a single individual, E. Sánchez Gullón obs.

Opuntia streptacantha is a very common species in the Mexican table-lands, especially in the deserts of San Luis Potosí (Britton & Rose, 1919-1923; Bravo-Hollis, 1978), where it is one of the most characteristic opuntias. It is also considered native in Guatemala where it is found in Sacatepequez, Chimaltenango and Quiché, at altitudes ranging between 1,600-2,500 m.a.s.l. (Véliz Pérez, 2008). It was formerly introduced to Australia where it has become an environmental weed in some states, for instance in New South Wales and Queensland (Novoa *et al.*, 2015; Sheehan *et al.*, 2017).

In Spain it has been known from a single locality in Ayamonte, where it was first referred to *O. huajuapensis* by one of us (ESG). A population of ca. 20-30 m² was detected in 2017 in degraded grassland with scattered *Retama* bushes and other cacti (*Austrocylindropuntia subulata*, *Opuntia ficus-indica*, etc.) in a vacant lot in a residential area:

SPAIN, province of Huelva, Ayamonte, angle of Calle Guatemala and Calle Ecuador, 37°13'17.59"N, 7°23'51.15"W, 41 m asl, E. Sánchez Gullón obs.

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References

- Arias, S., Gama-López, S., Ulises Guzmán-Cruz, L. & Vázquez-Benítez, B. 2012. Flora del Valle de Tehuacán-Cuicatlán. Fascículo 95. Cactaceae Juss. (2nd ed.). Inst. Biol. Univ. Nac. Aut. México: 1-235.
- Arreola-Nava, H.J., Cuevas-Guzmán, R., Guzmán-Hernández, L. & González-Durán, A. 2017. *Opuntia setocarpa*, una especie nueva de nopal del occidente de México. *Rev. Mex. Biodiv.* 88(4): 792-797. doi: 10.1016/j.rmb.2017.10.028.
- Backeberg, C. 1982. Einleitung und Beschreibung der Peireskioideae und Opuntioideae. Gustav Fischer Verlag, Stuttgart.
- Bravo-Hollis, H. 1954. Iconografía de las cactáceas mexicanas (tercera ser.). Cactáceas de las Mixtecas Altas. *An. Inst. Biol.* 25: 473-552.
- Bravo-Hollis, H. 1978. Las Cactáceas de México. Vol. 1. Univ. Nac. Aut. México, México.
- Britton, N.L. & Rose, J.N. 1919-1923. The Cactaceae, Vol. 1-4. Carnegie Inst. Publ. n. 248. 1083 pp.

- Galasso, G., Conti, F., Peruzzi, L., Ardenghi, N.M.G., Banfi, E., Celesti-Grappo, L., Albano, A., Alessandrini, A., Bacchetta, G., Ballelli, S., Bandini Mazzanti, M., Barberis, G., Bernardo, L., Blasi, C., Bouvet, D., Bovio, M., Cecchi, L., Del Guacchio, E., Domina, G., Fascetti, S., Gallo, L., Gubellini, L., Guiggi, A., Iamónico, D., Iberite, M., Jiménez-Mejías, P., Lattanzi, E., Marchetti, D., Martinetto, E., Masin, R.R., Medagli, P., Passalacqua, N.G., Peccenini, S., Pennesi, R., Pierini, B., Podda, L., Poldini, L., Prosser, F., Raimondo, F.M., Roma-Marzio, F., Rosati, L., Santangelo, A., Scoppola, A., Scortegagna, S., Selvaggi, A., Selvi, F., Soldano, A., Stinca, A., Wagensommer, R.P., Wilhalm, T. & Bartolucci, F. 2018. An updated checklist of the vascular flora alien to Italy. *Plant Biosyst.* 152: 556–592.
- Gómez Bellver, C., Álvarez, H., Nualart, N., Ibáñez, N., Sáez, L. & López-Pujol, J. 2019. New records of vascular plants alien in Catalonia (NE Iberian Peninsula). *Collect. Bot.* 38: e004. doi:10.3989/collectbot.2019.v38.004.
- Guiggi, A. 2008. Catalogo delle Cactaceae naturalizzate in Italia con osservazioni tassonomiche, nomenclaturali e corologiche. *Riv. Piem. St. Nat.* 29: 103–140.
- Hunt, D.R. 2011. *Opuntia*. In: Cullen, J., Knees, S.G., Cubey, H.S. (Eds.). *The European Garden Flora* (2nd edition), vol. 2. Pp. 315–317. Cambridge Univ. Press, Cambridge.
- Hunt, D.R., Taylor, N. & Charles, G. (Eds.) 2006. *The New Cactus Lexicon*. dh books, Milborne Port, England.
- Huxley, A.J. (Ed.) 1999. *The new Royal Horticultural Society dictionary of gardening*. R. Hort. Soc. (RHS), London.
- Kiesling, R. 2005. Cactales. In: Burkart, A & Bacigalupo, N.M. (Eds.). *Flora Ilustrada de Entre Ríos, Geraniales a Umbeliflorales, Parte IV, B*. Pp. 401–444. Inst. Nac. Tec. Agr. Col. Ci.
- Korotkova, N. & von Raab-Straube, E. 2017. Cactaceae. In: Euro+MedPlantbase - the information resource for Euro-Mediterranean plant diversity. <http://www.emplantbase.org/home.html>. Accessed on 18 October 2018.
- Novoa, A., Le Roux, J.J., Robertson, M.P., Wilson, J.R.U. & Richardson, D.M. 2015. Introduced and invasive cactus species: a global review. *AoB PLANTS* 7. doi:10.1093/aobpla/plu078.
- Pyke, S. 2008. Contribución al conocimiento de la flora alóctona catalana. *Collect. Bot.* 27: 95–104.
- Sánchez Gullón, E., Guillot Ortiz, D. & Lodé, J. 2014. Notas sobre cuatro cactáceas interesantes para la xenoflora española. *Acta Bot. Malacit.* 39: 242–245.
- Sánchez de Lorenzo Cáceres, J.M. 2000. Cactaceae. In: Sánchez de Lorenzo Cáceres, J.M. (Ed.). *Flora Ornamental Española*, vol. II Cactaceae-Cucurbitaceae. Pp. 11–148. Mundi-Prensa, Madrid.
- Sanz-Elorza, M., Dana Sánchez, E.D. & Sobrino Vesperinas, E. 2004. Sobre la presencia de cactáceas naturalizadas en la costa meridional de Cataluña. *An. Jard. Bot. Mad.* 61(1): 27–33.
- Sanz-Elorza, M., Dana Sánchez, E.D. & Sobrino Vesperinas, E. 2006. Further naturalised Cactaceae in northeastern Iberian Peninsula. *An. Jard. Bot. Mad.* 63(1): 7–11.
- Scheinvar, L. 1974. *Opuntia heliabravoana*, una especie nueva de Cactaceae. *An. Inst. Biol.* 45: 75–86.
- Scheinvar, L. 1982. Redescubrimiento de la *Opuntia spinulifera*. *An. Inst. Biol.* 47: 1–20.
- Scheinvar, L., Gallegos Vázquez, C., Olalde Parra, G. & Rodríguez Fuentes, A. 2010. *Opuntia* ser. *Streptacanthae* (Cactaceae) - neotypifications and taxonomic notes on four species. *Schumannia* 6: 277–296.
- Scheinvar, L., Olalde, G., Filardo, S. & Beckler, P. 2009. Diez Especies Mexicanas Productoras de Xoconostles: *Opuntia* spp. y *Cylindropuntia imbricada* (Cactaceae). *Univ. Nac. Aut. México, Univ. Aut. Est. Hidalgo. Univ. Aut. Metropolitana-Xochimilco*.
- Sheehan, M.R., Potter, S. & Rutherford, H. 2017. *Field Identification Guide: Austrocylindropuntia, Cylindropuntia and Opuntia species* (2nd edition). Dep. Prim. Ind. Reg. Dev., Perth.
- Véliz Pérez, M.E. 2008. *Las Cactáceas de Guatemala*. Univ. San Carlos de Guatemala, Guatemala. 129 pp.
- Verloove, F. & Guiggi, A. 2019. Further records of cacti (Cactaceae) from Tarragona province (Spain). *Haseltonia* 26: 23–35.
- Walters, M., Figueiredo, E., Crouch, N.R., Winter, P.J.D., Smith, G.F., Zimmermann, H.G. & Mashope, B.K. 2011. Naturalised and invasive succulents of southern Africa. *ABC Taxa* 11: 358 pp.

Websites

- Environmental Information Service Namibia 2018. *Opuntia spinulifera*. In: *Atlas in Namibia. Biodiversity monitoring in Namibia*. <http://www.the-eis.com/atlas/?q=node/7374>. Accessed on 18 October 2018.