Bradleya 29/2011
pages 73 – 78

South Africa's ongoing *Opuntia* Mill. (Cactaceae) problem: the case of *Opuntia microdasys* (Lehm.) Pfeiff.

Gideon F. Smith[1], Estrela Figueiredo[2], James S. Boatwright[3] and Neil R. Crouch[4]

[1] Office of the Chief Director: Biosystematics Research & Biodiversity Collections, South African National Biodiversity Institute, Private Bag X101, Pretoria, 0001 South Africa / H.G.W.J. Schweickerdt Herbarium, Department of Plant Science, University of Pretoria, Pretoria, 0002 South Africa and Centre for Functional Ecology, Departamento de Ciências da Vida, Universidade de Coimbra, 3001-455 Coimbra, Portugal (email: g.smith@sanbi.org.za).

[2] Department of Botany, P.O.Box 77000, Nelson Mandela Metropolitan University, Port Elizabeth, 6031 South Africa / Centre for Functional Ecology, Departamento de Ciências da Vida, Universidade de Coimbra, 3001-455 Coimbra, Portugal (email: estrelafigueiredo@hotmail.com).

[3] Compton Herbarium, South African National Biodiversity Institute, Private Bag X7, Claremont 7735, Cape Town, South Africa / Department of Botany and Plant Biotechnology, University of Johannesburg, P.O. Box 524, Auckland Park 2006, Johannesburg, South Africa (email: s.boatwright@sanbi.org.za).

[4] Ethnobotany Unit, South African National Biodiversity Institute, P.O. Box 52099, Berea Road, 4007 South Africa / School of Chemistry, University of KwaZulu-Natal, Durban, 4041, South Africa (email: n.crouch@sanbi.org.za).

Summary: The history of *Opuntia* Mill. in South Africa is well documented with invasive species of this genus having been controlled for many years. Despite these costly efforts some 12 species (13 taxa) of *Opuntia* are evidently persisting in a naturalised state and some are emerging as alien invasives. One such species is *Opuntia microdasys* (Lehm.) Pfeiff., which is already known from the Gauteng, and Western and Eastern Cape provinces. A description of the species in South Africa is provided, along with notes on its areas of occurrence and likely means of spread. A summary of the nomenclature of the genus *Opuntia* in South Africa is also provided, dating from 1976 to the present.

Zusammenfassung: Die Geschichte von *Opuntia* Mill. in Südafrika ist aufgrund von mehreren invasiven Arten, die seit vielen Jahren bekämpft werden, gut beaknnt. Trotz dieser kostenintensiven Anstrengungen persistieren 12 Arten (13 Taxa) von Opuntia als naturalisierte Pflanzen, und einige werden zunehmend als gefährliche invasive Unkräuter wahrgenommen. Eine dieser Arten ist *Opuntia microdasys* (Lehm.) Pfeiff., die bereits aus Gauten sowie den Provinzen Western Cape und Eastern Cape bekannt ist. Es wird eine Beschreibung der Art, wie sie in Südafrika vorkommt, gegeben, zusammen mit Bemerkungen über die Gebiete ihres Vorkommens und die wahrscheinlichen Ausbreitungswege. Zudem enthält der Beitrag eine Zusammenfassung der Nomenklatur der Gattung *Opuntia* in Südafrika ab dem Jahr 1976 bis heute.

Introduction

Over the past several years South Africa has awarded significant funding to the eradication of alien invasive plants, particularly through the Working for Water Programme (WfW) of the government (Van Wilgen *et al*., 2000). In addition, invasive plant eradication has also attracted the attention of policy-makers and politicians, including the then president of the country (Environment Writer, 2000). The control of alien organisms must indeed count as one of the biggest success stories of science advocacy in South Africa, as the WfW Programme has now been extended to cover several related issues, including Working on Fire (Anon., not dated; Preston, 2009).

The Cactaceae have contributed several invasive species that have transformed large areas of South Africa's natural landscape (Henderson, 1995). The largest number of such taxa in this near-endemic New World family issue from the genus *Opuntia* Mill. No fewer than 10 species of this predominantly Mexican and continental North American genus are currently listed as category 1 invaders in South Africa (Henderson, 2001).

These species were largely introduced for use as ornamentals or as sources of fodder or fruit (Henderson & Anderson, 1966; Brutsch & Zimmermann, 1993). The Cactaceae were treated for the *Flora of Southern Africa* project (Obermeyer, 1976), but this volume was published over 30 years ago, and the nomenclature of *Opuntia* and its constituent species have seen considerable changes since then. The treatment of the cactus family for the most recent approximation of the checklist of South African plants (Germishuizen *et al*., 2006) is now similarly outdated. At present 12 species (13 taxa) of *Opuntia* are accepted as occurring naturalised in the country (Walters *et al*., in press), which is the treatment followed here (Table 1). One species in particular, *O. ficus-indica* (L.) Mill., contributed extensively to rendering large parts of the arid karroid interior of South Africa virtually useless for agricultural purposes about 100 years ago. Although products derived from the species are widely used and consumed, even in its adopted country (see for example Zimmermann & Zimmermann, 1987; Velázquez, 1998), biological control has fortunately succeeded in largely ridding the landscape of *O. ficus-indica* (see e.g. Zimmermann *et al*., 2004). However, several other *Opuntia* species have since been recorded as becoming established in the country (Henderson, 1995; Hoffman *et al*., 1999). This paper reports on *Opuntia microdasys* (Lehm.) Pfeiff., which is here recorded from several parts of South Africa, where it has the potential to move from being naturalised to becoming, by definition (Colautti & MacIsaac, 2004; Pyšek *et al*., 2004), invasive. Unfortunately, this species is not known to be adversely affected by the larvae of the moth *Cactoblastis cactorum* (Soberon *et al*., 2001), the biocontrol agent which so spectacularly brought various cacti under control in, *inter alia,* South Africa and Australia. For the first time a description of the species as it occurs in South Africa is provided.

Opuntia microdasys as an emerging invasive plant

Opuntia microdasys is a favourite to cultivate, especially by beginner cactophiles; plants are accordingly distributed widely in cultivation throughout South Africa. It is exceedingly easy to propagate, especially from cuttings (Smith, 2006; Smith & Crouch, 2009). Pads detached at the joint or constriction between segments are simply placed erect in, or flat atop the soil where they are intended to grow. When so treated, these stem sections strike root easily, and grow rapidly into small to medium-sized clumps consisting of a dense network of oval-shaped to round pads. Such colonies have been observed near Graaff-Reinet in the Great Karoo (Figures 1 and 2), for example, where plants established after having seemingly been discarded from domestic gardens. Although popular amongst cactus growers the irritating glochids of this spineless species often prove as unpleasant, or more so, than the spines of many other cacti. Consequently, cultivated plants are often removed by gardeners and inappropriately disposed of through dumping. Long range seed dispersal is possibly effected by birds, in the same manner that *O. ficus-indica* in the Karoo is dispersed by crows (Dean & Milton, 2000). The red to purplish-red fruits – one-celled berries – of *O. microdasys* carry numerous small, black seeds embedded in the fleshy matrix and are eaten by birds that drop seeds in the veld. However, the role of sexual reproduction in the dispersal of *O. microdasys* in South Africa requires further investigation given that this species is reportedly fully self-incompatible (Piña *et al*., 2007) and that in any event, seedling recruitment of some opuntias can be be very poor (one seedling established per 3 million seeds produced by *O. rastrera* F.A.C.Weber in habitat) following vertebrate – including avian – frugivory (Montiel & Montaña, 2000). Further, in its Mexican habitat fruit abortion in *O. microdasys* is prevalent, although aborted fruits are able to root and produce new plants (Piña *et al*., 2007). Evans *et al*. (2004) considered the force needed to detach terminal stem segments of 15 opuntias and 10 cylindropuntias, and their propensity for subsequent establishment. They were able to demonstrate that those species with large numbers of stem segments along each stem rely mostly on sexual reproduction whilst those with fewer stem segments rely mostly on asexual reproduction via rooting of detached stem segments. These authors found *O. microdasys* to be adapted well to vegetative reproduction, with stem segments breaking off relatively easily and 85% of these establishing. In view of the above it is likely that in South Africa humans are presently the most effective current dispersal agent, of vegetative propagules in the form of stem segments.

Plants of *O. microdasys* remain shrub-like for many years, becoming miniature tree-like in appearance, although they never attain a height greater than 1 m. The pale green flattened pads are comparatively small and lack the rather long, prominent spines that most opuntias bear. However, the areoles carry a multitude of small, barbed glochids that are arranged in dense bundles over the entire surface of the stem segments. These glochids easily get stuck in clothing, skin, and the fur of animals. They are known to cause severe dermatitis and intense irritation of the eyes (Whiting & Bristow, 1975). Various

Figure 1. A dense clump of *O. microdasys* photographed near Graaff-Reinet in South Africa's Great Karoo. **Figure 2**. Close-up of the bright yellow flowers of *O. microdasys*, here taking on an orange hue as the flower ages. **Figure 3**. *O. microdasys* 'Albispina', a form with white glochids, has not become naturalised in South Africa. Picture taken of material in cultivation. Photos: Gideon F. Smith.

Table 1. Comparative nomenclature of the naturalised members of the genus *Opuntia* recorded in South Africa (1976–2011). The taxonomic treatment of *Opuntia* included in Walters *et al*. (in press; fourth column of this table) is followed here. This accounts for 12 presently accepted species (13 taxa).

Obermeyer (1976)	Germishuizen *et al.* (2006)	AGIS (2007)	Walters *et al.* (in press)
O. aurantiaca Lindl.	*O. aurantiaca* Lindl.	*O. aurantiaca* Lindl.	*O. aurantiaca* Lindl.
			O. elata Salm-Dyck var. *elata*
O. lindheimeri Engelm.	*O. lindheimeri* Engelm.	*O. engelmannii* Salm-Dyck ex Engelm.	*O. engelmannii* Salm-Dyck
O. ficus-indica (L.) Mill.	*O. ficus-indica* (L.) Mill.	*O. ficus-indica* (L.) Mill.	*O. ficus-indica* (L.) Mill.
O. vulgaris Mill.	*O. vulgaris* Mill.		
		O. humifusa (Raf.) Raf.	*O. humifusa* (Raf.) Raf.
			O. leucotricha DC.
	O. microdasys (Lehm.) Pfeiff.	*O. microdasys* (Lehm.) Pfeiff.	*O. microdasys* (Lehm.) Pfeiff.
		O. monacantha Haw.	*O. monacantha* Haw.
	O. robusta J.C.Wendl.	*O. robusta* J.C.Wendl.	*O. robusta* J.C.Wendl.
	O. salmiana Parm. ex Pfeiff.		*O. salmiana* Parm. ex Pfeiff.
O. spinulifera Salm-Dyck	*O. spinulifera* Salm-Dyck	*O. spinulifera* Salm-Dyck	*O. spinulifera* Salm-Dyck
O. dillenii (Ker Gawl.) Haw.			*O. stricta* (Haw.) Haw. var. *dillenii* (Ker Gawl.) L.D.Benson
O. stricta (Haw.) Haw.	*O. stricta* (Haw.) Haw.	*O. stricta* (Haw.) Haw.	*O. stricta* (Haw.) Haw. var. *stricta*
O. exaltata A.Berger	*O. exaltata* A.Berger	*O. exaltata* A.Berger	*Austrocylindropuntia subulata* (Muehlenpf.) Backeb.
		O. fulgida Engelm.	*Cylindropuntia fulgida* (Engelm.) F.M.Knuth
O. imbricata (Haw.) DC.	*O. imbricata* (Haw.) DC.	*O. imbricata* (Haw.) DC.	*Cylindropuntia imbricata* (Haw.) F.M.Knuth
	Cylindropuntia leptocaulis (DC.) F.M.Knuth		*Cylindropuntia leptocaulis* (DC.) F.M.Knuth
O. rosea DC.	*O. rosea* DC.		*Cylindropuntia pallida* (Rose) F.M.Knuth

horticultural forms are found with white, brown or yellow glochids (Smith & Van Wyk, 2008), but only the yellow form has so far become naturalized in South Africa (Figure 3).

Plants take many years to reach flowering maturity, after which delicate, bright yellow flowers are carried in the summer months.

Opuntia microdasys (Lehm.) Pfeiff. in *Enum. Diagn. Cact.*: 154 (1837). Borg: 82–83 (1963); Britton & Rose: 120–121; (1963); Backeberg: 368 (1977) [including "v. ***rufida*** K. Sch. (non Op. rufida Eng.)"]; Anderson: 508 (2001); Pinkava: 144 (2003); Hunt *et al*.: 206 (2006); Smith: 78 (2006); Walters *et al*.: (in press).
=*Cactus microdasys* Lehm. in *Index Sem.* (Hamburg): 16 (1827).
=*Opuntia macrocalyx* Griffiths in *Rep. (Annual) Missouri Bot. Gard.* **19**: 268–269, pl. 28 (1908).

Much-branched, shrubby succulent perennial, erect to spreading, in time becoming tree-like, up to 1.0 m tall. Stem segments (pads) pale green, brighter green when young, round to oval-shaped,

0.08–0.16 × 0.07–0.16 m. Areoles prominent, round, close-set. Needle-like spines usually absent, sometimes a single short one present on an areole. Glochids dense, fine, bristle-like, yellow, white or brown. Flowers 40 mm in diameter, petals to 40 mm long, yellow with a slight reddish tint towards the slightly frilly tips of the petals. Fruits 30–40 mm in diameter, fleshy, egg-shaped to globose, red to purplish-red, densely covered with areoles bearing dense clusters of glochids.

Common names: angel('s) wings (this is also a cultivar name, correctly as 'Angel Wings', specifically for a plant with white, unbarbed glochids that is not naturalised in South Africa); bunny ear(s) (cactus); bunny-ears prickly pear; polka dot cactus; Spanish: cegador; nopal cegador; nopalillo cegador (Anderson, 2001; Smith, 2006). 'Nopal cegador' means 'blinder cactus'. The reason for this name is that the glochids can be blown by the wind into the eyes of livestock, blinding them (Conrad, 2007).

Distribution in South Africa: The species has been recorded in the provinces of Gauteng, Western Cape and Eastern Cape (Germishuizen *et al*., 2006). Early citings are especially from the Prince Albert district where plants were spreading from unkept gardens at ruined homesteads (Milton & Dean, 1987). Other citings include Beaufort West, Calitzdorp, Colesberg, Dysselsdorp, Hopetown, Klipplaat, Laingsburg, Ladismith, Middelburg, Oudtshoorn, Rietbron and Schoemanspoort (Personal observations; Southern African Plant Invaders Atlas). It is here recorded in natural vegetation around the Great Karoo town of Graaff-Reinet. This town, which falls in the succulent-rich Albany Centre of Endemism, has been shown to be particularly vulnerable to infestations by several different species of *Opuntia* Mill., particularly *O. ficus-indica* and *O. aurantiaca* Lindl. (Van Wyk & Smith, 2001). Although many of the other *Opuntia* species in South Africa are declared category 1 invaders, *i.e.* prohibited on any land or water courses and must be controlled or eradicated where possible, *O. microdasys* has not yet been declared as an invader under any category (Henderson, 2001). This latter species is also present in at least one country neighbouring South Africa, Botswana (Tibe *et al*., 2008).

Origin: The species has a wide geographical distribution range in the Chihuahuan Desert of México, and has been recorded from Chihuahua, Coahuila, Durango, Guanajuato, Hidalgo, Jalisco, Nuevo León, Querétaro, San Luis Potosí, Tamaulipas, Zacatecas (Hunt *et al*., 2006).

Acknowledgements
Ms Lesley Henderson of the Plant Protection Research Institute of the Agricultural Research Council is thanked for making distribution data of *Opuntia microdasys* available from the Southern African Plant Invaders Atlas (SAPIA). Roy Mottram is thanked for his digital work on the figures.

References

AGIS. (2007). *Agricultural Geo-Referenced Information System*. Accessed from www.agis.agric.za on [26/08/2009].

ANDERSON, E.F. (2001). *The cactus family*. Timber Press, Portland, Oregon.

ANON. (Not dated). *The catastrophe of invasive species*. Working for Water Programme, Cape Town.

BACKEBERG, C. (1977). *Cactus lexicon. Enumeratio diagnostica Cactacearum*. Blandford Press, Poole, Dorset.

BORG, J. (1963). *Cacti. A gardener's handbook for their identification and cultivation*. [Reissue of the 3rd ed., first published in 1959.] Blandford Press, London.

BRITTON, N.L. & ROSE, J.N. (1963). *The Cactaceae. Descriptions and illustrations of plants of the cactus family*. Vol. 1. [Facsimile of the 1937 large paper 2nd ed.] Dover Publications, Inc., New York.

BRUTSCH, M.O. & ZIMMERMANN, H.G. (1993). The prickly pear (*Opuntia ficus-indica* [Cactaceae]) in South Africa: utilization of the naturalized weed, and of the cultivated plants. *Econ. Bot.* **47**: 154–162.

COLAUTTI, R.I. & MACISAAC, H.J. (2004). A neutral terminology to define 'invasive' species. *Divers. Distrib.* **10**: 135–141.

CONRAD, J. (2007). Three more cacti from below Camargo. *Jim Conrad's Naturalist Newsletter,* February 23, 2007. http://www.backyardnature.net/n/07/070223.htm [accessed on 28/8/2009].

DEAN, W.R.J. & MILTON, S.J. (2000). Directed dispersal of *Opuntia* species in the Karoo, South Africa: are crows the responsible agents? *J. Arid Environ.* **45**: 305–314.

ENVIRONMENT WRITER. (2000). Mbeki declares war on SA's alien plants. *The Cape Argus*, Friday, February 25, 2000: 4.

EVANS, L.S., IMSON, G.J., EUN KIM, J. & KAHN-JETTER, Z. (2004). Relationships between number of stem segments on longest stems, retention of terminal stem segments and establishment of detached terminal stem segments for 25 species of *Cylindropuntia* and *Opuntia* (Cactaceae). *J. Torrey Bot. Soc.* **131**: 195–203.

GERMISHUIZEN, G., MEYER, N.L., STEENKAMP, Y. & KEITH, M. (eds.) (2006). *A checklist of South African plants*. Southern African Botanical Diversity Network Report No. **41**. SABONET, Pretoria.

HENDERSON, L. (1995). *Plant invaders of southern Africa*. Plant Protection Research Institute, Agricultural Research Council, Pretoria.

HENDERSON, L. (2001). *Alien weeds and invasive plants*. Plant Protection Handbook No. 12. Paarl Printers, Cape Town.

HENDERSON, M. & ANDERSON, J.G. (1966). *Common weeds in South Africa*. Botanical Survey Memoir No. 37, BRI, Pretoria.

HOFFMAN, J.H., MORAN, V.C & ZIMMERMANN, H.G. (1999). Integrated management of *Opuntia stricta* (Haw.) Haw. (Cactaceae) in South Africa: an enhanced role for two, renowned, insect agents. *Afri. Ent. Mem.* **1**: 15–20.

HUNT, D., TAYLOR, N. & CHARLES, G. (eds.) (2006). *The new cactus lexicon*. dh books, Milborne Port, England.

MILTON, S.J. & DEAN, W.R.J. (1987). Cactus in the Karoo: a thorny problem. *Veld & Flora* **73**: 128–131.

MONTIEL, S. & MONTAÑA, C. (2000). Vertebrate frugivory and seed dispersal of a Chihuahuan Desert cactus. *Plant Ecol.* **146**: 221–229.

OBERMEYER, A.A. (1976). Cactaceae. In J.H. ROSS (ed.) *Flora of Southern Africa* **22**: 144–156. Botanical Research Institute, Pretoria.

PIÑA, H.H., MONTAÑA, C. & DEL CARMEN MANDUJANO, M. (2007). Fruit abortion in the Chihuahuan-Desert endemic cactus *Opuntia microdasys*. *Plant Ecol.* **193**: 305–313.

PINKAVA, D.J. (2003). Cactaceae. Cactus Family Part 6. *Opuntia* P.Miller. Prickly pears. *J. Arizona-Nevada Acad. Sci.* **35**: 137–150.

PRESTON, G. (2009). Alien invaders. *Afri. Geog.* [October 2009] **17**(9): 36–37.

PYŠEK, P., RICHARDSON, D.M., REJMÁNEK, M., WEBSTER, G.J., WILLIAMSON, M. & KIRSCHNER, J. (2004). Alien plants in checklists and floras: towards a better communication between taxonomists and ecologists. *Taxon* **53**: 131–143.

SMITH, G.F. (2006). *Cacti & succulents. A complete guide to species, cultivation and care*. Ball Publishing, Batavia, Illinois.

SMITH, G.F. & CROUCH, N.R. (2009). *Guide to succulents of southern Africa*. Struik Nature, Cape Town.

SMITH, G.F. & VAN WYK, B-E. [Ben-Erik] (2008). *Guide to garden succulents*. Briza Publications, Pretoria.

SOBERON, J., GOLUBOV, J. & SARUKHÁN, J. (2001). The importance of *Opuntia* in Mexico and routes of invasion and the impact of *Cactoblastis cactorum* (Lepidoptera: Pyralidae). *Florida Ent.* **84**: 486–492.

TIBE, O., MODISE, D.M. & MOGOTSI, K.K. (2008). Potential for domestication and commercialization of *Hoodia* and *Opuntia* species in Botswana. *Afri. J. Biotech.* **7**: 1199–1203.

VAN WILGEN, B.W., VAN DER HEYDEN, F., ZIMMERMANN, H., MAGADLELA, D. & WILLEMS, T. (2000). Big returns from small organisms: developing a strategy for the biological control of invasive alien plants in South Africa. *S. Afr. J. Sci.* **96**: 148–152.

VAN WYK, A.E. [Braam] & SMITH, G.F. (2001). *Regions of floristic endemism in southern Africa. A review with emphasis on succulents*. Umdaus Press, Hatfield.

VELASQUEZ, E. (1998). *El nopal y su historia*. Clío Libros y Videos, S.A. de C.V., Mexico City.

WALTERS, M., FIGUEIREDO, E., CROUCH, N.R., WINTER, P., SMITH, G.F., ZIMMERMANN, H.G., & MASHOPE, B.K. (In press). *Naturalised and invasive succulents of southern Africa*. ABC Taxa, Brussels.

WHITING, D.A. & BRISTOW, J.H. (1975). Dermatitis and keratoconjunctivitis caused by a prickly pear (*Opuntia microdasys*). *S. Afr. Med. J.* **49**: 1445–1448.

ZIMMERMANN, H.G., MORAN, V.C. & HOFFMANN, J.H. (2004). Biological control in the management of invasive alien plants in South Africa, and the role of the Working for Water programme. *S. Afr. J. Sci.* **100**: 34–40.

ZIMMERMANN, H.G. & ZIMMERMANN, H. (1987). B.1.2/1987 (reprinted 1989). A novel use of a declared weed. Young prickly-pear leaves [*Opuntia ficus-indica* (L.) Mill.] for human consumption. *Farming in South Africa*. Department of Agriculture and Water Supply, Pretoria.