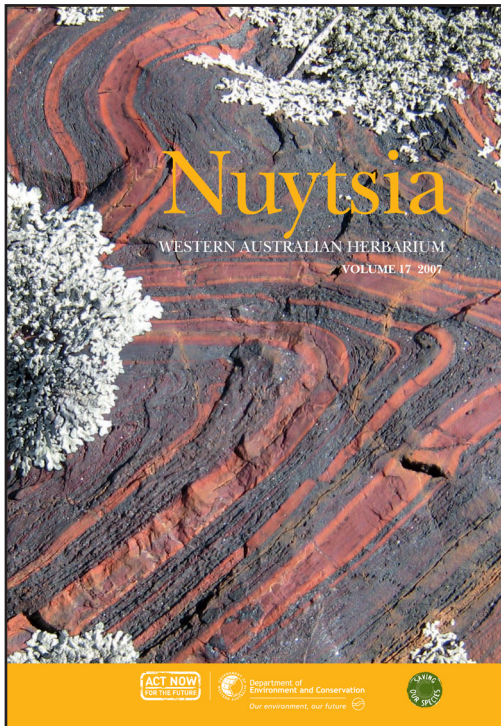


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***Tecticornia indefessa* (Chenopodiaceae: Salicornioideae), a new mat samphire (formerly *Tegicornia*) from north of Esperance, Western Australia**

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Abstract

Shepherd, K.A., *Tecticornia indefessa* (Chenopodiaceae: Salicornioideae), a new mat samphire (formerly *Tegicornia*) from north of Esperance, Western Australia. *Nuytsia* 17: 367–374 (2007). A taxon previously thought to be an intergeneric hybrid between an unknown species of the former genus *Halosarcia* Paul G.Wilson (now *Tecticornia* Hook.f.) and *Tegicornia uniflora* Paul G.Wilson (now *Tecticornia uniflora* (Paul G.Wilson) K.A.Sheph. & Paul G.Wilson) is recognised as a distinct species: *Tecticornia indefessa* K.A.Sheph. While sharing a similar mat-like habit and perianth structure to the dioecious *T. uniflora*, this taxon has bisexual or female flowers with distinctive seeds. Previous analysis of nuclear DNA sequences supports this taxon as distinct. Illustrations and maps and a revised description of *T. uniflora* are included.

Introduction

Recent phylogenetic analysis of nuclear DNA sequences has shown that *Tegicornia* Paul G.Wilson along with all other Australian samphires except *Sarcocornia* A.J.Scott, form a monophyletic group (Shepherd *et al.* 2004; Shepherd *et al.* 2005b). Consequently, the genera *Tegicornia*, *Halosarcia* Paul G.Wilson, *Pachycornia* Hook.f. and *Sclerostegia* Paul G.Wilson have been subsumed into a much expanded *Tecticornia* Hook.f. (Shepherd & Wilson 2007).

In his initial revision of the Australian Salicornioideae (Chenopodiaceae), Wilson (1980) recognised *Tegicornia* as a monotypic genus. The only representative of the genus, *Tegicornia uniflora* Paul G.Wilson (now *Tecticornia uniflora* (Paul G.Wilson) K.A.Sheph. & Paul G.Wilson), was considered unique as it is the only samphire which is dioecious. This taxon was further characterised by a distinct prostrate habit, having pairs of single flowers dispersed amongst vegetative articles and an obovate, dorsiventrally flattened perianth. Recent glasshouse studies have shown however, that under cultivation *T. uniflora* may produce spicate inflorescences comprised of 1–3-flowered cymes typical of other samphires (Shepherd 2004).

A mat samphire from near Truslove, north of Esperance, was also described by Wilson (1980) as a putative intergeneric hybrid between an unknown species of the former genus *Halosarcia* and the then *Tegicornia uniflora*. Plants from the Truslove population have the mat-like habit and unusual perianth shape typical of *Tecticornia uniflora*. However, they also produced small spicate inflorescences with

opposite pairs of 1–3-flowered cymes which had not been observed in *T. uniflora*. These plants have mostly hermaphroditic flowers, although towards the apex of some inflorescences the lateral flowers are female or sterile. Wilson (1980) suggested that, due to the sterility of flowers and the presence of immature seeds in combination with the presence of characters reminiscent of both *T. uniflora* and ‘a generalised species of *Halosarcia*’, that this taxon was of hybrid origin.

While hybridisation apparently readily occurs within the Salicornioideae (Dalby 1975; Wilson 1980; Castroviejo & Lago 1992; O’Callaghan 1992; Shepherd & Yan 2003), the Truslove taxon has a uniform population which has been sampled over a 28 year period. This taxon occupies a stable, undisturbed habitat, is apparently fertile and produces seed. Furthermore, as the closest population of one proposed parent *T. uniflora* is over 350 kilometres away, it was determined that this taxon was unlikely to be of hybrid origin. It was subsequently given the phrase name *Tegicornia* sp. Truslove (P.G. Wilson 11824C) in April 2003 (Western Australian Herbarium 1998–). While allied to *T. uniflora* in having a mat-like habit and distinctive obovate perianth, molecular sequence evidence shows that it is genetically distinct (Shepherd *et al.* 2004). The presence of hermaphrodite flowers and characteristic sculpturing of the seed coat also supports this taxon as unique, and it is therefore described as a new species herein.

Methods

This study is based on the examination of herbarium specimens lodged at the Western Australian Herbarium (PERTH). Floral characters were scored from fresh material, or material preserved in 70% ethanol. Inflorescence photographs were taken using a Nikon Digital Camera Head (DS-5M) mounted on a dissecting microscope using a DS Camera Control Unit (DS-L1). Seed images were obtained using an Environmental Scanning Electron Microscope (ESEM) (Danilastos 1993). Species distribution bioregions are based on Version 5.1 of the Interim Biogeographic Regionalisation for Australia (IBRA) categories (Thackway & Cresswell 1995; Environment Australia 2000) as modified on FloraBase (Western Australian Herbarium 1998–). Distribution maps were created using DIVA-GIS freeware Version 5.2.0.2 and show IBRA Version 6.1 regions (Department of the Environment and Water Resources 2007) with coordinates from collections lodged at PERTH. Precise localities are withheld due to conservation concerns. Terminology used to describe the inflorescence structure is outlined in Shepherd (2007).

Taxonomy

Tecticornia uniflora (Paul G. Wilson) K.A. Sheph. & Paul G. Wilson, *Aust. Syst. Bot.* 20:328. *Tegicornia uniflora* Paul G. Wilson, *Nuytsia* 3: 25 (1980). *Type*: Between Stirling Range and Porongurup Range, Western Australia, 30 October 1975, P.G. Wilson 11626, female plant (*holo*: PERTH 1149970!; *iso*: AD, BRI, CANB, K, MEL, NSW, NT).

Dioecious, *perennial* prostrate herb, 5–10 cm high to 0.5–1 m across. *Vegetative articles* obovoid or barrel-shaped to spherical, circular in cross section, glossy deep green and red, 1.5–5 mm long, 2–6 mm wide, apex rounded or truncate, margin entire. *Inflorescence* 3–7.5 mm long, 2–3.6 mm wide, of 1–3-flowered cymes forming a spike 2–3 nodes long, with a slightly undulating ellipsoidal outline, terminal to main or lateral branches, or flowers solitary and interspersed among vegetative articles. *Bracts* fused, barrel-shaped, convex in face view with the upper edge shallowly curved, concave in side view with the upper edge shallowly curved, outer face of bract not protruding, apex truncate to

acute, margins entire; not overlapping subtending bracts. *Flowers* dioecious, with the central floret larger than or more or less equal to lateral florets, exposed above subtending bracts, free from bracts, adjacent florets and opposite florets. *Perianth* fused, broadly obovate in the female, narrowly obovate in the male and dorsiventrally compressed, with both the adaxial and abaxial surfaces slightly ascending, apex truncate with the aperture at or just below the apex; lobes 3 with one small abaxial lobe inside two lateral lobes, margins entire. *Stamen* 1; the anther elliptic, 1–2 mm long, abaxial to the ovary. *Ovary* free from the stem cortex, style bifid, membranous. *Fruiting spikes* scarcely expanded, soft, membranous-papery, apical vegetative growth absent. *Fruitlets* partially exposed above subtending bracts, sunken in the stem, free from bracts, adjacent fruits and opposite fruits; fruiting perianth membranous-papery, not enclosing the seed, dehiscence not in the medial plane. *Pericarp* fused with the perianth, not enclosing the seed; style at fruiting stage absent, or present with the base thickened. *Seed* vertical and rotated to the left or right relative to the stem axis, ovate with a beak, 1.6–2 mm long, opaque, dark red-brown or black, with concentric fan-like porcate rows. *Embryo* curved, perisperm present. (Figure 1)

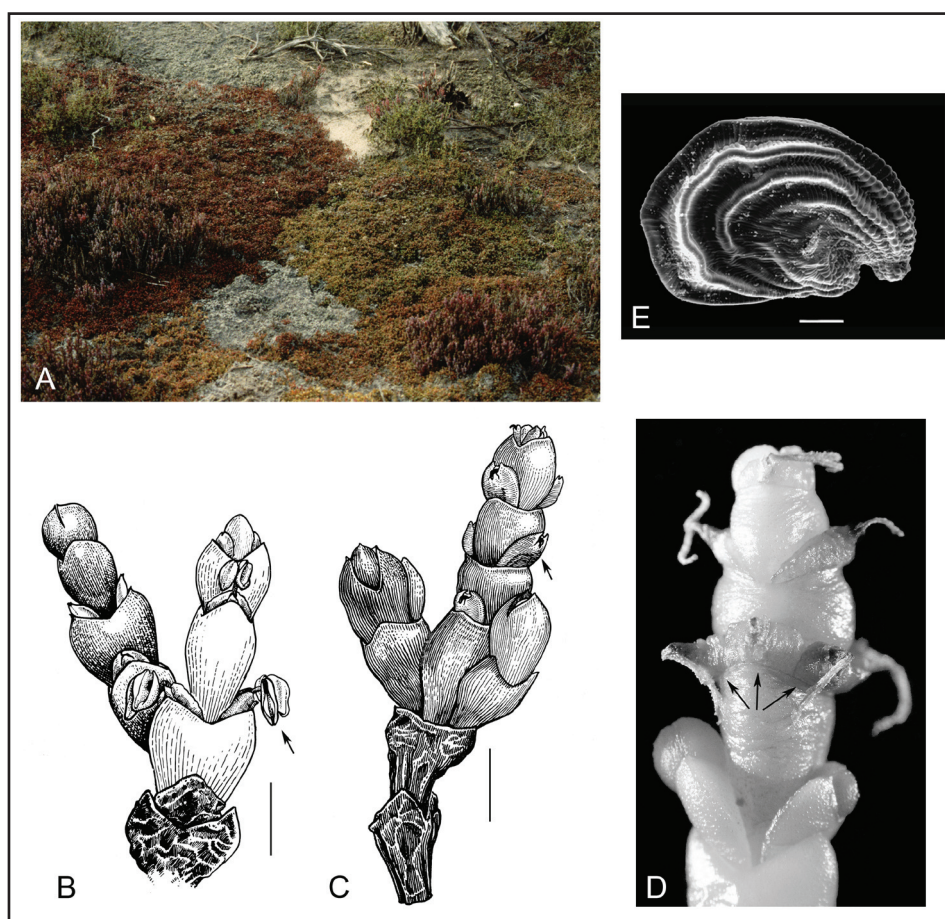


Figure 1. *Tecticornia uniflora*. A – distinct mat-like habit (K.A. Shepherd KAS 745 & J. English); B – solitary male florets in each bract; C – solitary female florets in each bract, showing the typical broad obovate perianth exposed above the subtending truncate bract; D – upright inflorescences may form when grown in cultivation, with arrows indicating a cluster of 3 female flowers (showing the exerted stigmas) (grown from seed collected from K.A. Shepherd KAS 748 & J. English); E – ESEM micrograph of a seed (K.A. Shepherd KAS 748 & J. English). Scale bars = 3 mm (B & C); 200 μ m (E). B & C adapted from Wilson (1980).

Specimens examined. WESTERN AUSTRALIA: [localities withheld]; 7 Apr. 2006, S. Barrett 1455 (PERTH 07434227); 14 Mar. 1989, M.S. Graham 069 (PERTH 1679600); 22 Jan. 2001, E. Hickman EJH 441 (PERTH 05846188); 14 Nov. 2002, E.M. Sandiford EMS 679 (PERTH 06787940); 4 May 2000, K.A. Shepherd KAS 745 & J. English (PERTH 07573200); 4 May 2000, K.A. Shepherd KAS 747 & J. English (PERTH 07573219); 4 May 2000, K.A. Shepherd KAS 748 & J. English (PERTH 07573235); 4 May 2000, K.A. Shepherd KAS 750 & J. English (PERTH 07573243); 4 May 2000, K.A. Shepherd KAS 751 & J. English (PERTH 07573227); 10 Nov. 1986, P.G. Wilson 12372 (PERTH 1153196).

Distribution. Found south of Newdegate to north of Mount Barker in the Esperance Plains, Jarrah Forest and Mallee regions of the South-West Botanical Province (Figure 2).

Habitat. This mat-like species grows in the low-lying flood zone around the margins of salt lakes in yellow or grey sandy clay (Figure 1A).

Phenology. Flowering from October to November.

Conservation status. *Tecticornia uniflora* is categorised as Priority Four under the Department of Environment and Conservation (DEC) Conservation Codes for Western Australian Flora (Atkins 2006), as it is restricted to a few isolated populations around the margins of salt lakes in the south-west of Western Australia.

Chromosome number. Diploid counts of $2n=18$ were previously published for this species under *Tecticornia uniflora* (Shepherd & Yan 2003).

Affinity. While *T. uniflora* remains the only dioecious Australian samphire, it is not as distinct as Wilson (1980) first thought. Nuclear DNA sequence analysis has shown that *T. uniflora* is related to *Tecticornia lylei* (Ewart & Jean White) K.A.Sheph. & Paul G.Wilson (as *Halosarcia lylei* (Ewart

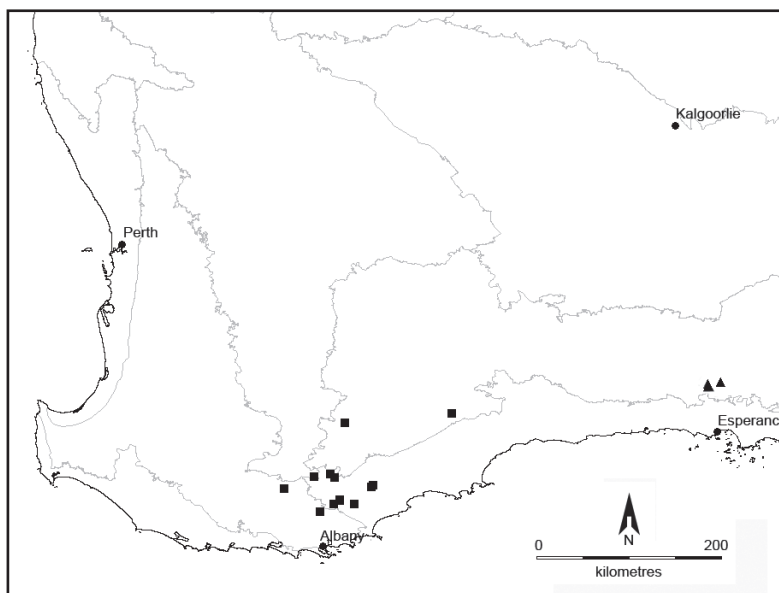


Figure 2. Distribution of *Tecticornia uniflora* (■) and *T. indefessa* (▲) in south-west Western Australia.

& Jean White) Paul G. Wilson, in Shepherd *et al.* 2004; Shepherd *et al.* 2005b). While this species is genetically similar to *T. lylei*, it is morphologically distinct from it. In appearance it is similar to *T. indefessa* but may be distinguished by a number of characters outlined under that species.

Notes. When grown in cultivation *T. uniflora* forms spicate inflorescences 2–3 nodes long, comprised of small 1–3-flowered cymes of male or female flowers (Figure 1D). The orientation of the seeds in this species is unusual and was described as ‘Type 5’ (Shepherd *et al.* 2005a) in which the seeds are orientated vertically but are rotated 90 degrees to the left or right.

Tecticornia indefessa K.A. Sheph., *sp. nov.*

Tecticorniae uniflorae (Paul G. Wilson) K.A. Sheph. & Paul G. Wilson affinis sed floribus hermaphroditis, articulis vegetativis acutis vel apiculatis, et sculptura in margine exteriori seminibus differt.

Typus: south-east of Truslove, Western Australia [precise locality withheld for conservation purposes], 15 January 1981, P.G. Wilson 11824 A (*holo:* PERTH 02493500; *iso:* CANB).

Halosarcia sp. x *Tecticornia uniflora* Paul G. Wilson, *Nuytsia* 3: 25 (1980).

Tecticornia sp. Truslove (Paul G. Wilson 11824 C), Western Australian Herbarium, in FloraBase <http://florabase.dec.wa.gov.au> [accessed 10 April 2007].

Bisexual or gynomonocious, *perennial* prostrate herb, 5–15 cm high to 0.5–2 m across. *Vegetative articles* obovoid or barrel-shaped to spherical, circular in cross section, glossy deep green and red, 3–6(–8) mm long and 2–6 mm wide, apex acute to shortly acuminate, margins entire. *Inflorescence* up to 9 mm long, 2–4.5 mm wide, of 1–3-flowered cymes forming a spike of 2–4 nodes, with a slightly undulating outline, terminal to main or lateral branches. *Bracts* fused, sometimes becoming free towards the apex of the inflorescence, barrel-shaped, convex in face view with the upper edge shallowly curved, concave in side view with the upper edge shallowly curved, outer face of bract not protruding, apex acute to shortly acuminate, margins entire; partially overlapping subtending bracts. *Flowers* bisexual or the lateral florets in the 3-flowered cyme female or sterile, with the central floret larger than or more or less equal to lateral florets, covered by the subtending bracts with only the apex exposed, free from bracts, adjacent florets and opposite florets. *Perianth* fused, broadly obovate and dorsiventrally compressed, with both the adaxial and abaxial surfaces slightly ascending, apex truncate with the aperture at or just below the apex; lobes 3 with one small abaxial lobe inside two lateral lobes, margins entire. *Stamen* 1; the anther elliptic, 1–2 mm long, abaxial to the ovary. *Ovary* free from the stem cortex, style bifid, membranous. *Fruiting spikes* scarcely expanded, soft, membranous-papery, apical vegetative growth absent. *Fruitlets* obscured or partially exposed above subtending bracts, sunken in the stem, free from bracts, adjacent fruits and opposite fruits; fruiting perianth membranous-papery, not enclosing the seed, dehiscence not in the medial plane. *Pericarp* fused with the perianth, not enclosing the seed; style at fruiting stage present with the base thickened. *Seed* vertical relative to the stem axis, ovate with a beak, 1.2–2 mm long, opaque, dark red-brown, with faint ribs on the outer margin, the sides smooth. *Embryo* curved, perisperm present. (Figure 3)

Specimens examined. WESTERN AUSTRALIA: [localities withheld] 6 Nov. 1978, R.J. Cranfield 1047 (PERTH 2493527); 18 Jan. 1978, G.J. Keighery 1829 (PERTH 02493462); 16 Jan. 1979, C.J. Robinson & J.M. Kochs n. (PERTH 02493535); 15 Jan. 1981, P.G. Wilson 11824 B (PERTH 02493470); 15 Jan. 1981,

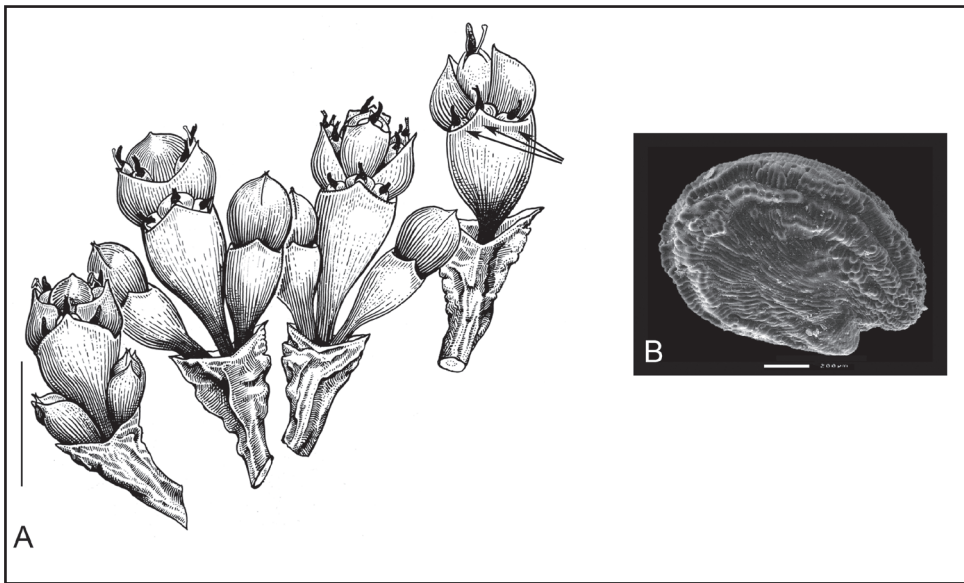


Figure 3. *Tecticornia indefessa*. A – upright inflorescences with arrows indicating a cluster of 3 hermaphrodite flowers above an acute, subtending bract (adapted from Wilson 1980); B – ESEM micrograph of a seed (G. Keighery s.n., 14 Oct. 2000). Scale bars = 5 mm (A); 200 μ m (B).

P.G. Wilson 11824 C (PERTH 02493489); 15 Jan. 1981, *P.G. Wilson* 11824 D (PERTH 02493497); 15 Jan. 1981, *P.G. Wilson* 11824 E (PERTH 02493519).

Distribution. Common around the margin of a salt lake in a conservation reserve north of Esperance, in the Mallee region of the South-West Botanical Province (Figure 2).

Habitat. In white to brown-grey sand near the edge of a salt lake.

Phenology. Flowering from September to October with fruits forming in December to January.

Conservation status. Recently listed as Priority Two under DEC Conservation Codes for Western Australian Flora, as although it is poorly known, a population occurs within a nature reserve.

Chromosome number. Unknown.

Etymology. The specific epithet is derived from the Latin *indefessus* (unworn, indefatigable), in recognition of the tireless work of Paul G. Wilson (1928–) who has contributed so much to the taxonomy of the Australia flora and who has freely shared his knowledge (and love) of the Australian samphires.

Affinity. This species is allied to *Tecticornia uniflora* in having a similar mat-like habit and flattened obovate perianth (in the female flowers of *T. uniflora*). It occurs approximately 350 km from the nearest known population of *T. uniflora* and is distinguished by having hermaphrodite (and sometimes female) flowers that are covered by subtending bracts which tend to have more acute rather than truncate apices (Figure 3A). The seeds of *T. indefessa* have sculpturing only on the outer margin of the seed coat rather than over the whole surface of the seed as in *T. uniflora* (Figure 3B).

Notes. Three collections (*G.J. Keighery & J.J. Alford* 1471 (PERTH 02493551), *K. Newbey* 7906 (PERTH 02493543) and *R. Hnatiuk* 761144 (PERTH 01153129)) from near the coast at Israelite Bay, have a distinctive prostrate habit similar to *T. indefessa* but with generally smaller vegetative articles which appear to have a dull rather than glossy surface. As two specimens are infertile and the third has immature flowers, this taxon cannot be identified with certainty and further collections are required to confirm its status.

The orientation of the seeds in *T. indefessa* is currently recorded as being vertical relative to the stem axis. This is based on a limited number of observations as there is a lack of material with mature seed available at PERTH. Further collections are required to confirm if the seeds are always vertical rather than having a 'Type 5' orientation (Shepherd *et al.* 2005a) as observed in *T. uniflora*.

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References

- Atkins, K.J. (2006). "Declared Rare and Priority Flora list for Western Australia." (Department of Environment and Conservation: Kensington, Western Australia.)
- Castroviejo, S. & Lago, E. (1992). Datos acerca de la hibridación en el género *Sarcocornia* (Chenopodiaceae). *Anales Jardín Botánico de Madrid* 50(2): 163–170.
- Dalby, D. (1975). *Salicornia* L. In: C.A. Stace (Ed.) "Hybridization and the flora of the British Isles." pp. 186–188. (Academic Press: London.)
- Danilastos, G.D. (1993). Microscopy research and technique. In: J.E. Johnson Jnr (Ed.) "Introduction to the environmental scanning electron microscope instrument." pp. 354–361. (Wiley-Liss Inc.: New York.)
- Department of the Environment and Water Resources (2007). IBRA Version 6.1. <http://www.environment.gov.au/parks/nrs/ibra/version6-1/index.html>. Updated 6th February 2007. [accessed 30 March 2007]
- Environment Australia (2000). Revision of the Interim Biogeographic Regionalisation for Australia (IBRA) and Development of Version 5.1 - Summary Report. <http://www.environment.gov.au/parks/nrs/ibra/version5-1/summary-report/index.html> [accessed May 2007].
- O'Callaghan, M. (1992). The ecology and identification of the southern African Salicornieae (Chenopodiaceae). *South African Journal of Botany* 58: 430–439.
- Shepherd, K.A. (2004). A systematic analysis of the Australian Salicornioideae (Chenopodiaceae). PhD Thesis. The University of Western Australia.
- Shepherd, K.A. (2007). Three new species of *Tecticornia* (formerly *Halosarcia*) (Chenopodiaceae: Salicornioideae) from the Eremaean Botanical Province, Western Australia. *Nuytsia* 17: 353–366.
- Shepherd, K.A., Colmer, T.D. & Macfarlane, T.D. (2005a). Morphology, anatomy and histochemistry of fruits and seeds of the Salicornioideae (Chenopodiaceae). *Annals of Botany* 95: 917–933.
- Shepherd, K.A., Macfarlane, T.D. & Waycott, M. (2005b). Phylogenetic analysis of the Australian Salicornioideae (Chenopodiaceae) based on morphology and nuclear DNA. *Australian Systematic Botany* 18(1): 89–115.

- Shepherd, K.A., Waycott, M. & Calladine, A. (2004). Radiation of the Australian Salicornioideae (Chenopodiaceae) – based on evidence from Nuclear and Chloroplast DNA sequences. *American Journal of Botany* 91(9): 1387–1397.
- Shepherd, K.A. & Wilson, P.G. (2007). Incorporation of the Australian genera *Halosarcia*, *Pachycornia*, *Sclerostegia* and *Tegicornia* into *Tecticornia* (Salicornioideae, Chenopodiaceae). *Australian Systematic Botany* 20(1): 319–339.
- Shepherd, K.A. & Yan, G. (2003). Chromosome numbers and size variations in the Australian Salicornioideae (Chenopodiaceae) – evidence of polyploidisation. *Australian Journal of Botany* 51(4): 441–452.
- Thackway, R. & Cresswell, I.D. (1995). An interim biogeographic regionalisation for Australia: a framework for setting priorities in the National Reserves System Cooperative Program, Version 4. Australian Nature Conservation Agency, Canberra.
- Wilson, P. G. (1980). A revision of the Australian species of Salicornieae (Chenopodiaceae). *Nuytsia* 3(1): 1–154.
- Western Australian Herbarium (1998–). FloraBase – The Western Australian Flora. Department of Environment and Conservation. <http://florabase.dec.wa.gov.au/> [accessed April 2007]