# A taxonomic revision of the genus Tecticornia (Chenopodiaceae)

By P. G. Wilson

**Abstract**

An account is given of the genus *Tecticornia* and of its relationship to other genera. Two species are described as new; they are *T. verrucosa* and *T. arborea*. The third species is provided with a new combination as *T. australasica* (based on *Halocnemum australasicum* Moq.). The nomenclatural confusion which has surrounded this name is outlined.

## Introduction

The genus *Tecticornia* is a member of the tribe *Salicornieae* in the family *Chenopodiaceae*. This tribe contains those succulent chenopod genera with apparently jointed, leafless stems and usually spike-like inflorescences.

The delimitation of genera within this tribe is notoriously difficult and, as far as Australian plants are concerned, the available generic names have been somewhat haphazardly applied by different authors. From this confusion the genus *Tecticornia* does stand apart, for it has, since its inception, been recognised as being a taxon distinct from the other members of the Australian *Salicornieae*. This recognition has persisted in spite of the fact that descriptions of its supposedly diagnostic characters which have been provided by various authors, are so general as to encompass several genera, or so incorrect as to render them useless. These errors are nevertheless understandable for the earlier workers had only dried material for examination, and for an adequate study of the plants in the flowering stage fresh or pickled material is essential. Fortunately, through the efforts of several workers mentioned in the acknowledgements, this material has been made available.

## Systematic Notes

The genus *Tecticornia* was placed by Ulbrich (1934) along with *Halostachys* and *Halocnemum* in the subtribe *Halostachinae* of the tribe *Salicornieae*. This systematic arrangement was based on the presence in all three genera of free opposite and decussate bracts, a character not in this case of phylogenetic significance, for in habit, and in perianth and seed morphology, *Tecticornia* is quite different from the other two.

Free opposite bracts are also found consistently in several Australian species of *Arthrocnemum*, and a state of transition from free to united bracts may be found in other species of that genus. This character cannot therefore be used by itself to separate the subtribes or genera of the *Salicornieae* found in Australia.

The characters which, when taken together, serve to distinguish the genus *Tecticornia* from other Australian members of the tribe are: (1) the free opposite and decussate bracts which have fleshy upturned outer margins; (2) the pair of laterally placed tepals that are eventually free from each other and from the surrounding bracts; and (3) the disintegration of the spike, when mature, into its separate components of bracts, tepals, pericarp, and seed. All *Tecticornia* species are annuals or short-lived perennials (while in other Australian genera the species are either long-lived perennials or shrubs), and all have glaucous, cylindrical articles.

### Distribution and Habitat

All of the three known species of *Tecticornia* are native to Australia. Two are endemic there while the third (*T. australasica*) is found also in Java and New Guinea. They are entirely tropical or sub-tropical in distribution (north of latitude 27°S) except for a single record of *T. verrucosa* from south of latitude 33°.

Two species, *T. australasica* and *T. verrucosa*, grow along the coast in mudflats above the normal diurnal tidal level. Germination of the seed under these conditions appears to be dependent upon the seasonal rain leaching the salt from the upper soil layers. *T. arborea* has been collected a few miles from the sea on claypans but it is not found directly on the coast. Both this species and *T. verrucosa* also occur far inland where they form monospecific stands on non-saline claypans, or, in the case of *T. verrucosa*, also on moderately saline flats. None of the species occurs around the inland salt-lakes where other members of the *Salicornieae* are so common.

### Aboriginal Use

The seeds of both *T. verrucosa* and of *T. arborea* were at one time used by Aborigines as food. Further notes on this subject appear under these two species.

## TECTICORNIA Hook. f.

Hook.f. in Benth. et Hook.f., Gen. Pl. 3:65 (1880); Black, Trans. Roy. Soc. S. Austral. 43:366. tab. 37 (1919); Ulbrich in Engler et Prantl, Nat. Pflanzenfam. ed. 2. 16c:548 (1934); Backer in van Steenis, Fl. Males. ser. 1. 4:103 (1949).

Annual or short-lived *perennial*, herbaceous to suffruticose, apparently leafless plants. *Branches* apparently jointed and succulent due to the opposite leaves enveloping the stem in a cylindrical sheath; leaf-blade minute or absent. *Inflorescence* of terminal and lateral spike-like cymes consisting of 3(5) flowers in the axils of opposite and decussate rows of free (or almost free) bracts. *Bracts* closely imbricate, standing vertical to spike axis, broadly deltoid to semicircular, the outer margin fleshy with an upturned rim. *Flowers* hermaphrodite, concealed within bracts and standing vertical to spike axis, free or at first loosely united to upper bract and to each other; *perianth* succulent, of two laterally placed, plano-convex tepals which are free or slightly united along lower margin towards base, the flat sides pressed together and enclosing the ovary; *stamen* solitary, abaxial; *ovary* thin-walled; *style* slender, weak, with a pair of filiform stigmas. *Fruiting perianth*: tepals completely free and, when dry, areolate and hyaline. Utricle obovoid, with membraneous pericarp. *Seed* erect, endospermous; testa thinly coriaceous; embryo on upper (adaxial) side, slender, curved; radicle inferior; seed dispersed on the drying and subsequent complete disintegration of the spike, perianth, and pericarp.

*Type species: T. cinerea* (F. Muell.) Baill. [ = *T. australasica* (Moq.) P. G. Wils.].

Origin of name: From the Greek words *tectum*, a roof, and *cornu* a horn. Presumably alluding to the manner in which the outer margin of the bracts forms a covering to the spike. Probably also to emphasize a relationship with the genus *Salicornia*.

### Key to Species

1. Spikes predominantly terminal; seed ovate with flat sides, shortly aculeate along upper margin **1. T. australasica**
1. Spikes lateral, or both terminal and lateral; seed neither flat nor aculeate.
   2. Spikes lateral, sessile and decussate; seed ± plano-convex, verruculose **2. T. verrucosa**
   2. Spikes terminal and lateral (but not sessile); seed bluntly ellipsoidal, smooth **3. T. arborea**

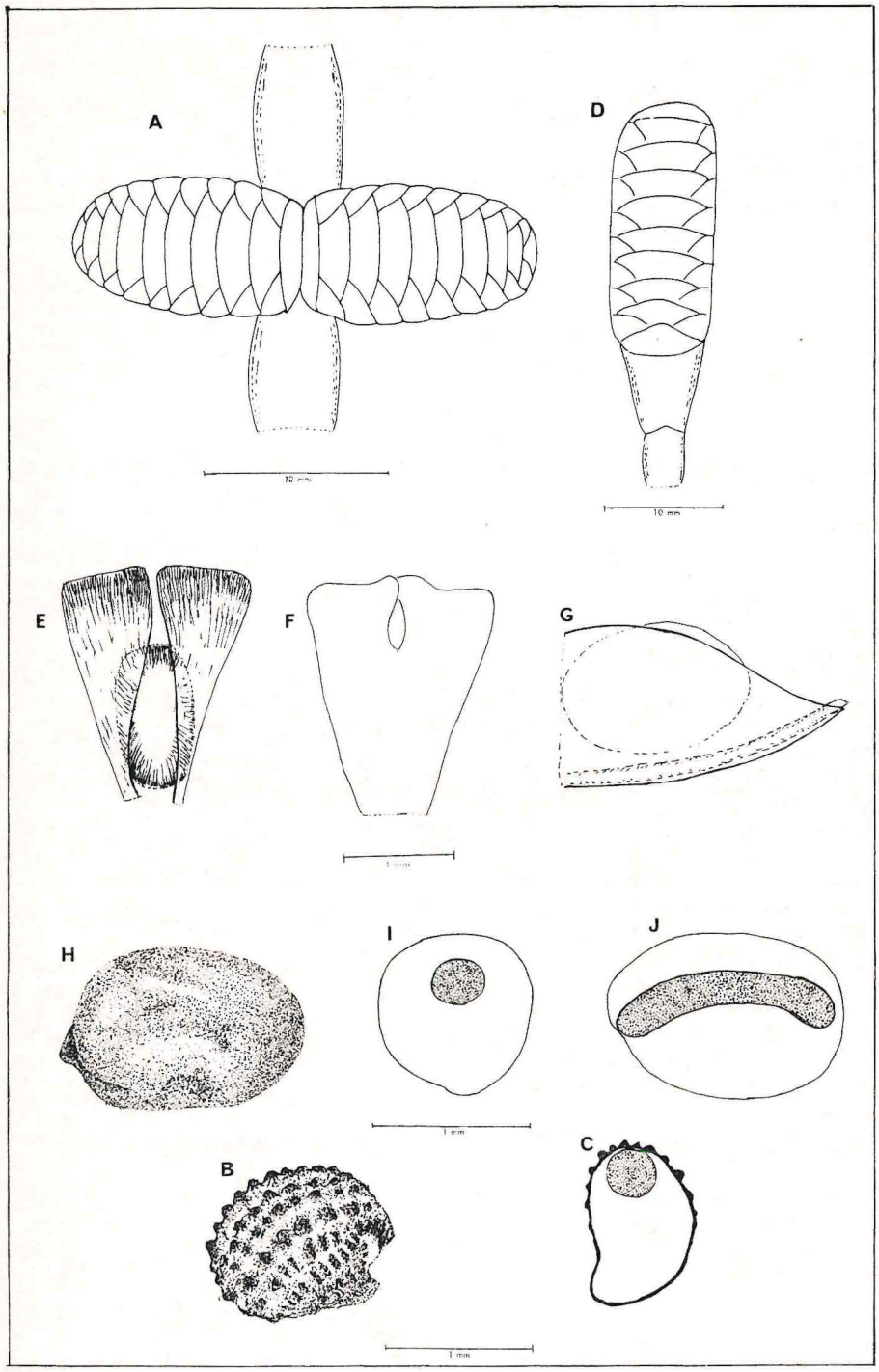


Figure 1—*Tecticornia verrucosa:* A, spike; B, seed; C, T.S. of seed. *Tecticornia arborea:* D, spike; E, flower from above, F from below, and G from side; H, seed; I, T.S. of seed; J, L.S. of seed.

(A–C from Maconochie 1036; D–G from Wilson 8577; H–J from Aplin B20).

## 1. **Tecticornia australasica** (Moq.) P. G. Wilson comb. nov.

*Halocnemum australasicum* Moq., Chenop. Enum. 110 (1840).—*Arthrocnemum australasicum* (Moq.) Moss apud Adamson, J. South Afr. Bot. 20:19 (1954), as to combination only.—*Salicornia australasica* (Moq.) Eichler, Taxon 12:296 (1963), as to combination only.—*Type:* " In nova Hollandia " (holo: P, photo seen, labelled " Nouv. Hollande—Port de Georges "). *H. cinereum* F. Muell., Fragm. 1:140 (1859).—*Salicornia cinerea* (F. Muell.) F. Muell. ex Benth., Fl. Austral. 5:203 (1870).—*Tecticornia cinerea* (F. Muell.) Baillon, Hist. Pl. 9:185 (1887).—*Type:* " In locis salinis terrae Arnhem's Land et Australiae centralis " (syn: " Sturt's Creek, Central Australia ", *F. Mueller*, MEL 36057 and 36058; " Point Pearce and Sturt's Creek ", *F. Mueller*, K, n.v., compared by D. J. McGillivray).

Succulent herbaceous to suffruticose *annual*, 12–40 cm high. Lower *branches* frequently procumbent, upper ones erect; internodes narrowly cylindrical, 7-15 mm long, bluish green and glaucous, apex shortly bilobed with a broad scarious margin. *Spikes* predominantly terminal (occasionally also lateral, in which case they are sessile and at right angles to stem), narrowly ovoid and ca. 1 cm long to narrowly cylindrical and up to 4 cm long, 5–7 mm diam. *Bracts* semicircular in shape. *Flowers* 3-5 in each bract (the lateral flowers sometimes sterile), ca. 2·5 mm long, at first fused with upper bract near base, otherwise free. *Tepals* laterally appressed, obovoid, acute, plano-convex in transverse section, at first united below (abaxially) towards base, otherwise free. *Staminal filament* slender, weak; anther oblong-cordate, ca. 1 mm long. *Seed* ovately discoidal, ca. 1·5 mm long; testa dark brown to black with about 10 indefinite rows of small, grey, translucent and aculeate tubercles along upper margin, the lower margin sparsely aculeate and the sides almost smooth. (Figure 2,4.)

*Distribution:* Coastal tropical Queensland and the Northern Territory (and Western Australia?), Java and New Guinea. (Figure 7.)

*Northern Territory:* Fog Bay 12° 48′ S, 130° 21′ E, *S. T. Blake* 16764 (BRI); Coast, 5 mi N of Finnis R., *N. Byrnes* 1686 (NT); Port Darwin, *Holtze* 355 (MEL); 21·8 mi NW of Mountnorris Bay, *G. Chippendale* 8168 (NT); East Alligator R., *N. Byrnes* 918 (NT); Oenpelli, 12° 18′ S, 133° 4′ E, *R. L. Specht* 1182 (BRI).

*Queensland:* Karumba, Burke Dist. *G. W. Trapnell* 200 (BRI); Cape York, *B. Hyland* 2507 (BRI); Trinity Bay, *W. Hill* 3 (MEL); Townsville, *N. Michael* 474 (BRI); Giru, 19° 31′ S, 147° 6′ E, Nov. 1968, *J. Burry* (BRI); Caley Valley via Bowen, 11 Nov. 1959, *H. J. Lavery* (BRI).

*New Guinea:* Terr. of Papua: 8 mi N of Kapa Kapa, *R. Schodde* 2736 (BRI); 7 mi NW of Hisiu village, *P. J. Darbyshire* 892 (BRI). West Irian: Merauke, *H. S. McKee* 1703 (NSW).

*Ecology :* Found on mudflats in coastal or near coastal situations, sometimes in association with mangroves. Mr. N. Byrnes has supplied the following notes which are derived from his personal observations: " The plant is an annual, germinating at the end of the ' wet '. It seldom grows much larger than 18 in. though some clumps can be dense. It varies between slightly procumbent to almost prostrate and begins to flower in August. It is normally found on the salt pans at the back of the mangroves along tidal creeks in pure communities or associated with *Arthrocnemum* sp.".

Apparently it is not able to withstand strongly saline conditions but grows well in coastal flats seasonally inundated by fresh water.

*Notes:* The taxonomy of this species has been confused due to the poor material the earlier workers had available to them and also to the fact that the short description of *Halocnemum australasicum* provided by Moquin was insufficient for the name to be used subsequently with any certainty. J. D. Hooker (1880) equated the name with *Salicornia quinqueflora* Bunge ex Ung.-Sternb. but did not make any formal transfer. This synonymy was also accepted by C. E. Moss (1954) who considered the species to belong to the genus *Arthrocnemum* and made the necessary new combination. Moss typified the species by a collection made by Robert Brown (" no. 3080 " at BM), supposedly in the

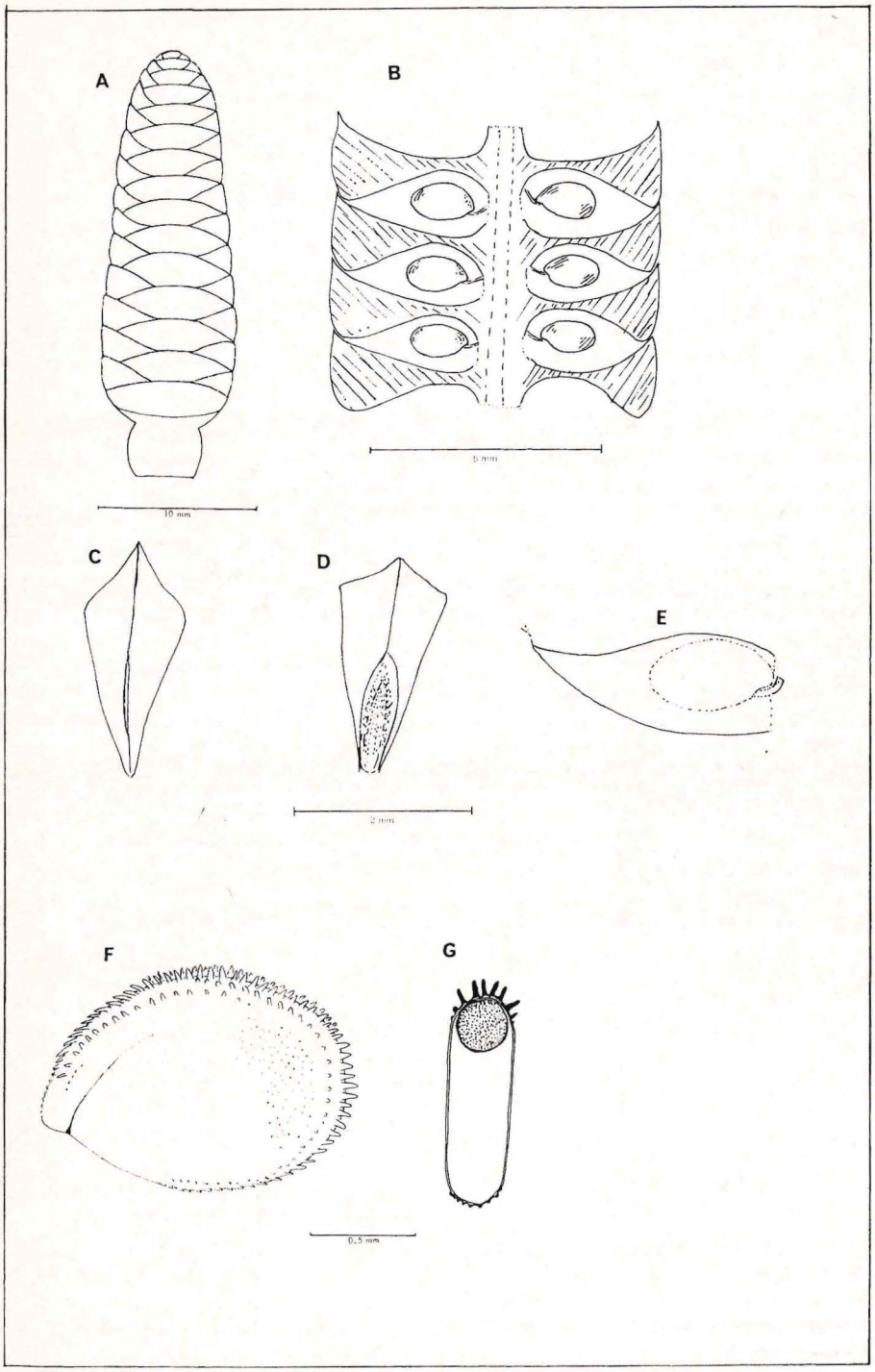


Figure 2—*Tecticornia australasica:* A, spike; B, L.S. of spike; C, flower from below, D from above, and E from side; F, seed; G, T.S. of seed. (A–E from Byrnes 1950; F–G from J. Burry, Qld.).

East Indies, and applied the name to a South African plant which was later described by H. R. Tölken (1967) as a new species, *Arthrocnemum decumbens*. A similar typification was accepted by Hj. Eichler (1963) who transferred *H. australasicum* to *Salicornia* and placed in synonymy under it *S. australis* Solander ex Bentham (1870).

The course followed by Eichler relied on the assumption that the names *H. australasicum* Moq. and *S. australis* Benth. were both based on *S. indica* [non Willd.] R. Br. (since the last name was cited by Moquin and Bentham in synonymy under their respective species), and therefore that Bentham's name was a synonym of Moquin's. The citation provided by Moquin was as follows: " *Salicornia Indica* R. Brown. Prodr. nov. Holl. 1. p.411 *?* non Willd. (v.s. in herb. Mus. Paris) ". This would appear to state that Moquin considered it possible that the plant described by R. Brown under the name " S. indica Willd." was in fact the same as his own species, *i.e.* as *H. australasicum*. Moquin had not, however, seen R. Brown's material, nor did he cite it. *H. australasicum* must therefore be typified by the specimen in Paris which Moquin had studied and which he had also used to draw up his description.

J. M. Black (1921) attempted to resolve the identity of this type specimen and published a description of the spike and seed from notes provided for him by Prof. Lecomte in Paris. Here Black assumed that it was probably related to *Arthrocnemum lylei* (Ewart et White) Black, which assumption was accepted and supported by Tölken (1967). The fact that Black was also unable to apply the name satisfactorily was partly due to the still inadequate description and partly to the confusion of localities. In his original paper of 1840 Moquin gave as the plant's origin only " In novâ Hollandia ". Subsequently (1849) he added " ad portum Georgii ", which was interpreted by both Bentham and Black as being King George Sound, a locality on the south coast of Western Australia. A photograph of the type of *H. australasicum* shows that it consists of two portions of stem, one of which has a short lateral branch attached. Fortunately the actual specimen had previously been studied by Dr. L. A. S. Johnson who recognised it as being conspecific with *Tecticornia cinerea*. Mr. J. Carrick, while working in Europe as the Australian Botanical Liaison Officer, compared the seed with that obtained from a recent collection of the species and found them to be the same.

The locality given by Moquin, and which also appears on the herbarium label as " Port de Georges ", is therefore either an error (as the species is tropical in distribution), or the name refers to a place other than King George Sound.

The only collection recorded from an inland situation was that made by F. von Mueller in 1856 along Sturt Creek, which is in the north-east of Western Australia. I have seen one other collection of a *Tecticornia* from this area ; this was made by Dr. J. S. Beard in 1968 at Lake Doman (approximately 70 km west of the southern end of Sturt Creek) and is of *T. verrucosa*. Although *T. verrucosa* has been confused with *T. australasica*, all of Mueller's specimens belong in fact to the latter species. These collections constitute therefore the only inland record for *T. australasica* (if the locality data are correct), and also the only record for Western Australia.

The application of the name *Salicornia australis* Sol. ex Benth. (1870) depends on its lectotypification. Solander applied the name (in manuscript) to a specimen collected by J. G. and J. R. Forster in New Zealand. This specimen was also referred to by Bentham and, if made the lectotype, the name would probably become a synonym of *S. quinqueflora* Ung.-Sternb. (1866).

The combination " *Tecticornia cinerea* " has been variously attributed to J. D. Hooker (1880), F. M. Bailey (1901), and J. M. Black (1919). Hooker never in fact published the combination and the first person to do so was

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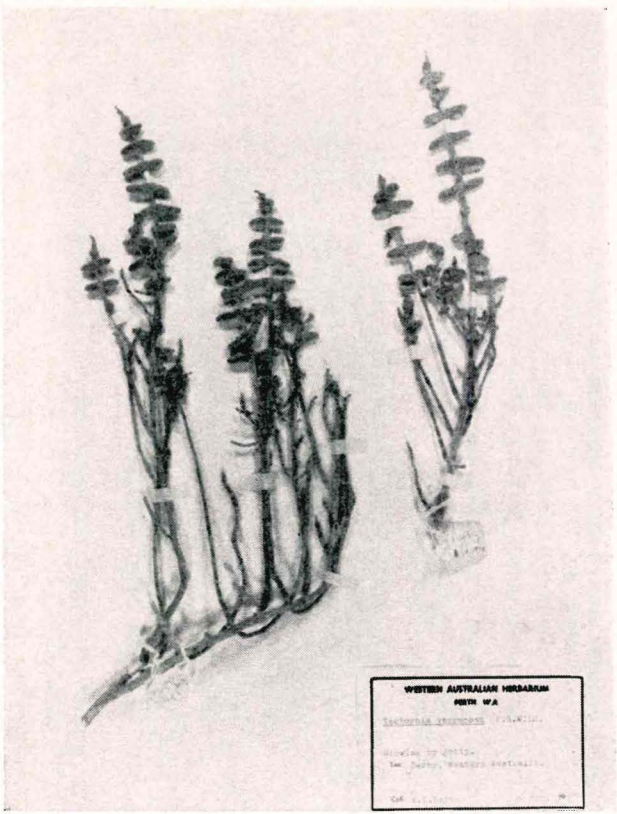


Figure 3—*Tecticornia verrucosa*, x approx. 1/4 (A. L. Payne s.n.).

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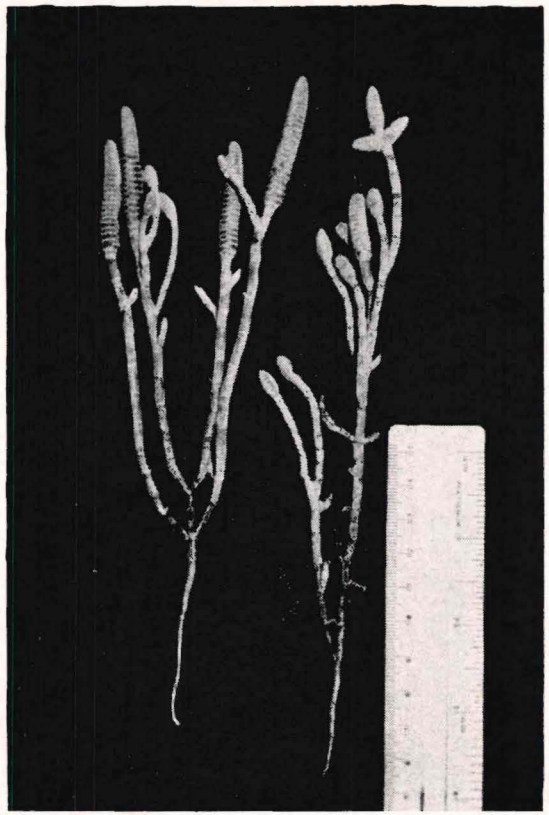

Figure 4—*Tecticornia australasica*, x approx. 3/4 (N. Byrnes 1950).

apparently H. E. Baillon in 1887. It was subsequently made by B. Daydon Jackson in Index Kewensis 2:1041 (1895) and then independently by both F. M. Bailey and J. M. Black.

### 2. **Tecticornia verrucosa** P. G. Wilson sp. nov.

*Spicae* oppositae et decussatae, ad axem rami verticales, sessiles, breviter cylindraceae, 10–20 mm longae, 6 mm latae. *Semina* late et obtuse elliptica vel suborbicularia, patelliformia (leviter concavo-convexa), ca. 1·8 mm longa, verruculosa.

*Type:* 9 mi SE of Rabbit Flat 20° 15′ S, 130° E, Northern Territory, small erect shrub with several stems to 8 in. high, 26 May 1970, *J. R. Maconochie* 1036 (holo: PERTH, iso: K, MEL, NSW).

Annual or short-lived perennial, to 40 cm high, branching at the sometimes woody base. *Lower branches* often decumbent and giving rise to erect stems. *Articles* cylindrical (to obovoid), 10-14 mm long, 5-6 (18) mm diam., pale bluish green (or pale red), glaucous; apex truncate with minute lobes; margin a narrow scarious rim. *Inflorescence* of opposite and decussate lateral spikes along upper portion of branches (occasionally a very small terminal spike is present), each opposite pair being separated from neighbouring pairs by a single internode. *Spikes* sessile, standing at right angles to branch axis, shortly cylindrical, 10-20 mm long, 6 mm diam.; *bracts* at first loosely adherent laterally to each other along basal margins, eventually free. *Flowers* in triads, free from each other and from lower bract, united in basal half to upper bract, the lateral florets loosely united in basal half to lateral bracts, *Perianth* obovoid, obtuse, ca. 2 mm long, elliptical in transverse section; tepals free below (abaxially) but lightly united adaxially in lower half, eventually completely free. *Staminal filament* eventually subulate; anther oblong-cordate, ca. 1·3 mm long (sometimes aborted). *Style* slender, the stigmas filamentous and ca. 3·5 mm long. *Seed* broadly and bluntly elliptical to suborbicular, plano-convex to slightly concavo-convex, ca. 1·8 mm long, verruculose around upper margin, grading to ± smooth below, brown to black, surrounded by and adherent to the transparent membranous pericarp. (Figure 1A-C, 3).

*Distribution:* Tropical and sub-tropical North-West and Central Australia. Also known from a single locality in the southern portion of Western Australia near Lake Grace. (Figure 7).

*Western Australia:* Derby, *R. D. Royce* 3336 (PERTH); ibid., *A. S. George* 6532 (PERTH); 13 mi ESE of Wyndham township, *R. A. Perry* 2559 (NSW, NT); 13 mi WSW of Yeeda Station, Kimberleys, *M. Lazarides* 6586 (PERTH); Noblys Well, E. Kimberley, Aug. 1906, *W. V. Fitzgerald* (NSW 126370); Lake Doman, *J. S. Beard* 5601 (PERTH); Dovers Hills, ca. 30 mi S of Lake Mackay, 13 June 1962, *J. Long* (NT, PERTH); SE of Lake Anec, Lat. 24° S, June 1958, *W. H. Moyle* (PERTH); Boolathanna Station N of Carnarvon, *T. E. H. Aplin* B14 (PERTH); 4 mi W of Dovers Hills, northern Gibson Desert, *A. S. George* 9003 (PERTH); ca. 13 km ESE of Mt. William Lambert, Sept., 1971, *D. Lowry* (PERTH); Lake Bryde, ca. 20 mi WSW of Newdegate, *T. E. H. Aplin* 4793 (PERTH).

*Northern Territory:* 7 mi SE of Rabbit Flat, 130° E, 20° 15′ S, *J. R. Maconochie* 1031 (PERTH); 75 mi W of The Granites, 21 Mar. 1963, *A. J. Mahood* (NT 10257); 3 mi NE of Lake Mackay, *G. Chippendale* 3391 (BRI, MEL, NSW, NT, PERTH).

*Ecology:* Found on coastal mudflats and also inland on fresh water claypans and slightly saline flats.

*Aboriginal Use:* A note attached to a specimen collected by J. Long from about 30 mi S. of Lake Mackay in 1962 states that the plant was used by natives as a food. A further account of its use as a food occurs in a " Report on health and nutrition of natives from Rawlinson Range to Lake MacDonald, 1958 " compiled by J. J. Elphinstone for the Department of Public Health, Western Australia. In this paper Mr. W. H. Moyle contributed the following comment: " Mungiba (*Tecticornia cinerea*)

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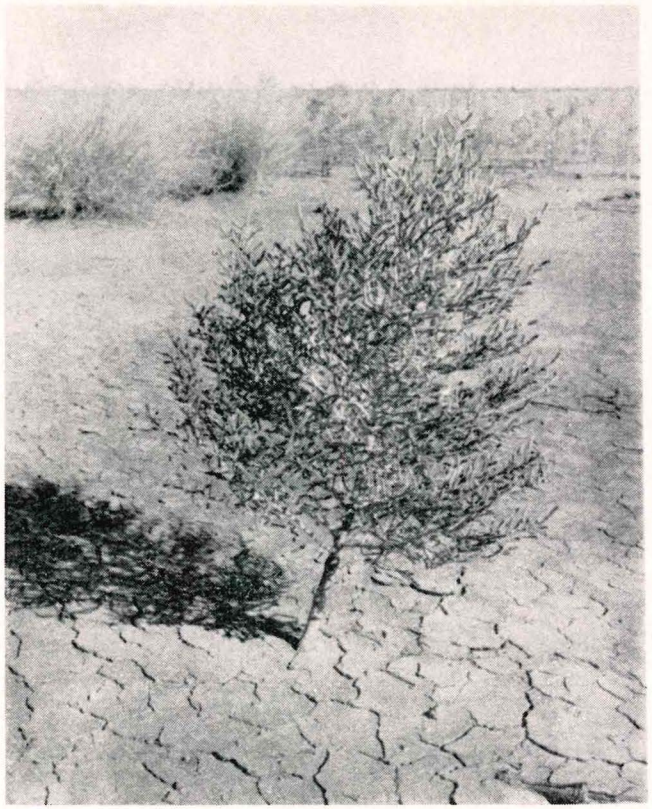

Figure 5—*Tecticornia arborea:* plant ca. 1·3 m high.

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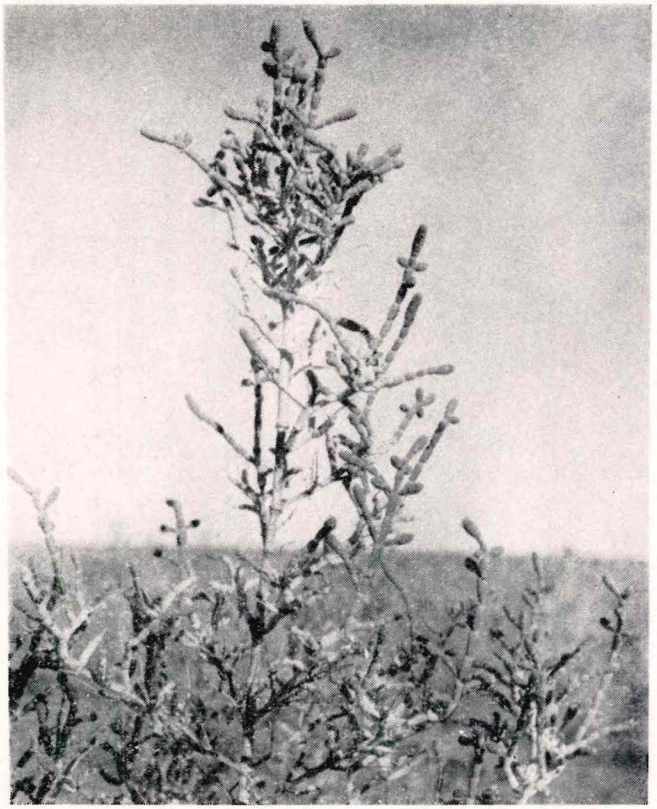

Figure 6—*Tecticornia arborea:* terminal portion of branches showing spikes. (At Bulli Bulli Clay Pan, near Cue, Western Australia).

This plant usually grows in salt pan country. The only patch we saw was in a fresh water clay pan S.E. of Lake Anec and almost on the 24° latitude. The plant is not known to natives in the Warburton-Rawlinson area, but it is a favourite source of food for those further north. The fleshy bulbs containing small seeds are eaten direct from the plant and have a pleasant, slightly salty flavour."

Specimens of the plant referred to have been lodged with the Western Australian Herbarium and are of *T. verrucosa.*

*Notes:* There is a slight variation in the shape and degree of verrucosity of the seed. In the northern collections the seed is narrower and bears more numerous but smaller verrucosities compared with seed from plants collected in inland localities.

The coastal form behaves as an annual. Its seed germinates after immersion in fresh water following the summer rains. In inland localities the plant has sometimes the appearance of being two or more years old.

### 3. **Tecticornia arborea** P. G. Wilson sp. nov.

*Spicae* terminales et laterales, pedunculatae (haud sessiles), cylindraceae vel leviter fusiformes, 10–20 mm longae, 7 mm latae. *Semina* late ellipsoidea, obtusa ca. 1·5 mm longa, laevia.

*Type:* Bulli Bulli Clay Pan, Glen Station, ca. 60 km NW of Cue, Western Australia; erect pine-like plants up to 172 cm high (average about 135 cm), well-spaced on hard reddish brown clay, the only species present; 5 Aug. 1969, *P. G. Wilson* 8577 (holo: PERTH, iso: AD, B, BRI, CANB, GH, K, L, MEL, NSW).

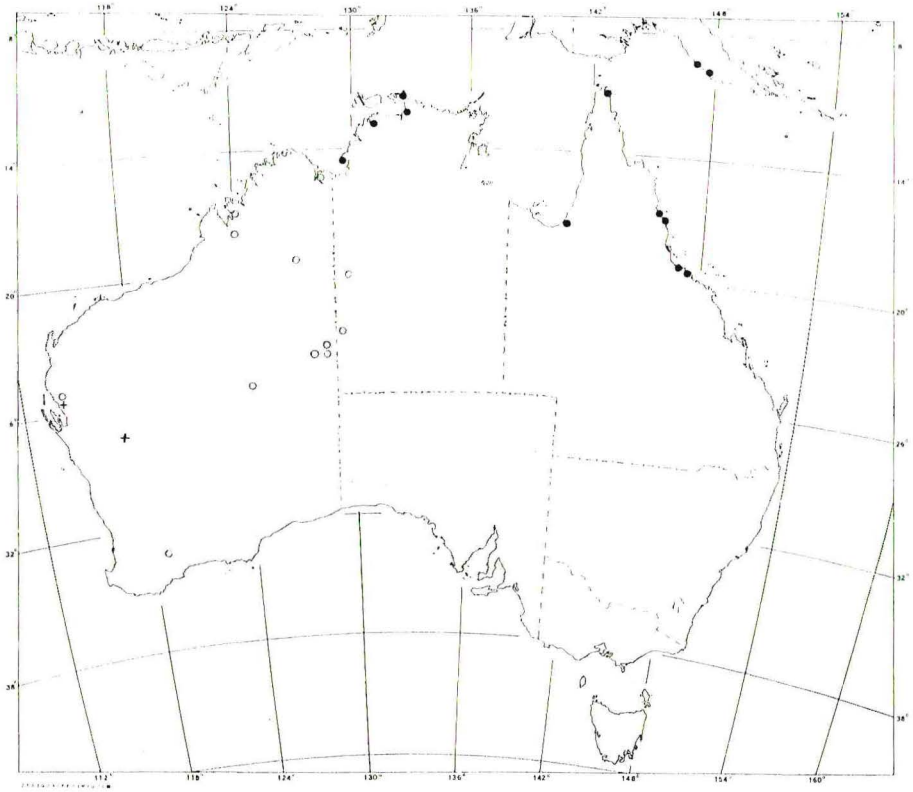

Figure 7—Distribution of *Tecticornia* species. *Tecticornia australasica* ● *T. arborea* + *T. verrucosa* ○.

Erect pyramidal-shaped plant, loosely branched and with a single stem, to ca. 150 cm high, woody towards base. *Articles* on branchlets cylindrical, ± truncate, 1-3 cm long, 5-12 mm diam., green to purple, glaucous. *Spikes* terminal to main and lateral branches (not sessile), cylindrical or slightly fusiform, 10-20 mm long, ca. 7 mm diam. smooth, bracts free, reniform. *Flowers* protogynous and arranged in triads, free from each other and from bracts. *Perianth* deltoid-shaped from above (broadest at apex), ca. 3 mm long, dorsiventrally flattened at apex, distal half thick and succulent, proximal portion thin; *tepals* separated on upper (adaxial) side, united in basal two-thirds on lower side, eventually free, slightly imbricate at apex. *Staminal filament* subulate; anther cordate-oblong, ca. 2 mm long. *Seed* broadly ellipsoidal, rounded at both ends, ca. 1·5 mm long, with long axis vertical to spike axis; testa smooth, reddish brown, glossy; embryo near upper margin of seed surrounded by copious endosperm. Pericarp, eventually tearing at base and forming a loose cap to the ripe seed. (Figure 1D-J, 5, 6).

*Distribution:* Known from only two localities in subtropical Western Australia between approximately the 24° and 27° of latitude. (Figure 7).

W end of Weld Range, 15 June 1961, *S. Davies* (PERTH); ibid., Apr. 1969, *Pat. Lindsey* (PERTH); 23 mi E of Kalli, *N. H. Speck* 1066 (PERTH); Boolathanna Station N of Carnarvon, *T. E. H. Aplin*, B. 20 (PERTH); Carnarvon, Apr. 1962 *J. N. Hutchinson* (PERTH).

It is probable, in spite of the varied locality data, that the plant has in fact been found in only two places, the one about 60 km north-west of Cue and the other north of Carnarvon.

*Ecology:* In the two localities where it has been recorded it grows in fresh-water claypans as a monospecific stand.

*Notes:* This species is remarkable because of its erect tree-like habit. It appears to be capable of living for several years although precise data on this point are lacking. A vigorous stand was observed at the type locality in August 1969 but a year later all the mature plants were dead and no young ones were found. Presumably regeneration from seed would have commenced with the first good rain of the new season.

*Aboriginal Use:* The seed is large compared with that of other samphire species, and was at one time collected by aborigines for use as a food. They gave it the name of " bulli bulli ".

**Acknowledgements**

Several people have substantially assisted in the study of the genus *Tecticornia*. Mr. N. Byrnes of the Northern Territory Administration at Darwin has sent fresh material of *T. australasica*, while Mr. J. R. Maconochie of the Northern Territory Administration, at Alice Springs and Mr. A. L. Payne of the W.A. Department of Agriculture at Derby have both provided fresh material of *T. verrucosa*.

During his period as Australian Botanical Liaison Officer at Kew Mr. D. J. McGillivray arranged for a photograph of the type of *Halocnemum australasicum* (which is in Paris) to be sent to me and also compared the syntypes at Kew of *Halocnemum cinereum* with recent collections of this species. Mr. J. Carrick, who later occupied the same position, kindly compared the seed on the type specimen of *H. australasicum* with that from several species in the *Salicornieae*.

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