

Eriocaulon insectum, a new species of Eriocaulaceae from Cape York, Queensland

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Abstract

A new species of pipewort (*Eriocaulon*; Eriocaulaceae) from Cape York, Queensland was recently discovered. *Eriocaulon insectum* Baleeiro & R.W.Jobson is distinguished from all other species by its golden-brown inflorescence head, having female flowers with large, winged sepals with two black spots, four black, exerted stamens, with male sepals as a spathe, and seeds with 3–5 hyaline, T-shaped peg-like projections. Diagnostic characters are illustrated and tabulated with comparison to closely related species. A taxonomic key containing all known species from Cape York is provided, and habitat preference, distribution, and conservation status are discussed and compared to that of closely related species.

Introduction

Eriocaulon L. (Eriocaulaceae, Poales) consists of more than 400 species with a worldwide distribution occupying a wide range of aquatic habitats, mostly in tropical regions (Giulietti *et al.* 2012, Giulietti and Hensold 1990, Han *et al.* 2019, Larridon *et al.* 2019). Most of the 33 recognised Australian species are confined to the Monsoon Tropics, with a few extending to temperate regions (Davies *et al.* 2007, Leach 2000, 2017). The Monsoon Tropics contains Australia's highest species richness involving 21 biogeographic regions, with the greatest endemism found across Kimberley, Arnhem Land, and Cape York (Crisp *et al.* 1995, Kalkman and Orr 2012, Jobson *et al.* 2017). Recent studies of ancient plant species exchange between the Sunda and Sahul shelves demonstrate that the relatively under-explored Cape York Peninsula (CYP) was a gateway for species migration into Australia (Joyce *et al.* 2020). Of the six species with distributions extending into Asia (*E. australe* R.Br., *E. cinereum* R.Br., *E. setaceum* L., *E. truncatum* Buch.-Ham. ex Mart., *E. zollingerianum* Körn., *E. willdenovianum* Moldenke), all are found in Cape York, with *E. zollingerianum* Körn. known only from the Weipa region.

Eriocaulon insectum Baleeiro & R.W.Jobson is recognised as a new species based on morphology (this paper) and preliminary molecular phylogenetic data (Baleeiro *et al.*, in prep.). At first glance, and due mainly to the shape and golden-brown colour of the inflorescence head, *Eriocaulon insectum* could be confused with *E. zollingerianum* or *E. hamiltonianum* Mart., the latter of which is restricted to south-east Asia and New Guinea (Ansari and Balakrishnan 2009, Prajaksood *et al.* 2012, Rashmi and Krishnakumar 2014, Leach 2018). Despite its superficial similarity to *E. hamiltonianum*, *E. insectum* differs in having a 2-locular ovary, two sepals and

petals, and four stamens. The closest species morphologically are the Australian *E. carpentariae* G.J.Leach and *E. concretum* F.Muell. (both endemics) and here, we compare and contrast the essential morphological characters differentiating these species (Table 1, Leach 2000, 2017).

The geographic distributions and habitat preferences are discussed and a diagnostic key of the 22 CYP species is provided.

Methods

Field trips to Northern Australia were undertaken in June 2022. General morphological measurements were made with a stereoscope and light microscope and images were obtained via camera lucida. The seed surface was air-dried, mounted, and coated with 4–5 nm of gold-palladium (40–60%) and then observed using a Thermo Scientific Phenom Pure Desktop Scanning Electron Microscope (SEM); both processes were carried out at the Queensland Herbarium, Brisbane, Australia.

Taxonomy

Eriocaulon insectum Baleeiro & R.W.Jobson, *sp. nov.*

Type: AUSTRALIA: QUEENSLAND: Cook District: Orchid Swamp, Steve Irwin Wildlife Reserve, 22 June 2022, *P.C. Baleeiro 619 & R. W. Jobson* (holo: BRI; iso: NSW).

Diagnosis: *Eriocaulon insectum* is similar to *E. carpentariae* and *E. concretum* but differs in having leaves 6–7-nerved, green scapes to 330 mm tall, each bearing a golden-brown inflorescence head, receptacle cylindrical, involucre bracts rhombic, flower bracts concave, female flowers monomorphic, sepals glabrous, four large, black, exerted stamens, and seeds with 3–5 hyaline, T-shaped peg-like projections.

Annual *herb* to 330 mm tall. *Leaves* lanceolate, 30–60 long, 3–4 mm wide, 6–7 nerved. Peduncle 120–320 mm long, with five ribs. Sheath 30–40 mm long. *Flower heads* golden-brown, ovoid, c. 5 mm long, c. 3 mm wide. *Involucre bracts* straw yellow, rhombic, c. 2 mm long, c. 1.5 mm wide, apex rounded, glabrous, strongly reflexed at maturity. *Floral bracts* straw yellow, concave, broadly obovate to almost circular, 1.5–2 mm long, c. 1 mm wide, glabrous, apex rounded or obtuse. *Receptacle* cylindrical, densely pilose. *Male flowers* 1.2–2 mm long, sepals 2, fused but split on one side to form a spathe, hyaline or straw yellow, c. 1.5 mm long, obtuse, irregularly lobed, glabrous; *petals* hyaline, ovate or fimbriate, obtuse, c. 0.2 mm long; *stamens* 4; *anthers* black. *Female flowers* monomorphic, sepals 2, straw yellow, navicular, broad dorsal wing with dark spot, 1.5–2 mm long, 2–3 mm wide, crested, glabrous; *petals* 2, hyaline, equal, linear, c. 1 mm long, acute, glabrous. *Ovary* 2-locular. *Seeds* c. 0.5 mm long, c. 0.2 mm diam.; epidermal cells with even wall thickenings and 3–5 thin, hyaline, unidirectional, T-shaped peg-like projections on transverse walls. (Figs 1, 2a, b, e, f, 3)

Additional specimens examined (precise locality withheld for conservation purposes): AUSTRALIA: QUEENSLAND: COOK DISTRICT: Peninsula Developmental Road, 5.3 km to Yarraden, 21 Jun 2022, *P.C. Baleeiro 606 and R. W. Jobson* (BRI, NSW); Steve Irwin Wildlife Reserve, 24 Jun 2022, *P.C. Baleeiro 631 and R. W. Jobson* (BRI, NSW); Bamaga, 25 Jun 2022, *P.C. Baleeiro 640 and R. W. Jobson* (BRI, NSW); Telegraph Track, 29 Jun 2022, *P.C. Baleeiro 670 and R. W. Jobson* (BRI, NSW); near Yarraden, 29 Jun 2022, *P.C. Baleeiro 681 and R. W. Jobson* (BRI, NSW); N of Dixie Road, on Peninsula Developmental Road, 29 Jun 2022, *P.C. Baleeiro 688 and R. W. Jobson* (BRI, NSW).

Etymology: The specific epithet is taken from the Latin *insectum*, a reference to the winged female flower with two antennae-like styles that resemble a flying insect.

Distribution, ecology, and phenology: Endemic to Cape York Peninsula, north Queensland, from Bamaga near the tip, south to Dixie Station, and west to near Weipa in the Steve Irwin Wildlife Reserve (Fig. 4). Commonly found growing with *Eriocaulon clarksonii*, *E. depressum*, *E. fistulosum*, and *E. concretum* at the margins of wetlands and lakes with *Melaleuca* spp., among sedges and grasses (Fig. 2e). Found in flower in June.

Conservation status: *Eriocaulon insectum* is relatively common at known collection localities, and the similarity of the golden-brown inflorescence head to those of local sedges makes it inconspicuous in the field (Fig. 2a, b). This feature is likely the reason it is under-collected across Cape York Peninsula. Given the frequency of occurrence across CYP, often in conservation reserves, we suggest *E. insectum* is not threatened and recommend the conservation status of Least Concern.

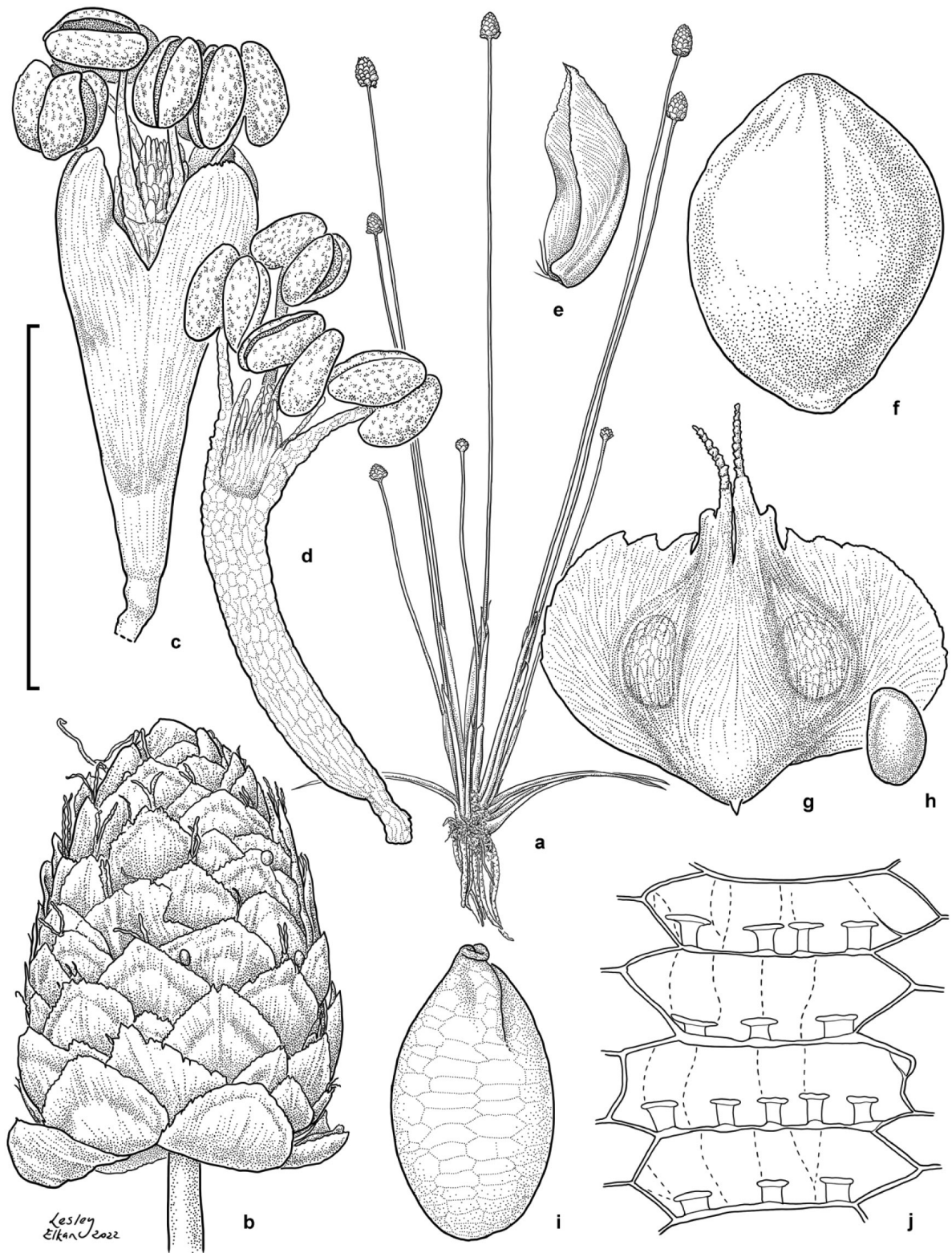


Fig. 1. *Eriocaulon insectum*. a, habit; b, inflorescence head; c, male flower with sepal; d, male flower without sepal; e, floral bract; f, involucre bract; g, female flower without petals; h & i, seed; j, seed surface. Scale bar: a = 60 mm; b = 3 mm; c & d = 0.75 mm; e–h = 1.5 mm; i = 0.5 mm; j = 0.1 mm. Voucher: *Baleeiro 631 & Jobson* (BRI).



Fig. 2. a, inflorescence of *Eriocaulon insectum*; b, inflorescence head with female petals when present (red arrow) of *E. insectum*; c, inflorescence of *E. concretum*; d, inflorescence of *E. carpentariae*; e & f, *E. insectum* habitat and habit. Scale bars shown. All images by P. Baleeiro.

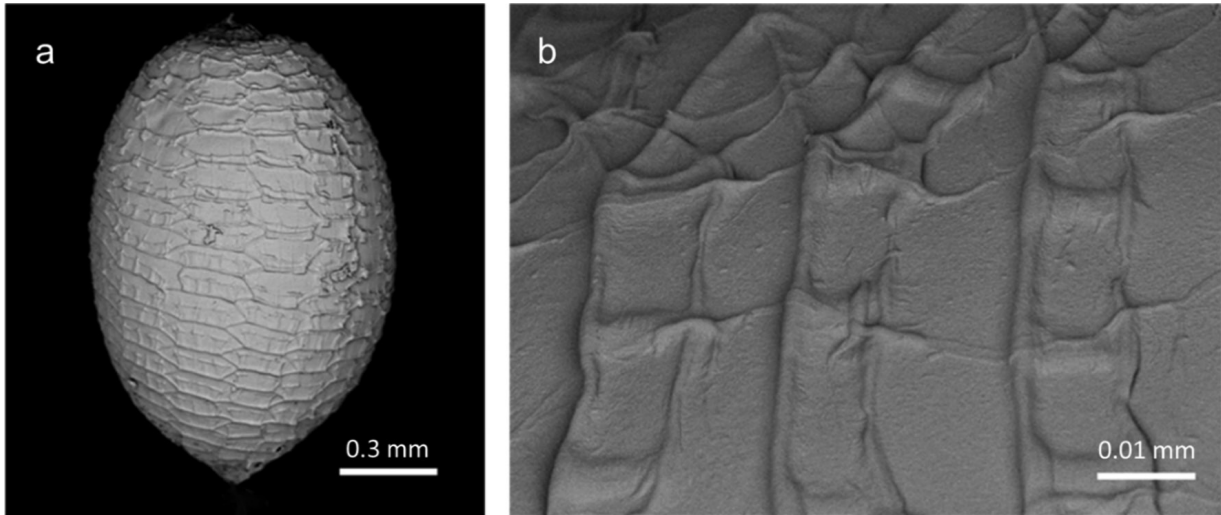


Fig. 3. *Eriocaulon insectum*. a, seed and b, seed surface. Voucher: *Baleiro 631 & Jobson* (BRI).

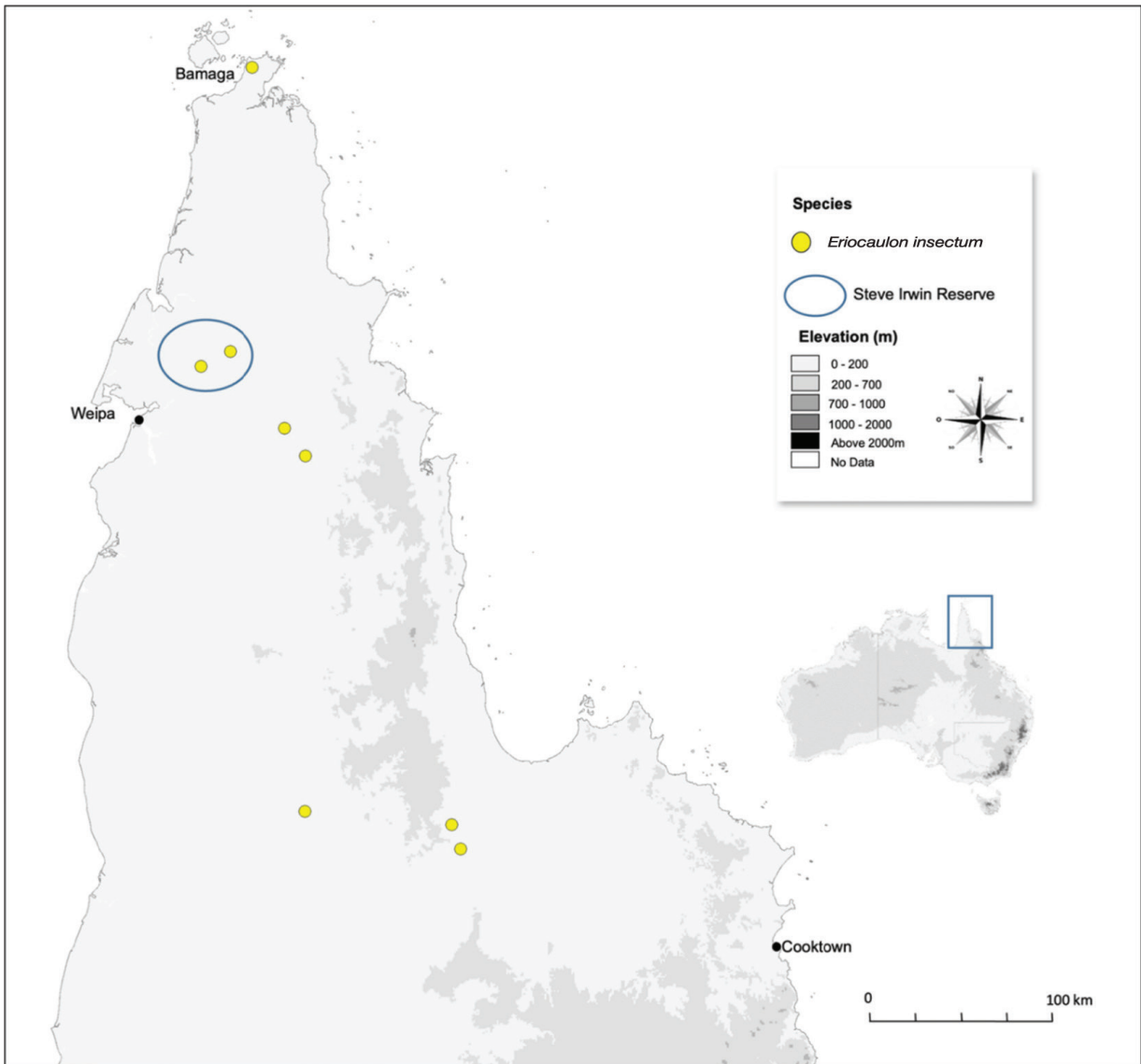


Fig. 4. Distribution map showing collection locations of *E. insectum* across Cape York Peninsula, Queensland.

Notes: *Eriocaulon insectum* is easily overlooked in the field, with its golden-brown inflorescence heads resembling co-occurring sedges, and this is presumably why it has not been collected previously. The golden-brown heads are ovoid in shape and superficially resemble those of *E. zollingerianum* and *E. hamiltonianum*. However, in addition to many other differing characters, the ovary of *E. insectum* is 2-locular vs. 3-locular, two sepals and petals vs. three, four stamens vs. six, and seed shape and surface structure with presences of peg-like projections (Prajaksood *et al.* 2012, Leach 2017, 2018).

Although our illustration of *E. insectum* shows a female flower lacking the two petals (Fig. 1g), it should be noted that petals generally dehisce during later stages of fruiting. Regardless, we have documented the petals in an image of the flower head from an earlier flowering stage (refer to red arrow in Fig. 2b). It should also be noted that male flowers of *E. insectum* have sepals fused in a spathe and opened to the base (refer to description) and visible only in frontal view. However, our illustration of the male flower (Fig. 1c) shows the rear to demonstrate the sepals are not completely fused.

Although Australian and Asian species, namely *E. carpentariae* (Australia), *E. dalzellii* Körn. (India), *E. gopalakrishnanum* K.Rashmi & G.Krishnak. (India), *E. thailandicum* Moldenke (Thailand), and *E. setaceum* L. (Pantropical) have similar seed-coat surface projections, the hyaline peg-like projections of *E. insectum* are about 3× thicker than the above species. In addition, many other characters can differentiate *E. insectum* from all five species such as the golden-brown inflorescence head, possessing four black stamens with sepals in a spathe, and female flowers with glabrous winged sepals (cf. Ansari and Balakrishnan 2009, Prajaksood *et al.* 2012, Rashmi and Krishnakumar 2014, Leach 2017, 2018).

Even though the floral morphology of *E. insectum* is most similar to *E. carpentariae* and *E. concretum*, major morphological characters such as those of the inflorescence, scape, involucre and floral bracts, female and male flowers and seeds, clearly differentiate the three species (see Table 1, Key, Fig. 2).

Table 1. Morphological character comparison: *Eriocaulon insectum*, *E. carpentariae* and *E. concretum*. n.a. = not applicable (male sepals not present).

Character	<i>E. insectum</i>	<i>E. carpentariae</i>	<i>E. concretum</i>
Plant size	10–33 cm	7–15 cm	1.5–8.5 cm
Flower head	ovoid	ovoid to hemispherical	Hemispherical
Involucral bract	concave, rounded or obtuse	flattish, lanceolate or elliptic to broadly obovate	obovate/ovate to elliptic
Receptacle	cylindrical, densely pilose	conical, sparsely hairy or glabrous	conical, sparsely hairy
Floral bract	broadly ovate, almost circular, golden apex	oblanceolate, dark apex	obovate to spatulate, black apex.
Male sepal	spathe, opened, hyaline or straw yellow	0	spathe, closed, hyaline
Anthers	exserted above sepals	n.a.	often enclosed within sepals
Female sepals	equal	Dimorphic	equal
Seed	hyaline T-shaped, peg-like projections	T-shaped peg-like projections	no projections

Moreover, new species status is supported by a preliminary molecular phylogenetic analysis using Bayesian inference on a plastid/nuclear DNA matrix that includes Asian sequences used in Larridon *et al.* (2019) and newly generated sequences representing distributions of all Australian species (Baleeiro *et al.*, in prep.). The three accessions of *E. insectum* used in the phylogenetic study form a fully supported grouping that is sister to clades of Asian taxa including *E. echinulatum* Mart., *E. zollingerianum*, *E. hamiltonianum*, and the Australian species *E. concretum* (Baleeiro *et al.*, in prep.).

Key to species of *Eriocaulon* from Cape York Peninsula (modified from Leach 2017)

1. Leaves in basal rosette 2
- 1: Leaves along an elongated stem *E. setaceum*
2. Ovary 2-locular 3
- 2: Ovary 3-locular 10
3. Female sepals with broad dorsal wings 4

3: Female sepals lacking a broad dorsal keel or wing	9
4. Involucral bracts thin, flexible, becoming reflexed at maturity	5
4: Involucral bracts thickened, rigid, not reflexed at maturity	8
5. Female flowers dimorphic within head with upper flowers lacking sepals; female sepal hairs marginal	6
5: Female flowers equal within head with all flowers having sepals; female sepal hairs on adaxial surface or absent	7
6. Floral bracts acuminate to acute; female petals spatulate, glabrous.....	<i>E. carpentariae</i>
6: Floral bracts obtuse; female petals elliptic, pubescent.....	<i>E. fistulosum</i>
7. Herbs over 10 cm tall, floral bracts straw yellow, receptacle densely pilose, stamens exerted, female sepals with black spot, seeds with T-shaped peg-like projections....	<i>E. insectum</i>
7: Herbs up to 8.5 cm tall, floral bracts hyaline, receptacle sparsely hairy, stamens included, female sepals with black window, seeds without projections	<i>E. concretum</i>
8. Floral bracts pubescent; male sepals fused for greater part, glabrous; four stamens	<i>E. willdenovianum</i>
8: Floral bracts glabrous; male sepals free to fused at base, pubescent; two stamens	<i>E. depressum</i>
9. Floral bracts hyaline; receptacle glabrous; stamens 4.....	<i>E. spectabile</i>
9: Floral bracts black; receptacle densely pilose; stamens 2.....	<i>E. wolseleyi</i>
10. Seed longitudinal thickenings white, prominent, thicker than transverse walls	11
10: Seed longitudinal thickenings lacking or similar thickness to transverse walls	12
11. Floral bracts obovate; male sepals 2, free to fused at base; female sepals equal.....	<i>E. pusillum</i>
11: Floral bracts spatulate; male sepals 3, fused but split on one side to form a spathe; female sepals dimorphic.....	<i>E. truncatum</i>
12. Anthers yellow, female petals lacking.....	<i>E. cinereum</i>
12: Anthers black, female petals present	13
13. Female sepals with a broad, flattened dorsal wing.....	14
13: Female sepals lacking a broad, flattened dorsal wing, at most a slight dorsal keel.....	15
14. Involucral and floral bracts with white trichomes.....	<i>E. australe</i>
14: Involucral and floral bracts glabrous	<i>E. zollingerianum</i>
15. Receptacle glabrous to sparsely hairy.....	16
15: Receptacle densely pilose	19
16. Floral bracts with white hairs	17
16: Floral bracts glabrous	18
17. Epidermal cells of seeds \pm isodiametric, peg-like projections on both transverse and longitudinal walls	<i>E. scariosum</i>
17: Epidermal cells of seeds transversely elongated, projections only on transverse walls	<i>E. clarksonii</i>
18. Seed epidermal thickenings continuous bands on transverse walls.....	<i>E. nanum</i>
18: Seed epidermal thickenings of unidirectional peg-like projections on transverse walls...	<i>E. athertonense</i>
19. Seeds with even thickenings around epidermal cells	20
19: Seeds with peg-like projections in various arrangements	21
20. Floral bracts aristate.....	<i>E. nematophyllum</i>
20: Floral bracts obtuse to acute, lacking arista.....	<i>E. pygmaeum</i>

21. Seed with transversely elongated epidermal cells and unidirectional peg-like projections on transverse walls22
- 21: Seed with \pm isodiametric epidermal cells and with peg-like projections on all walls.....23
22. Floral bracts pubescent; male sepals pubescent; female sepals equal, pubescent..... *E. odontospermum*
- 22: Floral bracts glabrous; male sepals glabrous; female sepals dimorphic, glabrous..... *E. athertonense*
23. Flower heads smooth in outline; involucre bracts glabrous; floral bracts lacking pronounced arista; male sepals fused into a spathe, rarely apparently free; female sepals dimorphic..... *E. scariosum*
- 23: Flower heads squarrose in outline; involucre bracts pubescent with white hairs; floral bracts with pronounced aristate tip; male sepals free; female sepals equal.....*E. tortuosum*

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