

A revision of *Neptunia* Lour. (Leguminosae: subfamily Caesalpinioideae, Mimosoid clade) in Australia and Malesia

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Summary

Bean, A.R. (2022). A revision of *Neptunia* Lour. (Leguminosae: subfamily Caesalpinioideae, Mimosoid clade) in Australia and Malesia. *Austrobaileya* 12: 59–106. *Neptunia* comprises 18 species for Australia and Malesia, including ten species newly named: *N. heliophila* A.R.Bean, *N. hispida* A.R.Bean, *N. insignis* A.R.Bean, *N. longipila* A.R.Bean, *N. paucijuga* A.R.Bean, *N. proxima* A.R.Bean, *N. scutata* A.R.Bean, *N. tactilis* A.R.Bean, *N. valida* A.R.Bean and *N. xanthonema* A.R.Bean. One taxon below species rank (*N. amplexicaulis* f. *richmondii* Windler) is also accepted. The distributions of all taxa are mapped, and all species are illustrated. Lectotypifications are provided for *N. amplexicaulis* Domin, *N. dimorphantha* Domin, *N. gracilis* Benth., *N. javanica* Miq. and *N. monosperma* F.Muell. ex Benth. Two identification keys are provided, one suited to flowering material and the other for fruiting material. A conservation status is suggested for *N. insignis*.

Key Words: Leguminosae; Caesalpinioideae; Mimosoid clade; *Neptunia*; *Neptunia heliophila*; *Neptunia hispida*; *Neptunia insignis*; *Neptunia longipila*; *Neptunia paucijuga*; *Neptunia proxima*; *Neptunia scutata*; *Neptunia tactilis*; *Neptunia valida*; *Neptunia xanthonema*; flora of Australia; flora of Malesia; flora of New Guinea; flora of Queensland; flora of Western Australia; flora of Northern Territory; flora of New South Wales; flora of South Australia; new species; morphology; thigmonasty; distribution maps; identification keys; conservation status

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Introduction

Neptunia Lour. was established by Loureiro (1790) with the single species *N. oleracea* Lour. The name is derived from Neptune, the Roman god of freshwater and the sea, and alludes to the aquatic habitat of the first named species. Previously, *Neptunia* species were described under the genus *Mimosa* L., e.g. *M. plena* L., *M. natans* L.f., *M. prostrata* Lam. Willdenow (1806) named the genus *Desmanthus* Willd. and included in it some species now known as *Neptunia*, with that usage followed by De Candolle (1825). It was through the seminal work of Bentham (1841) that the modern circumscription of the genus *Neptunia* was established; therein he distinguished *Neptunia* from the related genus *Desmanthus*, but still likened it strongly to his *Piptadenia* Benth. The morphological definition of *Neptunia* was further elaborated by Bentham (1864) in his treatment of the three Australian species that he recognised.

Neptunia can be recognised by its herbaceous habit, unarmed stems, bipinnate stipulate leaves, and the globose to ellipsoidal inflorescences solitary in the leaf axils, usually comprising a mixture of bisexual and neuter flowers that have yellow, petaloid staminodia. It comprises about 22 species and is distributed in the tropics and subtropics of North America, South America, Australia, mainland Asia, Malesia and Africa (Windler 1966). This taxonomic revision is restricted to the species that occur in Australia and Malesia.

The biogeographic region of Malesia comprises Indonesia, Malaysia, Brunei, the Philippines, Christmas Island (an Australian external territory), East Timor and the whole of New Guinea (van Steenis 1948). The two species of *Neptunia* named from Malesia, *N. javanica* Miq. and *N. depauperata* Merr., were described in 1855 and 1918 respectively.

The first Australian *Neptunia* species to be formally named was *N. gracilis* Benth. (Bentham 1841). In the *Flora Australiensis*, Bentham (1864) described *N. gracilis* var. *major* Benth. (= *N. major* (Benth.) Windler) and *N. monosperma* F.Muell. ex Benth., using a manuscript name provided by F. Mueller for the latter. Domin (1926) named two further species, *N. amplexicaulis* Domin and *N. dimorphantha* Domin, from specimens he collected in 1910 while visiting Queensland. In his revision of the genus, Windler (1966) raised *N. gracilis* var. *major* to species rank and named two new taxa at the rank of forma. No Australian or Malesian taxa have been described since that time. This revision recognises 18 species for Australia and Malesia, including ten that are newly described.

Morphology

a) **Habit.** In most species, the stems are quite prostrate, radiating from a central rootstock. In others (e.g. *Neptunia major*, *N. monosperma*, *N. valida* A.R.Bean) the stems are upright or ascending. In some populations of *N. heliophila* A.R.Bean, the upright shrubby plants occur in colonies, strongly suggesting the presence of a network of rhizomes. Most species are perennial, although the leaflets abscise and the stems die back each year, a few months after the wet season. Northern Territory botanists have coined the term “annual herb with perennial rootstock” for local species of *Neptunia*, except for *N. major* which they regard as an annual (Dunlop *et al.* 1995).

b) **Stipules.** Stipules are present in all species, but they vary in size (from 4–20 mm long) and persistence. In *Neptunia major* and *N. monosperma*, the stipules are narrow and deciduous (often visible only on the newly emerging vegetative growth). In all other species, the stipules are broad and persistent for many nodes.

c) **Stipels.** In *Neptunia*, the stipel is contiguous with the raised margin of the petiole or rachis. It is persistent, is sometimes deeply 2- to 4-lobed, and may have a gland-tipped apex. Stipels seem to be present in all species, but

often they are extremely short and barely noticeable. These structures were referred to as ‘pseudostipels’ by Cowan (1998).

d) **Leaves and nectaries.** The leaves of *Neptunia* are in all cases alternate and bipinnate, with the leaflets oblong and somewhat chartaceous. The number of pairs of pinnae and the number of leaflets per pinna vary considerably, but are to some degree taxonomically diagnostic, particularly if juvenile growth near the base of the plant is ignored. The indumentum density and pattern on the leaves and stems is somewhat diagnostic but must be used with caution. *Neptunia major*, *N. javanica*, *N. oleracea*, *N. plena* (L.) Benth. and *N. monosperma* are virtually glabrous on vegetative parts, while most other species have at least sparse hairs on the leaves or rachises. *Neptunia amplexicaulis* has a glabrous and a pubescent form, and *N. gracilis* has variable indumentum.

The petiole and sometimes the rachis, can bear one or more circular or elliptical nectaries on the upper (adaxial) side; the presence, number, size and position of these nectaries is usually diagnostic. However, there is some variation within a species, e.g. *Neptunia scutata* A.R.Bean. On a single plant or specimen the nectaries can be present on some leaves, but not on others, or may vary in number. Therefore, more than one leaf should be examined to properly assess the character. With herbarium specimens, the difficulty is that if a branch is mounted with the adaxial side of all leaves down, this character will be hidden from view.

e) **Peduncles and bracts.** The length of the peduncle is diagnostic. From examination of specimens, it is clear that in some species the peduncle reaches its full length at, or just before anthesis, as the peduncle does not elongate between the flowering and fruiting stages. In other species, the peduncle elongates considerably between flowering and fruiting. *Neptunia monosperma*, *N. scutata* and *N. xanthonema* A.R.Bean have short fruiting peduncles 10–20 mm long, while in *N. gracilis*, *N. plena* and *N. heliophila*, the fruiting peduncle may reach 105–140 mm in length. The peduncle indumentum

is also diagnostic, i.e. the type (glandular or eglandular), length and direction (antrorse or patent) of hairs.

The peduncular bracts are highly characteristic with regard to their number (0, 1, 2, or more), size and position (lower one-third of peduncle, middle one-third, or distal one-third). The bracts are usually prominently veined, but the venation does not seem to vary greatly between species.

f) **Inflorescence.** One of the defining features of Australian and Malesian *Neptunia* are the dimorphic inflorescences, where the spike has bisexual flowers at the apex, and neuter flowers at the base. Some American species (e.g. *N. pubescens*) have trimorphic inflorescences, with bisexual flowers at the apex, male flowers below the middle, and neuter or sterile flowers at the base (Tucker 1988).

The neuter flowers of Australian and Malesian species comprise a calyx, corolla, and 5–10, long flattened staminodes. Two Australian species (*Neptunia proxima* A.R.Bean and *N. tactilis* A.R.Bean) have wholly bisexual inflorescences. The occurrence of dimorphic inflorescences is often difficult to detect from herbarium specimens. While some specimens appear to have entirely bisexual inflorescences, this can be because the neuter flowers have abscised. Before anthesis, dimorphism is equally difficult to detect because the neuter flower buds are almost identical in appearance to the bisexual flower buds. The flowers (both bisexual and neuter) are nearly always yellow, and the number of stamens is in most species 5, but in a few species (*N. oleracea*, *N. plena*, *N. tactilis*, *N. hispida* A.R.Bean, *N. javanica*), there are between 5 and 10 stamens.

g) **Pods.** The pods for any given species of *Neptunia* are relatively consistent in size, shape, number of seeds, and indumentum. Five species (*N. longipila*, *N. monosperma*, *N. scutata*, *N. valida* and *N. xanthonema*) are consistently one-seeded and have circular or broadly elliptical pods. *Neptunia dimorphantha* and *N. paucijuga* have pods with 1–3 seeds; pods of *N. javanica*, *N. plena*

and *N. tactilis* typically have 7–14 seeds, and the remainder (*N. amplexicaulis*, *N. gracilis*, *N. heliophila*, *N. hispida*, *N. insignis*, *N. major*, *N. proxima*) usually have 3–7 seeds per pod.

Pod indumentum is a useful delimiting character: *Neptunia dimorphantha* has curved antrorse hairs mainly on the pod margins; *N. longipila*, *N. scutata*, *N. valida* and *N. xanthonema* have patent glandular hairs 0.2–0.5 mm long throughout; *N. gracilis* and *N. monosperma* pods are either glabrous or have dense patent eglandular hairs c. 0.1 mm long; *N. insignis* pods vary in the density and distribution of hairs; *N. proxima* has long patent hairs; *N. amplexicaulis* f. *richmondii* has short pubescent eglandular hairs; the remaining taxa (*N. amplexicaulis* f. *amplexicaulis*, *N. heliophila*, *N. hispida*, *N. javanica*, *N. major*, *N. paucijuga*, *N. plena*, *N. tactilis*) have pods that are strictly glabrous.

Neptunia pods are routinely described as ‘dehiscent’ (Windler 1966; Murray 1991; Nielsen 1992; Wheeler 1992), but for many species that is not the case. For all species with single-seeded pods, the pods are indehiscent – they fall to the ground with the seed inside and the seed is released only when the pod decays. The pods of *N. amplexicaulis*, *N. dimorphantha*, *N. major* and *N. paucijuga* are also indehiscent. In *N. hispida*, *N. javanica*, *N. plena*, and *N. tactilis* the pods open along one suture only. In the remaining species, dehiscence is along both sutures.

Chemical properties

Selenium hyperaccumulation

Selenium (Se) is a naturally occurring metalloloid element essential to human and animal health in trace amounts, but harmful in excess (Fordyce 2013). Some plant species are known to accumulate high concentrations of selenium. The Queensland species *Neptunia amplexicaulis* is one of the strongest selenium hyperaccumulators known (Harvey *et al.* 2020) and it is very tolerant of soils containing high levels of selenium. Irish *et al.* (2021) found that ‘*N. gracilis*’ (herein recognised as *N. heliophila*), growing in the same region as *N. amplexicaulis*, is not a

selenium accumulator and does not tolerate high levels of this element in the soil. The other Australian and Malesian species have not yet been investigated in this regard.

Leaf sensitivity (thigmonasty)

Thigmonasty, leaf movement triggered by touch, is found in numerous mimosoid legumes. In some species, e.g. *Mimosa pudica* L., the leaflets fold onto themselves within a few seconds when touched. Some (and possibly all) Australian species of *Neptunia* have sensitive leaves, but the movement is rather slow and the leaflets often do not fold completely. Further examination is required of live material of the species recognised in this revision.

The response results from a loss of turgor from extensor cells of the pulvini (Braam 2005). It is unclear what benefit species of *Neptunia* and other mimosoids derive from the leaflet-folding response. Eisner (1981) postulated that, for *Schrankia microphylla* (Dryand.) J.F. Macbr., (now *Mimosa microphylla* Dryand.) it is a defence mechanism against grazing animals, as the folding of the leaves exposes more of the prickles on the rachises and stems. This was disputed by Minorsky (2019), who considered that this response would not deter most herbivores.

Infrageneric classification and phylogeny

In his revision, Windler (1966) divided *Neptunia* into two sections, *N.* 'sect. *Neptunia*' and *N.* 'sect. *Pentanthera*'. In his key, these were distinguished (apart from geography) solely on stamen number (10 for sect. *Neptunia* and 5 for sect. *Pentanthera*). As there is no Latin diagnosis for sect. *Pentanthera*, it is an invalid name, and hence the autonym was not validly published either. In any case, the benefit of having two sections based on stamen number is debateable as some apparently related species (e.g. *N. gracilis* and *N. javanica*) would then be in separate sections. *Neptunia tactilis* has 5–8 stamens and would not fit easily into either section.

Previous authors have allied *Neptunia* with *Desmanthus* (Bentham 1841, 1864, 1875; Windler 1966) and *Dichrostachys* (Lewis & Elias 1981; Koenen 2020). Hughes *et al.* (2003) studied the generic relationships and phylogeny of these and several other mimosoid genera, establishing two monophyletic groups, the informal 'Dichrostachys group' which includes *Dichrostachys*, and the 'Leucaena group' which includes *Desmanthus*. This well-sampled study (including seven species of *Neptunia*) found that *Neptunia* is monophyletic, but that it lies outside both of these clades. The Australian species with 5 stamens formed a separate clade from the American species with 10 stamens, but problematic species (*N. hispida*, *N. javanica*, *N. tactilis*) were not sampled. Koenen *et al.* (2020) found that *Neptunia* belongs to a more broadly circumscribed 'Dichrostachys clade' along with 12 other genera, including *Desmanthus*, *Dichrostachys*, *Desmanthus*, *Leucaena* Benth. and *Schleinitzia* Warb. The presence of heteromorphic inflorescences with showy staminodes at the base is characteristic of *Neptunia* and several other genera in this clade, but the staminode character is perhaps not homologous.

Hughes *et al.* (2003) pointed out that the yellow petaloid staminodes of *Neptunia* are quite different from the filamentous, pink or white staminodes of *Desmanthus* and *Dichrostachys*.

Ecology

Koenen *et al.* (2020) stated that *Neptunia* is unlike any other mimosoid genus because of its "semi-aquatic lifestyle", but the only aquatic or semi-aquatic species are *N. oleracea* and *N. plena*; all other species are strictly terrestrial. *Neptunia plena* is naturalised in Australia and *N. oleracea* is either indigenous in Malesia or a long-established alien. The seemingly uncommon *N. javanica* inhabits terrestrial open-forest habitats in Malesia, as does *N. gracilis*.

Indigenous species of *Neptunia* in Australia are strictly terrestrial, and they are distributed in the northern half of Western Australia, throughout the Northern Territory

and Queensland, northern New South Wales, and in northern South Australia. A majority of species show a strong preference for heavy clay vertosol soils, often growing in grassland or open eucalypt woodland. Other species grow on flat to somewhat hilly terrain, in tropical woodland with loamy or sandy-loam soils, often associated with laterite.

It is not unusual to find two, or even three species of *Neptunia* growing at the same location in Australia (pers. obs.). This explains ‘mixed’ herbarium specimens, i.e. more than one taxon mounted on a herbarium sheet. Despite this sympatry, there is no clear evidence of hybridisation, from either field or herbarium study. However, hybridisation has played a part in *Neptunia* speciation, as a recently described species from Brazil, *N. windleriana* J.Santos-Silva & V.F.Mansano is a polyploid (Santos-Silva *et al.* 2020).

Only one of the species of *Neptunia* treated in this paper (*N. insignis*) is considered threatened under the criteria of the IUCN (2012) with a suggested conservation status provided. Most species are very widespread and/or are represented in conservation reserves. *Neptunia javanica* is represented by relatively few collections at L and other European herbaria; but was described by Nielsen (1992) as “locally common”. The Bogor herbarium (BO), the most likely repository for specimens of *N. javanica*, could not be consulted for this study.

Materials and methods

This revision is based on an examination of specimens at BRI, and those received on loan from AD, CANB, DNA, L, MEL, NT and PERTH. Specimens at NSW were not available for loan, but high resolution images of all their specimens of *Neptunia* were made available. Specimen images (mostly types) from K, P, PR, NY, US and W have also been examined and are indicated as *i.d.v.* (*imago digitalis visa*) in the text. Most species have been examined in the field, with observations including habit, stipule and bract persistence, extent of floral dimorphism and fruit morphology. The species are treated in alphabetical order.

Measurements of floral parts are based on material reconstituted in hot water or preserved in 70% alcohol; all other measurements were taken from dried material. The range of measurements is inclusive, i.e. 7.5–8.0 is given as 7.5–8. Where there is apparent overlap in some measurements given in the key, it is important to examine a range of examples on the specimen being identified (e.g. number of pinnae) and use the average. The number of pinnae and the number of leaflets per pinna were assessed and measured adjacent only to the flowering or fruiting peduncles on the distal parts of the plant, because the leaves from the basal part of the plant are not fully developed, and consistently have fewer pinnae and fewer leaflets per pinna. Only the largest available leaflets were measured for length and width on any given specimen. In this paper, the portion of the leaf stalk below the lowest pair of pinnae is termed the petiole; the portion above this point is termed the rachis; hence in leaves with a single pair of pinnae, the rachis is absent.

Abbreviations used in the specimens cited sections include ‘NP’ for National Park and ‘HS’ for Homestead. Herbarium acronyms follow Thiers (updated continuously). Distribution maps have been compiled with DIVA-GIS Version 7.5.0 using localities or geocodes given on the labels of specimens from the herbaria listed above. Latitudes and longitudes have been determined for some locations in Indonesia (*Neptunia javanica*) and are included in the specimen citation to enable geocoding curation in herbaria.

Taxonomy

Neptunia Lour., *Fl. Cochinch.* 653 (1790).

Desmanthus sect. *Neptunia* (Lour.) DC., *Prodr.* 2: 444 (1825). **Type:** *N. oleracea* Lour.

Hemidesmas Raf., *Sylva Tellur.* 119 (1838). **Type:** not designated

Annual or perennial herbs or shrubs, prostrate to upright, reaching 3 m in height; most species terrestrial, but some semi-aquatic; foliage unarmed; stems terete, small branchlets angular, glabrous or pubescent with simple trichomes. Stipules lanceolate to broadly

ovate, free, in pairs; in most species persistent for many nodes, but in some species caducous and visible only near growing tip. Leaves alternate, bipinnate, petiolate, with 1–6 pairs of pinnae, frequently touch-sensitive, with the leaflets folding in towards each other. Pinnae lacking a terminal leaflet; rachis and petiole canaliculate on upper side where 1 or more extrafloral nectaries are often present; petiole and rachis ridges extending at the nodes into subulate, branched or unbranched persistent stipels; rachis extending beyond last pair of pinnae; rachillas without nectaries, extending beyond distal pair of leaflets. Leaflets opposite, obliquely attached to rachilla, oblong, somewhat chartaceous, venation usually visible on lower surface. Inflorescence axillary, with a single peduncle per node, bearing a congested terminal spike. Peduncle usually with 1 or 2(–4) disjunct bracts (similar in appearance to the stipules), but in some species bracts are absent. Flowers 6–60 per inflorescence, sessile, each subtended by a bracteole. Inflorescences in some species dimorphic, with the upper flowers bisexual,

and the lower flowers neuter. Bisexual flowers: calyx fused, campanulate or obconical, 5-lobed, green; corolla with 5 free yellow elliptical petals; stamens often 5 but up to 10 in some species, filaments glabrous, anthers bilocular, with a small terminal gland (in some species), ovary superior. Neuter flowers: calyx campanulate; corolla with 5 free yellow elliptical petals; stamens absent; staminodes long-petaloid, yellow; gynoecium absent. Pods orbicular, broadly elliptical, oblong or falcate, flat, stipitate, dehiscent along one or both margins, or indehiscent, 1–20-seeded, brown at maturity; seeds flattened, orbicular to broadly elliptical in outline, transversely or obliquely arranged, pleurogram present. *Sensitive weed*, *Water Mimosa*

Tropical and subtropical parts of North America, South America, Asia, Africa, Malesia and Australia. *c.* 22 species worldwide; 18 species in Australia and Malesia, 16 indigenous and 2 naturalised (indicated * in text).

Key to the Australian and Malesian species of *Neptunia* (flowering material)

- 1 Plants aquatic, with inflated floating stems; staminal filaments 6–7.5 mm long 2
1. Plants terrestrial, stems not inflated; staminal filaments 2–5.2 mm long 3
- 2 Leaves with 2–4 pairs of pinnae, 12–24 pairs of leaflets per pinna; small nectary usually present at distal end of petiole. ***N. plena**
2. Leaves with 2 or 3 pairs of pinnae, 10–17 pairs of leaflets per pinna; petiole nectary absent. ***N. oleracea**
- 3 Petiole nectary absent from all leaves 4
3. Petiole nectary present on most or all leaves 14
- 4 Peduncles with 2–4 bracts 5
4. Peduncles without bracts or with 1 bract only 11
- 5 Peduncles mostly with 3 or 4 bracts, occasionally with 2 **N. valida**
5. All peduncles with 2 bracts 6
- 6 Bracts lanceolate, both on the middle one-third of peduncle. **N. hispida**
6. Bracts ovate to broadly ovate, with at least the lower one on proximal one-third of peduncle 7
- 7 Stipules 12–20 mm long. **N. amplexicaulis**
7. Stipules 4–10 mm long 8
- 8 Peduncles 7–35 mm long at anthesis 9
8. Peduncles 33–110 mm long at anthesis 10

- 9 Peduncles glabrous except at apex; largest leaflets 5.8–11 mm long; pinna pairs 2 or 3(–4) **N. xanthonema**
- 9. Peduncles hairy throughout; largest leaflets 3–7 mm long; pinna pairs 3–5(–6) **N. scutata**
- 10 Leaves with 4–6 pairs of pinnae; largest leaflets 4.6–7.8 mm long **N. heliophila**
- 10. Leaves with 2–3 pairs of pinnae; largest leaflets 8–13 mm long **N. insignis**
- 11 Neuter flowers absent; flowering peduncles 14–36 mm long. **12**
- 11. Neuter flowers present; flowering peduncles (25–)40–110 mm long. **13**
- 12 Pinnae with 16–21 pairs of leaflets; ovary hairy; stamens always 5 **N. proxima**
- 12. Pinnae with 20–28 pairs of leaflets; ovary glabrous; stamens 5–8. **N. tactilis**
- 13 Leaves predominantly with 2 or 3(rarely 4) pairs of pinnae; peduncles usually ± glabrous. **N. gracilis**
- 13. Leaves with 4–6 pairs of pinnae; peduncles with sparse to dense antrorse hairs **N. heliophila**
- 14 Peduncles without bracts; stamens 10 **N. javanica**
- 14. Peduncles with 2 bracts; stamens 5 **15**
- 15 Stipules deciduous, visible only on new growth; upright plants **16**
- 15. Stipules persistent for many nodes; prostrate plants **17**
- 16 Plant 1–2(–3) m high; petioles 10–18 mm long; peduncle 15–55 mm long at anthesis **N. major**
- 16. Plant to 0.5 m high; petioles 5–11 mm long; peduncle 4–12 mm long at anthesis **N. monosperma**
- 17 Peduncle glabrous except at apex; leaves with (1 or)2 or 3 pairs of pinnae **18**
- 17. Peduncles hairy throughout; leaves with 3–5 pairs of pinnae **19**
- 18 Ovary densely hairy; peduncles 7–32 mm long at anthesis; neuter flowers present. **N. xanthonema**
- 18. Ovary glabrous; peduncles 40–54 mm long at anthesis; neuter flowers absent **N. paucijuga**
- 19 Hairs on peduncle 0.5–0.9 mm long; inflorescences broadly-ellipsoidal **N. longipila**
- 19. Hairs on peduncle 0.1–0.5 mm long; inflorescences globose. **20**
- 20 Staminodes 4–7.5 mm long; ovary hairy throughout. **N. scutata**
- 20. Staminodes 8.5–14 mm long; ovary hairy along the margins only. **N. dimorphantha**

Key to the Australian and Malesian species of *Neptunia* (fruiting material, thus excluding *N. oleracea*)

- 1 All pods single-seeded **2**
- 1. All pods, or a majority of pods, with more than one seed **6**
- 2 Peduncles glabrous throughout, or with hairs only in the upper one-fifth **3**
- 2. Peduncles hairy throughout. **4**
- 3 Pods glabrous or with very dense eglandular hairs c. 0.1 mm long; leaflets 23–34 pairs per pinna; lower bract 1.5–2.3 mm long. **N. monosperma**
- 3. Pods with sparse glandular hairs 0.2–0.4 mm long; leaflets 11–24 pairs per pinna; lower bract 5–14.5 mm long. **N. xanthonema**

- 4 Peduncle hairs 0.5–0.9 mm long, eglandular **N. longipila**
4. Peduncle hairs 0.1–0.3 mm long, glandular. **5**
- 5 Erect shrub; some peduncles with 3 or 4 bracts; petiole nectary absent **N. valida**
5. Prostrate shrub; all peduncles with 2 bracts; petiole nectary usually present . . . **N. scutata**
- 6 Most or all petioles with a nectary **7**
6. No petioles with a nectary **11**
- 7 Pods 8–15-seeded **8**
7. Pods 1–5-seeded. **9**
- 8 Semi-aquatic plant; leaflets 11–18 mm long ***N. plena**
8. Terrestrial plant; leaflets 2.9–4.5 mm long **N. javanica**
- 9 Upright shrub; stipules deciduous; leaf pinnae with 23–39 pairs of leaflets **N. major**
9. Prostrate shrubs; stipules persistent; leaf pinnae with 10–20 pairs of leaflets **10**
- 10 Stems hairy; leaves with 3–5 pairs of pinnae; pods with short (0.1–0.2 mm) eglandular hairs along margin **N. dimorphantha**
10. Stems glabrous; leaves with (1 or) 2 pairs of pinnae; pods glabrous **N. paucijuga**
- 11 Largest leaflets 8.2–18 mm long **12**
11. Largest leaflets 3–8.2 mm long **14**
- 12 Plants semi-aquatic, with inflated floating stems; fruits 12–15 seeded ***N. plena**
12. Plants terrestrial, stems not inflated; fruits 2–7 seeded **13**
- 13 Fruiting peduncles 61–110 mm long; stems and peduncles with long spreading hairs; lower peduncle bract 5–9 mm long **N. insignis**
13. Fruiting peduncles 36–52 mm long; stems and peduncles glabrous or with short puberulous hairs; lower peduncle bract 11–19 mm long **N. amplexicaulis**
- 14 Peduncle bracts lanceolate, both on the middle one-third of peduncle. **N. hispida**
14. Peduncle bracts ovate to broadly ovate, on the proximal one-third of peduncle, or absent **15**
- 15 Leaves with 4–6 pairs of pinnae; rachises with straight or curved antrorse hairs 0.2–0.5 mm long **N. heliophila**
15. Leaves with 1–3(–4) pairs of pinnae; rachises glabrous or with patent hispid hairs **16**
- 16 Petioles 10–17 mm long; fruiting peduncles 50–105 mm long **N. gracilis**
16. Petioles 3–9 mm long; fruiting peduncles 20–59 mm long. **17**
- 17 Peduncle bracts consistently absent; pods 6–9-seeded, surface glabrous **N. tactilis**
17. One bract present on some peduncles; pods 3–6-seeded, surface with many patent glandular hairs **N. proxima**

1. *Neptunia amplexicaulis* Domin, *Biblioth. Bot.* 22(89): 801, t. 24 (1926).

Type citation: “open grassland at Hughenden, a robust, big form; at the Flinders River at Hughenden, a small form.” **Type:** Australia. Queensland. BURKE DISTRICT: in grassy areas opposite Hughenden, February 1910, *K. Domin s.n.* (lecto: PR 527689 [here designated]; isolecto: PR 527688).

Shrub, perennial, terrestrial. Stems prostrate or sprawling, to 0.35 m high, glabrous or pubescent. Stipules persistent, broadly ovate, 12–20 mm long, 6–10 mm broad, coriaceous, strongly nerved, glabrous or pubescent; apex attenuate; base obliquely cordate. Leaves with 2–4 pairs of pinnae; petioles 13–20 mm long, glabrous or pubescent, nectary absent; rachis 14–36 mm long, glabrous or pubescent, nectary absent; rachis extension linear, 6–9.5 mm long; pinnae with 7–15 pairs of leaflets, rachilla extension 2.6–5.3 mm long; stipels usually linear, 0.3–0.6 mm long, but rarely (at lowest node) expanded into a broadly elliptical structure up to 2 mm long. Largest leaflets 10–16 mm long, 3.5–6.7 mm wide, 2.2–4 times longer than broad, glabrous or pubescent, venation of 3 or 4 main veins, obvious on lower surface. Inflorescences globose, all, or most, with dimorphic flowers; peduncles 15–50 mm long at anthesis, 36–52 mm long at fruiting stage, glabrous or pubescent; bracts 2, at least the lower one positioned on proximal one-third of peduncle, persistent, ovate to broadly ovate, lower one 11–19 mm long, glabrous or pubescent; flowers 25–50 per spike; bracteole linear to lanceolate, 2.2–3.8 mm long, persistent. Bisexual flowers: calyx campanulate, 1.3–2.4 mm long, glabrous or pubescent; petals 2.8–3.5 mm long, glabrous or sparsely hairy; stamens 5, filaments 3.6–4 mm long, anthers 0.6–0.9 mm long, terminal gland not seen; style 2.4–2.6 mm long, glabrous. Neuter flowers: calyx 1.2–1.3 mm long; petals 2.1–2.5 mm long, glabrous or sparsely hairy; staminodes 5, 9–10 mm long, 0.7–0.8 mm wide. Pods oblong, 2–6-seeded, 16–25 mm long, 9–12 mm broad, indehiscent, stipe 1–2.5 mm long, apex obtuse; glabrous or pubescent with hairs 0.15–0.3 mm long. Seeds

broadly elliptical to orbicular in outline, 5–5.3 mm long, 4.2–4.8 mm wide, brown to black. *Selenium weed*.

Affinities: *Neptunia amplexicaulis* is morphologically similar to *N. insignis*. Both have two or three pairs of pinnae, few leaflets per pinna, no nectaries, and large leaflets. *Neptunia insignis* differs by the long spreading hairs on the stems and peduncles (glabrous or with short puberulous hairs for *N. amplexicaulis*); the stipules 4–7.5 mm long (12–20 mm long for *N. amplexicaulis*); the bracteoles and calyx with a few hairs (glabrous for *N. amplexicaulis*); the lower bracts 5–9 mm long (11–19 mm long for *N. amplexicaulis*); and the fruiting peduncles 61–110 mm long (36–52 mm long for *N. amplexicaulis*).

Typification: Domin evidently made two gatherings of *Neptunia amplexicaulis* in the Hughenden area; a robust form from the grasslands, and a small form from the Flinders River (Domin 1926). A specimen from the “grassland” gathering is here designated as lectotype.

1a. *Neptunia amplexicaulis* Domin f. **amplexicaulis**, Windler, *Aust. J. Bot.* 14: 408 (1966).

Illustrations: Windler (1966: 406); Cowan (1998: 22).

Stems, leaves, peduncles, ovaries and pods glabrous. **Fig. 1.**

Additional specimens examined: Australia. Queensland. BURKE DISTRICT: Kilterry, N of Richmond, Mar 2009, *Fensham 5856* (BRI); W of Swanson Street, Hughenden, Jun 2021, *Bean 34162* (BRI, CANB, MO, NY); ‘Silver Hills’, Richmond, Mar 1960, *McCray s.n.* (BRI [AQ235509]); near Ranmoor, 35 km N of Richmond, May 1974, *Byrnes 3064* (BRI); Gravel pit 11 km NW of Richmond, May 1974, *Byrnes 3043* (BRI); Flinders Highway, 19 km W of Hughenden, Jun 1998, *Bean 13356* (BRI); “Dunluce”, Hughenden, May 1963, *Johnston s.n.* (BRI [AQ235495]); 60 miles [97 km] NW of Maxwelton, Mar 1964, *Entwistle s.n.* (BRI [AQ235490]); ‘Sutherland’, 30 miles [48 km] N of Maxwelton, *s.dat.*, *Murray & Derrington s.n.* (BRI [AQ235488]); ‘Yan Yean’, c. 18 miles [29 km] NW of Richmond, Apr 1954, *Everist 5364* (BRI); ‘Lydia Downs’, c. 45 miles [72 km] NW of Maxwelton, Jan 1966, *Pedley 1967* (BRI); Telemon, 16 miles [26 km] NW of Hughenden, May 1958, *Skerman s.n.* (BRI [AQ235489]).



Fig. 1. Flowering branchlet of *Neptunia amplexicaulis* f. *amplexicaulis* (Bean 34162, BRI). Photo: A.R. Bean.

Distribution and habitat: *Neptunia amplexicaulis* f. *amplexicaulis* is endemic to northern Queensland, Australia, where it is restricted to an area between Hughenden and Cloncurry (**Map 1**). It inhabits dark cracking-clay soils that often have a high concentration of compounds with selenium content.

Phenology: Flowers are recorded from December to June; fruits are recorded from December to July.

1b. *Neptunia amplexicaulis* f. *richmondii* Windler, *Aust. J. Bot.* 14: 408 (1966).

Type: Australia. Queensland. BURKE DISTRICT: ‘Silver Hills’, Richmond, 23 March 1960, *W. McCray s.n.* (holo: BRI [AQ0022907]).

Stems, leaves, peduncles, ovary and pods with dense pubescent eglandular hairs 0.2–0.5 mm long. **Figs. 2D, 2E.**

Additional specimens examined: Australia. Queensland. BURKE DISTRICT: Flinders River, 20° 41’S 143° 08’E, Jul 1891, *Plant 380* (BRI); Silver Hills Station, Richmond, May 1974, *Byrnes 3011* (BRI); Gravel pit 11 km NW of Richmond, May 1974, *Byrnes 3044* (BRI); ‘Silver Hills’, Richmond, Apr 1970, *Murphy s.n.* (BRI [AQ235504]); c. 30 miles [48 km] WNW of Hughenden, 3 miles [5 km] SE of Telemon HS, Sep 1967, *McCray s.n.* (BRI [AQ235511]); 5 miles [8 km] NW of Richmond, ‘Yan Yean’ HS, Sep 1967, *McCray s.n.* (BRI [AQ235519]); c. 20 km NNW of Richmond on ‘Silver Hills’, Apr 1973, *Henderson H1927* (BRI); near Ranmoor, 35 km N of Richmond, May 1974, *Byrnes 3063* (BRI).

Distribution and habitat: *Neptunia amplexicaulis* f. *richmondii* is endemic to northern Queensland, Australia. Most records are within 30 km of Richmond, while there is a single record c. 45 km WNW of Hughenden (**Map 1**). It grows in grassland communities on flat or undulating terrain. The soils are heavy clays that have a high selenium content (Harvey *et al.* 2020).

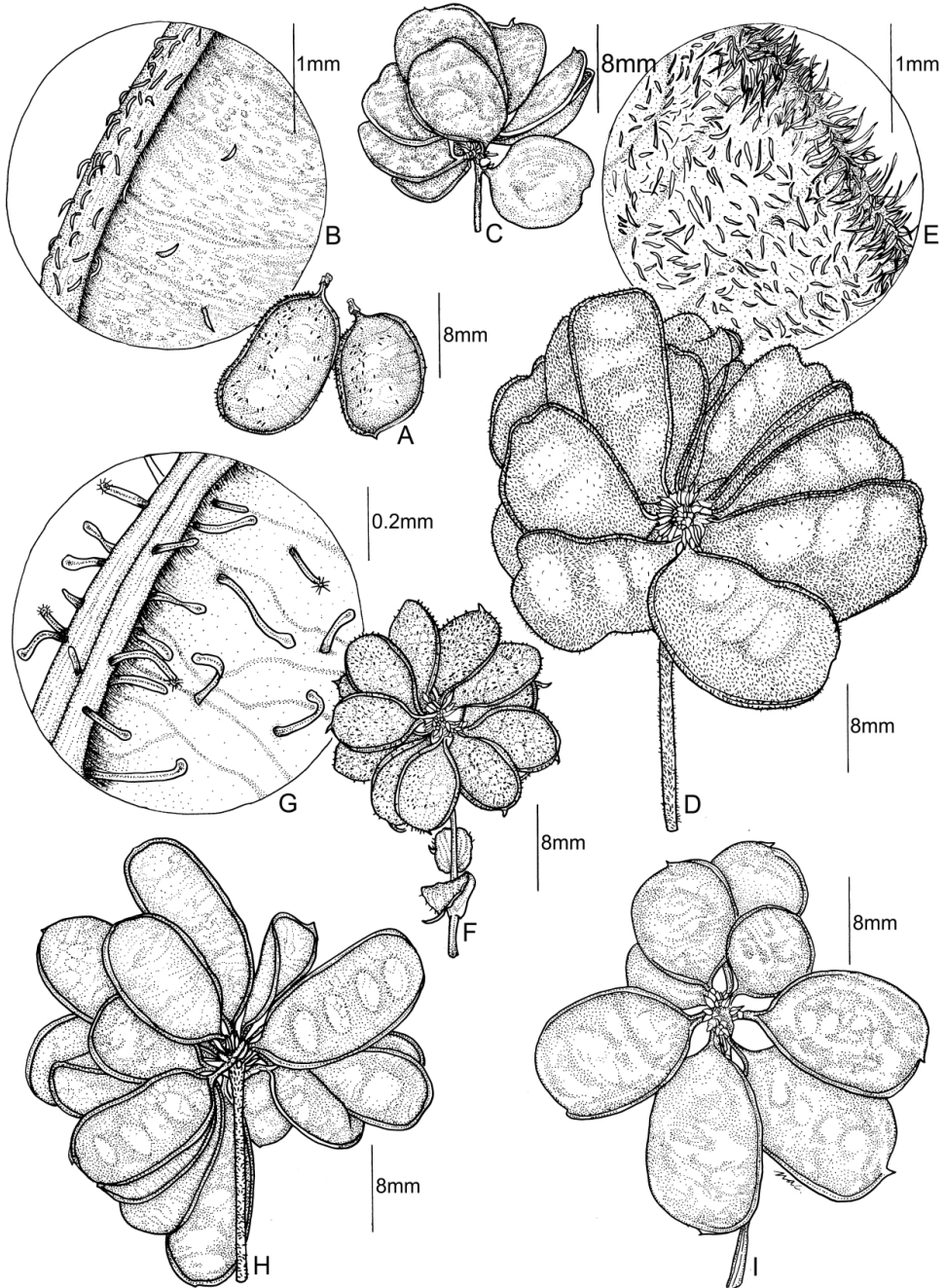


Fig. 2. *Neptunia dimorphantha*. A. pods B. indumentum on pod margin. *N. paucijuga*. C. group of pods. *N. amplexicaulis* f. *richmondii*. D. pods. E. pod indumentum. *N. xanthonema*. F. pods and peduncle bracts. G. pod indumentum. *N. heliophila*. H. pods. *N. major*. I. pods. A & B from *Hirst* 49 (DNA); C from *Michell & Risler* 2338 (DNA); D & E from *Byrnes* 3063 (BRI); F & G from *Bean* 26282 (BRI); H from *Bean* 9866 (BRI); I from *Clarkson* 6977 & *Simon* (BRI). Del. N. Crosswell.

Phenology: Flowers are recorded for March, May, September and October; fruits recorded from March to December.

Affinities: *Neptunia amplexicaulis* f. *richmondii* differs consistently from *N. amplexicaulis* f. *amplexicaulis* only by the indumentum. The two forms have been recorded growing together at Silver Hills Station (consecutive collections by *McCray* and *Byrnes*), near Ranmoor (*Byrnes* 3063 & 3064) and at a gravel pit north-west of Richmond (*Byrnes* 3043 & 3044), but no intergrades are known.

Notes: Windler (1966) stated that *Neptunia amplexicaulis* f. *amplexicaulis* has “stipels large, leaf-like”, while in *N. amplexicaulis* f. *richmondii* they are absent. My study indicates that leaf-like stipels are only rarely present in *N. amplexicaulis* f. *amplexicaulis*, and hence are of no practical value in distinguishing the two formae.

2. *Neptunia dimorphantha* Domin, *Biblioth. Bot.* 22(89): 802 (1926).

Neptunia dimorphantha var. *dimorphantha*, Domin, *Biblioth. Bot.* 22(89): 802 (1926).

Type citation: “Queensland: grassige Stellen auf den Karsthügeln bei Chillagoe (DOMIN II. 1910)” (translation: grassy spots on the Karst hills opposite Chillagoe). **Type:** Australia. Queensland. COOK DISTRICT: Chillagoe, February 1910, *K. Domin s.n.* (lecto: PR 527698 [here designated]; isolecto: PR 527699).

Neptunia gracilis f. *glandulosa* Windler, *Aust. J. Bot.* 14: 416 (1966). **Type:** Australia. Northern Territory. Barkly Tableland, 26 miles [42 km] SW of Beetaloo, 10 March 1959, *G.M. Chippendale NT5438* (syn: DNA A0005438; NSW 404600; SIU, *n.v.*), **syn. nov.**

Shrub, perennial, terrestrial. Stems prostrate, sparsely hairy, sessile glands present. Stipules persistent, ovate, 5.2–6.3 mm long, 1.4–2.6 mm broad, coriaceous, strongly nerved, glabrescent; apex attenuate; base obliquely cordate. Leaves with 3–5 pairs of pinnae; petioles 8–13 mm long, sparsely hairy, with a small or large circular nectary just below first pair of pinnae; rachis 15–28 mm long, with

sparse tubercle-based hairs, nectary absent; rachis extension linear, 2–2.7 mm long; pinnae with 14–20 pairs of leaflets, rachilla extension 0.8–1.3 mm long; stipels slender, 0.1–0.8 mm long, bifurcated, glandular. Largest leaflets 4.2–8.5 mm long, 1.1–1.9 mm wide, 3–5.3 times longer than broad, with marginal cilia, venation of 1–3 main veins, more obvious on abaxial surface. Inflorescences globose, some with dimorphic flowers; peduncles 25–90 mm long at anthesis, 42–90 mm long at fruiting stage, with sparse, antrorse eglandular hairs throughout, 0.25–0.5 mm long; bracts 2, positioned on proximal one-third of peduncle, persistent, broadly ovate, amplexicaul, lower one 3.2–8.5 mm long, glabrous or sparsely hairy, margin ciliate; flowers 24–40 per inflorescence; bracteoles oblanceolate, 1.4–1.6 mm long, caducous or persisting until anthesis. Bisexual flowers: calyx campanulate, 1–1.5 mm long, glabrous; petals 1.7–2.2 mm long, glabrous; stamens 5, filaments 2.7–3 mm long, anthers 0.7–0.8 mm long, terminal gland present; style 2–2.5 mm long, glabrous; ovary hairy along the margins only. Neuter flowers: calyx 0.5–0.8 mm long; petals 1.3–2 mm long, glabrous; staminodes 5, 8.5–14 mm long, 0.7–0.9 mm wide; gynoecium absent. Pods circular to elliptical, 1–3-seeded, 8–16 mm long, 7–9.5 mm broad, indehiscent, stipe 1–2 mm long, apex obtuse to mucronate; usually glabrous, but with sparse to dense curved eglandular hairs along pod margin (0.1–0.2 mm long), most often near base of style. Seeds broadly elliptical in outline, 3.5–3.7 mm long, 2.7–2.8 mm wide, brown. **Figs. 2A–B, 4F.**

Additional specimens examined: Australia. Western Australia. At camp, Mornington Wildlife Sanctuary, Jan 2006, *Legge 731* (PERTH); Karunje Station, Kimberleys, Oct 1954, *Rust 63K* (CANB); Kimberley Research Station, East Kimberley, Jul 1950, *Langfield 217* (CANB). Northern Territory. S side of Lomariem Lagoon, Limmen NP, Apr 2009, *Hirst 49* (DNA); 22 km N of Connells Bore, Jun 1982, *Latz 9270* (DNA); N of Camerons Bore, Cattle Creek Station, May 2004, *Cowie 10254 & Brocklehurst* (DNA); Wyndham Road, 4 miles [6 km] SW of Katherine, Jan 1964, *Adams 835* (BRI, CANB, DNA, L); Southern tributary of Broadarrow Creek, c. 75 km SSW of Bullita Outstation, Gregory NP, Apr 1996, *Duretto 899* (DNA, MEL); 20 km W of Kalkarindji, Mar 1992, *Williams 213* (DNA); Mataranka Reserve, May 1977, *Must 1472* (DNA); Jilkminggan, headwaters of Roper River, Feb 1990, *Wightman &*

Jackson 4977 (DNA); c. 40 km W of Kalkarindji off the Buntine Highway, near Burta, Mar 2012, *Lewis 1912* (CANB, DNA, NSW); 6 miles [10 km] W of Armchair Bore, Brunette Downs, Mar 1956, *Chippendale 1970* (AD, CANB, DNA); O.T. Station, May 1947, *Blake 17697* (BRI, CANB). **Queensland.** COOK DISTRICT: Brooklyn, 9.1 km WNW of Mt Carbine on Peninsula Developmental Road, Feb 2008, *Jensen 1607* (BRI); 21 km from Mt Surprise on O'Briens Gemfields Road, Feb 1996, *Forster PIF18495 & Ryan* (BRI); Chillagoe Creek, Chillagoe, Jun 2021, *Bean 34073* (BRI); Royal Arch Cave track, Chillagoe – Mungana Caves NP, Mar 2008, *McDonald KRM7336 & Little* (BRI); Talaroo Station, laneway to hay paddock, Mar 2017, *McDonald KRM19111 & Morrison* (BRI). BURKE DISTRICT: Finucane Island NP, 29 km NE of Burketown, May 2005, *Booth 4255 & Thompson* (BRI); c. 30 km W of Burke & Wills Roadhouse on Wills Development Road, Feb 2005, *Fox IDF3438 et al.* (BRI); Yelvertoft Station, c. 45 miles [72 km] SE of Camooweal, May 1963, *Gittins 784A* (BRI); 'Woodlands', on western side of Punchbowl Road, c. 60 km NW of Julia Creek township, Apr 2001, *Johnson & Kelman s.n.* (BRI [AQ733048]). NORTH KENNEDY DISTRICT: corner Ingham Road & Ronald Street, Garbutt, Townsville, Mar 2000, *Gunther 181/2* (BRI); 1.5 km W of Bohle River on Hervey Range Road, W of Townsville, Jan 1996, *Cumming 13941* (BRI).

Distribution and habitat: *Neptunia dimorphantha* is endemic to Australia and known from a few collections in the Kimberley region of Western Australia, but widespread in Northern Territory and Queensland (extending to the north-east coast at Townsville) (**Map 2**). It grows in grassland or open eucalypt woodland on grey to black clay soils, or sometimes on loamy soil derived from limestone, and prefers sites close to creeks or waterholes.

Phenology: Flowers are recorded from December to May; fruits from January to June.

Affinities: *Neptunia dimorphantha* and *N. gracilis* both have relatively long peduncles and long staminodes. The former differs from *N. gracilis* by the presence of a nectary on the petiole (nectary absent for *N. gracilis*); the 1–3 seeds per pod (3–6 seeds for *N. gracilis*); pods glabrous except for hairs mainly on the margins (pods either glabrous throughout or puberulous throughout for *N. gracilis*); and the peduncle with 2 bracts (no bracts or 1 bract for *N. gracilis*).

Typification: In naming *Neptunia gracilis* f. *glandulosa*, Windler (1966) cited two specimens from one gathering as the type (at DNA and SIU), but did not indicate either specimen as the holotype. Those specimens, therefore are syntypes (Turland *et al.* 2018, Art. 40.2, Note 1), as is another duplicate at NSW.

Notes: The name *Neptunia dimorphantha* has for many years been misapplied to four species with short peduncles and glandular hairs covering the fruit surface (*N. longipila*, *N. scutata*, *N. valida* and *N. xanthonema*), all newly named in this paper. The type specimens of both *N. dimorphantha* and *N. gracilis* f. *glandulosa* have relatively long peduncles, a nectary at the top of the petiole, and fruits with short curved eglandular hairs mainly along the margins; they clearly belong to the same taxon.

A specimen collected from Timor in 1962/63 by R. Cinatti (at L) was determined by M. Lavaleye as *Neptunia dimorphantha* and confirmed as that by I. Nielsen for the *Flora Malesiana* (Nielsen 1992). I have examined this flowering specimen and find that it is not *N. dimorphantha* because of its short peduncles and glabrous ovary. The specimen appears to have much in common with *N. major* (flowering peduncles 20–28 mm long, with two bracts; stems and leaves virtually glabrous; large nectary at the apex of the petiole). However, it has fewer leaflets per pinna than *N. major* and the stems on the specimen are thin and curved, suggesting a decumbent or prostrate habit. *Neptunia major* is an erect shrub and specimens of it typically display thick straight stems. It is not possible at this stage to reliably classify the specimen from Timor.

3. *Neptunia gracilis* Benth., *J. Bot. (Hooker)* 4: 355 (1841).

Neptunia gracilis var. *typica* Domin, *Biblioth. Bot.* 22(89): 802 (1926), *nom. illeg.*; *N. gracilis* f. *gracilis*, Windler, *Aust. J. Bot.* 14: 414 (1966). **Type citation:** “Australia, Bauer, Mitchell”. **Type:** [Australia. New South Wales] Interior of New Holland, *s.dat.* [1835 or 1836], *T. Mitchell s.n.* (lecto: K 000791032 [here designated]; isolecto: P 02735407, W 0028233, W 0028231).

Neptunia depauperata Merr., *Philipp. J. Sci. Sect. C. Botany* 13(3): 16 (1918). **Type:** Philippines. LUZON: Ilocos Norte Province, Burgos, 13 March 1917, *M. Ramos 27169* (syn: K 000295941 *i.d.v.*; syn: BM 000946904 *i.d.v.*; syn: NY *i.d.v.*; syn: P 02436150 *i.d.v.*).

Illustrations: Windler (1966: 413); Pedley (1983: 335); Murray (1991: 380).

Shrub, perennial, terrestrial. Stems prostrate, glabrous, or with hispidulous hairs 0.1–0.2 mm long, or rarely with hispid hairs 0.2–0.5 mm long; sessile glands present or absent. Stipules persistent, broadly ovate, 2.5–5.2 mm long, 1.8–2.3 mm broad, coriaceous, strongly nerved, glabrous; apex attenuate; base obliquely cordate. Leaves with 2 or 3(–4) pairs of pinnae; petioles 10–17 mm long, glabrous or hispidulous, nectary absent; rachis 9–21 mm long, with sparse tubercle-based hairs or hispidulous hairs, nectary absent; rachis extension linear, 1.8–2.4 mm long; pinnae with 12–17 pairs of leaflets, rachilla extension 1–1.2 mm long; stipels slender, 0.4–1.3 mm long, entire or divided, gland-tipped. Largest leaflets 5.4–8.2 mm long, 1.1–2.2 mm wide, 3.4–5 times longer than broad, glabrous or with small marginal cilia, venation of 1–3 main veins, more obvious on lower surface. Inflorescences globose, some with dimorphic flowers; peduncles (25–)40–90 mm long at anthesis, 50–105 mm long at fruiting stage, glabrous throughout or with sparse tubercular hairs; bracts absent or 1, positioned on proximal one-third of peduncle, persistent, ovate, amplexicaul, 2.5–9.5 mm long, with hispid hairs on margin; flowers 12–25 per inflorescence; bracteoles oblanceolate, 0.9–2 mm long, persisting until anthesis. Bisexual

flowers: calyx campanulate, 1.3–1.9 mm long, glabrous; petals 2.5–2.8 mm long, glabrous; stamens 5, filaments 2–2.5 mm long, anthers 0.7–0.9 mm long, terminal gland absent; style 2.3–3 mm long, glabrous; ovary glabrous or hairy. Neuter flowers: calyx 0.6–0.8 mm long; petals 1.8–2.1 mm long, glabrous; staminodes 5, 7–13 mm long, 0.5–0.9 mm wide. Pods oblong, 3–6-seeded, 13–24 mm long, 6.5–8.5 mm broad, dehiscent along both margins, stipe 1–2 mm long, apex obtuse; glabrous or with dense patent hairs 0.1–0.3 mm long, or rarely with hispid hairs 0.3–0.8 mm long. Seeds broadly elliptical in outline, 3.5–3.9 mm long, 2.8–3 mm wide, dark brown.

Additional selected specimens examined: Philippines. LUZON: Burgos, Ilocos Norte Province, Jul 1918, *Ramos 32898* (US). **Indonesia.** LESSER SUNDA ISLANDS: Soenda, Flores, Nov 1967, *Schmutz 1888* (L); Manggarai, West Flores, 8° 34'S 116° 37'E, Mar 1982, *Schmutz 5027* (L). WEST TIMOR: Fatukopa, 9° 18'S 124° 47'E, Jan 1967, *Kooy 271* (L). **Papua New Guinea.** CENTRAL PROVINCE: Moitaka, Dec 1964, *Gillison NGF22061* (BRI, CANB, L); Oval, UPNG Campus, Mar 1972, *Stevens UPNG1371* (L). **Australia. Queensland.** COOK DISTRICT: Mt Molloy, Apr 1962, *McKee 9123* (BRI); Alma-den to Mount Surprise Road, 8.8 km N of the Gulf Development Road, Jun 2021, *Bean 34105* (BRI; MEL, NSW, US, *distribuendi*). BURKE DISTRICT: Bowthorn Station, 32.9 km NW of Bowthorn HS, Jun 2006, *Thompson WES647 & Hogan* (BRI). NORTH KENNEDY DISTRICT: Valley of Lagoons, 1.8 km from the Ingham Road on the road to Lake Lucy, Apr 1989, *Clarkson 7936 & Henderson* (BRI, CNS, K). SOUTH KENNEDY DISTRICT: Mt Blackjack, ‘Weetalaba’, Feb 1994, *Bean 7322 & Forster* (BRI). LEICHHARDT DISTRICT: c. 4 miles [6 km] E of Moura, Mar 1967, *Henderson 226* (BRI). PORT CURTIS DISTRICT: Shoalwater Bay training area, Pine Mountain sector, Stevens Road, Apr 2011, *Halford QM271 & Bean* (BRI); State Forest 60, Rundle Range, Nov 1987, *Gibson 936* (BRI). BURNETT DISTRICT: 14 km from Murgon, towards Nanango, Nov 1996, *Bean 11377* (BRI, MEL). WIDE BAY DISTRICT: Booyal Hall, W of Childers, Nov 2001, *Bean 18037* (BRI); Elliot Heads, Nov 1978, *Stanley 78146 & Ross* (BRI). MARANOVA DISTRICT: Noonduo, Feb 1950, *Everist 4288* (BRI). DARLING DOWNS DISTRICT: Lake Broadwater, 25 km SW of Dalby, Nov 1984, *Ballingall NHA512* (BRI); 11 km N of Warra, Feb 1995, *Fensham 2065* (BRI). MORETON DISTRICT: Ipswich, Jan 1878, *Bailey s.n.* (BRI [AQ235558]); Hays Landing, Wivenhoe Dam, Feb 2020, *Phillips 3022 & Phillips* (BRI). **New South Wales.** 10 km NNE of Ashley on the Boggabilla Road, Mar 1987, *Coveny 12531 et al.* (MEL, NSW); 14 miles [23 km] N of Nyngan, Dec 1973, *Cunningham 1659* (NSW); ‘Iolanthe’, 16 miles [26 km] W of Garah, Dec 1970, *Solling s.n.* (NSW 580902); Mitchell Highway, 6 miles [10 km] SSE of Dubbo towards Wellington, Nov 1969, *Coveny 2506* (CANB, NSW).

Distribution and habitat: In Malesia, *Neptunia gracilis* is known from northern Luzon in the Philippines, the islands of Flores and Timor in Indonesia, and in the vicinity of Port Moresby in Papua New Guinea. In Australia, it is a common species in the eastern half of Queensland south from the Atherton Tableland, with two disjunct records in the far north-west of the state and is also in the north-east of New South Wales as far south as Tuggerah Lake, near Gosford (**Map 3**). It has also been recorded from southern Taiwan (Huang & Huang 1996). Away from the coast, it typically inhabits heavy clay soils in grassland or open eucalypt woodland, but it also occurs in loamy or sandy-loam soils in coastal areas.

Phenology: Flowers and fruits are mostly recorded between October and April in Australia, with few records from other months of the year.

Affinities: The name *Neptunia gracilis* has been broadly applied to any small-leaved *Neptunia* without a nectary on the petiole, or even with a nectary, in the case of *N. gracilis* f. *glandulosa*. Here it is restricted to plants having dimorphic inflorescences, leaves with 2 or 3 or sometimes 4 pairs of pinnae, long peduncles bearing one bract or without bracts, and bisexual flowers with 5 stamens. It is perhaps most closely related to *N. heliophila*, as both lack a petiole nectary, have neuter flowers with five staminodes, and relatively long peduncles. *Neptunia heliophila* differs by the two bracts on the peduncle (except for specimens from the Pilbara region of Western Australia which frequently have only one); stems, rachises and peduncles with antrorse hairs (stems and peduncles either glabrous or with patent hairs for *N. gracilis*), leaf pinnae 4–6 pairs (2 or 3 pairs, sometimes 4 for *N. gracilis*), and 25–40 flowers per inflorescence (12–25 flowers for *N. gracilis*).

Typification: Cowan (1996) published a paper in which he typified many names in the Mimosaceae. For *Neptunia gracilis* (described by Bentham in 1841), he designated as lectotype a specimen collected by Thomas Mitchell in 1846. This specimen was obviously not available to Bentham when

he was describing the species, hence it is not original material and Cowan's attempted lectotypification is ineffective.

A specimen collected from Mitchell's second or third expedition (which took place in 1835 and 1836 respectively) is here designated as the lectotype. The label of the lectotype at K has printed on it "Interior of New Holland/ Major Mitchell's Expedition, 183 .". Handwritten notes have been added saying "*Neptunia gracilis* Benth in Hook. Journ. 4.355" and "Lindley 8 [i.e. 1838]". This indicates that the specimen was received by Kew from John Lindley in 1838. Mitchell had sent all his botanical specimens directly to Lindley, who then described some of them as new species in Mitchell's journal (Mitchell 1838) and distributed specimens to major herbaria.

The isolectotype at P has the identical printed label, and the handwritten addition says "M[onsieur] Lindley 1838". The isolectotypes at W have the same printed label, plus a handwritten "1839.V./ Lindley" indicating that they received the specimens from Lindley in (May?) 1839.

Notes: *Neptunia gracilis* as circumscribed here has three morphological forms; 1. the most common form with glabrous stems, glabrous peduncles and glabrous pods; 2. a form with dense hairs 0.1–0.3 mm long on stems, sparse tubercle-based hairs on peduncles and dense puberulous hairs on the pods; 3. an uncommon form with hispid hairs 0.3–0.8 mm long on stems, peduncles and pods. Forms 1 & 2 apparently grow in mixed populations, as *Fensham 2065* (BRI) comprises one branchlet of each. Form 3 can be confused with *N. proxima*, but the latter has inflorescences comprised entirely of bisexual flowers, shorter petioles and peduncles, and smaller leaflets.

4. *Neptunia heliophila* A.R.Bean sp. nov.

Differing from *Neptunia gracilis* by the two bracts on the peduncle; the stems, rachises and peduncles with crisped antrorse hairs, the greater number of flowers (25–40) per inflorescence, and the leaves commonly having a greater number (4–6 pairs) of pinnae. **Typus:** Australia. Queensland. MARANOA DISTRICT: 7.2 km E of St George, junction of Carnarvon Hwy [Highway] and road to Dirranbandi, 8 December 2001, *D. Halford Q7680* & *G.N. Batianoff* (holo: BRI [AQ783984 comprising 1 sheet]; iso: MEL 2196385A, NSW 672784).

Neptunia gracilis var. *villosula* Benth., *Fl. Austral.* 2: 300 (1864). **Type:** [Australia. Western Australia/Northern Territory] Sturt's Creek, [in 1855], *F. Mueller s.n.* (lecto: K 000791029, lower right-hand specimen, *vide* Cowan 1996: 14).

Shrub, perennial, terrestrial. Stems prostrate, sprawling or erect, to 1 m high with sparse to dense antrorse hairs, sessile glands present. Stipules persistent, ovate to broadly ovate, 5.8–6.5 mm long, 2–2.8 mm broad, coriaceous, strongly nerved, ciliate on margins; apex attenuate; base obliquely cordate. Leaves with 4–6 pairs of pinnae; petioles 9–13 mm long, with sparse antrorse hairs, nectary absent; rachis 16–37 mm long, with sparse to dense antrorse hairs 0.2–0.5 mm long, nectary absent; rachis extension linear, 2–4.5 mm long; pinnae with 15–19 pairs of leaflets, rachilla extension 1.5–2.5 mm long; stipels slender, 0.6–2.2 mm long, entire, gland-tipped or not. Largest leaflets 4.6–7.8 mm long, 1.1–2.6 mm wide, 3–5 times longer than broad, glabrous except for marginal cilia, venation of 1–3 main veins, more obvious on lower surface. Inflorescences globose, some with dimorphic flowers; peduncles 35–110 mm long at anthesis, 45–130 mm long at fruiting stage, with sparse to dense antrorse hairs throughout; bracts 2 (rarely 1), positioned on proximal one-third of peduncle, persistent, ovate, amplexicaul, lower one 5.4–8 mm long, with crisped hairs on margin; flowers 25–40 per inflorescence; bracteoles narrowly elliptic, 1.7–2.4 mm long, persisting until anthesis. Bisexual flowers: calyx campanulate, 1.1–1.4

mm long, glabrous; petals 2–2.5 mm long, glabrous; stamens 5, filaments 3.3–3.5 mm long, anthers 0.6–0.8 mm long, terminal gland present; style 1.8–2 mm long, glabrous; ovary glabrous. Neuter flowers: calyx *c.* 0.7 mm long; petals 1.4–1.5 mm long, glabrous; staminodes 5, 8.5–10 mm long, 0.5–0.8 mm wide. Pods oblong to elliptical, 3–6(–8)-seeded, 13–22 mm long, 6–9 mm broad, tardily dehiscent along both sutures, stipe 1–2 mm long, apex obtuse; glabrous. Seeds broadly elliptical in outline, 3.3–4.2 mm long, 3–3.5 mm wide, dark brown to black. **Figs.** 2H, 3A–D.

Additional selected specimens examined: Australia. **Western Australia.** Karunjie Station, Nov 1954, *Rust 63* (PERTH); 30 km on Millewinde Road from Gibb River Road, King Leopold Ranges, Apr 1988, *Simon 4027* (BRI, PERTH); 2 km N of Beverley Springs Station HS, May 1988, *Cranfield 6686* (BRI, PERTH); Mullalang Paddock, Flora Valley Station, Nov 2000, *Craig ABC1628* (PERTH); Munjina Claypan, Juna Downs Station, 15.1 km S of Mt Lockyer, 24.8 km ENE of Mt Windell, 37.4 km N of Packsaddle Hill, Hamersley Range, Sep 1988, *van Leeuwen 3928* (PERTH); *c.* 24 km S of the intersection of Nanutarra to Munjina Road and Hamersley Road, 29.5 km NNE of Tom Price and 118.4 km SE of Silver Grass Peak, May 2011, *Maier & Adam CA006* (PERTH); Winning Pool, Oct 1941, *Gardner 6225* (PERTH). **Northern Territory.** *c.* 168 km SSW of 'Calvert Hills' on road to 'Creswell Downs', May 1974, *Pullen 9282* (CANB); Brunette Downs HS waterhole, Nov 1999, *Brock 50* (NT); 35 km SW of Eva Downs HS, Nov 1999, *Brock 37* (NT); Kidman Springs Station fire plots, Victoria River, Apr 2016, *Lebbink GHL163* & *Cowley* (BRI); Pigeon Hole Station, May 2005, *Risler & Fisher 2748* (DNA); Toplanes paddock, Moolooloo Station, Victoria River district, May 1995, *Van Kerckhof 73* (DNA); Anthony Lagoon, Feb 1998, *Michell & Carrow 1307* (DNA). **Queensland.** BURKE DISTRICT: Calton Hills Station, *c.* 50 km N of Mt Isa, May 2006, *Booth CAM04-23* & *Kelman* (BRI); 12 km W of Richmond on Flinders Highway, May 2016, *McKenzie RAM16/12* (BRI). SOUTH KENNEDY DISTRICT: 2 km N of Natal Downs HS, Jan 1987, *Dorney 49* (BRI). GREGORY NORTH DISTRICT: Crawford Creek, *c.* 45 km SE of Winton on road to Longreach, Aug 2005, *Batianoff 0508448* & *Butler* (BRI, MEL). MITCHELL DISTRICT: Thomson River, 800 m SW of Waterloo HS, Mar 1989, *Emmott 268* (BRI); 30 km from Longreach along Landsborough Highway towards Winton, May 1991, *Telford 11469* (BRI, CANB). LEICHHARDT DISTRICT: Near 'Yandina' turn-off, Arcturus Road, NW of Rolleston, Oct 1998, *Bean 14114* (BRI, NSW). MARANOA DISTRICT: Roma, Feb 1938, *Blake 13291* (BRI, CANB, K, MEXU, NSW); 1.7 km along Bindaroo Road, E of Roma, Apr 2021, *Bean 33909* (BRI, CANB, MEL, NSW). DARLING DOWNS DISTRICT: 15 km along Goodar Road, NW of Goondiwindi, Feb 1996, *Bean 9866* (BRI, MEL); Barwon Highway, *c.* 35 km W of Goondiwindi,

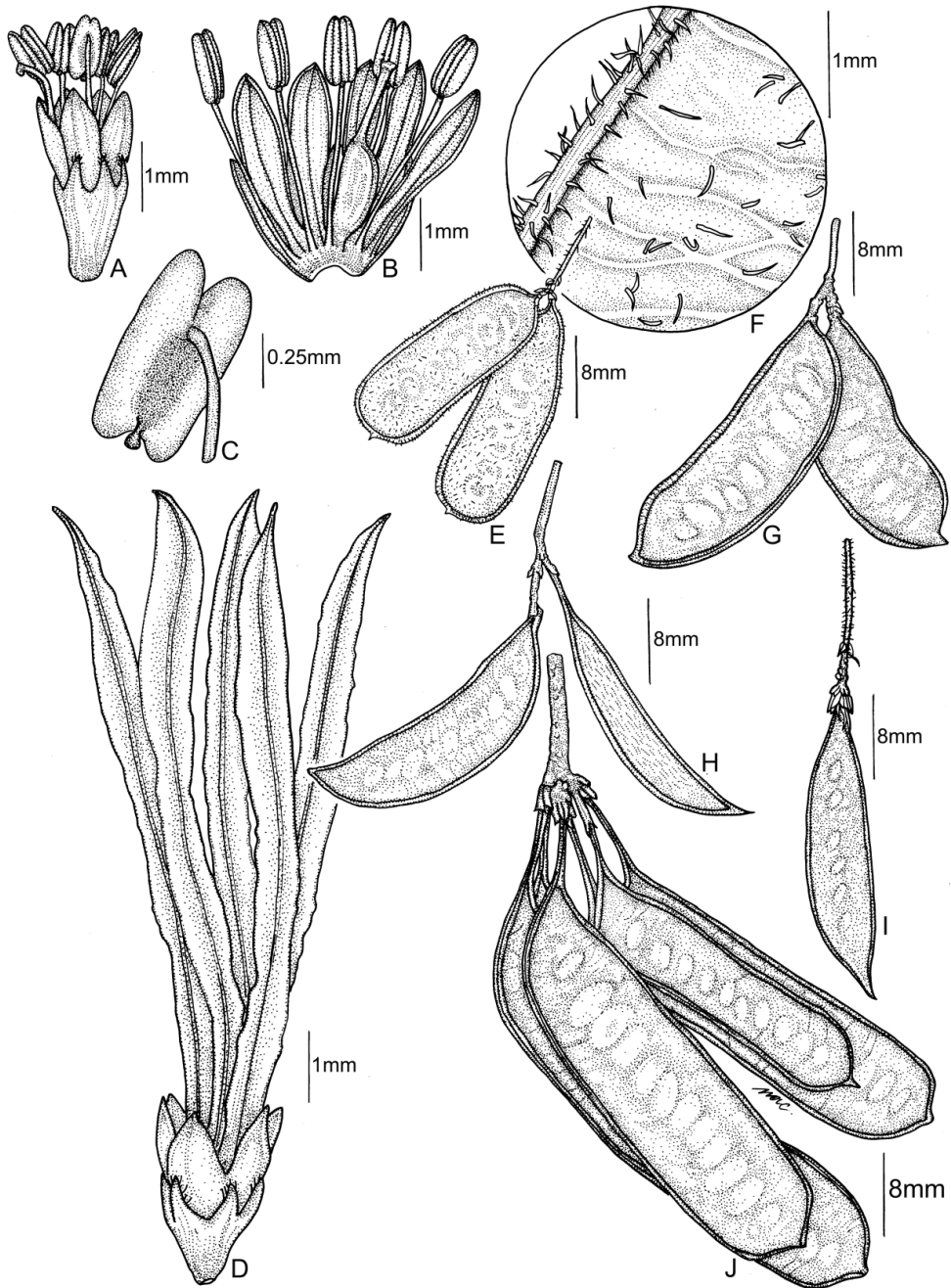


Fig. 3. *Neptunia heliophila*. A. biseexual flower, side view B. biseexual flower, opened out. C. anther. D. neuter flower showing staminodes. *N. proxima*. E. pods. F. pod indumentum. *N. tactilis*. G. pods. *N. javanica*. H. pods. *N. hispida*. I. pod. *N. plena*. J. pods. A–D from *Bean 33909* (BRI); E & F from *Forster PIF44127 & McDonald* (BRI); G from *Brennan 6421* (DNA); H from *Backer 19564* (L); I from *Brennan 6913* (DNA); J from *Mitchell 7041* (BRI). Del. N. Crosswell.

Dec 2001, *Halford Q7818 & Batianoff* (BRI, CANB, NSW). **New South Wales.** 3.6 km NW of Fort Grey turnoff on Binerah Well – Tibooburra road, May 1977, *Donner 5704* (AD); c. 500 m upstream of South Werri Tank, Sturt NP, Mar 1993, *Logan s.n.* (NSW 404883); 28 miles [45 km] N of Bourke on North Collierina Road, Mar 1974, *Millthorpe 1727 & Cunningham* (NSW); S of railway line c. 0.9 km E of the junction of the Quirindi to Gunnedah Road and the Binnaway to Werris Creek Railway line, Jan 2002, *Hosking 2177* (CANB, MEL, NSW). **South Australia.** Margaret Creek, 32 km W of Coward Springs, Mar 1984, *Badman 699* (AD).

Distribution and habitat: *Neptunia heliophila* is endemic to Australia. It is broadly distributed across northern Australia (though sporadically) from the west coast of Western Australia, through much of semi-arid Northern Territory, the north of South Australia, much of Queensland (as far east as Collinsville) and extending south to Werris Creek in New South Wales (**Map 4**). It grows in heavy clay soils in grassland or open eucalypt woodland.

Phenology: Flowers and fruits are recorded from every month of the year except September.

Notes: *Neptunia heliophila* has the most conspicuous stipels of all the Australian and Malesian taxa; they are frequently more than 1 mm long and can reach 2.2 mm in length.

Some populations from the Maranoa district of Queensland and Werris Creek area, N.S.W. (*Hosking 2177*) are notable for their upright or ascending habit, and for occurring in dense colonies, with adjacent plants presumably connected by rhizomes. A specimen from the Northern Territory (*Pullen 9282*) is likewise described as an “erect annual to 80 cm high”.

Etymology: From the Greek *helios* (sun), and *philios* (loving). This refers to the distribution of this species in the part of Australia that receives the most sunlight annually.

5. *Neptunia hispida* A.R.Bean sp. nov.

With affinity to *Neptunia gracilis* but differing by the two lanceolate bracts positioned on the middle one-third of the peduncle; the 9 or 10 stamens; the leaves with 3–5 pairs of pinnae, and most vegetative parts with long hispid hairs. **Typus:** Australia. Northern Territory.

Litchfield National Park, 16 March 1995, *I.D. Cowie 5319 & S. Taylor* (holo: DNA [D0122064 comprising 1 sheet]; iso: MEL 0282099A).

Neptunia ‘Darwin’, *pro parte*: Dunlop *et al.* (1995: 27).

Shrub, perennial, terrestrial. Stems prostrate, with patent hispid hairs 0.4–0.8 mm long, sessile glands absent. Stipules persistent, ovate, 2.8–3.5 mm long, 1.3–2.1 mm broad, chartaceous, faintly nerved, sparsely hairy; apex acute; base cordate, symmetrical. Leaves with 3–5(–6) pairs of pinnae; petioles 8–13 mm long, hispid, nectary absent; rachis 12–33 mm long, with sparse patent hispid hairs, nectaries absent; rachis extension linear, 1.9–2.6 mm long; pinnae with 16–25 pairs of leaflets, rachilla extension 1.4–2.3 mm long; stipels slender, 0.1–0.3 mm long, entire, gland-tipped. Largest leaflets 4.1–6 mm long, 0.8–2 mm wide, 3–5.1 times longer than broad, with a few marginal cilia, venation of 1–3 main veins, more obvious on lower surface. Inflorescences globose, all with dimorphic flowers; peduncles 16–45 mm long at anthesis, 25–47 mm long at fruiting stage, with sparse hispid hairs; bracts 2, positioned on middle one-third of peduncle, usually persistent, lanceolate, ± equal, base obtuse, lower one 2.2–4.1 mm long, sparsely hairy on margins; flowers 18–26 per inflorescence; bracteoles oblanceolate, 0.9–1.6 mm long, caducous, usually falling before anthesis. Bisexual flowers: calyx campanulate, 1.5–2.2 mm long, ciliate; petals 2.5–3.1 mm long, glabrous; stamens 9–10, filaments 5–5.2 mm long, anthers 0.7–1 mm long, terminal gland prominent; style 3.3–5.5 mm long, glabrous; ovary glabrous. Neuter flowers: calyx 1.8–2.2 mm long; petals 1.9–2 mm long, glabrous; staminodes 7–10, 6.2–6.4 mm long, 0.6–0.8 mm wide. Pods oblong to elliptical, 3–7-seeded, 18–31 mm long, 7–8 mm broad, dehiscent along one margin only, apex acute to obtuse, stipe 2–6 mm long; glabrous. Mature seeds not seen. **Figs. 3I, 4B, 4D.**

Additional specimens examined: Australia. Northern Territory. Melville Island, Nov 1986, *Fensham 380* (DNA); [*ibid*, Melville Island, Apr 1986, *Fensham 102* (DNA)]; *ibid*, Apr 1986, *Johnson 4203* (BRI, DNA)]; Milikipiti Road, Melville Island, Feb 2018, *Hirst 359*

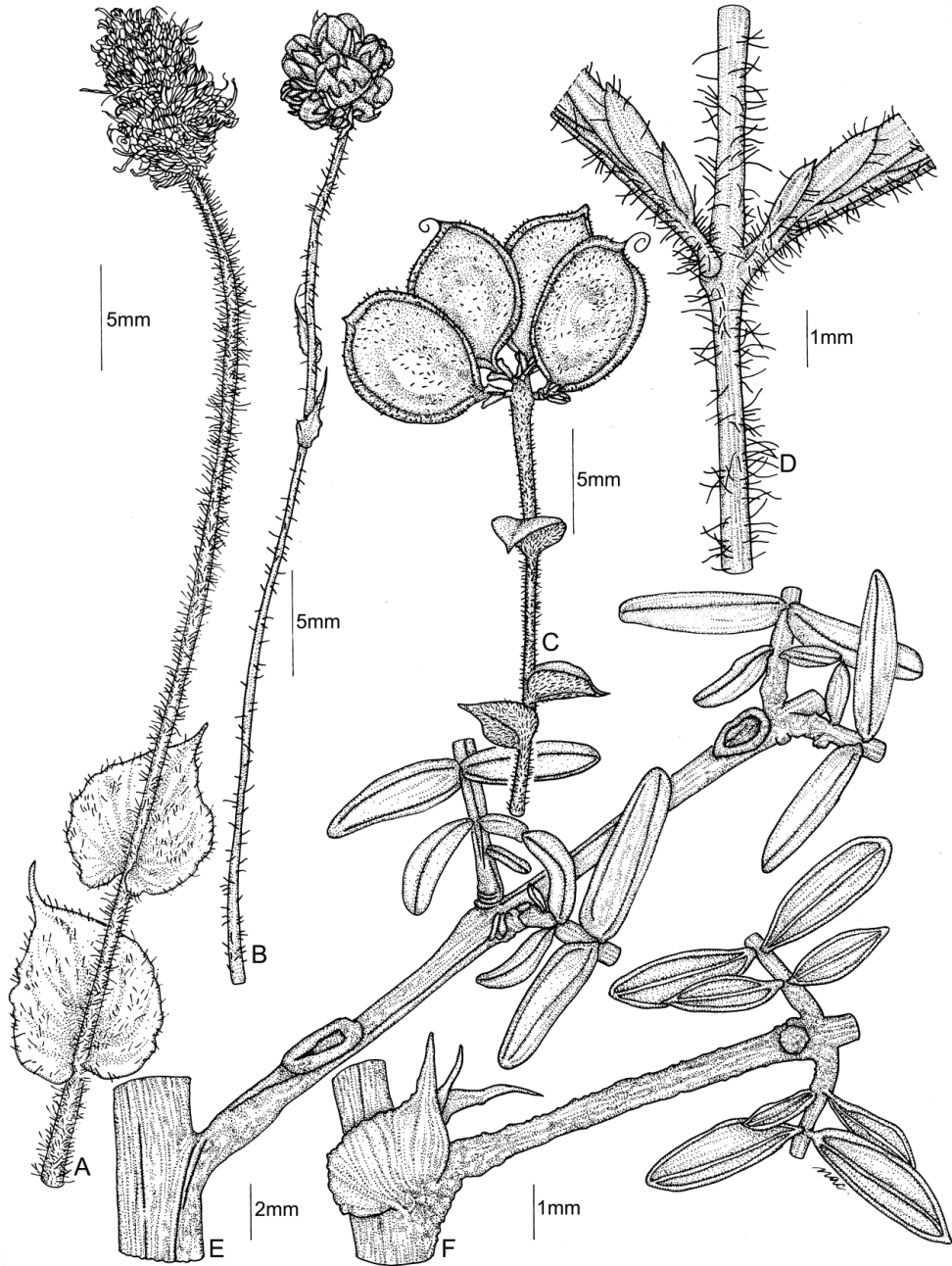


Fig. 4. *Neptunia longipila*. A. inflorescence, with peduncle and bracts. *N. hispida*. B. inflorescence, with peduncle and bracts. *N. valida*. C. group of pods, with peduncle and bracts. *N. hispida*. D. indumentum on leaf rachis and rachilla. *N. monosperma*. E. section of leaf rachis showing extra-floral nectaries and lack of stipule. *N. dimorphantha*. F. section of leaf rachis showing extra-floral nectary and persistent stipule. A from van Leeuwen *et al.* PBS2080 (PERTH); B from Fensham 380 (DNA); C from Roberts APR1079 (PERTH); D from Cowie 5319 & Taylor (DNA); E from Bean 15177 (BRI); F from McDonald KRM7336 & Little (BRI). Del. N. Crosswell.

(DNA); Maclear Creek Road, 1 km S of Notch Creek, Melville Island, Jan 1992, *Leach 2941 & Cowie* (BRI); 1 km E of Punelli, Melville Island, Feb 1992, *Fensham 1207* (DNA); Emu Plains, Melville Island, Dec 1984, *Jones 1697* (DNA, PERTH); Port Darwin, in 1886, *Tenison-Woods 328* (MEL); Cobourg Peninsula, Apr 2006, *Brennan 7141* (DNA); Gurig NP, Apr 2006, *Brennan 6913* (DNA); Charles Darwin NP, Feb 1998, *Harwood 315* (DNA); Channel Island Road, 1 km E of Elizabeth River, Palmerston, Jan 1992, *Cowie 2201* (DNA); power line track between Cox Peninsula Road and Finn Road, Berry Springs, Jan 2016, *Wirf 985 & Holland* (CANB, DNA); Berry Creek, Dec 1974, *Must 1323* (DNA); Litchfield NP, 15 km WSW of Adelaide River township, Mar 1996, *Booth 1495 & Cowie* (DNA); Bulman Community near Telstra site, Nov 2009, *Murfet 6651* (AD, DNA); 0.25 miles N of Ooloo crossing, Daly River levee, Jun 1964, *Robinson R599* (DNA); between Douglas River and Block, Jan 1964, *Robinson R244* (DNA); c. 21 miles [33.8km] SE of Oenpelli Mission, Feb 1973, *Lazarides 7779* (BRI, CANB, DNA); Noonamah area, Feb 1963, *Muspratt SSO249* (DNA); Glenluckie Creek, Stuart Highway, Dec 2009, *Brennan 8230* (DNA).

Distribution and habitat: *Neptunia hispidia* is endemic to the ‘Top End’ of the Northern Territory, Australia where it occurs from Melville Island to Katherine and from Daly River to Bulman (**Map 5**). It is most often recorded from lateritic slopes and ridges with gravelly or skeletal soil, although one specimen from Melville Island was said to be from a “cracking clay plain”. Dominant eucalypts include *Eucalyptus miniata* A.Cunn. ex Schauer, *Corymbia bleeseri* (Blakely) K.D.Hill & L.A.S.Johnson, *E. oligantha* Schauer and *E. tetradonta* F.Muell.

Phenology: Flowers are recorded from November to April; fruits between December and April.

Affinities: *Neptunia hispidia* is closely related to *N. tactilis*, these being the only two Australian species with more than 5 stamens per flower. *Neptunia hispidia* differs by the 3–5(–6) pairs of leaf pinnae (1–3 pairs for *N. tactilis*), the presence of bracts on the peduncle (vs. absent for *N. tactilis*); the presence of long spreading hispid hairs on the stems, rachises and peduncles (glabrous or sparsely hairy for *N. tactilis*); and the dimorphic inflorescences (vs. all bisexual for *N. tactilis*).

Notes: *Neptunia hispidia* is a prostrate plant. The leaves have 3–5 pairs of pinnae and no petiole nectaries. The stems, rachises, leaves, peduncles, bracteoles and calyces have conspicuous long spreading hispid hairs, and there are two narrow bracts positioned on the middle one-third of the peduncle; the inflorescences are dimorphic with neuter flowers at the base; anthers are 0.7–1 mm long with a prominent terminal gland.

A specimen from Elsey Station (*Menkhorst 1223*, DNA) is similar to *Neptunia hispidia* but differs by the fruits that are very hairy and have an obtuse apex. It could represent an unnamed taxon.

Etymology: From the Latin *hispidus*, meaning ‘covered with stiff hairs’. The stems and leaves of this species are densely covered in stiff patent hairs.

6. *Neptunia insignis* A.R.Bean sp. nov.

With affinity to *Neptunia amplexicaulis* but differing by the long spreading hairs on the stems, peduncles and rachises, the longer fruiting peduncles, the smaller bracts and the smaller stipules. **Typus:** Australia. Queensland. COOK DISTRICT: 3.7 km by road from Elizabeth Creek towards Chillagoe, 6 March 2022, *K.R. McDonald KRM22410 & L. Little* (holo: BRI [comprising 1 sheet]; iso: AD, BM, CANB, DNA, L, MEL, NSW, US *distribuendi*).

Shrub, perennial, terrestrial. Stems prostrate, with dense patent hairs 0.4–0.8 mm long, sessile glands absent. Stipules persistent, broadly ovate, 4–7.5 mm long, 1.8–5 mm broad, coriaceous, strongly nerved, hairy on both surfaces; apex attenuate; base obliquely cordate. Leaves with 2 or 3 pairs of pinnae; petioles 15–24 mm long, hispid, nectary absent; rachis 14–28 mm long, with hispid hairs, nectary absent; rachis extension linear, 2.8–3.8 mm long; pinnae with 8–14 pairs of leaflets, rachilla extension 2–2.6 mm long; stipels slender, 0.9–2 mm long, not divided, not gland-tipped. Largest leaflets 8.2–13 mm long, 1.8–4 mm wide, 2.9–4.9 times longer

than broad, surfaces \pm glabrous, margin with many cilia, venation of 1–3 main veins, more obvious on lower surface. Inflorescences globose, some with dimorphic flowers; peduncles 33–95 mm long at anthesis, 61–110 mm long at fruiting stage, with patent hairs throughout, 0.4–0.8 mm long; bracts 2, positioned on proximal one-third of peduncle, persistent, broadly ovate, amplexicaul, lower one 5–9 mm long, with hispid hairs on lower surface and margin; flowers 25–35 per inflorescence; bracteoles oblanceolate, 1.4–1.7 mm long, persistent until anthesis. Bisexual flowers: calyx campanulate, 1–1.3 mm long, glabrous or with a few hairs; petals 2.3–2.5 mm long, glabrous; stamens 5, filaments *c.* 3 mm long, anthers *c.* 0.8 mm long, terminal gland absent; style *c.* 2.2 mm long, glabrous; ovary glabrous or hairy. Neuter flowers: calyx *c.* 1 mm long; petals *c.* 2.1 mm long, glabrous; staminodes 5, 4.5–7 mm long, 0.3–0.4 mm wide. Pods oblong to broadly elliptical, 3–7-seeded, 13–22 mm long, 9–11 mm broad, dehiscent along both margins, stipe 1–1.5 mm long, apex obtuse; with dense patent eglandular hairs *c.* 0.4 mm long, or short hairs *c.* 0.1 mm long, confined to margins, or glabrous. Seeds broadly elliptical in outline, 4–4.5 mm long, 3.5–3.7 mm wide, dark brown. **Figs. 5, 6.**

Additional specimens examined: **Australia.** **Queensland.** COOK DISTRICT: 4.9 km along Bellevue Station access road, Mar 2022, *McDonald KRM22415 & Little* (BRI; B, CANB, MEL, MO, P, PRE *distribuendi*); Access road to Bellevue, NNW of Chillagoe, Apr 2002, *Bean 18740 & McDonald* (BRI); 3 km E of Elizabeth Creek on road to Chillagoe, Jan 1982, *Clarkson 4256* (BRI, P); South of The Oasis on Greenvale Road, Jun 1999, *Addicott 171* (BRI). NORTH KENNEDY DISTRICT: Lake Lucy, *s.dat.*, *Anon. 78* (MEL). SOUTH KENNEDY DISTRICT: Redcliffe Vale on Redcliffe Tableland, Apr 2012, *Champion IGC2139 et al.* (BRI).

Distribution and habitat: *Neptunia insignis* is endemic to Queensland, Australia. It extends from north-west of Chillagoe to Redcliffe Tableland, north-west of Mackay (**Map 6**). It grows on flat or gently undulating terrain, in cracking clay soil, in open eucalypt woodland.

Phenology: Flowers are recorded for January and March; fruits for January, March, April and June.



Fig. 5. Flowering branchlet of *Neptunia insignis* (*McDonald 22415 & Little*, BRI). Photo: K.R. McDonald.

Affinities: *Neptunia insignis* is most similar to *N. amplexicaulis* as they both have 2 or 3 pairs of pinnae, few leaflets per pinna (7–15 pairs), no nectaries on the petiole, and large leaflets (8.2–16 mm long). *Neptunia insignis* differs by the long spreading hairs on the stems and peduncles (*vs.* glabrous or with short puberulous hairs for *N. amplexicaulis*); the stipules 4–7.5 mm long (*vs.* 16–19 mm long for *N. amplexicaulis*); the bracteoles and calyx with a few hairs (*vs.* glabrous in *N. amplexicaulis*); the lower bracts 5–9 mm long (*vs.* 11–19 mm long for *N. amplexicaulis*); and the fruiting peduncles 61–110 mm long (*vs.* 36–52 mm long for *N. amplexicaulis*). One of the forms of *N. gracilis* has coarse hispid hairs on the rachises and peduncles as in *N. insignis*, but the latter differs consistently by the larger leaflets and the presence of two bracts on the peduncle.



Fig. 6. Fruiting branchlet of *Neptunia insignis* (McDonald 22410 & Little, BRI). Photo: K.R. McDonald.

Note: The 3–7-seeded pods of *Neptunia insignis* may be sparsely hairy at the base only (Bean 18740, McDonald KRM22415 & Little), or on the margins (Clarkson 4256), or hairy throughout (Addicott 171, Anon. 78, Champion IGC2139 et al.).

Conservation status: *Neptunia insignis* is suggested to qualify as ‘Endangered’ under Red List Criterion B (IUCN 2012). The area of occupancy is far less than 500 km², there are five known locations, and there is a projected continuing decline in area, extent and/or quality of habitat, due to weed incursion, especially by Grader grass (*Themeda quadrivalvis* (L.) Kuntze), and heavy grazing by cattle.

Etymology: From the Latin *insignis* meaning ‘distinguished’ or ‘conspicuous’. This species is quite conspicuous by virtue of its relatively large leaflets and bracts.

7. *Neptunia javanica* Miq., *Fl. Ned. Ind.* 1(1): 51 (1855).

Type citation: “Java, op heuvels van G. Sahari, G. Soerabaja”. **Type:** Indonesia. G. Saharie, near Surabaya, Java, 9 January 1847, *H. Zollinger 3231* (lecto: P 02735395 [here designated]; isolecto: P 02735394, P 02735393).

[*Neptunia acinaciformis* auct. non (Span.) Miq. (1841): Windler (1966: 393)]

Illustration: Windler (1966: 394), as *N. acinaciformis*.

Shrub, perennial, terrestrial. Stems prostrate, glabrous, sessile glands absent. Stipules persistent, ovate, 2–3.3 mm long, 0.8–1.2 mm broad, chartaceous, with a single nerve, glabrous; apex attenuate; base obliquely cordate. Leaves with (2–)3(–4) pairs of pinnae; petioles 3–8 mm long, glabrous, with 1 small nectary in the middle one-third, and rarely a second one near the distal end; rachis 13–16 mm long, glabrous, nectary absent; rachis extension linear, 0.8–1 mm long; pinnae with 9–15 pairs of leaflets, rachilla extension 1.3–2.5 mm long; stipels slender, 0.1–0.3 mm long, entire, gland-tipped. Largest leaflets 2.9–4.5 mm long, 0.9–1.3 mm wide, 3.2–4.1 times longer than broad, glabrous, venation of 1–3

main veins, more obvious on lower surface. Inflorescences globose, some with dimorphic flowers; peduncles 25–57 mm long at anthesis, 40–70 mm long at fruiting stage, glabrous; bracts absent; flowers 8–12 per inflorescence; bracteoles oblanceolate to obovate, c. 0.5 mm long, caducous, usually falling before anthesis. Bisexual flowers: calyx obconical, 1.1–1.4 mm long, glabrous; petals 1.8–2.4 mm long, glabrous; stamens 10, filaments c. 2.2 mm long, anthers 0.6–0.9 mm long, terminal gland obscure; style c. 2.5 mm long, glabrous; ovary glabrous. Neuter flowers: calyx 0.5–0.9 mm long; petals 0.9–1 mm long, glabrous; staminodes 10, 1.8–3 mm long, 0.2–0.4 mm wide. Pods falcate, 8–11-seeded, 26–33 mm long, 7.7–9 mm broad, dehiscing along one suture only, stipe 5–7 mm long, apex acute; glabrous. Seeds broadly elliptical in outline, c. 4.5 mm long and 2.6 mm wide, brown. **Fig. 3H.**

Additional specimens examined: Indonesia. LESSER SUNDA ISLANDS: Orong, Flores, 8° 29′ S 120° 39′ E, Apr 1966, *Schmutz 34* (L). JAVA: Soerabaja, Grisee, 7° 09′ S 112° 37′ E, Feb 1924, *Dorgelo 2292* (L); Koepang, Soerabaja, May 1922, *Dorgelo 377* (L); Sampang to Rapa, Madoera, 7° 00′ S 113° 20′ E, Mar 1915, *Backer 19773* (L); Sampang, Madoera, 7° 00′ S 113° 20′ E, Mar 1915, *Backer 19564* (BRI, L); Kesongo, Rembang, 7° 36′ S 110° 50′ E, *s. dat.*, *van Steenis 17436* (L); Mons Lengis, East Java, 7° 09′ S 112° 39′ E, Apr 1932, *Coert 1097* (L); road to Rapa, Sampang, Madura, 7° 11′ S 113° 14′ E, Jan 1925, *Rant s.n.* (L 2042660).

Distribution and habitat: In Malaysia, *Neptunia javanica* is known only from Java and Flores (**Map 3**). Elsewhere, it is recorded for Thailand, Cambodia and Vietnam. It inhabits salty mud-plains and grassy fields on heavy clay at altitudes below 650 metres (Nielsen 1992).

Phenology: Flowers have been recorded in March and April; fruits have been recorded in January, February and March.

Affinities: *Neptunia javanica* is a terrestrial, prostrate shrub with small leaflets and flowers with 10 stamens. It is similar to both *N. gracilis* and *N. tactilis*. From *N. gracilis*, it differs by the presence of a petiole nectary (absent for *N. gracilis*), flowers with 10 stamens (always 5 for *N. gracilis*); and the falcate acute pods containing 8–11 seeds (pods oblong, apex obtuse, pods with 3–6 seeds for *N. gracilis*).

From *N. tactilis*, it differs by the leaf pinnae with 9–15 pairs of leaflets (15–28 pairs for *N. tactilis*); the presence of dimorphic inflorescences (inflorescences all bisexual in *N. tactilis*); and the presence of a petiole nectary (absent for *N. tactilis*).

Typification: Nielsen (1981) cited a specimen at Utrecht (U 164863) as the holotype of *Neptunia javanica*, and he annotated it as such. However, that specimen does not match the protologue. In particular, the protologue states that the fruits are 1.25 inches long, while the sole fruit on U 164863 is 5 mm (0.2 inches) long. The “Index of Botanists” (HUH 2021) states that while Miquel’s herbarium and types are at U, new names are “also based on specimens at G, K, L (most), P”. A specimen at P collected by Heinrich Zollinger (number 3231) matches the protologue with respect to the dimensions of leaves, peduncles and fruit, and its label includes text that is replicated in the protologue. For example, Zollinger’s label states “Fl. lutei odorati” and the protologue states “Flores odorati lutei”. Zollinger’s label includes “Daun luttie Jav.” (perhaps an indigenous name?), and the protologue states “Daun litti jav.”. Furthermore, Zollinger’s locality of ‘G. Saharie’ is cited in the protologue. This specimen is designated as the lectotype, while two other specimens bearing the number 3231 are isoelectotypes.

8. *Neptunia longipila* A.R.Bean sp. nov.

With affinity to *Neptunia scutata* but differing by the non-glandular peduncle hairs 0.5–0.9 mm long, the bracts 7.5–10.4 mm long, and the longer peduncles. **Typus:** Australia. Western Australia. 20–25 km N of Fortescue Valley on main Port Hedland Road from Wittenoom/Newman, East Chichester Range, May 1988, *K.L. Tinley 3324* (holo: PERTH 1848410, comprising 1 sheet).

Shrub, perennial, terrestrial. Stems prostrate, with dense patent to antrorse hairs, sessile glands absent. Stipules persistent, broadly ovate, 5.9–8.2 mm long, 3–4.3 mm broad, coriaceous, strongly nerved, sparsely hairy; apex attenuate; base obliquely cordate. Leaves with (3–)4 or 5 pairs of pinnae; petioles 9–12 mm long, with patent hairs, with a prominent

nectary around halfway along or just below first pair of pinnae, rarely a second nectary present; rachis 23–35 mm long, with dense eglandular hairs, nectary absent; rachis extension linear, 2.4–4.5 mm long; pinnae with 17–22 pairs of leaflets, rachilla extension 1.2–1.8 mm long; stipels 0.1–0.2 mm long, entire, gland-tipped. Largest leaflets 5–8.8 mm long, 1.2–2.3 mm wide, 3.8–4.6 times longer than broad, glabrous on upper surface, sparsely hairy on margins and lower surface, venation of 1–3 main veins, more obvious on lower surface. Inflorescences broadly ellipsoidal, some with dimorphic flowers; peduncles 27–52 mm long at anthesis, 28–69 mm long at fruiting stage, with dense patent hairs throughout, 0.5–0.9 mm long; bracts 2, positioned on proximal one-third of peduncle, persistent, ovate, amplexicaul, lower one 7.5–10.4 mm long, sparsely hairy, margin ciliate; flowers 30–50 per inflorescence; bracteoles oblanceolate, 1.5–1.8 mm long, persistent until anthesis. Bisexual flowers: calyx campanulate, 1.1–1.2 mm long, glabrous; petals 1.7–2 mm long, glabrous; stamens 5, filaments 2.5–3 mm long, anthers 0.6–0.7 mm long, terminal gland absent; style 1.9–2.1 mm long, glabrous; ovary hairy. Neuter flowers: calyx 0.7–0.8 mm long; petals 1.3–1.5 mm long, glabrous; staminodes 5, 5.2–6 mm long, 0.3–0.5 mm wide. Pods broadly elliptical, 1-seeded, 7.5–9 mm long, 5.5–6 mm broad, indehiscent, stipe 0.5–1 mm long, apex obtuse; with dense patent hairs 0.2–0.4 mm long, at least some with glandular apex. Seeds broadly elliptical in outline, 3.6–4 mm long, 2.7–3 mm wide, brown. **Fig. 4A.**

Additional specimens examined: Australia. Western Australia. Fortescue River, in 1895, *Cusack 211* (MEL); 11.1 km W of junction with main Millstream-Chichester NP entry road on Millstream-Pannawonica Road, 14.6 km NNE of Mt Flora, 72.9 km E of Pannawonica, Pilbara, Apr 2004, *Leeuwen et al. PBS2081* (PERTH); 12 km SSW of Mt Herbert, Millstream-Chichester NP, May 1997, *Trudgen MET18127* (PERTH); 10.5 km SSW of Mount Herbert, Millstream-Chichester NP, May 1997, *Trudgen MET18132* (PERTH); 16 km S of Barowina Hill, Mar 1984, *Newbey 9934* (PERTH); 7.2 km N of Hamersley Iron Railway crossing on Roebourne-Wittenoom Road, Millstream NP, Jul 2002, *Wajon 444* (PERTH); c. 1 km W of Mt Florence HS on Roebourne Road, Apr 1995, *Mitchell PRP249* (PERTH); 11.6 km ESE of Mt Sabine, Millstream-Chichester NP, Apr 1997, *Trudgen 15196* (MEL, PERTH); 2.9 km N of Tom

Price-Dampier Railway crossing on the Roebourne-Munjina Road, 4 km N of Barowanna Hill, 69.4 km S of Roebourne, Millstream-Chichester NP, Pilbara, Apr 2004, *Leeuwen et al. PBS2080* (PERTH); 6.6 km SSE of West Angela Hill, Hamersley Ranges, Jun 1997, *Trudgen 15805* (AD, PERTH); 11.7 km NE of Mt Regal, 15.9 km SE of White Peak, 3.7 km S of Karratha, Pilbara IBRA, Aug 2005, *Leeuwen et al. PBS5887* (PERTH); Millstream NP, Sep 2013, *Davis & Dillon s.n.* (PERTH 8562121); 8.7 km WSW of Mt Herbert, Millstream-Chichester NP, Hamersley Ranges, Sep 1997, *Trudgen MET18131* (PERTH); 560 m N on Karratha Road from the North West Coastal Highway, 1.6 km S of the Coolawanyah Road turnoff, 2.8 km SE of Stove Hill, 2.5 km WSW of Tobacco Well, 3.9 km E of Tom Well, Aug 2002, *Leeuwen 5099* (CANB, PERTH); 2.9 km W along track (from the main track) just south of the (old) Robe camp, 4.7 km ESE of West Angela Hill, Hamersley Ranges, Jun 1997, *Trudgen MET18128* (PERTH).

Distribution and habitat: *Neptunia longipila* is endemic to Western Australia in Australia and confined to the Pilbara bioregion, from Karratha to Newman (**Map 7**). It grows in reddish-brown to orange-brown cracking clay, or red to brown gravelly loam, on flat or very gently sloping terrain, in grassland or open shrubland.

Phenology: Flowers and fruits are recorded from March to September.

Affinities: *Neptunia longipila* is clearly allied to *N. scutata*, with which it shares the glandular-hairy one-seeded fruits and the leaves with 3–5 pairs of pinnae. It differs from *N. scutata* by the generally longer peduncles 27–52 mm long at anthesis (8–35 mm long for *N. scutata*), the hairs on the peduncle 0.5–0.9 mm long and eglandular (hairs 0.1–0.3 mm long and glandular for *N. scutata*), the broadly ellipsoidal inflorescences (globose for *N. scutata*) and the peduncle bracts 7.5–10.4 mm long (2.5–8 mm long for *N. scutata*).

Etymology: From the Latin *longus* meaning long and *pilus* meaning hair. This refers to the long pilose hairs on the peduncles and the leaflet margins, much longer than in the related species *N. scutata*.

9. *Neptunia major* (Benth.) Windler, *Aust. J. Bot.* 14: 408 (1966).

Neptunia gracilis var. *major* Benth., *Fl. Austral.* 2: 300 (1864). **Type:** Australia. Queensland. [PORT CURTIS DISTRICT:] Rockhampton, *s.dat.*, *J. Dallachy s.n.* (lecto:

K 000791035, *vide* Cowan (1996: 14); isolecto: MEL 596304; P 02735402 *i.d.v.*, right-hand specimen only; P 02735403 *i.d.v.*, right-hand specimen only).

Illustrations: Windler (1966: 409); Wheeler (1992: 342).

Shrub, annual, terrestrial. Stems erect, 1–2(–3) m high, glabrous, thick, sessile glands present. Stipules deciduous, visible only on new growth, lanceolate to ovate, 3–4.8 mm long, 0.8–1.4 mm broad, chartaceous, weakly nerved, glabrous; apex acute; base obtuse or slightly oblique. Leaves with 2–5 pairs of pinnae; petioles 10–18 mm long, glabrous, with a prominent nectary (sometimes two) in the upper half, often just below first pair of pinnae; rachis 10–35 mm long, glabrous, nectary sometimes present below some or all pairs of pinnae; rachis extension linear, 2–2.8 mm long; pinnae with 23–39 pairs of leaflets, rachilla extension 1–1.7 mm long; stipels slender, 0.1–0.5 mm long, entire or divided, gland-tipped. Largest leaflets 5.4–7.1 mm long, 1–1.6 mm wide, 4–5.5 times longer than broad, glabrous or with a few marginal cilia, venation of 1–3 main veins, more obvious on lower surface. Inflorescences globose, some with dimorphic flowers; peduncles 15–55 mm long at anthesis, 25–60 mm long at fruiting stage, glabrous throughout; bracts 2, positioned on middle one-third of peduncle, deciduous, ovate, amplexicaul, lower one 2.5–4 mm long, glabrous or with a few hairs on margin; flowers 25–35 per inflorescence; bracteoles oblanceolate, 1–1.4 mm long, caducous, usually falling before anthesis. Bisexual flowers: calyx campanulate, 1.2–1.3 mm long, glabrous; petals 1.9–2 mm long, glabrous; stamens 5, filaments 2.7–3.2 mm long, anthers 0.7–0.8 mm long, terminal gland absent; style 1.6–3 mm long, glabrous; ovary glabrous. Neuter flowers: calyx 0.9–1 mm long; petals 1.9–2 mm long, glabrous; staminodes 5, 6.5–11 mm long, 0.6–0.8 mm wide. Pods oblong, (1–)2–5-seeded, 8–23 mm long, 8–11.5 mm broad, indehiscent, stipe 1–2.5 mm long, apex obtuse; glabrous. Seeds broadly elliptical to broadly ovate in outline, 3.9–4.4 mm long, 3.4–3.9 mm wide, brown. **Fig. 21.**

Additional selected specimens examined: Australia. **Western Australia.** Fitzroy River, 1881, *Paterson s.n.* (MEL 596333); Kimberley Research Station, Ord River, Apr 1956, *Burbridge 5177* (CANB); Yanunara Gap, Napier Range, May 1981, *Demarz 8836* (CANB); Riverfarm Road, Kununurra, May 1993, *Mitchell 2853* (BRI); near Mount House Station, Apr 1955, *Lazarides 5166* (AD, BRI, MEL, NSW, PERTH). **Northern Territory.** Port Darwin, Oct 1888, *Holtze 900* (MEL); Mouth of Daly River, near Palmerston Island, Feb 1994, *Leach 4007* (BRI, DNA); Wyndham Road, 4 miles [6 km] SW of Katherine, Jan 1964, *Adams 834* (CANB, NSW); 5 miles [8.3 km] NE of Leguna Station, Jul 1949, *Perry 2583* (CANB). **Queensland.** COOK DISTRICT: 2.9 km N of the Palmerville Road turnoff the Peninsula Development Road, Fairview Station, Apr 2014, *Thompson ST14019* (BRI, MEL, NSW); 18.5 km NNW of Bizant HS, 2 km W of Bizant River, Apr 1992, *Neldner 3796 & Clarkson* (BRI, DNA, NSW, PERTH); Lakefield NP, 12 km from Jam Tin Creek on the track from Bizant to Jane Tableland, May 1987, *Clarkson 6977 & Simon* (BRI); Talaroo Station, Top Horse paddock boundary with Eveleigh, Mar 2017, *McDonald KRM19147 & Morrison* (BRI). NORTH KENNEDY DISTRICT: Outskirts of Gumlu, NW of Bowen, May 2000, *Bean 16614* (BRI, MEL, PRE); Ooonoona, Feb 1980, *Stanley 80204* (BRI); near Guthalungra, Oct 1950, *Blake 18617* (BRI, CANB, K); Gregory Developmental Road, c. 85 km N of Charters Towers, Jul 2017, *Gardiner CPGT561* (BRI). PORT CURTIS DISTRICT: 7.5 km from Bruce Highway at Bajool, towards Port Alma, Apr 2012, *Bean 32011* (BRI); Duck Pond reserve, Rockhampton, Jan 2000, *McCabe s.n.* (BRI [AQ550902]).

Distribution and habitat: *Neptunia major* is endemic to Australia, where it is known from near Derby in Western Australia to near Borroloola in the Northern Territory, and from Princess Charlotte Bay to Rockhampton in Queensland (**Map 8**). It grows in grassland or open eucalypt woodland on black-soil plains, usually on the margins of ephemeral freshwater lagoons or gilgais, but sometimes on the edge of marine saltpans in association with *Sporobolus virginicus* (L.) Kunth.

Phenology: Flowers and fruits are most commonly recorded from December to May, but with a few records from other times of the year.

Affinities: *Neptunia major* is closely related to *N. monosperma* as both are upright plants with glabrous stems and leaves, leaf pinnae with numerous pairs of leaflets, and deciduous stipules. *Neptunia monosperma* differs by the peduncles at anthesis 4–12 mm long (15–55 mm long for *N. major*); fruiting peduncles 5–21 mm long (25–60 mm long for

N. major); 10–20 flowers per inflorescence (25–35 flowers for *N. major*); staminodes 2.5–3.5 mm long (6.5–11 mm long for *N. major*); and pods strictly 1-seeded ((1 or)2–5-seeded for *N. major*).

Typification: Cowan (1996) selected as the lectotype of *Neptunia major*, a fruiting specimen at K collected at Rockhampton by John Dallachy. Two specimens similar in appearance, both bearing ripe fruits and collected from Rockhampton are present at P. The specimen P 02735402 is attributed to “Ferd. Mueller” because it is Mueller’s name that appears on the printed label, but Mueller never visited Rockhampton, and the specimen was almost certainly collected by Dallachy. The sheet has two *Neptunia* branches mounted on it. The one on the right is *N. major*; the one on the left is *N. gracilis*. P 02735403 (right-hand branch) is without collector, but it matches the other specimen very well and looks like a duplicate of the other. The two branches on the left, from “between the Darling and Coopers Creek” appear to belong to *N. heliophila*. The specimen at MEL has a mounted branch bearing leaves and flowerbuds and there are several mature fruits in a fragment packet. It bears a handwritten label by Dallachy giving the collection date as December 26, 1862.

Note: *Neptunia major* is the tallest species of *Neptunia*, typically 1–2 metres high, but reputed to attain 3 metres in height.

10. *Neptunia monosperma* F.Muell. ex Benth., *Fl. Austral.* 2: 300 (1864).

Type: Australia. [Northern Territory.] Victoria River, [1855–56], *F. Mueller s.n.* (lecto [second-step, here designated]; K 000791027; isolecto: MEL 596309, branch ‘A’ only).

Illustrations: Windler (1966: 411); Wheeler (1992: 342); Cowan (1998: 22, fig. 36 L–N).

Herb, perennial, terrestrial. Stems ascending to erect, to 0.5 m high, glabrous, sessile glands absent. Stipules deciduous, visible only on new growth, narrowly ovate, 1.5–2.8 mm long, 0.5–1.1 mm broad, chartaceous, without nerves or with the midvein visible, glabrous;

apex acute, base truncate or obliquely cordate. Leaves with (1–)2 or 3(–4) pairs of pinnae; petioles 5–11 mm long, glabrous, with one or two prominent nectaries, one about halfway along, the other (sometimes absent) distal; rachis 7–32 mm long or absent in 1-jugate leaves, glabrous, nectaries present, 1 below each pair of pinnae; rachis extension deltate, 0.8–3.5 mm long, glabrous; pinnae with 23–34 pairs of leaflets, rachilla extension 0.9–1.2 mm long; stipels slender, 0.1–0.3 mm long, entire, sometimes faintly gland-tipped. Largest leaflets 6.3–10 mm long, 1.5–2.4 mm wide, 3.6–4.6 times longer than broad, glabrous above and below, sometimes with a few marginal cilia, venation of the midrib only or sometimes 1 or 2 lateral veins that are also visible on lower surface. Inflorescences globose, some with dimorphic flowers; peduncles 4–12 mm long at anthesis, 5–21 mm long at fruiting stage, glabrous; bracts 2, positioned in middle one-third of peduncle, deciduous, ovate, amplexicaul, glabrous; lower bract 1.5–2.3 mm long; flowers 10–20 per spike; bracteole elliptical, 0.6–1 mm long, caducous, usually falling before anthesis. Bisexual flowers: calyx campanulate, 1–1.3 mm long, glabrous; petals 1.8–2.1 mm long, glabrous; stamens 5, filaments 2.4–2.8 mm long, anthers 0.5–0.6 mm long, terminal gland absent; style 1.5–2 mm long, glabrous; ovary glabrous or hairy. Neuter flowers: calyx 0.6–0.7 mm long, glabrous; petals 1.4–1.5 mm long, glabrous; staminodes 5, 2.5–3.5 mm long, 0.25–0.3 mm wide. Pods circular, 7–9 mm long, 7.5–8.5 mm broad, indehiscent, glabrous or with dense patent eglandular hairs 0.05–0.2 mm long; stipe 1–2 mm long. Seeds 1 per pod, broadly elliptical in outline, 4.5–4.8 mm long, 3.8–4.3 mm wide, brown. **Figs. 4E, 7.**

Additional selected specimens examined: Australia. **Western Australia.** Kimberley Research Station, Kununurra, Mar 1963, *Lazarides 6729* (CANB, K, PERTH); gravel extension of Packsaddle Road, Nov 2009, *Byrne 3663* (MEL, PERTH); 44.3 km from Karratha on North West Coastal Highway towards Millstream, May 2008, *Guerin GG1007 & Trudgen* (AD, PERTH); 3 km N of Nicholson Station, May 1973, *Aplin 5363* (PERTH); Miles Bore area [near Derby], Feb 1992, *Mitchell 2061* (PERTH); Flora Valley Station, Nov 2000, *Craig ABC1627* (PERTH). **Northern Territory.** c. 20 km NW of Burta Wurta, Apr 2012, *Lewis 2008* (BRI,



Fig. 7. Shrubs of *Neptunia monosperma* (McDonald 22338, BRI). Photo: K.R. McDonald.

CANB, DNA); 7 miles [11 km] E of Stuart Highway, Beetaloo Station Road, Feb 1969, *Must 382* (CANB, NT); K1 Bore, Brunette Downs Station, Jun 2016, *Schubert 811* (NT); 23 miles [37 km] SSW of Georgina Downs Station, Mar 1953, *Perry 3486* (BRI, CANB, MEL, NSW); N of ‘Creswell Downs’ on the road to ‘Calvert Hills’, c. 148 km from ‘Calvert Hills’, Jun 1974, *Pullen 9270* (CANB, NSW); Daly Waters, Mar 1972, *Byrnes 2503* (CANB, DNA, NT); Bore 29, Wavehill Station, Jun 1952, *Perry 2908* (CANB, NSW [lower specimen only]); 43 km E of Daly Waters, Carpentaria Highway, May 1994, *Albrecht 5893* (BRI, DNA, NT); McDonnell trucking yards [Alice Springs], Jan 1975, *Mitchell 211* (CANB, DNA). **Queensland.** **BURKE DISTRICT:** 15 km along the road to Magoura Station, SW of Normanton, Apr 1974, *Pullen 8889* (BRI, CANB); Barkly Highway 74.2 km NW of Mt Isa (by air), Nov 2001, *Fraser 363* (CANB). **COOK DISTRICT:** 32.9 km S from the Oasis Roadhouse on Kennedy Development Road, Jan 2022, *McDonald KRM22338* (BRI). **NORTH KENNEDY DISTRICT:** 65 km ESE of Ayr, Jan 1982, *Pedley 4802* (BRI, MEL). **SOUTH KENNEDY DISTRICT:** Suttor River, [Feb–Mar 1864], *Bowman 19* (MEL); 12 km E of Avon Downs HS towards Bell Lagoon, Jan 1998, *Thompson 444 & Fox* (BRI, MEL). **GREGORY NORTH DISTRICT:** Jessamine Creek, 8 km from Winton towards Longreach, Jun 1999, *Bean 15177* (BRI); Bladensburg

NP, S of Winton, near Mistake Hut Dam, Mar 1998, Forster PIF22223 & Booth (BRI, MEL). MORETON DISTRICT: 14 km WSW of Ipswich CBD off Coopers Road, Willowbank, Feb 2017, Ryan CR01 (BRI). New South Wales. Gurley district, Feb 2016, Parsons s.n. (NSW 991194).

Distribution and habitat: *Neptunia monosperma* is endemic to northern Australia where it is very widespread. The main distribution is from Derby in Western Australia, through the northern half of the Northern Territory to Bowen in Queensland. The highly disjunct specimen records from Alice Springs, the Moreton district of Qld and north-east N.S.W. (cited above) are presumed to have resulted from inadvertent human-mediated transportation. The habitat at the Ipswich location is highly modified and right beside a well-used road; the Alice Springs location is a trucking yard – the specimen label states “introduced in cattle fodder”; no habitat data are available for the Gurley site. *Neptunia monosperma* was first collected from the Karratha area of Western Australia in 1997 – it is unclear whether these populations are naturally occurring or not. (Map 9). It inhabits grassland or open eucalypt woodland on heavy clay soils.

Phenology: Flowers are recorded from November to April; fruits from January to June.

Affinities: *Neptunia monosperma* is an upright plant to 50 cm high, and with strictly 1-seeded pods. Herbarium specimens of it most resemble *N. major*, as they both have glabrous stems and leaves, leaf pinnae with numerous pairs of leaflets, and deciduous stipules. *Neptunia monosperma* differs by the peduncles at anthesis being 4–12 mm long (15–55 mm long for *N. major*); fruiting peduncles being 5–21 mm long (25–60 mm long for *N. major*); 10–20 flowers per inflorescence (25–35 flowers for *N. major*); staminodes 2.5–3.5 mm long (6.5–11 mm long for *N. major*); and pods strictly 1-seeded ((1)–2–5-seeded for *N. major*).

Typification: Windler (1966) chose the Victoria River syntype as lectotype for *Neptunia monosperma*, although he did not cite the herbarium in which it was held. Cowan

(1996) ignored this choice and selected instead the specimen collected by Landsborough from the Gulf of Carpentaria. Cowan argued that Windler did not deliberately choose a lectotype, and that he “simply repeated the collection(s) cited in the protologue”. That is not the case. In the protologue, Bentham cited “N. Australia. Upper Victoria river, *F. Mueller*; Gulf of Carpentaria, *Landsborough*, *Henne*. Queensland, *Bowman*.” while Windler (1966) stated “Type.—Upper Victoria River, *F. Mueller*”. Windler has clearly selected the Victoria River gathering from amongst the syntypes. As Windler did not designate which herbarium holds the type, a second-step lectotypification is needed, and that is effected here. The sheet on which the lectotype is mounted includes two other taxa, but the barcode K 000791027 is associated only with the lectotype, i.e. the two branches on the left-hand side of the sheet.

Notes: *Neptunia monosperma* has the shortest peduncles of any of the Australian or Malesian species. At anthesis, the peduncles are just 4–12 mm long, increasing to 5–21 mm at the fruiting stage.

The specimen *Perry 2908* (AD, CANB, NSW) is a mixed gathering; the CANB specimen is *Neptunia monosperma*, the AD specimen is *N. scutata*, the NSW specimen comprises one branch of *N. scutata* and one of *N. monosperma*.

*11. *Neptunia oleracea* Lour., *Fl. Cochinch.* 2: 654 (1790).

Type: Cochinchina, *s.dat.*, *J. Loureiro s.n.* (lecto [probably holo]: BM 000952356, *vide* Merrill 1935: 188).

Mimosa prostrata Lam., *Encycl.* 1: 10 (1783), *nom. illeg.* (*M. natans* L.f. (1782) cited in synonymy); *Neptunia prostrata* (Lam.) Baill., *Bull. Soc. Linn. Paris* 1: 356 (1883), *nom. illeg.*

Mimosa lacustris Bonpl., *Pl. Aequinoct.* 1: 55, t. 16 (1806); *Desmanthus lacustris* (Bonpl.) Willd., *Sp. Pl.*, ed. 4, 4(2): 1044 (1806); *Acacia lacustris* (Bonpl.) Desf., *Tabl. École Bot.*, ed. 3 (*Cat. Pl. Horti Paris.*) 301 (1829). **Type:** [Colombia]. ‘Near Monpox’ [Santa Cruz de Mompo], *n.v.*

Desmanthus natans Willd., *Sp. Pl.* 4: 1044 (1806), *nom. illeg.* (*Neptunia oleracea* cited in synonymy); *Neptunia natans* W.Theob., *Burmah [Mason]*, ed. 3. 2: 541 (1883), *nom. illeg. nom. superfl.*

Illustration: Windler (1966: 402).

Shrub, perennial, aquatic. Stems prostrate and trailing, glabrous, sessile glands absent, frequently with inflated ellipsoidal “floats” up to 8 cm long and 3 cm diameter and rooting at the nodes. Stipules deciduous, broadly ovate, 4.2–5.3 mm long, 2.8–3.5 mm broad, chartaceous, faintly nerved, glabrous; apex acute; base obliquely cordate. Leaves with 2 or 3 pairs of pinnae; petioles 35–47 mm long, glabrous, nectary absent; rachis 10–28 mm long, glabrous, nectaries absent; rachis extension linear, 1.2–2.3 mm long; pinnae with 10–17 pairs of leaflets, rachilla extension 0.8–0.9 mm long; stipels absent. Largest leaflets 6.2–9.3 mm long, 1.8–2.5 mm wide, 3.4–4.4 times longer than broad, glabrous, venation of 1–3 main veins, more obvious on lower surface. Inflorescences ellipsoidal, all with dimorphic flowers; peduncles 130–175 mm long at anthesis, glabrous; bracts 2, positioned on proximal one-third of peduncle, caducous before anthesis, ovate, amplexicaul, glabrous, lower one *c.* 3 mm long; flowers 40–60 per inflorescence; bracteoles oblanceolate, *c.* 2.2 mm long, caducous, usually falling before anthesis. Bisexual flowers: calyx campanulate, 2–2.5 mm long, glabrous; petals 3.3–3.6 mm long, glabrous; stamens 10, filaments 6.5–7.5 mm long, anthers 0.8–1 mm long, terminal gland absent; style *c.* 6 mm long, glabrous; ovary glabrous. Neuter flowers: calyx 1–1.3 mm long; petals 1.8–2.6 mm long, glabrous; staminodes 10, 6.5–9 mm long, 0.7–0.9 mm wide. Pods and seeds not seen.

Additional specimens examined: **Philippines.** MINDANAO: Bunauan, in 1913, *Taylor s.n.* (US 02209018). **Indonesia.** JAVA: Sentiong, Aug 1904, *Backer s.n.* (L 2042612); Batavia, *s.dat.*, *Blume s.n.* (L 2042604); *ibid.*, Aug 1907, *Harrevelde s.n.* (L 2042613); Rawa Bening bij Ambarawa, Jul 1940, *Hoed & van der Meer 600* (L 2042610); Rawah Gesian, Feb 1914, *Backer 11723* (L 2042600); Rawah Bening, Jun 1927, *Coert 440A* (L 2042601).

Distribution and habitat: *Neptunia oleracea* is distributed in tropical Asia, Africa, central America and South America (Windler 1966). From Malesia, I have seen specimens only from Java and Philippines (**Map 3**), but ILDIS (2022) records it also from Sumatra, Borneo, Moluccas and Sulawesi. It inhabits warm, slow-moving and often stagnant waters.

Phenology: It flowers year-round in the tropics (Anon. 2022).

Affinities: Very closely allied to *Neptunia plena* (see Notes under that species).

Notes: None of the available specimens of *Neptunia oleracea* bears any fruits, and only a few of them have flowers or flower buds.

Neptunia oleracea is a nutritious vegetable, containing Vitamins A, B₁, B₂, B₃ (niacin) and C. In Thailand, the plant is cultivated for its young shoots, which are eaten raw or as a fried vegetable (Paisooksantivatana 1993).

12. *Neptunia paucijuga* A.R.Bean sp. nov.

With affinity to *Neptunia dimorphantha*, but differing by the glabrous fruits, the leaves with two pairs of pinnae (rarely one pair), and the nectary positioned away from the distal end of the petiole. **Typus:** Australia. Northern Territory. Nitmiluk National Park, 21 March 2000, *K. Brennan 4941* (holo: BRI [AQ1024487 comprising 1 sheet]; iso: DNA D0169730).

Shrub, perennial, terrestrial. Stems prostrate, glabrous, sessile glands rare or absent. Stipules persistent, ovate, 5.3–6.6 mm long, 1.2–1.9 mm broad, coriaceous, strongly nerved, glabrous; apex attenuate; base obliquely cordate. Leaves with (1 or) 2 pairs of pinnae; petioles 5–10 mm long, glabrous, with 1 or 2 nectaries on the lower half or about halfway along or in upper half; rachis 7–9 mm long, glabrous or with a few hairs, nectary absent; rachis extension linear, 1.8–2.8 mm long; pinnae with 10–18 pairs of leaflets, rachilla extension 1.4–1.8 mm long; stipels slender, 0.4–1 mm long, divided, gland-tipped. Largest leaflets 6.1–9 mm long, 1.3–2.4 mm wide, 3.7–4.7 times longer than broad,

glabrous or with a few marginal cilia, a single vein visible on lower surface. Inflorescences globose, all bisexual; peduncles 40–54 mm long at anthesis, 44–65 mm long at fruiting stage, glabrous; bracts 2, positioned on proximal one-third of peduncle, persistent, ovate, amplexicaul, lower one larger, 2.2–6.6 mm long, glabrous; flowers 16–28 per inflorescence; bracteoles oblanceolate, *c.* 1.3 mm long, caducous, usually falling before anthesis. Bisexual flowers: calyx campanulate, 1.2–1.3 mm long, glabrous; petals 2–2.2 mm long, glabrous; stamens 5, filaments *c.* 2.2 mm long, anthers 0.9–1 mm long, terminal gland prominent; style 3.5–3.8 mm long, glabrous; ovary glabrous. Neuter flowers: absent. Pods broadly elliptical, 1–3-seeded, 11–19 mm long, 9–13 mm broad, indehiscent, stipe 1–2 mm long, apex (excluding style) obtuse; glabrous. Seeds broadly elliptical in outline, *c.* 3.9 mm long and 3.2 mm wide, brown. **Fig. 2C.**

Additional specimens examined: Australia. Northern Territory. Edith River area, Apr 1999, *Michell & Risler 2338* (DNA); Fire plot 45, Nitmiluk NP, Mar 2000, *Brennan 4958* (DNA); 17 Mile Valley, Nitmiluk NP, Mar 2002, *Michell & Kerrigan 3954* (DNA); Old Edith Falls track, Mar 1987, *Bowman 471* (DNA); Mt Todd mine site, Mar 1995, *Egan 4443* (DNA); Warlock [Warloch] Ponds, Apr 1968, *Byrnes NB630* (AD, DNA); Bradshaw Military Training Area, *c.* 60 km NW of Timber Creek, May 2017, *Cuff 662* (DNA).

Distribution and habitat: *Neptunia paucijuga* is endemic to Australia in the Northern Territory. It is known from the Katherine, Timber Creek and Mataranka areas (**Map 7**). It inhabits rocky sandstone hills and rises in grassy open woodland dominated by eucalypts, except for the Warloch Ponds location, which is a flat site with black cracking clay.

Phenology: Flowers and fruits are recorded from March and April.

Affinities: *Neptunia paucijuga* is related to the widespread *N. dimorphantha*, with which it shares the 1–3-seeded pods, the relatively long peduncle (42–90 mm long) bearing two bracts on the proximal one-third, and the presence of a nectary (or nectaries) on the petiole. In *N. paucijuga*, the position of the petiole nectary is variable, and sometimes

there are two adjacent nectaries. In *N. dimorphantha*, the nectary is consistently located at the distal end of the petiole (between the lowest pair of pinnae), and there is never a second nectary. *Neptunia paucijuga* has leaves with 2 pairs (rarely 1 pair) of pinnae, while *N. dimorphantha* has 3–5 pairs of pinnae. The stems and leaflets of *Neptunia paucijuga* are glabrous or almost glabrous although the rachilla bears some long hairs; *N. dimorphantha* stems and leaves are sparsely to moderately hairy. An important characteristic of *N. dimorphantha* is the presence of short hairs along the margins of the pods. These hairs are absent in *N. paucijuga* and its pods are glabrous.

Note: The few flowering specimens of *Neptunia paucijuga* bear only bisexual flowers, and it is possible that neuter flowers do not occur in this species.

Etymology: From the Latin *paucus* meaning ‘few’, and *-jugus*, meaning ‘paired’. This refers to the fewer pairs of pinnae in this species when compared to the related *Neptunia dimorphantha*.

***13. *Neptunia plena* (L.) Benth., *J. Bot. (Hooker)* 4: 355 (1841).**

Mimosa plena L., *Sp. Pl.* 1: 519 (1753); *Desmanthus plenus* (L.) Willd., *Sp. Pl., ed. 4*, 4(2): 1045 (1806); *Hemidesmas plenus* (L.) Raf., *Sylva Tellur.* 119 (1838). **Type citation:** “Habitat in Vera Cruce”. **Type:** Herb. Linn. No. 1228.12 (lecto: LINN, *fide* Kostermans 1980: 462).

Mimosa punctata L., *Syst. Nat. ed. 10*, 2: 1311 (1759); *Desmanthus punctatus* (L.) Willd., *Sp. Pl., ed. 4*, 4(2): 1047 (1806); *Acacia punctata* (L.) Desf., *Tabl. École Bot., ed. 3 (Cat. Pl. Horti Paris.)* 300 (1829). **Type:** “America”, *s.dat.*, *P. Browne s.n.*, Herb. Linn. No. 1228.14 (lecto: LINN, *fide* Wijmans 1983: 152).

Desmanthus polyphyllus DC., *Prodr.* 2: 444 (1825); *Neptunia polyphylla* (DC.) Benth., *J. Bot. (Hooker)* 2: 129 (1840). **Type:** locality unknown, herb. Moricand ex hort. Napol. (holo: G?, *n.v.*).

Mimosa adenanthera Roxb., *Fl. Ind.* 2: 554 (1832). **Type:** “East India”, *s.dat.*, *W. Roxburgh s.n.* (syn: K 000791019).

Illustration: Windler (1966: 399).

Shrub, perennial, aquatic. Stems sprawling or erect, to 1 m high, glabrous, sessile glands absent frequently with inflated ellipsoidal “floats” up to 8 cm long and 3 cm diameter and rooting at the nodes. Stipules deciduous, broadly ovate, 9–12 mm long, 3.5–6 mm broad, chartaceous, faintly nerved, glabrous; apex acute; base obliquely cordate. Leaves with 2 or 3(–4) pairs of pinnae; petioles 35–55 mm long, glabrous, nectary usually present, small, near distal end, sometimes absent; rachis 20–48 mm long, glabrous, nectaries absent; rachis extension linear, 3–6 mm long; pinnae with 16–24 pairs of leaflets, rachilla extension 1.5–2 mm long; stipels absent. Largest leaflets 11–18 mm long, 2.2–3.3 mm wide, 4.7–5.8 times longer than broad, glabrous, venation of 1–3 main veins, more obvious on lower surface. Inflorescences ellipsoidal, all with dimorphic flowers; peduncles 75–125 mm long at anthesis, 80–140 mm long at fruiting stage, glabrous; bracts 2, positioned on proximal or middle one-third of peduncle, caducous before anthesis, ovate, amplexicaul, glabrous, lower one 5.5–8.2 mm long; flowers 30–50 per inflorescence; bracteoles elliptical, 1.2–1.5 mm long, caducous, usually falling before anthesis. Bisexual flowers: calyx campanulate, 2–2.4 mm long, glabrous; petals 3.3–3.4 mm long, glabrous; stamens 10, filaments 6–6.5 mm long, anthers 0.9–1.2 mm long, terminal gland absent; style 4.3–4.7 mm long, glabrous; ovary glabrous. Neuter flowers: calyx 0.8–1 mm long; petals 1.9–2.3 mm long, glabrous; staminodes 10, 8–13 mm long, 0.5–1.2 mm wide. Pods oblong, 12–15-seeded, 31–41 mm long, 8.5–10 mm broad, dehiscent along one margin only, apex obtuse, stipe 6–10 mm long; glabrous. Mature seeds not seen. **Figs. 3J, 8.**

Additional selected specimens examined: **Indonesia.** JAVA: *s.loc.*, *s.dat.*, *Zollinger 3160* (MEL); Buitenzorg, Jan 1950, *Ooststroom 12641* (L); Bogor, Feb 1950, *Ooststroom 12732* (CANB). **Papua New Guinea.** WESTERN (FLY): Old Mawatta, South Fly district, Feb 2018, *Waterhouse BMW8301* (BRI, CANB, CNS). **Australia. Northern Territory.** 80 Cunjevoi Road,

Virginia, Nov 2011, *Mitchell 7041* (BRI, DNA); Nhulunbuy town lagoon, NE Arnhem Land, Mar 2012, *Westaway JOW3786* (BRI, CANB, DNA). **Queensland.** COOK DISTRICT: Lake Placid, Cairns, May 2009, *Vitelli WM198* (BRI). NORTH KENNEDY DISTRICT: 15 km S of Home Hill, May 2013, *O'Bryan s.n.* (BRI [AQ796758], MEL). SOUTH KENNEDY DISTRICT: 6 Staceys Road, Kuttabul, Jun 2020, *Gunasekera s.n.* (BRI [AQ952483]). MORETON DISTRICT: 266 Ritchie Road, Pallara, Brisbane, Mar 2006, *Johnson s.n.* (BRI [AQ751366]); *c.* 14 km W of Peak Crossing, Feb 2006, *Wickman s.n.* (BRI [AQ751351]).

Distribution and habitat: *Neptunia plena* is known from North and South America, almost exclusively between the Tropic of Cancer and the Tropic of Capricorn, including islands of the Caribbean Sea (Windler 1966). In the Old World, it is known from India, China, Malaysia, Singapore, Java, Sri Lanka (ILDIS 2022), Papua New Guinea and Australia. It is a recent introduction to Australia, with the first non-cultivated record in 2001 (**Map 10**). It inhabits dams, lagoons and swampy areas where water movement is minimal.

Phenology: Flowers and fruits can be found throughout the year.

Notes: Both *Neptunia plena* and *N. oleracea* have been recorded as naturalised species for Queensland (Brown 2020). These species have always been poorly distinguished. Bentham (1875) and Schery (1950) used the presence or absence of spongy floating stem tissue as the major determining character between *N. plena* and *N. prostrata* (Lam.) Baill. (= *N. oleracea*), and Schery (1950) introduced, as a secondary distinguishing character, the presence (*N. plena*) or absence (*N. oleracea*) of a nectary gland on the leaf (at the apex of the petiole near the basal pair of pinnae). Windler (1966) gave increased importance to the nectary character and did not mention the spongy stem tissue in his key or discussion. Other characters Windler (1966) used in his key to distinguish them are 1. the number of leaflets per pinna (but in his descriptions there is considerable overlap (9–38 pairs for *N. plena*; 8–20 pairs for *N. oleracea*); and 2. the number of seeds per pod (8–20 for *N. plena*, 4–8 for *N. oleracea*). These are of little practical value as none of the south-east Asian specimens at L determined by Windler as *N. oleracea* (or its synonym *N. prostrata*)



Fig. 8. *Neptunia plena*, flowering and fruiting (Waterhouse BMW8301, BRI). Photo: B. Waterhouse.

bears any fruits. Subsequent authors (e.g. Kostermans 1980; Nielsen 1992; Santos-Silva *et al.* 2020) have not provided an alternative key to these species – all have copied or adapted Windler’s key.

Using Windler’s key, most Queensland specimens can be assigned to *Neptunia plena* because of the presence of the small nectary on the petiole. However, in some specimens, the nectary is developed on just one or two leaves and is lacking on the remaining leaves. There are also a few specimens where the nectary is lacking altogether and these have previously been identified as *N. oleracea*, but their morphology in every other way matches the *N. plena* specimens and hence I regard them as *N. plena* also.

Herbarium specimens of *Neptunia oleracea* from Malesia do often appear morphologically distinct from the *N. plena* from Australia (fewer leaflets per pinna; more abundant spongy stem tissue), but this could be due to the growth stage that has been selected, with *N. oleracea* specimens representing younger plants growing across the water (leaves in juvenile phase and plants too young to bear fruits), and *N. plena*

representing older growth with ascending mostly non-spongy stems, and often bearing fruits.

Schery (1950) commented “Probably *N. prostrata* [= *N. oleracea*] is not a valid species, but merely a form of *N. plena* growing floating in water and assuming a prostrate position.” Peck & Serviss (2011) accepted *N. oleracea* but said that “*Neptunia oleracea* is extremely similar morphologically to *N. plena* ...”.

It does seem doubtful that *Neptunia oleracea* is taxonomically distinct from *N. plena*, but that determination would require a more wide-ranging study than is possible here.

14. *Neptunia proxima* A.R.Bean sp. nov.

With affinity to *Neptunia gracilis* but differing by the long spreading hairs on leaves, peduncles and pods; the lack of staminodes; and the shorter peduncles. **Typus:** Australia. Queensland. COOK DISTRICT: Maytown, near historical Jimmy Ah Fun stores site in Leslie Street, 13 April 2016, *P.I. Forster PIF44127* & *K.R. McDonald* (holo: BRI [AQ940153 comprising 1 sheet]).

Shrub, perennial, terrestrial. Stems prostrate, with patent hispid hairs 0.2–0.5 mm long, sessile glands absent. Stipules persistent, ovate to broadly ovate, 2.8–6.2 mm long, 2–2.3 mm broad, coriaceous, strongly nerved, with hispid hairs along margin; apex attenuate; base obliquely cordate. Leaves with 2 or 3 pairs of pinnae; petioles 5–8 mm long, hispid, nectary absent; rachis 6–15 mm long, with patent hispid hairs 0.2–0.4 mm long, nectary absent; rachis extension linear, 2.5–3.1 mm long; pinnae with 16–21 pairs of leaflets, rachilla extension 1.2–1.6 mm long; stipels slender, 0.1–0.4 mm long, divided, gland-tipped. Largest leaflets 3–4.4 mm long, 0.9–1.1 mm wide, 3.3–4.4 times longer than broad, surfaces glabrous but margins ciliate, venation of 1–3 main veins, more obvious on lower surface. Inflorescences globose, all flowers bisexual; peduncles 17–24 mm long at anthesis, 30–45 mm long at fruiting stage, hispid hairy throughout; bracts absent or 1, positioned on proximal one-third of peduncle, persistent, broadly ovate, amplexicaul, 2.5–3.3 mm long, margin ciliate, surface glabrous or sparsely hairy; flowers 12–25 per inflorescence; bracteoles oblanceolate, 1–1.3 mm long, persistent until anthesis. Bisexual flowers: calyx obconical, 1.3–1.5 mm long, glabrous; petals 2–2.6 mm long, glabrous; stamens 5, filaments 2.5–3 mm long, anthers 0.6–0.8 mm long, terminal gland absent; style 2.1–3.4 mm long, glabrous; ovary hairy. Neuter flowers absent. Pods oblong, (2–)3–6-seeded, 15–27 mm long, 8–9 mm broad, tardily dehiscent along both margins, stipe 1.5–2 mm long, apex obtuse; with dense eglandular patent hairs 0.2–0.4 mm long. Seeds broadly elliptical in outline, 3.8–4 mm long, 3.2–3.3 mm wide, brown. **Fig. 3E–F.**

Additional specimens examined: Australia. Queensland. COOK DISTRICT: Cabbage Tree Creek, c. 1 mile [1.6 km] E of the Kennedy River, Laura – Coen Road, Oct 1962, *Smith 11691* (BRI); Kings Plains Station, 10.3 km old coach road from homestead, Apr 2015, *McDonald 17070 & Thompson* (BRI); Littleton NP, 1.3 km by road N of ranger station, Mar 2016, *McDonald KRM18188* (BRI); Rockfields, Gilbert River, May 1954, *Everist 5473* (BRI).

Distribution and habitat: *Neptunia proxima* is endemic to Queensland, Australia. It extends from near Laura to Gilbert River, east of Croydon (**Map 7**). It grows in hilly terrain in eucalypt woodland with sandy-loam soil, or in *Melaleuca* woodland on plains with clayey soil.

Phenology: Flowers are recorded for March, April and May; fruits are recorded for March, April and October.

Affinities: *Neptunia proxima* differs from the similar *N. gracilis* by the petioles 5–8 mm long (10–17 mm long for *N. gracilis*); 16–21 leaflet pairs per pinna (12–17 pairs for *N. gracilis*); largest leaflets 3–4.4 mm long (5.4–8.2 mm for *N. gracilis*); inflorescences all bisexual (inflorescence dimorphic, with some neuter flowers for *N. gracilis*); peduncles (at anthesis) 17–24 mm long ((25–)40–90 mm long for *N. gracilis*) and peduncles (at fruiting stage) 30–45 mm long (50–105 mm long for *N. gracilis*).

Etymology: The epithet is from the Latin *proximus*, meaning ‘next’ or ‘nearest’. This is in reference to its relationship with *Neptunia gracilis*.

15. *Neptunia scutata* A.R.Bean sp. nov.

With affinity to *Neptunia xanthonema* but differing by the lack of nectaries on the leaf rachis, the peduncles hairy throughout, the smaller leaflets and the smaller bracts. **Typus:** Australia. Northern Territory. Gregory National Park, Bullita section, 14 February 1992, *I. Cowie 2376 & P.S. Brocklehurst* (holo: CANB 00471857 comprising 1 sheet; iso: DNA D0066573, MEL 0717866A).

[*Neptunia dimorphantha* auct. non Domin, *pro parte*: Whibley (1981: 114); Wheeler (1992: 341)].

Illustration: Cowan (1998: 22, fig. 36 J, K), as *N. monosperma*

Shrub, perennial, terrestrial. Stems prostrate or sprawling, glabrous, sparsely hairy or densely hairy, glandular or not, sessile glands rare or absent. Stipules persistent, broadly ovate, 3.5–6.8 mm long, 1.2–2.9 mm broad, coriaceous, usually with 1 strong nerve and

several faint nerves, apex attenuate, base obliquely cordate, glabrous or with sparse hairs. Leaves with 3–5, rarely 6 pairs of pinnae; petioles 4–13 mm long, hairy, with a prominent nectary about halfway along, or in the upper half, occasionally absent; stipels slender, 0.2–0.8 mm long, divided, gland-tipped; rachis 7–28 mm long, with sparse to dense simple hairs, nectaries absent; rachis extension linear, 1–3.8 mm long, glabrous or sparsely hairy; pinnae with 11–24 pairs of leaflets, rachilla extension 0.8–1.5 mm long. Largest leaflets 3–7 mm long, 1–1.8 mm wide, 2.8–4.3 times longer than broad, glabrous above, glabrous or sparsely hairy below, and with marginal cilia, venation of 1–3 main veins, more obvious on lower surface. Inflorescences globose to broadly ellipsoidal, some with dimorphic flowers; peduncles 8–35 mm long at anthesis, 18–35 mm long at fruiting stage, with patent glandular hairs throughout, 0.1–0.3 mm long; bracts 2, positioned on proximal one-third of peduncle, persistent, ovate, amplexicaul, the lower one 2.5–8 mm long, glabrous above, glabrous or hairy below; flowers 25–50 per inflorescence; bracteole oblanceolate, 0.9–1.2 mm long, caducous, usually falling before anthesis. Bisexual flowers: calyx campanulate, 0.8–1.6 mm long, glabrous or with sparse hairs; petals 1.4–2.4 mm long, glabrous or with sparse hairs; stamens 5, filaments 2.1–3.2 mm long, anthers 0.5–0.6 mm long, terminal gland absent; style 1.3–3 mm long, glabrous; ovary hairy. Neuter flowers: calyx 0.5–0.8 mm long, glabrous; petals 1.1–2.4 mm long, glabrous; staminodes 5, 4–7.5 mm long, 0.3–0.6 mm wide. Pods broadly elliptical to circular, 1-seeded, 7.5–9.5 mm long, 5–8.5 mm broad, indehiscent, with patent glandular hairs 0.2–0.5 mm long; stipe 1–2.5 mm long. Seeds broadly elliptical in outline, 3.8–4.5 mm long, 2.8–3.4 mm wide, brown. **Fig. 9.**

Additional specimens examined: **Australia. Western Australia.** Long Spring, 66 km NNE of Carlton Hill HS, c. 10 km NE of Knob Peak in the Ningbing Range, Mar 1978, *Lazarides 8481* (BRI, CANB); Langey Crossing on west bank of Fitzroy River, on Jarrananga Plain in Yeeda Station, Mar 1986, *Foulkes 421* (CANB, PERTH); Great Northern Highway, 84 km N from Halls Creek, May 1999, *Purdie 4866* (CANB, PERTH); Revolver Creek, upper slopes of southern Carr Boyd Ranges, Mar 1978, *Hartley 14516* (CANB); Kimberley Research Station,

Kununurra, Apr 1964, *Richards 75* (CANB). **Northern Territory.** Darwin wharf area, adjacent to duck pond, Feb 2007, *Roberts 137* (BRI, CANB); c. 27 km SW of 'Calvert Hills' on the road to 'Cresswell Downs', May 1974, *Pullen 9254* (CANB); 1 mile [1.6 km] S of Mt Sanford Outstation, Jun 1949, *Perry 2183* (CANB); Morphet Creek, Jan 1994, *Egan 2995* (CANB, DNA). **Queensland.** COOK DISTRICT: 33 km along 'Blackdown' Road, from Chillagoe – 'Wrotham Park' Road, Jan 1993, *Bean 5637 & Forster* (BRI, MEL). BURKE DISTRICT: 20 miles [32 km] NNE of Camooweal township, May 1948, *Perry 983* (BRI, CANB); 1 km along road to Herbert Vale HS, off Lawn Hill to Riversleigh Road, Apr 1997, *Forster PIF20867 & Holland* (BRI, DNA, MEL). NORTH KENNEDY DISTRICT: 20 km from Charters Towers, towards Clermont, Apr 2002, *Bean 18966* (BRI); 7 km from Homestead towards Pentland, Feb 1994, *Bean 7485 & Forster* (BRI). SOUTH KENNEDY DISTRICT: 3 km W of Yarrowmere HS, Mar 1993, *Thompson BUC987 & Henderson* (BRI). GREGORY NORTH DISTRICT: Diamantina NP, northern boundary of park, Apr 1997, *Forster PIF20754 & Holland* (BRI, DNA); 20 miles [32 km] W of Winton, May 1966, *Pedley 1996* (BRI). MITCHELL DISTRICT: Stonehenge, on road to airstrip, May 2004, *Bean 22446* (BRI).

Distribution and habitat: *Neptunia scutata* is widespread in northern Australia, from Karratha in Western Australia to Charters Towers in Queensland (**Map 11**). It inhabits grassland often dominated by Mitchell grass (*Astrebula* spp.) growing in brown to black clay soil, and sometimes occurs in *Melaleuca* or eucalypt woodland with sandy to clayey soils.

Phenology: Most flowering and fruiting records are between December and June, with occasional records in the other months.

Affinities: *Neptunia xanthonema* differs from *N. scutata* by the frequent presence of nectaries on the leaf rachis, one adjacent to each pair of pinnae (nectaries absent from rachis in *N. scutata*); peduncles usually glabrous except at the apex (hairy throughout for *N. scutata*); seeds 2.7–3.6 × 2.4–2.8 mm (3.8–4.5 × 2.8–3.4 mm for *N. scutata*); and the mostly larger leaflets, 5.8–11 mm long (3–7 mm long for *N. scutata*). In addition, *N. xanthonema* has 2 or 3(–4) pairs of pinnae (3–5(–6) pairs for *N. scutata*).

Note: The petiolar nectary that is a feature of this species, is occasionally absent for all petioles on a herbarium sheet.



Fig. 9. *Neptunia scutata*, showing leaf, inflorescence, peduncle, bracts and young fruits (Bean 18966, BRI).

Etymology: From the Latin *scutatus*, meaning 'shield-shaped'. This is given in reference to the flattened broadly elliptical fruits that resemble a small shield.

16. *Neptunia tactilis* A.R.Bean sp. nov.

With affinity to *Neptunia javanica* but differing by the lack of a nectary on the petiole, the lack of staminodes, and the 15–28 pairs of leaflets per pinna. **Typus:** Australia. Queensland. COOK DISTRICT: 4.6 km S of Batavia Downs on the Peninsula Development Road, 19 April 1990, J.R. Clarkson 8248 & V.J. Neldner (holo: BRI [AQ512120 comprising 1 sheet]; iso: DNA D0061355, L 2042652).

Neptunia 'Darwin', *pro parte*: (Dunlop *et al.* 1995: 27).

Illustration: Dunlop *et al.* (1995: 26).

Shrub, perennial, terrestrial, prostrate to trailing. Stems glabrous, sessile glands absent. Stipules persistent, narrowly ovate, 4.5–6.5

mm long, 1.1–1.8 mm broad, coriaceous, with several strong nerves, apex attenuate, filamentous, base obliquely cordate or obtuse, glabrous or with a few hairs along margin. Leaves with 1–3 pairs of pinnae; petioles 3–9 mm long, glabrous or sparsely hairy, nectary absent; rachis absent or 6–19 mm long, with sparse simple hairs, nectaries absent; rachis extension linear, 2.2–6 mm long; pinnae with 20–28 pairs of leaflets, rachilla extension 1–3.3 mm long; stipels slender, 0.1–0.9 mm long, entire, sometimes gland-tipped. Largest leaflets 4.5–6.7 mm long, 1.1–1.5 mm wide, 3.6–5.2 times longer than broad, glabrous above, glabrous or sparsely hairy below, and with marginal cilia, midvein and a few lateral veins visible on lower surface. Inflorescences globose, all with bisexual flowers only; peduncles 14–36 mm long at anthesis, 20–59 mm long at fruiting stage, glabrous or with sparse eglandular patent hairs throughout; bracts absent; flowers 6–12 per spike; bracteoles oblanceolate, 0.8–1.9 mm long, caducous or somewhat persistent. Bisexual flowers: calyx campanulate to obconical, 1–2.2 mm long, glabrous; petals 1.9–2.8 mm long, glabrous; stamens 5–8, filaments 2.5–4 mm long, anthers 0.6–1 mm long, terminal gland very small or conspicuous; style 2.2–4 mm long, glabrous; ovary glabrous. Neuter flowers absent. Pods oblong or elliptical, 16–42 mm long, 7.5–11 mm broad, dehiscent along one margin only; stipe 2–6 mm long; apex acute or obtuse; surface of pod glabrous. Seeds 6–9 per pod, broadly elliptical in outline, 3.8–4.5 mm long, 3.5–3.6 mm wide, brown. **Fig. 3G.**

Additional selected specimens examined: Australia. **Western Australia.** Boongaree Island, Prince Frederick Harbour, Jul 1973, *Wilson 11320* (PERTH); 2 km W of camp, Mitchell Plateau, Apr 1982, *Keighery 4998* (PERTH); Dunvert Island, Buccaneer Archipelago, NE of Derby, Apr 1997, *Martin CB132* (PERTH); Adjacent to Mermaid Tree, behind beach at Careening Bay, North Kimberley, May 1998, *Mitchell 5410* (AD, PERTH); Augustus Island, May 2008, *Handasyde TH3541* (PERTH). **Northern Territory.** Elcho Island, Jul 1975, *Maconochie 2168* (CANB, DNA); Fossil Head, Feb 1994, *Leach 4222* (DNA); 15 km WSW of Cape Arnhem, Feb 1994, *Brennan 2440* (DNA); Bickerton Island, Milyakburra Community, Apr 1993, *Leach 3480 & Cowie* (DNA); Arnhem Bay, mouth of Cato River, May 1992, *Cowie 2882* (DNA); Copeland Island, Mountnorris Bay, Apr 1883, *Foelsche 82* (AD, MEL); Road to Matt

Wilson Lookout, Gregory NP, Jan 1998, *Harwood 277* (DNA); Gunn Point, Mar 1993, *Egan 617* (DNA); North Goulburn Isle, May 1992, *Dunlop 9042* (DNA); SE end of Fisher airstrip, Gimbat, Nov 1991, *Brennan 1593* (DNA); Grootte Eylandt, c. 25 km E of Angurugu, Mar 2005, *Risler & Brennan 2946* (DNA); Near Glenluckie Creek, Stuart Highway, Mar 1991, *Cowie 1566 & Munns* (DNA, MEL); on Katherine road, 10.2 km from Gove airport, Nov 1989, *Forster PIF6012* (BRI); Grootte Eylandt, GE 115, Mar 2005, *Brennan 6421* (DNA). **Queensland.** COOK DISTRICT: Beside the road to Pormpuraaw, Apr 2009, *Wannan 5603* (BRI); 6.8 km N of the new road turnoff to Weipa, on the Peninsula Development Road, Jul 1985, *Clarkson 6043* (BRI, CANB, MEL, NSW); NW Cape York Peninsula, Skardon River landing area, Mar 1995, *Gunness 2478* (BRI); vicinity of Weipa township, Jun 1997, *Grimshaw JFG697E & Gollan* (BRI); South Cape Bedford, May 1990, *Clarkson 8652 & Neldner* (BRI); East of Weipa on Peninsula Development Road, Feb 2000, *Wannan 1547 & Jago* (BRI); S of Strathburn boundary on Strathburn access road, Feb 2015, *Thompson SLT15006* (BRI); Alkoomie Station, W of Cooktown, Mar 2015, *McDonald KRM16695* (BRI); Brooklyn Nature Reserve, Mt Spurgeon Road, 19 February 2009, *McDonald KRM8229 & Puschendorf* (BRI, MEL). BURKE DISTRICT: North Bountiful Island, South Wellesley Group, Gulf of Carpentaria, Nov 2002, *Pedley BOI23 & Thomas* (BRI).

Distribution and habitat: *Neptunia tactilis* is endemic to Australia where it is found in northern parts of the Kimberley region of Western Australia, the ‘Top End’ of the Northern Territory, and Cape York peninsula in Queensland (**Map 6**). It grows in eucalypt woodland on stony lateritic plains and slopes.

Phenology: Flowers are recorded from November to April, although there is one additional record from September. Fruits are recorded from November to May, and one record in September. The September record was associated with regrowth after a fire.

Affinities: *Neptunia tactilis* is a very sparsely hairy species with few pinnae, numerous leaflets per pinna, short petioles, no bracts on the peduncle, and bisexual inflorescences. It is similar to *N. javanica* but differs by the lack of a nectary on the petiole (present in *N. javanica*), the 5–8 stamens (10 for *N. javanica*), the 15–28 pairs of leaflets per pinna (9–15 pairs for *N. javanica*), and the lack of staminodes (present in *N. javanica*). *N. tactilis* differs from *N. gracilis* by the 5–8 stamens (always 5 for *N. gracilis*), the 15–28 pairs of leaflets per pinna (12–17 pairs for *N. gracilis*), the petioles only 3–9 mm long (10–

17 mm long for *N. gracilis*), the consistent lack of bracts on the peduncle (1 bract present on some peduncles for *N. gracilis*), and the 6–12 flowers/inflorescence (12–25 flowers for *N. gracilis*).

Note: A specimen from 4 miles S of Katherine (*I.B. Wilson 51*, CANB, DNA) resembles *Neptunia tactilis*, but has dense hispid hairs on the stems and leaves. It may represent a distinct taxon.

Etymology: The species epithet is from the Latin *tactilis*, meaning ‘sensitive to touch’. This refers to the leaflets which close in on each other when touched, a feature of this and other species of *Neptunia*.

17. *Neptunia valida* A.R.Bean sp. nov.

With affinity to *Neptunia scutata* but differing by the upright habit, the lack of a nectary on the petiole, and the frequent presence of three or four bracts on the peduncle. **Typus:** Australia. Western Australia. Near Wyndham port hotel, 17 April 2000, *A.A. Mitchell 6148* (holo: BRI [AQ642949]; iso: PERTH 6195342).

[*Neptunia dimorphantha* auct. non Domin, *pro parte*: Wheeler (1992: 341)].

Shrub, perennial, terrestrial. Stems erect, 1–1.5 m high, densely glandular-hairy, sessile glands absent. Stipules persistent, broadly ovate, 4.9–8.3 mm long, 2.2–4.1 mm broad, coriaceous, strongly nerved, hairy; apex acute to attenuate; base obliquely cordate. Leaves with (2 or)3 pairs of pinnae; petioles 6–10 mm long, hairy, nectary absent; rachis 8–15 mm long, with dense glandular hairs, nectary absent; rachis extension linear, 2.7–2.9 mm long; pinnae with 9–15 pairs of leaflets, rachilla extension 0.5–1.5 mm long; stipels slender, 0.2–0.5 mm long, divided, gland-tipped. Largest leaflets 4–7.4 mm long, 1.4–2.3 mm wide, 2.8–3.5 times longer than broad, glabrous on upper surface, sparsely to dense hairy on margins and lower surface, venation of midvein only, visible only on lower surface. Inflorescences globose, some with dimorphic flowers; peduncles 14–27 mm long at anthesis, 27–38 mm long at fruiting stage, with glandular hairs throughout, 0.1–

0.3 mm long; bracts 2–4, usually 3, positioned on proximal or middle one-third of peduncle, persistent, broadly ovate, amplexicaul, lower one 5.4–7.5 mm long, glabrous above, hairy below; flowers 25–40 per inflorescence; bracteoles oblanceolate, 1.5–1.8 mm long, persisting until anthesis. Bisexual flowers: calyx obconical, 1–1.2 mm long, hairy on lobe margins; petals 2.2–2.5 mm long, sparsely hairy on outer surface; stamens 5, filaments 3.4–3.6 mm long, anthers 0.7–0.9 mm long, terminal gland present; style 3.5–4.5 mm long, hairy on lower half; ovary hairy. Neuter flowers: calyx 0.9–1 mm long; petals 1.8–2 mm long, sparsely hairy on outer surface; staminodes 5, 8.5–9.5 mm long, 0.5–0.9 mm wide. Pods circular to broadly elliptical, 1-seeded, 7.5–9.5 mm long, 5.5–7.5 mm broad, indehiscent, stipe *c.* 0.5 mm long, apex obtuse; surface of pod with dense patent hairs 0.1–0.25 mm long, at least some with glandular apex. Seeds broadly elliptical in outline, 4.3–4.6 mm long, 3.5–3.8 mm wide, brown. **Fig. 4C.**

Additional specimens examined: **Australia. Western Australia.** Cambridge Gulf, in 1887, *Wright s.n.* (MEL 596323); Gorge north of Devil Devil Spring, Smoke Creek, SW of Lake Argyle, May 1980, *Weston 12344* (PERTH); Shell garage grounds, Wyndham, Mar 1992, *Mitchell 2141* (PERTH); along Victoria Highway, 15 km S of highway, 40 km E of Kununurra, Apr 1989, *Halford H50* (BRI, PERTH); Wyndham Port, East Kimberley, Jun 2008, *Roberts APR1079* (CANB, DNA, PERTH); Port Wyndham, Jul 1974, *Carr 3269 & Beaglehole 47047* (CANB, PERTH); Wyndham graveyard, Mar 1991, *Petty s.n.* (PERTH 1258222); Ord River station, May 1985, *Newland CN22* (PERTH); *c.* 4 km from Wyndham along road to port, Apr 1987, *Purdie 3309* (CANB).

Distribution and habitat: *Neptunia valida* is endemic to Australia in Western Australia, and apparently confined to the eastern Kimberley region, mostly around Wyndham and Kununurra (**Map 5**). Only three specimen labels (all coastal) record habitat information, viz. ‘disturbed roadside near mangroves’, ‘next to tidal flat’ and ‘plain just above supratidal plain’, but because the species extends inland, it must have a broader ecological range.

Phenology: Flowers and fruit are recorded from March to July.

Affinities: *Neptunia valida* and *N. monosperma* are the only upright species with single-seeded fruits. *Neptunia valida* is very different in the dense glandular indumentum (vegetative parts glabrous in *N. monosperma*) and the (2–)3–4 hairy bracts (2 glabrous bracts for *N. monosperma*). *Neptunia valida* is perhaps closest to *N. scutata*, but differs by the upright habit, the lack of a nectary on the petioles, the longer staminodes, and the frequent presence of three or four bracts on the peduncle.

Note: Some illustrations in the *Flora of Australia* (Cowan 1998: 22, figs. E–I), depict plant parts including mature fruits, a nectary gland on the petiole, and 2 bracts on the peduncles. They are labelled as *Neptunia dimorphantha*, but all are in fact *N. xanthonema*. Figs. E and F are said to be based on *Purdie 3309*, but that specimen has no petiole nectaries and all peduncles have either 3 or 4 bracts. Clearly those illustrations were not made using *Purdie 3309* but the actual voucher specimen is unknown. *Purdie 3309* is *Neptunia valida*.

Etymology: From the Latin *validus*, meaning ‘strong’. This is reference to the thick and strong stems allowing an upright habit.

18. *Neptunia xanthonema* A.R.Bean sp. nov.

With affinity to *N. monosperma*, but differing by prostrate habit, the conspicuous and persistent stipules, the pods with glandular hairs, the fewer leaflets per pinna, and the larger bracts on the peduncle. **Typus:** Australia. Northern Territory. Anthony Lagoon, 19 February 1998, *C.R. Mitchell 1311 & R. Carrow* (holo: BRI [AQ1024483 comprising 1 sheet]; iso: DNA D0134434).

Neptunia dimorphantha var. *clementii* Domin, *Biblioth. Bot.* 22(89): 802 (1926). **Type:** Australia. Western Australia. “Between Ashburton and Yule River”, *s.dat.*, *E. Clement s.n.* (*n.v.*)

[*Neptunia monosperma* auct. non Domin: Black (1948: 429)].

[*Neptunia dimorphantha* auct. non Domin, *pro parte*: Whibley (1981: 114); Whibley (1986: 513); Murray (1991: 380); Kenneally *et al.* (1996: 137); Wheeler (1992: 341)].

Illustrations: Cowan (1998: 22), as *Neptunia dimorphantha*, but see note under *N. valida*; Murray (1991: 380), as *N. dimorphantha*; Kenneally *et al.* (1996: 137), as *N. dimorphantha*.

Shrub, perennial, terrestrial. Stems prostrate or sprawling, to 0.25 m high, glabrous, sessile glands present. Stipules persistent, broadly ovate, 6–9.7 mm long, 3–4.6 mm broad, coriaceous, strongly nerved, glabrous; apex attenuate; base obliquely cordate. Leaves with 2 or 3(–4) pairs of pinnae; petioles 5–13 mm long, glabrous, with a prominent nectary in the upper half, often just below first pair of pinnae; rachis 8–28 mm long, with sparse tubercle-based hairs, nectary present below each pair of pinnae; rachis extension linear, 2.2–6 mm long; pinnae with 11–24 pairs of leaflets, rachilla extension 0.9–1.8 mm long; stipels slender, 0.2–0.8 mm long, divided, gland-tipped. Largest leaflets 5.8–11 mm long, 1.6–2.4 mm wide, 3.7–4.6 times longer than broad, glabrous or with a few marginal cilia, venation of 1–3 main veins, more obvious on lower surface. Inflorescences globose, some with dimorphic flowers; peduncles 7–32 mm long at anthesis, 19–45 mm long at fruiting stage, usually glabrous except at apex, sometimes sparsely hairy throughout; bracts 2, positioned on proximal one-third of peduncle, persistent, ovate, amplexicaul, glabrous, lower one 5–14.5 mm long; flowers 30–40 per inflorescence; bracteoles oblanceolate, 0.9–1.1 mm long, caducous, usually falling before anthesis. Bisexual flowers: calyx campanulate, 0.9–1.3 mm long, glabrous; petals 1.5–2 mm long, glabrous; stamens 5, filaments 2.2–2.8 mm long, anthers 0.4–0.55 mm long, terminal gland absent; style 1.3–2.1 mm long, glabrous; ovary densely hairy. Neuter flowers: calyx 0.5–0.6 mm long; petals 1.2–1.4 mm long; staminodes 5, 6–8.5 mm long, 0.5–1 mm wide. Pods broadly elliptical, 1-seeded, 7.5–9.5 mm long, 5.5–7 mm broad, indehiscent, stipe 1–1.7 mm long, apex obtuse; surface

of pod with dense patent hairs 0.2–0.4 mm long, at least some with glandular apex. Seeds broadly elliptical in outline, 2.7–3.6 mm long, 2.4–2.8 mm wide, brown. **Figs. 2F, 2G, 10.**

Additional selected specimens examined: **Western Australia.** c. 5 km from Nanutarra on Mt Stuart Road, Aug 1971, *Ashby 4064* (AD); Jigalong Creek, near 'Ethel Creek', NE of Newman, May 2006, *Bean 25378* (BRI); Mt Vernon Station, Nov 1976, *Sarti 10/96* (PERTH); Near Rudall River, May 1971, *George 10776* (PERTH); 5 km W of Mulga Downs Station HS along Mulga Downs Road, 91 km NE of Tom Price, Aug 2016, *Lyons & Coppen FV0589* (PERTH); Mardie HS, Mardie Station, Aug 2002, *Smith 136* (PERTH); Noonkanbah Station, Fitzroy River area, May 1984, *Stuart s.n.* (PERTH 1669559); 4 miles [6 km] E of Derby, Jan 1971, *Allan 559* (PERTH). **Northern Territory.** Track SW of Tobacco Waterhole, Mittebah Station, Apr 2014, *Jobson 11177 & Latz* (DNA, NT); McArthur River, Feb 1976, *Rice 2276* (CANB); 6.5 miles [10.5 km] E of Stuart Highway, Beetaloo Station Road, Feb 1969, *Must 384* (AD, CANB, MEL); Burt Plain, 36 miles [58 km] N of Alice Springs, May 1962, *Chippendale 9014* (CANB, MEL, NT); Narwietooma HS, Apr 1967, *Maconochie 56* (AD, CANB, DNA, NT); Charlotte Waters, c. 260 km SSE of Alice Springs, May 1939, *Crocker s.n.* (AD 96434301). **Queensland.** BURKE DISTRICT: Georgina River, just SW of Camooweal, May 2006, *Cumming 24151* (BRI). SOUTH KENNEDY DISTRICT: SW of Mazeppa NP, Feb 1998, *Fairfax 298 & Holman* (BRI). GREGORY NORTH DISTRICT: Goomerchie Paddock, 'Monkira', c. 100 km E of Bedourie, May 2007, *Bean 26282* (BRI); Chartwage Bore, Headingly, May 1985, *Neldner 1776 & Stanley* (BRI). MITCHELL DISTRICT: Jireena Station, 90 km SSE of Torrens Creek, Apr 2005, *Booth 3830 & Thompson* (BRI). GREGORY SOUTH DISTRICT: 10 miles [16 km] W of Windorah, Jun 1967, *Gittins 1252* (CANB); Windorah to Yaraka Road, 24.4 km E from crossroads at Retreat, Oct 1993, *Slee 3332 & Lepschi* (AD, BRI, CANB). WARREGO DISTRICT: Gilruth Plains, Feb 1941, *Roe RR155* (CANB). **New South Wales.** Mount Murchison, *s.dat.*, *Bonney 29* (MEL); Warri Gate, Sturt NP, May 1988, *Marcom s.n.* (NSW 213151). **South Australia.** Eringa Waterhole, Lindsay Creek, Hamilton station, Apr 1985, *Badman 1664* (MEL); 11 km S from Candradecka Dam on Cordillo Downs – Innamincka road, May 1986, *Purdie 2931* (AD, CANB); c. 22 km NW of Stuart Creek crossing (near Blower Waterhole) on track to Coward Springs from Stuart Creek HS, Mar 1984, *Jackson 5114* (AD); Welbourne Hill Station, 13 miles [21 km] S of Hawks Nest Well, May 1980, *Henshall 3023* (AD, NT); Arckaringa Station, 21.5 km direct NNW of Arckaringa, May 2000, *Lang BSOP-450* (AD).

Distribution and habitat: *Neptunia xanthonema* is endemic to Australia. It is distributed in the Pilbara and western Kimberley regions of Western Australia, the northern part of South Australia, south-western Queensland, southern Northern

Territory and north-western New South Wales (**Map 12**). It grows in red or brown clay soils on alluvial flats or low rises in grassland or *Acacia* woodland.

Phenology: Flowers and fruits are recorded for every month of the year except December.

Affinities: *Neptunia xanthonema* differs from *N. scutata* by the frequent presence of nectaries on the leaf rachis, one adjacent to each pair of pinnae (nectaries absent from rachis in *N. scutata*); peduncles usually glabrous except at the apex (hairy throughout for *N. scutata*); seeds 2.7–3.6 × 2.4–2.8 mm (3.8–4.5 × 2.8–3.4 mm for *N. scutata*); and the mostly larger leaflets, 5.8–11 mm long (3–7 mm long for *N. scutata*). In addition, *N. xanthonema* has 2 or 3(–4) pairs of pinnae (vs. 3–5(–6) pairs for *N. scutata*).

Typification: Type material of *Neptunia dimorphantha* var. *clementii* was sought from PR, L, K and BM, without success. The placement of this name as a synonym of *N. xanthonema* is based on the description in the protologue and assisted by the fact that there are few species of *Neptunia* known to occur in the area cited.

Notes: Specimens of *Neptunia xanthonema* from the Derby area (western Kimberley region) lack a nectary on the petiole or on the rachis, but they are otherwise typical of the species. This variant is accommodated in the identification keys.

Etymology: The epithet is derived from the Greek *xanthos* (yellow) and *-nema* (thread) and refers to the conspicuous yellow staminodes present on some inflorescences.

Excluded names

Neptunia spicata F.Muell. = **Dichrostachys spicata** (F.Muell.) Domin

Neptunia cinerea (L.) F.Muell. = **Dichrostachys cinerea** (L.) Wight & Arn.

Dubious name

Neptunia acinaciformis (Span.) Miq., *Fl. Ind. Bat.* 1: 51 (1855); *Desmanthus acinaciformis* Span., *Linnaea* 15: 198 (1841).

Spanoghe (1841) described *Desmanthus acinaciformis* in his posthumous treatise on the flora of Timor, and it was transferred to *Neptunia* some years later by Miquel. Windler (1966) accepted this name, and applied it to specimens that were formerly known as *N. javanica* and collected from Java, India, Burma and Thailand. Nielsen (1992) argued that because no type material or illustration can be found for *N. acinaciformis*, and because the original description is non-diagnostic, the species name should be regarded as dubious. The present author agrees with that conclusion.

Nielsen (1992) rejected a synonymy with *Neptunia javanica* because that species has more seeds per pod than the “4–5 seeds” stated in the protologue for *N. acinaciformis*, and because *N. javanica* has not been found on Timor.

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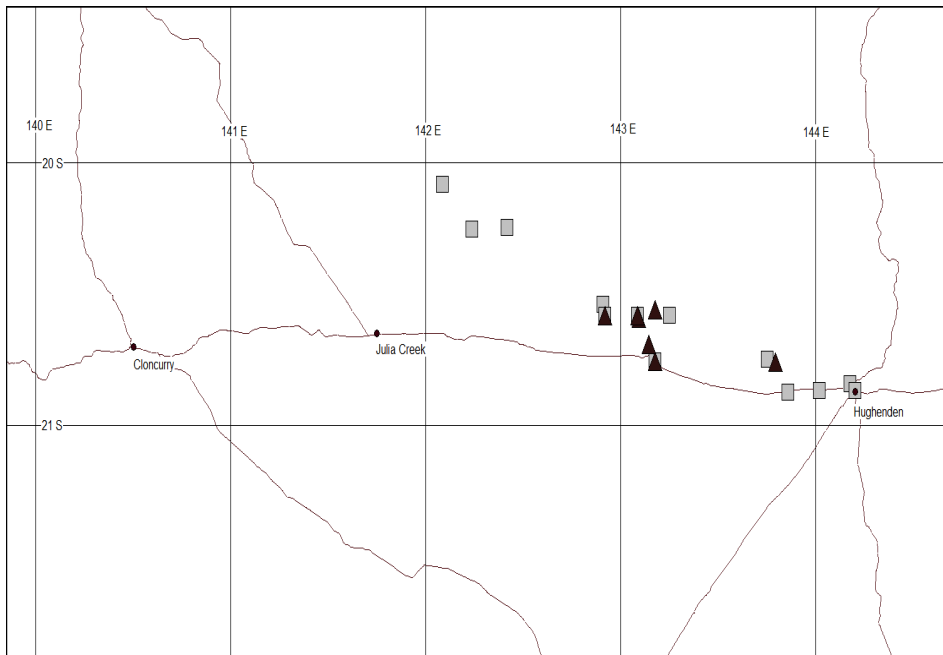
Fig. 10. *Neptunia xanthonema*, showing leaves, inflorescences, peduncles and bracts (McKenzie 03/96, BRI).

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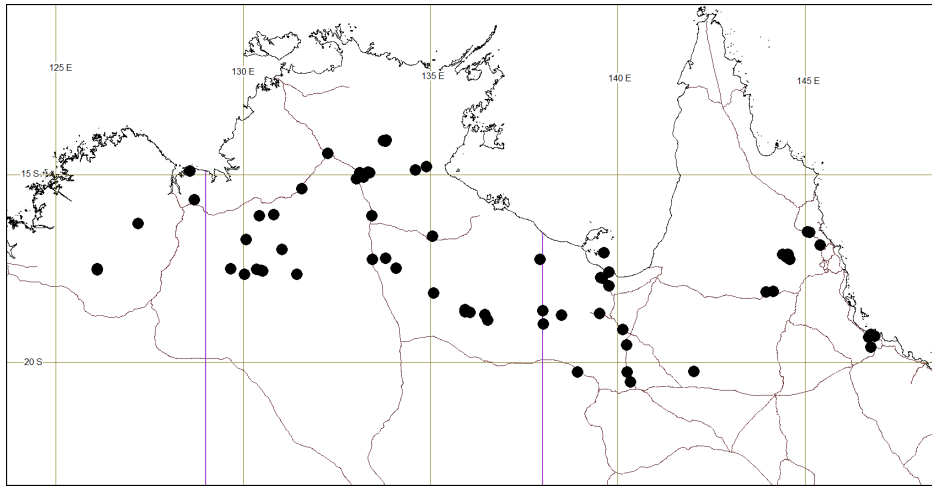
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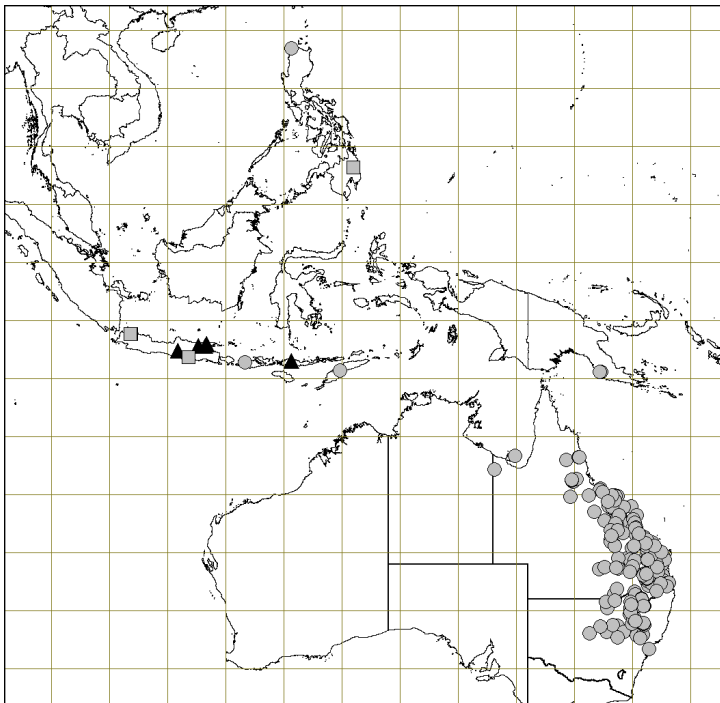
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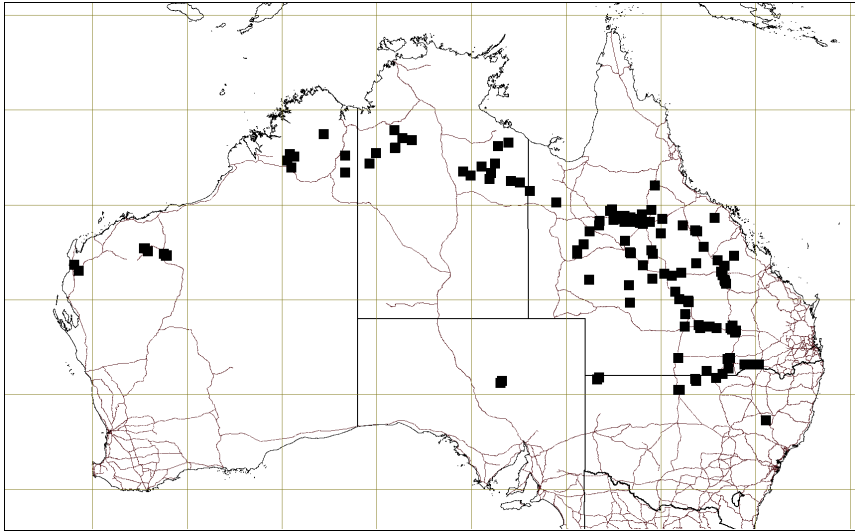
Map 1. Distribution of *Neptunia amplexicaulis* f. *amplexicaulis* (■) and *N. amplexicaulis* f. *richmondii* (▲).



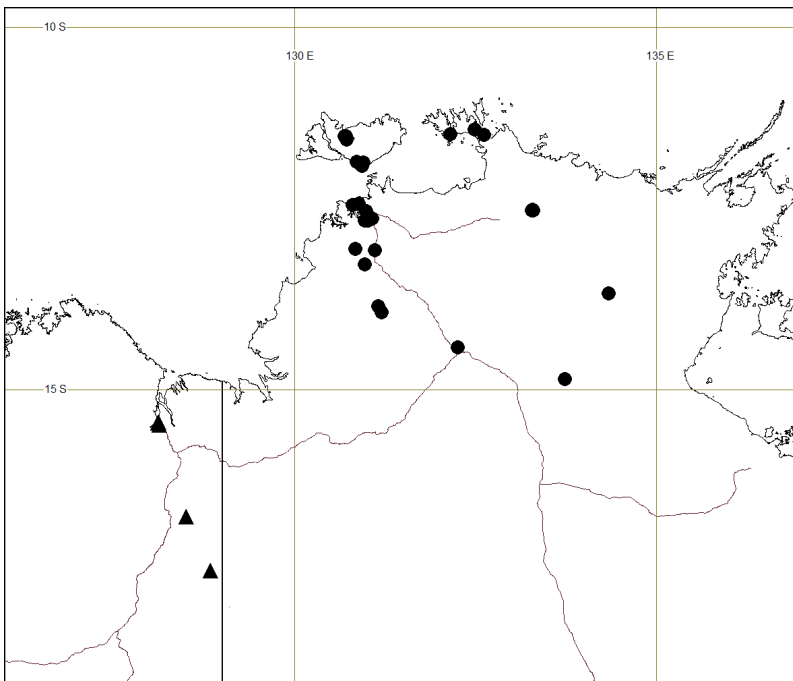
Map 2. Distribution of *Neptunia dimorphantha*.



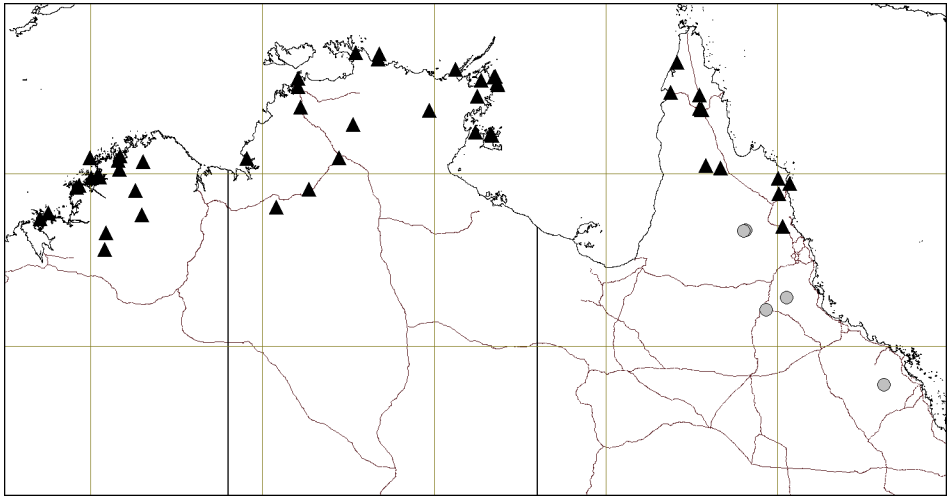
Map 3. Distribution of *Neptunia gracilis* (●), *N. javanica* (▲) and *N. oleracea* (■).



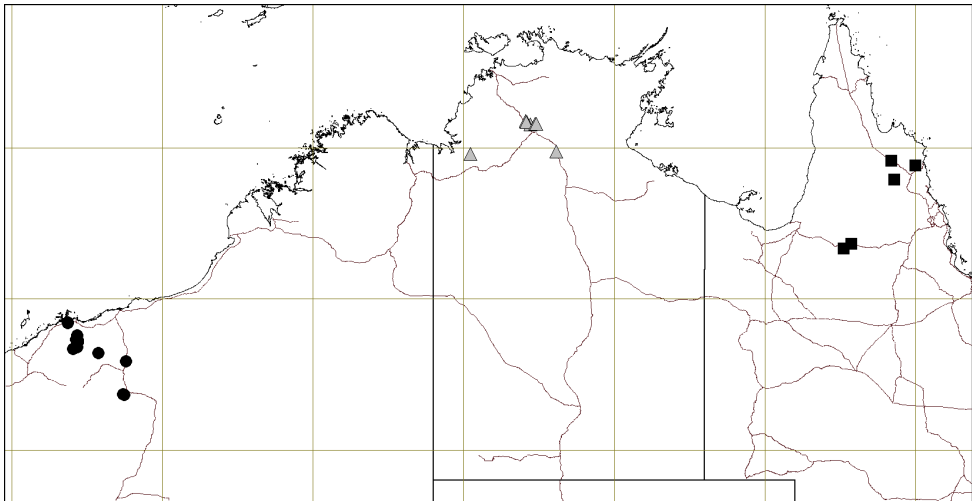
Map 4. Distribution of *Neptunia heliophila*.



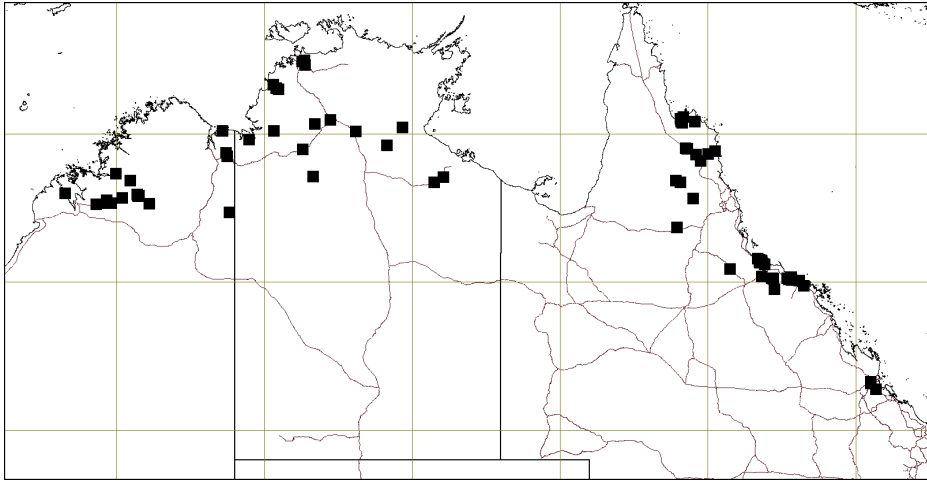
Map 5. Distribution of *Neptunia hispida* (●) and *N. valida* (▲).



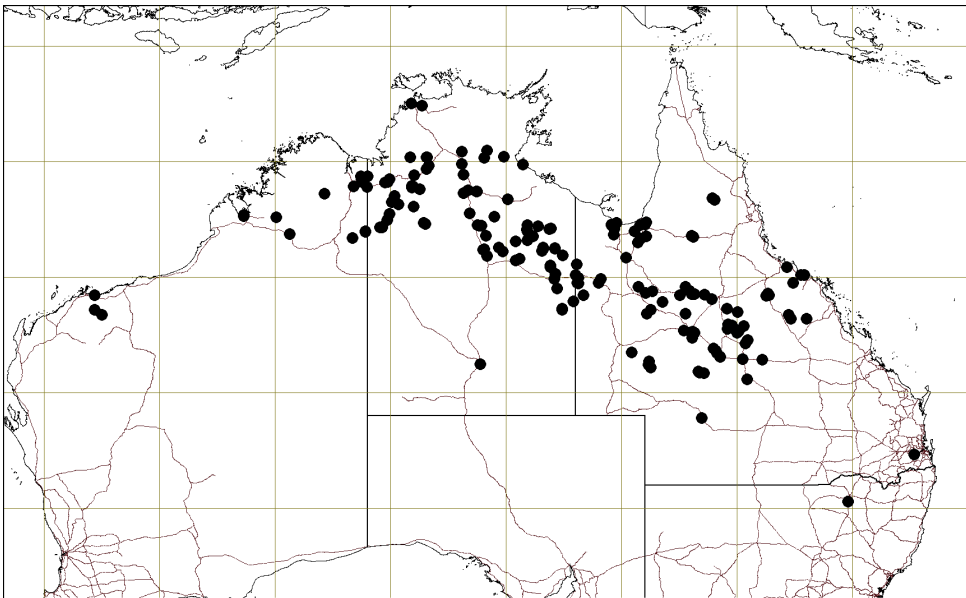
Map 6. Distribution of *Neptunia insignis* (●) and *N. tactilis* (▲).



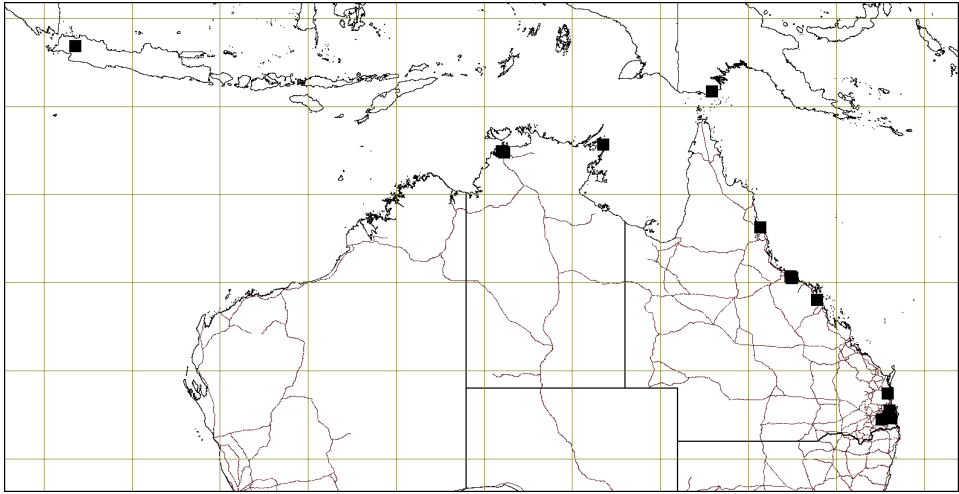
Map 7. Distribution of *Neptunia longipila* (●), *N. paucijuga* (▲) and *N. proxima* (■).



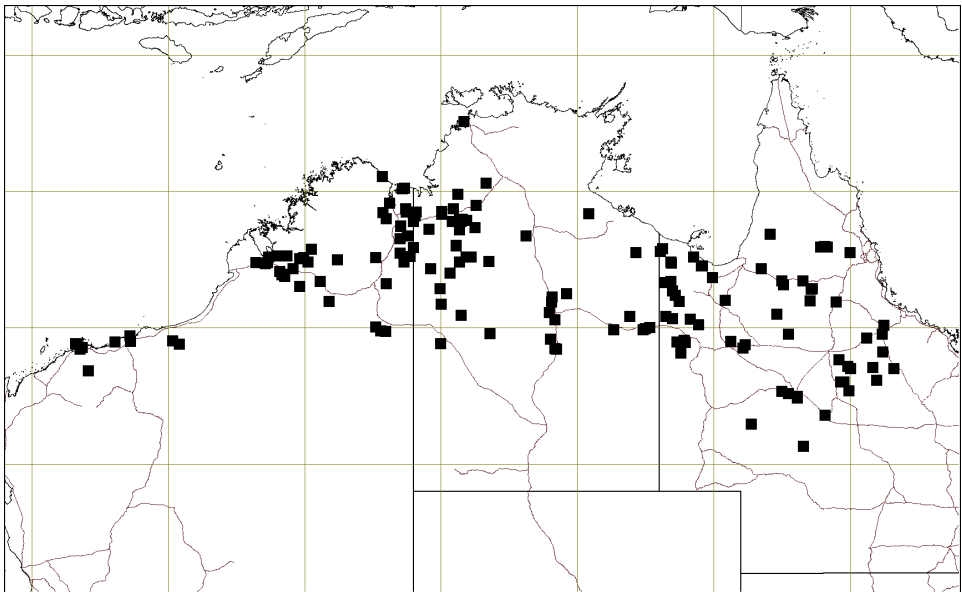
Map 8. Distribution of *Neptunia major*.



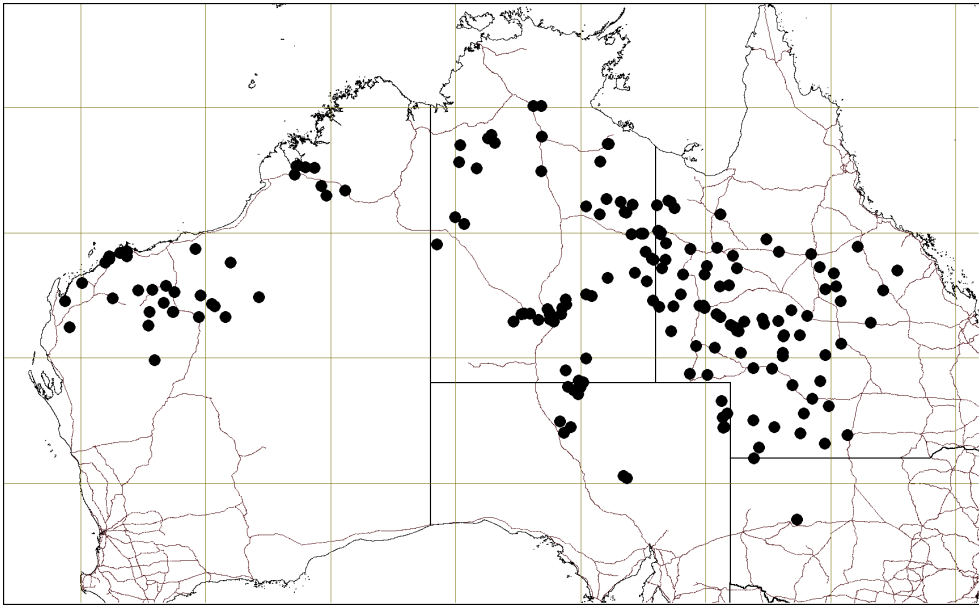
Map 9. Distribution of *Neptunia monosperma*.



Map 10. Distribution of *Neptunia plena*.



Map 11. Distribution of *Neptunia scutata*.



Map 12. Distribution of *Neptunia xanthonema*.