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## A taxonomic revision of *Libertia* (Iridaceae) in New Zealand

D. J. BLANCHON\*  
B. G. MURRAY  
J. E. BRAGGINS

School of Biological Sciences  
The University of Auckland  
Private Bag 92019  
Auckland, New Zealand

\*Present address: School of Landscape and Plant Science, UNITEC, Private Bag 92025, Auckland, New Zealand.

**Abstract** The genus *Libertia* is revised for New Zealand, with seven species being recognised as endemic. These include three of the species recognised by L. B. Moore (*L. grandiflora*, *L. ixioides*, and *L. peregrinans*), the resurrection of *L. micrantha* for New Zealand material formerly included within *L. pulchella*, and three new species, *L. cranwelliae*, *L. edgariae*, and *L. mooreae*. A key is provided for endemic and exotic *Libertia* in New Zealand. One natural hybrid is reported. A neotype is designated for *L. peregrinans*, and *L. tricolor* is placed into synonymy under *L. ixioides*. No type material is available for *L. tricolor* and *L. macrocarpa*.

**Keywords** Iridaceae; *Libertia*; *L. caerulea*; *L. cranwelliae*; *L. edgariae*; *L. formosa*; *L. grandiflora*; *L. ixioides*; *L. ixioides* × *L. peregrinans*; *L. macrocarpa*; *L. micrantha*; *L. mooreae*; *L. orbicularis*; *L. paniculata*; *L. peregrinans*; *L. pulchella*; *L. sessiliflora*; *L. tricolor*; biogeography; New Zealand flora

### INTRODUCTION

*Libertia* (Iridaceae) is Gondwanic in distribution, with the c. 12 species occurring in New Zealand, Australia, New Guinea, and Andean South America. The genus was created by Sprengel (1824) who transferred three species of *Sisyrinchium* into *Libertia*. Several species have been described from the New Zealand flora since 1824, by Sweet (1830), Cunningham (1837), Klatt (1861–1862), Lemaire (1863), Colenso (1883), and Cockayne & Allan (1926). Geerinck (1974) moved one species, *L. pulchella*, back to *Sisyrinchium*, which was later upheld by Van Royen (1979) and Innes (1985). However, subsequent authors, including Cooke (1986), have considered *L. pulchella* to be a species of *Libertia*. The genus as a whole would seem to be monophyletic for all the species presently within it, with brightly coloured, foveolate-reticulate seeds, a large inner perianth whorl and smaller outer perianth whorl, free filaments, and a common base chromosome number of  $n = 19$  being synapomorphies (Blanchon 1999; Blanchon et al. 2000a).

Since the work of Moore (1967) questions have arisen over the status of certain morphotypes within *L. grandiflora*, *L. ixioides*, and *L. peregrinans* (A. P. Druce pers. comm.). With the advent of new techniques, especially DNA technology, a further revision of *Libertia* in New Zealand was considered to be appropriate.

### BIOGEOGRAPHY

Members of the genus *Libertia* are found in Andean South America (3–6 spp.), New Zealand (7 spp.), Tasmania (1 sp.), mainland Australia (2 spp.), and New Guinea (1 sp.), indicating a possible Gondwanic origin for the genus. Similar distributions are also found in such diverse genera as *Nothofagus*, *Libocedrus*, *Prumnopitys*, and *Dacrydium* and the family Araucariaceae. New Zealand is a centre of species diversity for the genus.

Cytological (Blanchon et al. 2000a), morphological, and molecular (Blanchon 1999) evidence show that the larger hexaploid/dodecaploid *Libertia* taxa in New Zealand are a lineage separate from those in Australia and South America. Chromosome numbers and molecular and morphological data easily separate this lineage (*L. cranwelliae*, *L. edgariae*, *L. grandiflora*, *L. ixioides*, *L. mooreae*, and *L. peregrinans*) from the other diploid/tetraploid lineages, suggesting that it evolved separately in New Zealand. Furthermore, these species themselves are less easily separated from each other, suggesting more recent divergence within New Zealand. Data from hybrid studies (Blanchon 1999; Blanchon et al. 2000b) support this, with a failure of crosses between New Zealand and South American species but successful crosses among most of these New Zealand species. This would be consistent with the hypothesis of Cooper & Cooper (1995) that, as a consequence of a reduction in land area and niches during the late Oligocene and early Miocene, a genetic bottleneck occurred in surviving taxa, followed by speciation in the later part of the Miocene when more land became available. An alternative explanation could be reproductive isolation in glacial refugia, followed by rapid recolonisation during the postglacial period similar to that discussed by McQueen (1992). The second New Zealand lineage, the single species *L. micrantha*, has affinities with *L. pulchella* from Australia, Tasmania, and New Guinea, but is distinct both morphologically and at a molecular level, with a substitution in the *trnL* cpDNA spacer and in the 5S rDNA spacer (Blanchon 1999). It fails to cross successfully with Tasmanian specimens of *L. pulchella*, suggesting some genetic distance between them.

Unfortunately, fossil evidence of *Libertia* in New Zealand is limited. *Libertia* pollen has been recognised as early as the mid Miocene (Mildenhall 1980) and also in the late Pliocene and early Pleistocene (Mildenhall & Suggate 1981). As for the specific identity of the *Libertia* pollen, Mildenhall (1995) noted that in the more recent glacial periods, *Libertia* pollen was found in association with *Arthropodium* or largely alpine genera such as *Bulbinella*, *Drosera*, *Epilobium*, *Gentiana*, *Geranium*, *Neopaxia*, and *Wahlenbergia*. This suggests that either *Libertia* was widespread in a glacial context, with subalpine-alpine plant assemblages, similar to much of the range of present-day *L. micrantha*, or presence of *Arthropodium* pollen might indicate that some of the *Libertia* pollen was in a non-alpine context, which suggests the possible

presence of the ancestors of the larger, lowland *Libertia* species.

### Sympatry

New Zealand species of *Libertia* frequently occupy the same geographic areas but do not usually occupy the same habitat.

### Chromosome numbers

Numbers range from  $2n = 2x = 38$  in *L. micrantha*, through  $2n = 6x = 114$  in *L. edgariae*, *L. grandiflora*, and *L. mooreae*,  $2n = 9x = 171$  in *L. ixioides*  $\times$  *L. peregrinans*, to  $2n = 12x = 228$  in *L. cranwelliae* and *L. ixioides*.

### Reproductive biology

The New Zealand species of *Libertia* show variability in their breeding systems. Both *L. grandiflora* and *L. mooreae* appear to be self-incompatible, while *L. cranwelliae*, *L. edgariae*, *L. ixioides*, and *L. peregrinans* appear to be self-compatible (Blanchon 1999; Blanchon et al. 2000b). No information is available for *L. micrantha*. All species in cultivation except *L. micrantha* routinely set seed.

### Hybridity

The production of hybrids between species seems to be rare, perhaps due to the effective reproductive isolation of most populations. However, one natural hybrid is known from North-West Nelson, and hybrids may also occur at Lake Te Anau, Taranaki, and Mt Ruapehu. The parentage and morphology of the Nelson hybrid is discussed fully under the name *L. ixioides*  $\times$  *L. peregrinans*.

### Conservation

Of the New Zealand species of *Libertia*, only *L. peregrinans* is listed as "Declining" by de Lange et al. (1999). Of the new species, *L. cranwelliae* would seem to have a restricted distribution but is insufficiently known.

## MATERIALS AND METHODS

Plant material was obtained from a variety of sources, including botanical gardens and field sites. Plants were grown in uniform conditions outside, in a glasshouse, or in a shadehouse; where appropriate, voucher specimens were prepared and deposited in the Herbarium of the Auckland Institute and Museum (AK). Herbarium specimens and Types were obtained from a number of herbaria, including AK, AKU, BM, CHR, HO, K, NSW, and WELT.

Representative plant parts were also preserved in 70% ethanol or FAA (6.5 ml 37% formalin, 4.5 ml glacial acetic acid, made up to 100 ml with 70% ethanol) for later observation and/or sectioning.

Herbarium specimens were used only when in good condition and for characters that did not involve colour judgements, otherwise fresh material was used. Measurements of inflorescence characters were made using fresh material or herbarium specimens of mature plants. The infructescence to leaf ratio was a comparison of the lengths of the mature infructescence and the leaves, while the ovary to bud ratio was taken to be the ratio of the length of the ovary to that of the bud just prior to anthesis. Measurements of macroscopic details were made with a ruler or Vernier callipers, or with a dissecting microscope fitted with an eyepiece graticule and calibrated against a slide micrometer.

Sections cut by hand were stained with either 0.05% toluidine blue in benzoate buffer (0.25 g benzoic acid, 0.29 g sodium benzoate, 200 ml water, at pH 4.4) (O'Brien & McCully 1981) or iodine solution (10 g iodine, 15 g potassium iodide, and 1 litre 30% ethanol) (a modification based on O'Brien & McCully (1981)). Fixed specimens for mechanical sectioning were processed in a vacuum infiltration processor (Tissue Tek V. I. P. 2000) for 16–48 h. This involved dehydration in a graded ethanol series (70%, 95%, and 100%), clearing in xylol, and infiltration in molten paraffin wax. Samples were then embedded in wax blocks and sectioned on a rotary microtome set at 8  $\mu$ m. Sections were floated on a warm waterbath, picked up on albumenised slides, and dried in an oven at 60°C. Prior to staining, slides were dewaxed and rehydrated through a graded series (100% ethanol, 95% ethanol, water). Rehydrated slides were then stained with toluidine blue in benzoate buffer, dehydrated in 95% followed by 100% ethanol, and cleared in HistoClear. The sections were then covered with a synthetic resin and coverslip for permanent mounting. Slides were examined and pollen dimensions and other microscopic features were determined using a Zeiss Lab 16 compound light microscope fitted with an eyepiece graticule calibrated against a slide micrometer.

Stomatal measurements were taken from nail-varnish peels (O'Brien & McCully 1981). Clear nail varnish was painted onto each surface of the leaf, allowed to dry, and then gently peeled off. This was then dry-mounted on a slide with a coverslip and examined under the microscope. Measurements of the guard cells of 100 stomata were made with the eyepiece graticule.

Pollen was taken fresh from flowers and mounted in water for measurement. Measurements of 300 pollen grains were made with an eyepiece graticule on the microscope.

Photographs were taken using a camera mounted on a Zeiss Axioplan 2 microscope, using Fujifilm 100 colour film.

Chromosome counts are from Moore (1967) and Blanchon et al. (2000a).

## TAXONOMIC TREATMENT

*Libertia* Sprengel, *Syst. Veg. 1*: 127 (1824), *nom. cons.* (*L. ixioides* (G.Forst.) Spreng.)

≡ *Nematostigma* A.Dietr., *Sp. Pl. 2*: 509 (1833).

= *Libertia* Spreng. 1824 (*nom. cons.*).

= *Tekel* Adans., *Fam.Pl. 2*: 497, July–August (1763), rejected in favour of *Libertia* Spreng. (Type: “Feuille, t.4”).

= *Tekelia* Scop. *Introd. Hist. Nat.* 88 (1777) is an *orth. var.* of *Tekel* Adans., so is also rejected.

= *Renalmia* R.Br. *Prod. Fl. Nov. Holland. Add.* 592 (1810) is rejected in favour of *Renalmia* L. (1782) (*Zingiberaceae*; *nom. cons.*) (Type: non-designatus).

= *Taumastos* Raf., *Fl. Tellur. 4*: 9 (1838), based on *T. compressus* Raf.

LECTOTYPE SPECIES: *L. ixioides* (G.Forst.) Spreng. (*vide* Moore (1967)).

Panicles laxly branched or with dense clusters of flowers, sometimes simple; sterile spathes foliaceous, floral bracts membranaceous. Flowers usually white, rarely blue. Perianth spreading; tepals free, the outer three (sepals) usually smaller than the inner three (petals). Stamens three, staminal filaments very shortly connate at the base,  $\pm$  flattened; anthers versatile. Pollen ellipsoidal, monosulcate. Ovary 3-locular; style short with 3  $\pm$  keeled entire branches that spread between stamens. Fruit a subglobose to oblong or pyriform capsule. Seeds many, rounded to angular,  $\pm$  reticulate-foveolate. Tufted, shortly rhizomatous or stoloniferous herbs of grass-like habit, wholly or almost completely glabrous. Leaves usually in flattened fans, connected by short or elongate rhizomes. Perennial (Moore & Edgar 1970).

DISTRIBUTION: Australia: Queensland, New South Wales, Victoria, Australian Capital Territory, Tasmania. New Zealand: North Island, South Island, Stewart Island, Chatham Islands. South America: Chile, Juan Fernández Islands.

### Key to species of *Libertia* in New Zealand

- 1 Leaf in transverse section simple, single row of vascular bundles, no sclerenchyma on inside of leaf sheath, leaves different on each side; rhizome simple, sparingly branched and leafy; 3 or more bracts at inflorescence branches; pedicels pubescent; flowers tepallate; pollen sacs narrow, divided by broad connective ..... 2  
 Leaf in transverse section thickened, convex or irregular-shaped (vascular bundles causing protrusions in epidermis), two rows of vascular bundles present, sclerenchyma present on inside of leaf sheath, leaves similar on each side; rhizome not leafy; one bract at inflorescence branches; pedicels glabrous; flowers not tepallate; pollen sacs broad, connective narrow ..... 3
- 2 Leaf margins finely scabrid; leaves narrow and grass-like; bracts at inflorescence branches narrow; inflorescences delicate and simple; outer tepals slightly shorter and narrower than inner, apiculus present at tips, cleft absent; pollen sacs white; flowers opening outside bracts on long pedicels; seeds lemon yellow or yellow-orange, seed surface texture pitted, not reticulate or foveolate ..... *L. micrantha*  
 Leaf margins coarsely scabrid (or not scabrid); leaves broad; bracts at inflorescence branches broad or absent (*L. pulchella* var. *pygmaea*); inflorescences stout and often multi-branched; outer tepals almost indistinguishable from inner, apiculus absent from tip, small cleft present; pollen sacs cream or yellow; flowers opening initially within bracts, capsules carried subsequently beyond bracts by pedicel elongation; seeds red or red-brown, reticulate-foveolate sculpturing on surface ..... *L. pulchella*\*
- 3 Leaf in transverse section irregular in shape, vascular bundles causing protrusions in epidermis; marginal vascular bundles absent from leaf, margin in transverse section acute; rhizome short and erect, raising fans above ground ..... 4  
 Leaf in transverse section convex lens-shaped, vascular bundles within leaf thickness in two rows centrally, marginal vascular bundles present giving swollen appearance to leaf margin in transverse section; rhizome short and highly branched or elongate at or below ground level ..... 6
- 4 Pedicels long (10–30 mm); outer whorl of tepals nearly as long as inner, but narrower .....  
 ..... *L. paniculata*\*
- Pedicels short (0–13 mm); outer whorl of tepals half or less than half the length of the inner ..... 5
- 5 Pedicels almost non-existent (flowers sessile); outer whorl of tepals similar size to inner and rounded; flowers blue ..... *L. caerulescens*\*†  
 Pedicels short but visible (6–13 mm); outer whorl of tepals < ½ of inner ones and pointed; flowers white ..... *L. formosa*\*
- 6 Rhizomes elongate, fans spreading some distance from parent plant ..... 7  
 Rhizomes short and highly branched, fans clustered ..... 10
- 7 Leaf veins indistinct or forming slight midrib; flowers and capsules held above leaf tips; outer whorl of tepals, > ½ or less the area of the inner tepals, elliptical and adaxial face concave; inner whorl orbicular; capsules partially dehiscent\*\* ..... *L. edgariae*  
 Leaf veins distinct or indistinct; flowers and capsules usually held below leaf tips; outer whorl of tepals large, > ½ the area of the inner tepals, blunt and flat; inner whorl oval-elliptical; capsules indehiscent\*\* ..... 8
- 8 Leaf veins indistinct; leaves turn yellow in full sun; leaves straight or at most slightly falcate; capsules large (>20 mm long), turning yellow-orange on ripening ..... *L. cranwelliae*  
 Leaf veins raised and prominent; leaves remain green or bronze even in full sun; leaves stiff and falcate; capsules small (<15 mm long), turning from green to yellow-brown, then black on ripening ..... 9
- 9 Leaf veins prominent and red or orange; plants in coastal areas ..... *L. peregrinans*  
 Leaf veins uncoloured or pale yellow; plants inland ..... *L. ixioides* × *L. peregrinans*
- 10 Leaves turning yellow in full sun; flowers and capsules usually held below leaf tips; ovary larger than perianth bud at anthesis\*\*; outer whorl of tepals > ½ the area of the inner tepals, flat and elliptical; inner whorl orbicular-elliptical ..... *L. ixioides*  
 Leaves not turning yellow in full sun; flowers and capsules usually held above the leaf tips; ovary same size or smaller than perianth bud at anthesis\*\*; outer whorl of tepals < ½ the area of the inner tepals, adaxially concave and elliptical; inner whorl orbicular ..... 11

- 11 Plants small (100–400 mm leaf length); leaf bases purple-red; leaf veins evenly spaced; inflorescences simple and delicate; capsules cupiform, partially dehiscent\*\*; seeds yellow or yellow-orange ..... *L. mooreae*
- Plants usually larger (100–1400 mm leaf length); leaf bases green or pale pink; leaf veins coalescing centrally to form midrib; inflorescences highly branched and stout; capsules pyriform and usually fully dehiscent\*\*, revealing column of seeds; seeds bright orange ..... *L. grandiflora*

\* These species are foreign and are cultivated in New Zealand. *Libertia paniculata* is found naturally in mainland Australia, *L. pulchella* in mainland Australia, Tasmania, and New Guinea, while *L. caerulescens* and *L. formosa* are found in Chile.

\*\* For comprehensive diagrams of buds and capsules, see Moore & Edgar (1970).

† This taxon will be referred to as *L. caerulescens*, although there is a case for using the name *L. sessiliflora* (Blanchon 1999).

### New Zealand indigenous species

*L. cranwelliae* Blanchon, Murray & Braggins, sp. nov. Fig. 1, 2

*Libertia ixioides* auctt. non. (G.Forst.) Spreng. (1824); Moore, *N. Z. Jl. Bot.* 5: 271–272 (1967); Moore & Edgar, *Fl. N. Z.* 2: 93–94 (1970).

DIAGNOSIS: *L. ixioides* (Forster f.) Sprengel similis a qua differt rhizomatibus elongatis et ovarii minoribus.

Similar to *Libertia ixioides* but differs from it by its elongate rhizomes and smaller ovaries.

HOLOTYPE: New Zealand, North Island, East Cape, Kopuapounamu Valley, *N. Potts*, 12 February 1963, CHR 142809.

DISTRIBUTION: Plants consisting of leafy fans crowded or emerging at intervals from far-spreading horizontal stolons; stolons c. 3–5 mm diam., bright yellow. Leaves 150–900 mm × 5–11 mm, the two surfaces similar; inclined to turn yellow where exposed to full sun; leaf bases yellow; nerves many, median ones crowded to form a midrib; margins not scabrid, leaf in transverse section convex lens-shaped, two rows of vascular bundles present, marginal vascular bundles present, sclerenchyma present on inside of leaf sheath. Peduncles long ( $\frac{2}{3}$  the length of inflorescence) but inflorescences short ( $\frac{2}{3}$  the length of the leaves), flowers and fruits not usually reaching top of leaves. Panicle narrow, sparsely branched; lower bracts long (180–250 mm), lanceolate and orange-green, upper bracts smaller and membranous brown, occurring singly; 1–3 flowers per branch. Pedicels stout, 5–16 mm long, glabrous. Flower bud sometimes yellowish or brown, usually similar size to ovary sometimes smaller, flowers 20–35 mm diam.; tepals all white internally, widely patent; outer tepals usually  $> \frac{1}{2}$  the length of the inner, narrower, elliptical, flattened,



Fig. 1 Holotype of *Libertia cranwelliae* (*N. Potts*, CHR 142809). Scale bar = 5 cm.

with an apiculus; inner tepals oval-elliptical, shortly unguiculate, not usually covering outer tepals, cleft at tip. Staminal filaments very shortly connate; anthers c. 3 mm long, yellow, pollen sacs broad, connective narrow; pollen ellipsoidal, monosulcate,  $28.5\text{--}38.0 \times 19.0\text{--}31.4 \mu\text{m}$ . Ovary yellowish green,

**Table 1** Diagnostic characters of seven species of *Libertia*. Colours refer to fresh samples.

Character	<i>L. cranwelliae</i>	<i>L. edgariae</i>	<i>L. grandiflora</i>	<i>L. ixioides</i>	<i>L. micrantha</i>	<i>L. mooreae</i>	<i>L. peregrinans</i>
Rhizome type	Elongate	Elongate	Short	Short	Erect, leafy	Short	Elongate
Leaf base colour	Yellow	Yellow-green	Pink-green	Red-green	Green	Purple-red	Yellow-green
Leaf venation	Inconspicuous	Inconspicuous	Inconspicuous	Coalescing to form midrib	Inconspicuous	Inconspicuous	Raised and coloured
Vascular bundles in leaf cross section	2 rows alternating	2 rows alternating	2 rows alternating	2 rows alternating	1 row alternating	2 rows alternating	2 rows, 3 large centrally
Inflorescence:leaf ratio (length)	1:2.05	1:1.0	1:0.96	1:1.39	1:0.75	1:0.88	1:1.36
Petal:sepal area ratio	1:0.32–0.47	1:0.22–0.35	1:0.11–0.22	1:0.36–0.52	1:0.70–0.85	1:0.13–0.29	1:0.33–0.54
Petal shape	Oval-elliptical	Orbicular	Orbicular	Orbicular-elliptical	Elliptical	Orbicular	Obovate-elliptical
Sepal shape	Elliptical and flattened	Elliptical and concave	Oblong-elliptical and concave	Elliptical and flattened	Elliptical and flattened	Elliptical and concave	Oblong-elliptical and flattened
Cleft at petal tip	Defined	Defined	Defined	Slight	Slight	Slight	Defined
Anther colour	Yellow	Yellow	Yellow	Yellow	White	Yellow	Yellow
Anther connective	Narrow	Narrow	Narrow	Narrow	Broad	Narrow	Slight
Ovary:bud ratio (length)	1:1.0	1:1.6	1:2.1	1:0.5	1:4.0	1:2.0	1:1.6
Capsule dehiscence	None	Full	Full	Partial	Full	Partial	None

ribbed cupiform, equal to or larger than perianth bud; style branches not winged, pointing outwards. Capsule large, often 20 mm long, barrel-shaped, ripening from green to yellow-orange to black, usually indehiscent, although apex may split slightly. Seeds dispersed when capsule disintegrates. Seeds c. 1.5 mm × 1.5 mm, globose to angular, surface texture reticulate-foveolate, orange-brown in colour. Chromosome number  $2n = 12x = 228$  (Blanchon et al. 2000a). FL Sep–Nov; FR Jan–Dec.

REPRESENTATIVE SPECIMENS: NORTH ISLAND: EAST CAPE: Awatere Valley, *N. Potts*, Feb 1963, CHR 142809; Kopuapounamu, *M. Taylor*, Oct 1965, CHR 173031; East Cape, *W. L. Williams*, WELT 31067; East Cape, *W. L. Williams*, WELT 31068; East Cape, *G. Platt*, AK 240225.

NOTES: Specimens were previously referred to *L. ixioides* (Moore 1967). However, a number of morphological features, most notably the elongate rhizomes, differentiate this species from *L. ixioides* (Table 1). The dodecaploid ploidy level (Blanchon et al. 2000a), molecular evidence (5S rDNA and *trnL* cpDNA) placing *L. cranwelliae* with *L. grandiflora* rather than *L. ixioides* or *L. peregrinans* (Blanchon 1999), and the fact that *L. cranwelliae* will not cross with either *L. ixioides* or *L. peregrinans* (Blanchon 1999; Blanchon et al. 2000b) suggests that it is unlikely to be of hybrid origin.

DISTRIBUTION: Restricted to the Awatere and Kopuapounamu valleys of the East Cape of the North Island.

ETYMOLOGY: The name is in honour of the New Zealand botanist and monocotyledon pollen specialist, the late Dr Lucy Cranwell (1907–2000).

*L. edgariae* Blanchon, Murray & Braggins, sp. nov. Fig. 2, 3

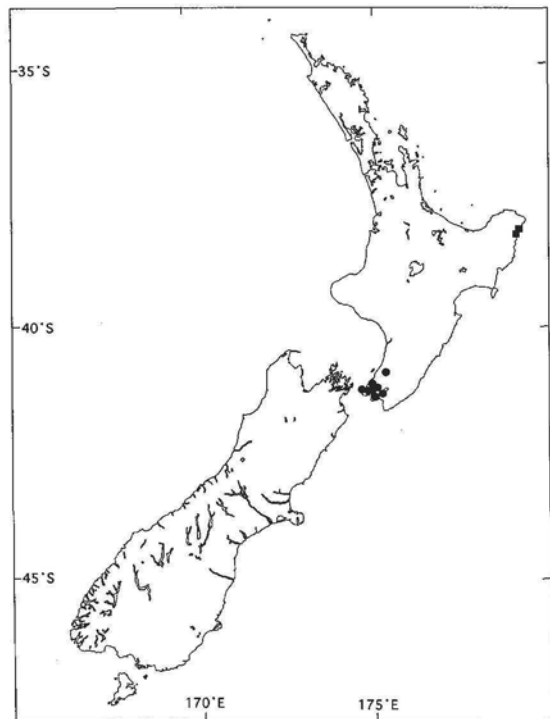
*Libertia grandiflora* auct. non. (R.Br.) Sweet (1830); Moore, *N. Z. Jl. Bot.* 5: 268–269 (1967).

DIAGNOSIS: *L. grandiflorae* (R.Br.) Sweet similis a qua differt statura minori, foliis falcatis; rhizomatibus elongatis et capsulis cupiformibus.

Similar to *Libertia grandiflora* but differs from it by its smaller size, falcate leaves, elongate rhizomes, and barrel-shaped capsules.

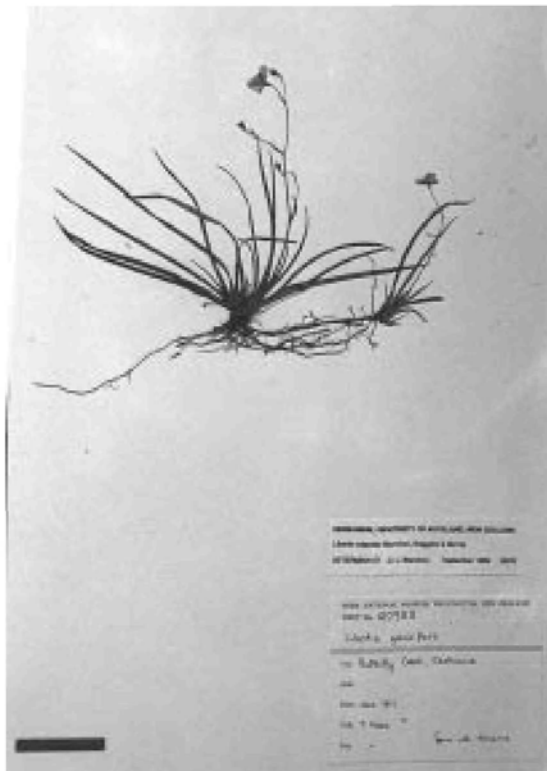
HOLOTYPE: New Zealand, North Island, Wellington, Eastbourne, Butterfly Creek, *T. Moss*, November 1977, WELT 67763.

DESCRIPTION: Plants consisting of leafy fans crowded or emerging at intervals from far-



**Fig. 2** Distribution of *Libertia cranwelliae* (squares) and *L. edgariae* (circles).

spreading horizontal stolons; stolons c. 2 mm diam., pale yellow in colour. Leaves 120–620 mm × 1–5(–9) mm, the two surfaces similar; green to pale yellow; nerves many, the median ones sometimes crowded to form a pale midrib; margins only scabrid at tip of leaf; leaf in transverse section convex lens shaped, two rows of vascular bundles present centrally, marginal vascular bundles present, sclerenchyma present on inside of leaf sheath. Peduncles  $\frac{1}{2}$  length of total inflorescence, inflorescences of similar length to leaves. Panicle broad, much and widely branched, lower bracts long (15–120 mm), lanceolate, green, upper bracts shorter, brown and membranous, occurring singly, 1–4 flowers per branch. Pedicels slender, glabrous, 10–20(–35) mm long. In flower bud, perianth often pigmented externally, often larger than ovary. Flowers 10–20 mm diam.; tepals all white internally, widely patent; outer tepals  $< \frac{1}{2}$  the length of the inner, narrower, elliptical, boat-shaped, with reduced apiculus; inner tepals orbicular, unguiculate, often overlapping outer, cleft present at tip. Staminal

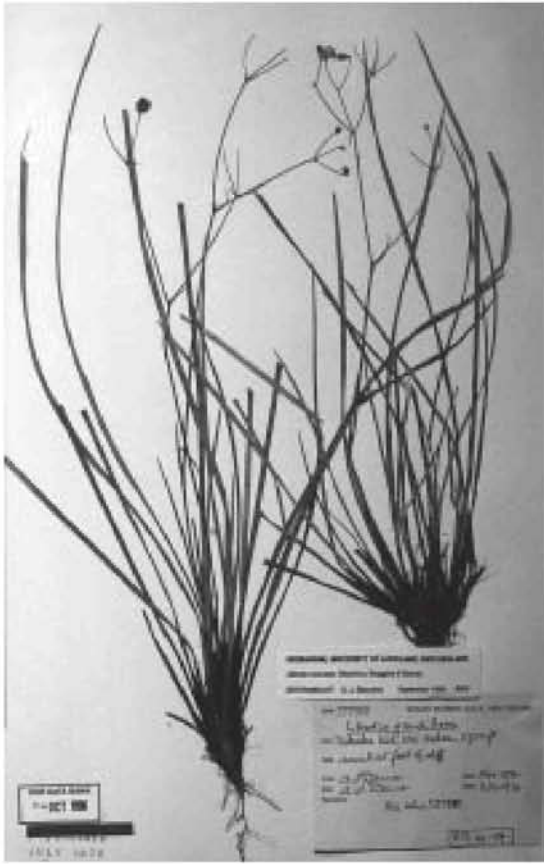


**Fig. 3** Holotype of *Libertia edgariae* (T. Moss, WELT 67763). Scale bar = 5 cm.

filaments shortly connate; anthers 2–3 mm long, bright yellow, pollen sacs broad, connective narrow; pollen ellipsoidal, monosulcate, 24.9–32.6 × 17.3–24.9  $\mu$ m. Ovary small compared with perianth bud at anthesis; style branches not winged, pointing upwards. Capsule 5–9 mm long, 3–6 mm diam., barrel-shaped, green, turning black on maturity, dehiscent fully or partially from shorter or longer loculicidal splitting, the longer valves often recurved. Seeds c. 1.0 × 1.5 mm, rounded or sometimes angular, surface texture reticulate-foveolate, bright tangerine orange. Chromosome number  $2n = 6x = 114$  (Blanchon et al. 2000a). FL Sep–Nov; FR Dec–May.

REPRESENTATIVE SPECIMENS: NORTH ISLAND: WELLINGTON: Otaki Gorge, *I. M. Morice*, Mar 1967, CHR 174881B; Porirua, *W. R. B. Oliver*, Apr 1950, WELT 15580; Days Bay, *W. R. B. Oliver*, Apr 1948, WELT 15584; Rona Bay, *W. R. B. Oliver*, Dec 1920, WELT 31059; Gollans Valley, *A. Lush*, Nov 1950, WELT 31138; Butterfly Creek, Eastbourne, *M. Sutherland*, Oct 1936, WELT 64023; Butterfly





**Fig. 4** Holotype of *Libertia mooreae* (A. P. Druce, CHR 277990). Scale bar = 5 cm.

Creek, Eastbourne, T. Moss, Nov 1977, WELT 67763; Butterfly Creek, Eastbourne, AK 240217; Eastbourne, A. Lush, Apr 1950, WELT 79727; Orongorongo Valley, L. B. Moore, Mar 1944, CHR 56417; Wellington, T. Kirk, AK 11212. WAIRARAPA: Aorangi Range, A. P. Druce, Oct 1986, CHR 469740A; Wairongomai, I. M. Morice, Apr 1964, CHR 148487; Wairongomai, I. M. Morice, CHR 174983.

**NOTES:** Specimens were previously determined as stoloniferous forms of *L. grandiflora* (Moore 1967). *L. edgariae* differs from *L. grandiflora* and *L. mooreae* by its elongate rhizomes and falcate leaves, and from *L. peregrinans* by its taller inflorescences and petal shape (Table 1). A study of molecular data places *L. edgariae* with *L. mooreae* using *trnL* chloroplast DNA, but with *L. peregrinans* or *L. grandiflora* with 5S rDNA (Blanchon 1999). Morphologically, *L. edgariae* combines the

inflorescence structure of *L. grandiflora* or *L. mooreae* with the spreading rhizomes of *L. peregrinans*. Taken together, this suggests that *L. edgariae* is of hybrid origin, with *L. mooreae* and *L. peregrinans* as probable parents. Some variability in size is apparent in this taxon, with small plants found at localities such as Days Bay and Eastbourne (Wellington). This taxon was given specific status because if it is of hybrid origin, it appears to have stabilised, setting viable seed and inhabiting a niche separate from either *L. mooreae* or *L. peregrinans*.

**DISTRIBUTION AND HABITAT:** Coastal Wellington and western Wairarapa, in coastal scrub, on hillsides and old marine terraces in manuka scrub (*Leptospermum scoparium*) and bracken (*Pteridium esculentum*).

**ETYMOLOGY:** The name is in honour of the New Zealand botanist and monocotyledon specialist Dr Elizabeth Edgar.

*Libertia mooreae* Blanchon, Murray & Braggins, sp. nov. Fig. 4, 5

*Libertia grandiflora* auctt. non. (R.Br.) Sweet (1830); Moore, *N. Z. Jl. Bot.* 5: 268–271 (1967); Moore & Edgar, *Fl. N. Z.* 2: 93–94 (1970).

**DIAGNOSIS:** *L. grandiflora* (R.Br.) Sweet similis a qua differt statura minori; foliorum basibus purpureis-ruberis; capsulis cupiformibus dehiscentibus partialiter; seminibus flavis-aurantiacis.

Similar to *Libertia grandiflora* but differs from it by its smaller size, purple-red leaf bases, barrel-shaped, partially dehiscent capsules, and yellow-orange seeds.

**HOLOTYPE:** New Zealand, South Island, North-West Nelson, Takaka Hill, A. P. Druce, Nov 1974, CHR 277990!. **ISOTYPE:** CHR 277989!

**DESCRIPTION:** Plants consisting of leafy fans, closely bunched on short, much branched rhizomes. Leaves 100–400 mm × 1–4 mm, green to glaucous, slightly falcate, the two sides similar, although in some accessions they are all concave on the same face; leaf bases red-purple; veins numerous; margins finely scabrid; leaf in transverse section a flattened convex lens shape, two rows of vascular bundles present centrally, marginal vascular bundle present, sclerenchyma present on inside of leaf sheath. Inflorescences long (140–560 mm), carrying flowers above leaves; peduncles  $\frac{2}{3}$  the length of the inflorescence. Panicle broad, usually openly branched; lower bracts long (20–60 mm), green and lanceolate, upper bracts short and brown, occurring singly; 1–7 flowers per branch. Pedicels slender and

delicate, glabrous, 10–35 mm long. Perianth bud often pigmented externally, often 2× as long as ovary at anthesis. Flowers 10–20 mm diam.; tepals all white internally, inner tepals orbicular, sometimes overlapping outer tepals; outer tepals  $> \frac{1}{2}$  length of inner tepals but  $< \frac{1}{3}$  the area, elliptical, beige or pink, boat-shaped. Staminal filaments very shortly connate; anthers 2–3 mm long, yellow; pollen sacs broad, connective narrow; pollen ellipsoidal, monosulcate,  $24.7\text{--}38.0 \times 17.1\text{--}30.4 \mu\text{m}$ . Ovary dark green,  $\frac{1}{2}$  the length of perianth bud; style branches not winged, usually pointing upwards. Capsule small, rarely reaching 5–8 mm long, 3–5 mm diam., barrel-shaped with ribs, ripening from green to brown or black, partially or occasionally fully dehiscent by short loculicidal openings. Seeds  $1 \times 1\text{--}1.5$  mm, globose to angular, with reticulate-foveolate surface patterning, yellow to yellow-orange. Chromosome number:  $2n = 6x = 114$  (Blanchon et al. 2000a). FL Aug–Nov; FR Dec–Feb.

REPRESENTATIVE SPECIMENS: SOUTH ISLAND: NELSON: Mt Burnett, *D. Blanchon*, Nov 1995, AK 240215; Aorere River, *A. P. Druce*, Nov 1976, CHR 285838; Takaka Hill, *A. P. Druce*, Nov 1974, CHR 277990; Takaka Hill, *A. P. Druce*, Nov 1974, CHR 277989; Whangamoa Valley, *H. H. Allan*, Jun 1945, CHR 45475. MARLBOROUGH: D'Urville Island, *R. E. Beever*, Jan 1988, AK 179107; Attempt Hill, D'Urville Island, *W. R. B. Oliver*, Nov 1942, WELT 31193; D'Urville Island, *W. R. B. Oliver*, Feb 1943, WELT 15577; D'Urville Island, *E. Gibbons*, Jan 1969, CHR 192296; Resolution Bay, Marlborough Sounds, *J. Clarke*, Nov 1966, CHR 174993; Mt Piripiri, Marlborough Sounds, *J. Clarke*, Apr 1967, CHR 174976; Essons Valley, Picton, *W. R. B. Oliver*, Jan 1946, WELT 15581; Essons Valley, Picton, *W. R. B. Oliver*, Jun 1948, WELT 15579; Picton, *W. R. B. Oliver*, Jan 1946, WELT 63632; Pelorus Bridge, AK 220214; Marlborough Sounds, *L. Moore*, Oct 1965, CHR 159057B; Marlborough Sounds, *Graeme Platt*, AK 240216.

NOTES: *L. mooreae* ranges from small, grass-like plants in Marlborough (such as those at Pelorus Bridge) to larger plants in North-West Nelson, such as those found on Mt Burnett and along the Aorere River. Similar plants are also found locally in the southern North Island, on the Rimutaka Ranges and near the Manawatu Gorge. Most plants examined lacked a leaf midrib, the leaves being slightly glaucous and sometimes concave. Variation of overall size and also of capsule and inflorescence size was observed.

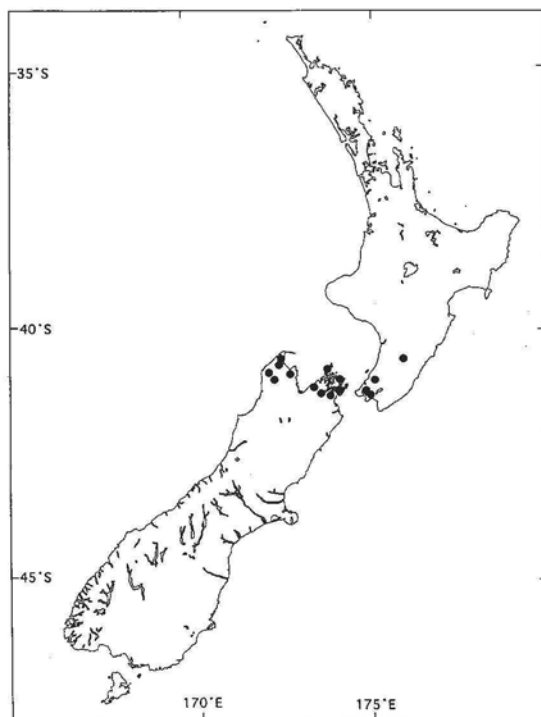


Fig. 5 Distribution of *Libertia mooreae*.

Collections of *L. mooreae* from Nelson, Marlborough, and the southern North Island were previously considered to be small forms of *L. grandiflora* (Moore 1967). However, a number of morphological and anatomical differences separate this new species from *L. grandiflora* and the other *Libertia* taxa in New Zealand (Table 1). *Libertia mooreae* differs from *L. grandiflora*, *L. ixioides*, and *L. peregrinans* by plant size and leaf structure. It is generally smaller than the other species, and its leaves have equally spaced veins, unlike the other species, which have veins coalescing centrally to form a thickened midrib. *L. mooreae* often also has bluish, concave leaves. It differs from *L. grandiflora* by its semi-dehiscent, barrel-shaped capsules, purple-red leaf bases, and yellowish seeds; from *L. ixioides* by its tall inflorescence, orbicular petals, small sepals, and green leaves in summer; and from *L. peregrinans* and hybrids by its lack of elongate rhizomes. *Libertia mooreae* differs from *L. micrantha* in flower shape and rhizome and leaf anatomy.

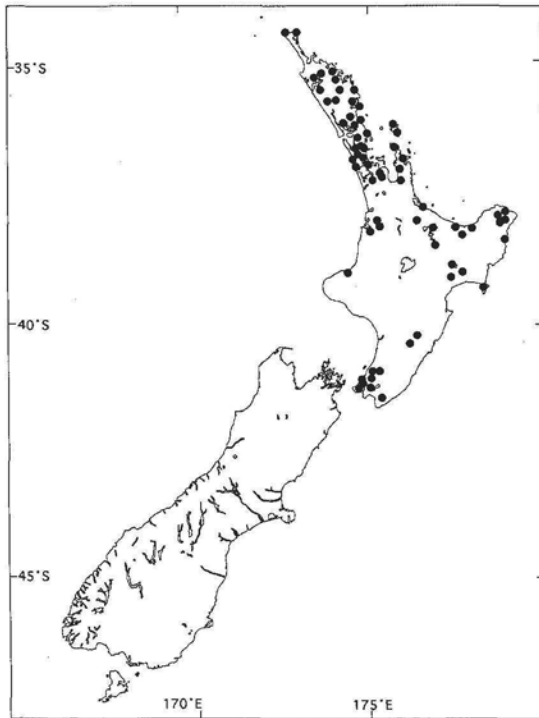


Fig. 6 Distribution of *Libertia grandiflora*.

**DISTRIBUTION AND HABITAT:** *Libertia mooreae* ranges from North-West Nelson to Marlborough, and into the southern North Island as far north as the Manawatu Gorge. It is recorded from ridges, cliffs, rocky river banks, and forest edges. It is commonly collected under beech forest (*Nothofagus menziesii* and *N. solandri* var. *solandri*), podocarp forest (*Podocarpus totara*, *P. hallii*, and *Dacrydium cupressinum*), and manuka scrub (*Leptospermum scoparium*).

**ETYMOLOGY:** The name *Libertia mooreae* is in honour of the late New Zealand botanist and monocotyledon expert, Dr Lucy Moore (1906–1987).

***Libertia grandiflora*** (R.Br.) Sweet, *Hort. Brit.* (ed. 2): 498 (1830) Fig. 6  
 ≡ *Renalmia grandiflora* R.Br. *Prodr. Fl. Nov. Holland. Add.*: 592 (1810), (non *Renalmia* L.f. (1781)). **LECTOTYPE:** (fide Moore 1967) New Zealand, Tolaga Bay?, *Banks & Solander*, 1769/70, WELT 318601.

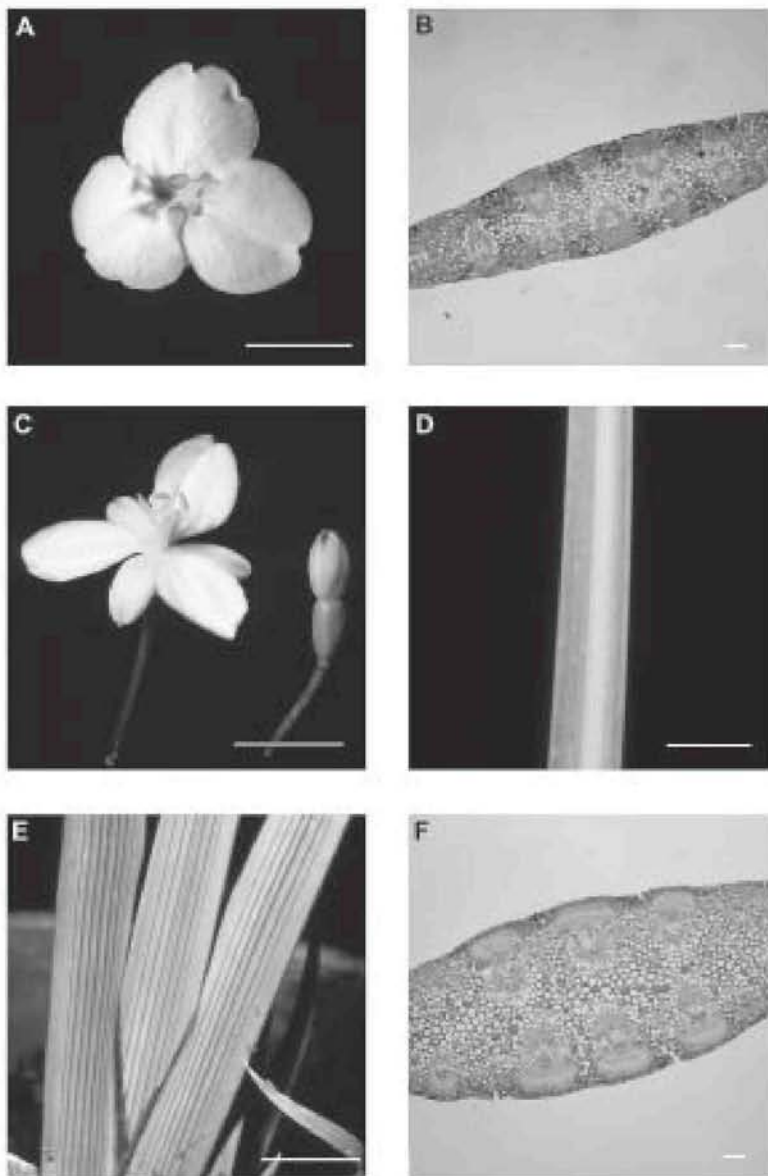
≡ *Tekelia grandiflora* (G.Forst.) Kuntze *Revis. Gen. Pl.*: 702 (1891).

≡ *Libertia orbicularis* Colenso *Trans. & Proc. New Zealand Inst.* 15: 329 (1883). **LECTOTYPE:** (fide Moore 1967) New Zealand, North Island, Norsewood, *Colenso, s.d.*, WELT 24292A.

**DESCRIPTION:** Plants consisting of leafy fans, closely bunched on short, highly branched rhizomes, joined by short stolons. Leaves (100–)500(–1400) mm × 2–12 mm, the two surfaces similar; leaf bases pink-green; nerves many, median ones may be crowded to sometimes form a midrib; margins often finely scabrid; leaf in transverse section convex lens-shaped, with two rows of vascular bundles present centrally, marginal vascular bundle present, sclerenchyma present on inside of leaf sheath. Inflorescences long, usually carrying flowers above leaves; peduncles also long. Panicle broad, much and openly branched, lower bracts long (40–130 mm), green and lanceolate, upper bracts narrow and pale brown, occurring singly; 1–6 flowers per branch. Pedicels slender but stiff, (10–)20–50 mm long, glabrous. Perianth bud often pigmented externally, equal to or twice as long as ovary, flowers 10–30 mm diam.; tepals all white internally, widely patent; outer tepals < ½ of inner, narrower, oblong-elliptical, boat-shaped, with apiculus; inner tepals, unguiculate, distal portion orbicular and often overlapping outer tepals, cleft present at tips. Staminal filaments shortly connate; anthers c. 3 mm long, bright yellow, pollen sacs broad, connective narrow; pollen ellipsoidal, monosulcate, 28.5–45.6 × 17.1–36.1 μm. Ovary pyriform, small compared with perianth bud; style branches scarcely winged, pointing upwards. Capsule 6–14 mm × 4–8 mm, tear-drop shaped, green, turning to black on maturity, fully dehiscent by shorter or longer loculicidal splitting, the longer valves often widely recurved. Seeds c. 1–1.5(–2) × 1–1.5 mm, rounded or sometimes angular if crowded, reticulate-foveolate, bright tangerine orange. Chromosome number: 2n = 6x = 114 (Blanchon et al. 2000a). **FL** Sep–Nov; **FR** Dec–Apr.

**REPRESENTATIVE SPECIMENS:** **NORTH ISLAND:** **NORHLAND:** Omahuta Forest, *P. J. Bellingham*, Jan 1984, AK 164916; Puketiti Forest, *P. J. Bellingham*, Sep 1984, AK 168939; Whangarei, *L. B. Moore*, Oct 1964, CHR 141294; Mt Manaia, *K. Reynolds*, Feb 1968, CHR 183496; Rodney, Flat Top Hill, *R. O. Gardner*, Nov 1979, CHR 440625; Rodney, Mt Tamahunga, *L. B. Moore*, Dec 1968, CHR 129196. **COROMANDEL:** Great Barrier Island, Rosalie Bay, *T. Kirk*, Dec 1884, WELT 31064; Coromandel, Te Mata River, *R. O. Gardner*, Apr 1983, AK 164617. **AUCKLAND:** Waitakere

**Fig. 7** A, *L. grandiflora* flower; B, *L. ixioides* leaf transverse section; C, *L. ixioides* flower and bud prior to anthesis; D, *Libertia ixioides* leaf midrib; E, *L. peregrinans* leaf veins; F, *L. peregrinans* leaf transverse section. Scale bars: A, C–E =10 mm; B, F =100  $\mu$ m.



Ranges, Whites Beach, *R. O. Gardner*, Mar 1981, AK 153746. WAIKATO: Tuakau, *R. O. Gardner*, Feb 1979, AK 149763. EAST CAPE: Raukumara Range, Mt Horokawa, *A. P. Druce*, Jan 1972, CHR 245865; Lake Waikaremoana, *F. C. Duguid*, Jan 1964, CHR 148355. TARANAKI: Waipingao Valley, *A. P. Druce*, Mar 1978, CHR 323901. WELLINGTON: Mt Pukeokahu, *A. P. Druce*, Feb 1966, CHR 173008; Rimutaka Hill, *I. M. Morice*, Nov 1964, CHR 141288.

NOTES: *Libertia grandiflora* is a variable species, ranging from plants with long inflorescences, which easily overtop the leaf tips, to those where the inflorescence is at a similar height to the leaves. Overall plant size is also a variable feature, with plants from cooler areas often smaller than their northern counterparts, although those from the Rimutaka Ranges (near Wellington) are of larger size. Small plants from Nelson, Marlborough, and the southern North Island, which superficially

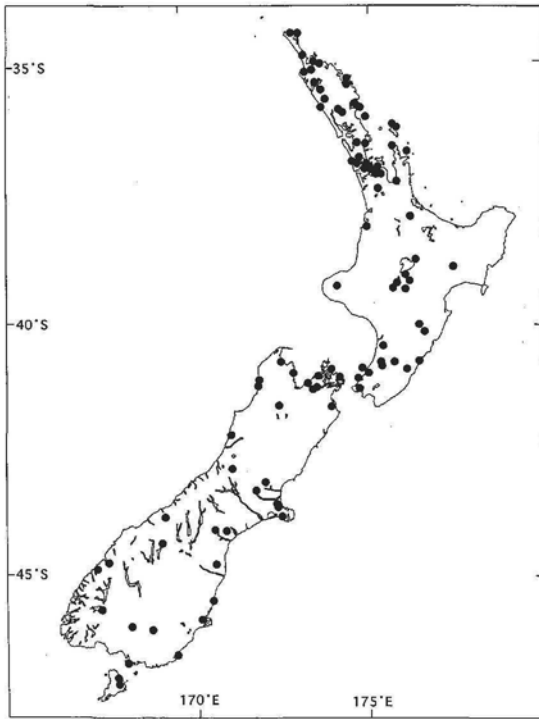


Fig. 8 Distribution of *Libertia ixioides*.

resemble *L. grandiflora*, have been described as a new species, *L. mooreae* (q.v.), and no specimens of true *L. grandiflora* have been identified from the South Island. Rhizomatous plants from Wellington and Wairarapa have been described as a new species, *L. edgariae* (q.v.). Inflorescence, capsule, and flower sizes vary within the species, but this is often dependent on the health of the population. Live accessions have been observed to produce a shorter inflorescence than in previous years if nutrients are deficient. In the course of this investigation, all accessions have been found to be hexaploid, although Moore (1967) noted a dodecaploid population from Mt Tamahunga, Rodney District, Northland, herbarium specimens of which would seem to be *L. grandiflora*.

The possession of large orbicular petals (Fig. 7A), small boat-shaped sepals, and inflorescences which generally overtop the leaf tips separates *L. grandiflora* from the other New Zealand taxa. *L. grandiflora* differs from *L. mooreae* by leaf length, the lack of red-purple leaf bases, fully dehiscent capsules, bright orange seeds, lens-shaped leaves, and marginal vascular bundles. It differs from

*L. peregrinans*, *L. cranwelliae*, and *L. edgariae* by the lack of elongated rhizomes and vascular bundle arrangement (Fig. 7B), from *L. ixioides* by the petal and sepal shape, perianth bud:ovary ratio, and the taller inflorescences, and from *L. micrantha* by the petal:sepal ratio, overall plant size, rhizome type, and leaf internal structure (Table 1).

*Libertia grandiflora* was first published as *Renealmia grandiflora* by Brown (1810), as an observation under the description of *R. paniculata*, which had also been previously described in the same work under the genus *Sisyrrinchium*, with *S. pulchellum*. Sweet (1824) referred to Brown (1810), redescribing the species in "The British Flower Garden", unfortunately including a drawing representing *L. ixioides* rather than *L. grandiflora*, although he did refer to a drawing of *L. grandiflora* sent by Brown. Later, Sweet (1830) referred the species to *Libertia*. Colenso (1883) noted a new species, *L. orbicularis*, from Hawke's Bay, which Moore (1967) treated as a synonym of *L. grandiflora*. Moore (1967) designated a Banks and Solander specimen (WELT 31860) as lectotype for *L. grandiflora*, based on Brown's reference to "ab Illustr. Banks in Nova Zealanda lecta", Solander's unpublished field notes referring to "*Sisyrrinchium exaltatum*", and Parkinson's sketch. She chose the type from five sheets in New Zealand herbaria, based on perianth characters, that distinguished the type of *L. grandiflora* from several associated sheets representing *L. ixioides*. The British Museum did not hold any New Zealand specimens of *Libertia* from Cook's first voyage (Moore 1967). Moore (1967) considered that the type locality was probably Tolaga Bay, as the specimens were flowering, to be expected at the time of year the *Endeavour* visited Tolaga Bay (23–29 October).

**DISTRIBUTION AND HABITAT:** Widespread in the North Island from North Cape to Wellington, absent on the Volcanic Plateau and in the South Island. Common in open, lowland forest remnants, forest margins, steep slopes, ridges, bluffs, cliffs, stream banks, and river terraces. Often associated with *Agathis australis*, *Arthropodium cirratum*, *Kunzea ericoides*, *Leptospermum scoparium*, *Meliccytus ramiflorus*, *Microlaena avenacea*, *Nothofagus truncata*, *Phormium cookianum*, *Podocarpus totara*, and *Weinmannia racemosa*.

*Libertia ixioides* (G.Forst.) Spreng., in *Syst. Veg.* 1: 168 (1824) Fig. 8  
 ≡ *Sisyrrinchium ixioides* G.Forst. *Fl. Ins. Austr.*: 61 (1786).

LECTOTYPE: (*vide* Moore 1967) New Zealand, Queen Charlotte Sound?, *G. Forst.*, 1773/74, BM!

≡ *Moraea ixioides* (G.Forst.) Thunb. *Diss. Moraea*: 8 (1787).

≡ *Ferraria ixioides* (G.Forst.) Willd. *Sp. Pl.* 3: 582 (1800).

≡ *Nematostigma ixioides* (G.Forst.) A.Dietr. *Sp. Pl.* 2: 509 (1833).

≡ *Renalmia ixioides* (G.Forst.) Ker Gawl. *Irid. Gen.*: 27 (1827).

≡ *Tekelia ixioides* (G.Forst.) Kuntze *Revis. Gen. Pl.*: 702 (1891).

= *Renalmia grandiflora* auct. non R.Br. (1810); Sweet *Brit. Fl. Gard.* 1: 64 (1824).

= *Libertia macrocarpa* Klatt *Linnaea* 31: 384 (1861–62). Type: Missing, supposed to be in Herb. Kunth, Berlin.

= *Libertia tricolor* Lem. *Ill. Hort.*: 10, misc. 35 (1863). Type: None designated or available.

DESCRIPTION: Plants consisting of leafy fans, close together on short, much branched rhizomes, joined by short stolons. Leaves (150–)550(–1160) mm × 3–12 mm, the two surfaces similar; inclined to turn yellow where exposed to full sun; leaf bases pale red-green; nerves many, median ones crowded to form pale midrib; margins often finely scabrid, leaf in transverse section convex lens-shaped, two rows of vascular bundles present, marginal vascular bundle present, sclerenchyma present on inside of leaf sheath. Peduncles long ( $\frac{2}{3}$  the length of the inflorescence), but inflorescence short, usually not carrying flowers or fruits above leaves. Panicle narrow, but much branched, or sometimes simply branched; lower bracts long (50–410 mm), green, lanceolate, upper bracts narrow and pale brown, occurring singly; 1–6 flowers (often 2) per branch. Pedicels stout, 10–20(–28) mm long, glabrous. Flower bud sometimes yellowish, usually much smaller than ovary, flowers 8–15(–25) mm diam.; tepals all white internally, widely patent; outer tepals about  $\frac{1}{2}$  length of inner tepals and narrower, elliptical, flattened, with apiculus; inner tepals orbicular-elliptical, shortly unguiculate, not usually covering outer tepals, slight cleft at tips. Staminal filaments very shortly connate; anthers c. 2 mm long, yellow, pollen sacs broad, connective narrow; pollen ellipsoidal, monosulcate, 41.8–53.2 × 26.6–39.9  $\mu$ m. Ovary pale, larger than perianth bud; style branches sometimes slightly winged, usually pointing outwards. Capsule (7–)15–25 mm long, 5–14 mm diam., barrel-shaped, ripening from green to yellow

to black, partially dehiscent by short loculicidal splitting; old valves pale and not widely patent. Seeds 1–2 × 1–1.5 mm, rounded or occasionally angular, reticulate-foveolate, bright tangerine orange. Chromosome number:  $2n = 12x = 228$  (Blanchon et al. 2000a). FL Sep–Dec; FR Jan–Dec.

REPRESENTATIVE SPECIMENS: NORTH ISLAND: NORTHLAND: Kaiaka, Mangonui, *H. Carse*, Oct 1914, WELT 31154; Mt Manaia, *P. J. de Lange*, 1973, CHR 497445; Mt Lion, *D. Court*, Aug 1977, AK 182129. COROMANDEL: Te Moehau, *A. J. Dakin*, Dec 1972, AK 213888. AUCKLAND: Karekare, *D. Petrie*, Nov 1914, WELT 31150; Maraetai, *R. O. Gardner*, Feb 1981, AK 153753; Clevedon, *R. O. Gardner*, Oct 1979, AK 151015. WELLINGTON: Mt Ruapehu, *B. L. Enting*, Apr 1974, WELT 67718; Kapiti Island, *W. R. B. Oliver*, May 1949, WELT 15583; Paraparaumu, *C. C. Ogle*, Apr 1976, WELT 67713; Mana Island, *C. C. Ogle*, Mar 1984, WELT 77660. SOUTH ISLAND: MARLBOROUGH: Chetwode Island, *G. Y. Walls*, Jan 1981, CHR 416798A. CANTERBURY: Ashley Gorge, *E. M. Heine*, Apr 1933, WELT 31085B. OTAGO: Moeraki Point, *G. I. Collett*, Mar 1965, CHR 150251. SOUTHLAND: Hokonui Hills, *D. L. Poppelwell*, 1913, WELT 31141A. STEWART ISLAND: Halfmoon Bay, *P. Hynes*, Feb 1963, AK 92002.

NOTES: *Libertia ixioides* is a variable species, with wide variation in leaf length and width, inflorescence length, number of flowers, and capsule size. Inflorescences are usually short and well below the leaf tips, or just below the leaves in some plants. The number of flowers produced varies from 3 or 4 to many. Capsules are large for the genus, reaching a maximum size in populations from coastal Northland, such as those at Mt Manaia and Mt Lion near Whangarei (CHR 497445 and AK 182129). Overall plant size and capsule size is generally larger in northern areas, but populations with large capsules are also known from the South Island. This species has short rhizomes only, and specimens from the East Cape with elongate rhizomes are described as a new species, *L. cranwelliae*. All accessions of *L. ixioides* have been counted at the dodecaploid chromosome number of  $2n = 12x = 228$ .

The possession of large ovaries (Fig. 7C) (when compared with perianth bud size at anthesis) and large partially dehiscent capsules which dry to a pale tan colour (rather than black) on herbarium sheets, separates this species from all the others. *Libertia ixioides* also differs from *L. grandiflora* and *L. mooreae* by its shorter inflorescences, large sepals,



Fig. 9 Lectotype of *Libertia micrantha* (A. Cunningham, K). Scale bar = 5 cm.

and oblong petals (Fig. 7C) and yellow leaf colour in summer. It differs from *L. peregrinans* by a lack of raised coloured midveins on the leaves (Fig. 7D), and also because *L. ixioides* lacks the long rhizomes of *L. peregrinans*, *L. edgariae*, *L. cranwelliae*, and *L. ixioides* × *L. peregrinans*. It differs from *L. micrantha* by its petal:sepal ratio, overall plant size, rhizome type, and internal leaf structure (Tables 1 and 2).

*Libertia ixioides* was first published by Forster (1786) as *Sisyrinchium ixioides*, with a very general description. Sprengel (1824) referred the species to his new genus *Libertia*, along with *L. paniculata* and *L. pulchella*. He noted it as coming from both New Zealand and Chile, without citing any specimens; this later became a source of confusion. Moore (1967) chose a Forster specimen from the British Museum (Natural History) (BM) as lectotype.

The specimen has a long leaf and an inflorescence. Sweet (1824) in his discussion of *L. grandiflora* (as *Renalmia grandiflora*) published an excellent illustration of *L. ixioides*, with its short inflorescence and large ovaries. Synonyms include *Moraea ixioides* (G.Forst.) Thunb, *Ferraria ixioides* (G.Forst.) Willd., *Nematostigma ixioides* (G.Forst.) A.Dietr., *Renalmia ixioides* (G.Forst.) Ker Gawl., and *Tekelia ixioides* (G.Forst.) Kuntze.

Klatt (1861–1862) published the name *Libertia macrocarpa*. Moore (1967) noted that Klatt had determined a number of specimens in European herbaria as *L. macrocarpa*, but that these were all referable to *L. ixioides*, *L. grandiflora*, or *L. peregrinans*. The type specimen of *L. macrocarpa* should be in Kunth's herbarium at the Berlin Botanical Gardens and Museum (B), but, when it was requested, the reply noted that "the relevant specimen has presumably been destroyed in 1943" (Th. Raus pers. comm.), probably as a result of World War II. Klatt's (1861–1862) description matches *L. ixioides*, especially in the size of the ovaries and capsules, and the shape of the inner tepals. In the absence of a type specimen or illustration, the recommendation of Moore (1967), that *L. macrocarpa* be a synonym of *L. ixioides*, is accepted.

*Libertia tricolor* Lemaire (1863) has no type specimen and no material or illustration which could be considered as such, but the detailed description leaves no doubt as to the affinity of this plant. The plant was exhibited at the 1863 Exposition of the Royal Society of Agriculture and Botany, Ghent, by Messieurs Beaucarne and van Geert, under the name "*Sisyrinchium versicolore*". Lemaire (1863) obtained some material of the plant and published it under the name *L. tricolor*, noting that it originally came from New Zealand and had affinity with *L. grandiflora* Sweet. The detailed Latin description and accompanying notes in French describe a species with a scape shorter than the leaves, a prominent midvein of pale colour, green blade, red marginal veins, and biflorous inflorescence branches, all of which point to *L. ixioides*. There is no mention of elongate rhizomes which would have indicated *L. peregrinans*, which in any case has very different leaf coloration from that described for *L. tricolor*. Other supporting evidence comes from the alternative name the plant was known as, "*Sisyrinchium versicolore*", the "versicolore" perhaps referring to the change of leaf colour from green to yellow that occurs in *L. ixioides* when exposed to full sun. Specimens sold as *L. tricolor* or

*L.* 'tricolor' in New Zealand are referable to *L. ixioides* both on morphological and molecular evidence (Blanchon 1999). The name is placed into synonymy under *L. ixioides*.

**DISTRIBUTION AND HABITAT:** Widespread in the North Island from North Cape to Wellington, including the Volcanic Plateau, but excluding East Cape. Common throughout the South Island, and present in Stewart Island. Some localities noted by Moore (1967) are referable to *L. grandiflora*, while those from East Cape are discussed under the name *L. cranwelliae* (q.v.). The species is locally common on ridges, cliffs, gullies, river banks, coastal cliffs, and upland forest. It has been recorded as epiphytic in some northern sites. *L. ixioides* has been found associated with *Agathis australis*, *Alectryon excelsus*, *Arthropodium* spp., *Beilschmiedia tarairi*, *Blechnum* spp., *Brachyglottis repanda*, *Carex* spp., *Coprosma robusta*, *Corynocarpus laevigatus*, *Dacrydium cupressinum*, *Dianella nigra*, *Dysoxylum spectabile*, *Kunzea ericoides*, *Leptospermum scoparium*, *Libocedrus* spp., *Macropiper excelsum*, *Metrosideros excelsa*, *M. robusta*, *Nothofagus fusca*, *Phormium tenax*, *Phyllocladus* spp., *Poa* spp., *Podocarpus totara*, *P. hallii*, *Sophora microphylla*, *Uncinia* spp., *Vitex lucens*, *Weinmannia racemosa*, and *W. silvicola*.

***Libertia micrantha*** A.Cunn. Bot. Mag. Comp.

2: 375 (1837).

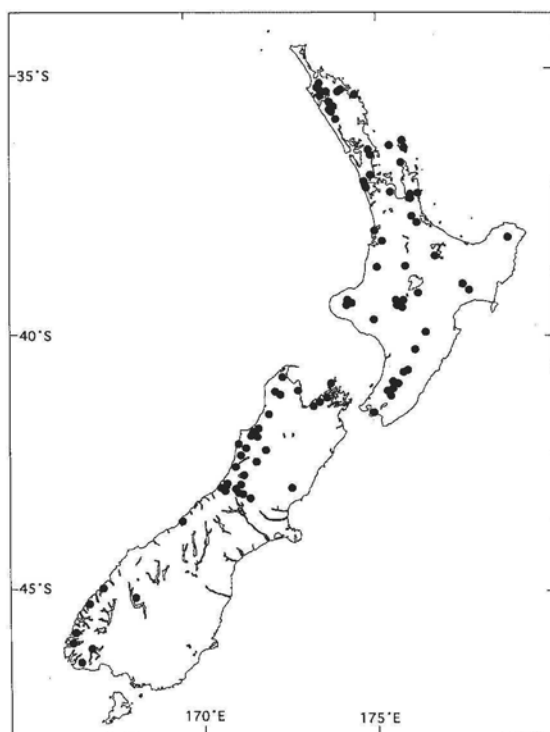
Fig. 9, 10

**LECTOTYPE:** (fide Moore 1967) New Zealand, Whangaroa, A. Cunningham, (1826), (K!).

*Sisyrrinchium pulchellum* auctt. non R.Br. (1810); Innes, C. *World of the Iridaceae* (1985); Geerinck, D. *Bull. Jard. Bot. Belg.* 44: 29–60 (1974).

*Libertia pulchella* auctt. non. (R.Br.) Spreng. (1824); Moore, *N. Z. Jl. Bot.* 5: 263 (1967); Moore & Edgar, *Fl. N. Z.* 2: 93 (1970).

**DESCRIPTION:** Plants consisting of leafy fans erect or semi-erect; sparsely branched leafy rhizomes, (30–)50–100(–180) mm long, attached to substratum, sometimes insecurely, by thin, wiry roots. Leaves 30–100(–220) mm × 1–3.5(–5) mm, the downward-facing surface much duller than the upper, due to more white lines of stomata and raised cells being present; veins inconspicuous, leaf bases green or pale yellow, leaf margins often finely scabrid, stomata often only present on lower surface of leaf; leaf in transverse section simple, only one row of vascular bundles present, marginal vascular bundle absent, no sclerenchyma on inside of leaf sheath. Inflorescences long, usually greater than leaves; peduncle slender. Panicle simple; bracts



**Fig. 10** Distribution of *Libertia micrantha*.

5–35 mm long, narrow lanceolate, green or brown when dried, in clusters of three or more; 1–8 flowers on very slender, usually pubescent pedicels, 13–35 mm long. Flowers white, 5–12(–15) mm diam., predominantly tepallate, outer whorl slightly shorter and narrower, elliptical with apiculus, inner whorl larger, elliptical with apical cleft. Staminal filaments very shortly connate; anthers c. 1.5 mm long; pollen sacs white, narrow, connective broad; pollen ellipsoidal, monosulcate, 28.5–41.8 × 19.0–34.2 μm. Ovary triquetrous, c. ¼ length of the perianth bud at anthesis; style branches not winged, pointing upwards. Capsule triquetrous, 2–3 × 2–5 mm; dehiscent by loculicidal splitting; valves keeled and strongly recurved at dehiscence, green-brown. Seeds 0.75–1 × 1–1.2 mm, rounded to egg-shaped, almost smooth, yellow. Chromosome number: 2n = 2x = 38 (Blanchon et al. 2000a). FL Sep–Dec; FR Dec–Jun.

**REPRESENTATIVE SPECIMENS:** NORTH ISLAND: NORTHLAND: Omahuta Forest, P. J. de Lange, Jan 1992, CHR 475157; Little Barrier Island, R. Bieleski & R. Beever, June 1984, AK 156785; Great Barrier Island, F. M. Warren, Jan 1962, AK 71536.



COROMANDEL: Te Moehau, *L. M. Moore & L. M. Cranwell*, Dec 1933, AK 108679; Kauaeranga Valley, *A. E. Wright*, Mar 1974, AK 134539. AUCKLAND: Paremuremo, *M. Sexton*, Dec 1957, AK 50840; Huia, Waitakere Ranges, *K. Wood*, Dec 1961, AK 219249; Hunua Ranges, *L. B. Moore*, Dec 1936, AK 211762. WAIKATO: Mt Karioi, Raglan, *W. R. B. Oliver*, Dec 1919, WELT 15574. TARANAKI: Mt Egmont, *W. R. B. Oliver*, Jan 1937, WELT 15573. WELLINGTON: Ruahine Ranges, *D. Petrie*, Jan 1889, WELT 31108; Mt Hector, Tararua Ranges, *D. Petrie*, Jan 1907, WELT 31106. SOUTH ISLAND: NELSON: North-West Nelson, Heaphy Track, *P. Hynes*, Feb 1964, AK 100502. WESTLAND: Seddonville, *H. Powell*, Jan 1946, AK 44881. FIORDLAND: Hollyford Valley, *D. L. Poppelwell*, Dec 1916, AK 108677.

NOTES: Northland specimens are generally larger than those from the southern North Island and South Island. Most plants except those from Nelson and Marlborough are generally glabrous. Exposure to harsh conditions stunts plants (such as those on Te Moehau, Coromandel Peninsula), and competition with mosses causes stem elongation. All accessions have a diploid chromosome number of  $2n = 2x = 38$ .

*Libertia micrantha* differs from all the other New Zealand species of *Libertia* by a number of features, including its smaller size, the presence of white lines on the abaxial side of the leaf, anatomically simple leaves, leafy rhizomes, bunches of bracts at inflorescence branches, pubescent pedicels, tepallate flowers, white pollen sacs, broad pollen sac connectives, and being diploid (Tables 1 and 2).

*Libertia micrantha* differs from *L. pulchella* (Table 2) in size and shape of the leaves and bracts. *Libertia micrantha* has long, narrow, grass-like leaves and bracts, while the leaves and bracts of *L. pulchella* are coarser and broader, and the plants often attain a larger size overall. The peduncle is generally slender in *L. micrantha*, and much stouter in *L. pulchella*. Flowers and flowering habit also show differences between the two species. *Libertia micrantha*, while generally tepallate, has outer tepals slightly narrower and shorter than the inner ones. Each outer tepal has an apiculus and lacks a cleft. The pollen sacs are uniformly white. The flowers open outside the bracts on long pedicels, which elongate only slightly after anthesis. The flowers of *L. pulchella* are truly tepallate, with even the point of attachment of the tepal whorls difficult to discern. Each outer tepal lacks an apiculus, instead having a cleft similar to those of the inner whorl. Pollen sacs in live plants are cream or yellow. In live plants and herbarium specimens of *L. pulchella*, flowers opened while within bracts. Van Royen (1979) noted that New Guinean specimens of *L. pulchella* had pedicels 10–15 mm in length, but these were up to 40 mm long when fruiting (i.e., showing pedicel elongation post-anthesis). Seeds also show differences, with lemon-yellow or yellow-orange pitted seeds in *L. micrantha*, and red, red-brown, or orange reticulate-patterned seeds in *L. pulchella*. Seed colour is, however, often lost in herbarium material.

Cunningham (1837) published the name *L. micrantha* for New Zealand specimens, with the type specimen from Kerikeri, Northland. Moore (1967)

**Table 2** Characters distinguishing *L. micrantha* from *L. pulchella*. Seed colour may darken in herbarium specimens.

Character	<i>L. micrantha</i>	<i>L. pulchella</i>
Leaf size/shape	Narrow, 3–10(–22) cm × 1–3.5(–5) mm	Broad, 5–18 cm × 2–7 mm
Leaf base colour	Green	Yellow-green
Leaf scabridity	Finely scabrid to ½ leaf length	Coarsely scabrid, full leaf length
Infructescence:leaf ratio (length)	1:0.75	1:0.46
Peduncle diameter	Thin (0.6–0.7 × 0.3 mm)	Thick (1.5 × 2.0 mm)
Pedicel diameter	0.3 × 0.3 mm	0.5 × 0.5 mm
Sepal tip	Forming an apiculus	Forming a slight cleft
Petal:sepal area ratio	1:0.70–0.85	1:0.98–1.03
Anther colour	White	Pale yellow
Seed colour	Yellow	Red

considered that there were insufficient differences between *L. micrantha* and *L. pulchella* to maintain them as separate species, and *L. micrantha* was reduced to synonymy. Geerinck (1974) placed *L. pulchella* within the genus *Sisyrrinchium*, as he considered that “the only difference between *Libertia* and *Sisyrrinchium* is the dimorphic tepals in the first genus and the similar tepals in the second genus”. This placement was maintained by Van Royen (1979) and Innes (1985). However, it is obvious from morphological, chromosomal (Blanchon et al. 2000a), and molecular data (Blanchon 1999) that *L. pulchella* and *L. micrantha* belong in *Libertia* and not *Sisyrrinchium*, a position taken by Cooke (1986).

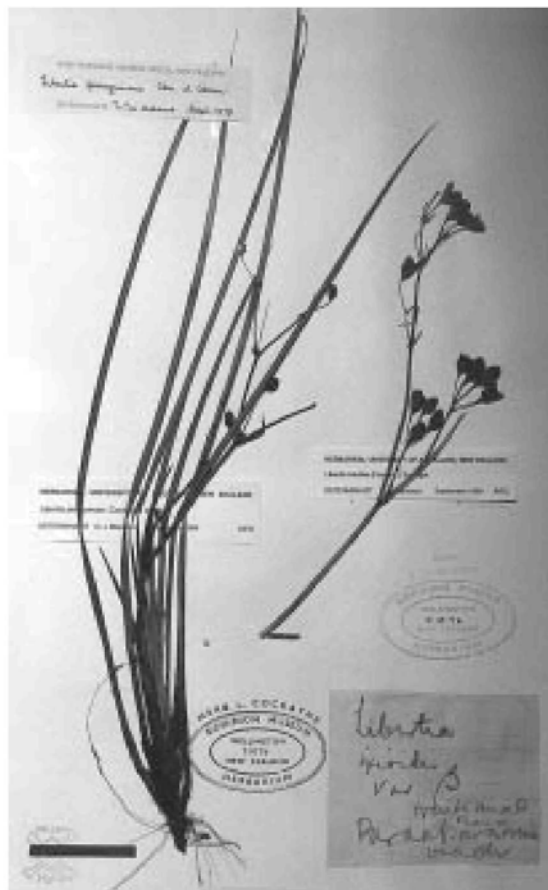
**DISTRIBUTION AND HABITAT:** Widespread on mountain ranges in the North Island from Mangonui, Northland, to Wellington, and in the South Island from Nelson and Marlborough to Fiordland. Absent from Stewart Island and the east coast of the South Island. Plants are locally common in upland forests in high rainfall areas, which would explain their absence from the eastern South Island. Found commonly under *Nothofagus menziesii* and less commonly *N. truncata*, also collected under *Agathis australis*, *Beilschmiedia tawa*, *Dacrydium cupressinum*, *Elaeocarpus dentatus*, *Ixerba brexioides*, *Leptospermum scoparium*, *Libocedrus bidwillii*, *Manoao colensoi*, *Metrosideros robusta*, *Prumnopitys ferruginea*, and *Weinmannia racemosa* and often on fallen logs and root mounds, usually associated with mosses and liverworts.

*Libertia peregrinans* Cockayne et Allan, in *Trans. & Proc. New Zealand Inst.* 57: 56 (1926)

Fig. 11, 12

**NEOTYPE** (here chosen): New Zealand, Waikanae River, Paraparaumu Beach, *B. C. Aston, s. d.*, WELT 31076!; **Iso**neotypes: WELT 31076a!, WELT 31076b!, WELT 31076c!.

**DESCRIPTION:** Plants consisting of leafy fans crowded or emerging at intervals from far-spreading horizontal stolons, c. 3 mm diam., yellow in colour. Leaves 130–700 mm × 3–9 mm, the two surfaces similar; often +/- copper coloured where exposed to full sun; nerves many, the median ones crowded and coloured red or orange; margins usually not scabrid; leaf in transverse section convex lens-shaped, two rows of vascular bundles present centrally, marginal vascular bundles present, sclerenchyma present on inside of leaf sheath. Peduncles short, inflorescences usually not carrying flowers or fruits above leaves. Panicle narrow, but usually closely branched, lower



**Fig. 11** Neotype of *Libertia peregrinans* (*B. C. Aston*, WELT 31076). Scale bar = 5 cm.

bracts long (40–170 mm), lanceolate, often brown, upper bracts shorter and brown, occurring singly; 1–7 flowers per branch. Pedicels stout, c. 14–40 mm long, glabrous. In flower bud, perianth often brownish externally, similar size or slightly larger than ovary. Flowers 10–25(–30) mm diam.; tepals all white internally, widely patent; outer tepals usually  $> \frac{1}{2}$  the length of the inner, narrower, oblong-elliptical or oblong, flattened, without apiculus; inner tepals obovate-elliptical, shortly unguiculate, usually leaving most of outer tepals visible, cleft present at tip. Staminal filaments very shortly connate; anthers c. 3–3.5 mm long, dark yellow-brown, pollen sacs broad, connective also broad; pollen ellipsoidal, monosulcate,  $26.6\text{--}38.0 \times 15.2\text{--}30.4 \mu\text{m}$ . Ovary cupiform, green; style branches narrowly winged, pointing outwards. Capsule 6–15 mm long, 4–10 mm diam., ovoid-barrel-shaped, ripening from green to orange, yellow, or black on maturity, often

indehiscent for a year after ripening, seeds released after capsule disintegrates. Seeds c. 1.0–1.5 mm diam., subglobose, surface texture reticulate-foveolate, orange or orange-brown. Chromosome number:  $2n = 6x = 114$  (Blanchon et al. 2000a). FL Oct–Jan; FR Jan–Dec.

REPRESENTATIVE SPECIMENS: NORTH ISLAND: AUCKLAND: Piha, *M. Mackie*, Jan 1932, AK 103868. WELLINGTON: Hokio Coast, Levin, *P. J. de Lange*, Jul 1993, WELT 79265a; Levin Beach, *B. C. Aston*, WELT 48437; Waikanae River, Paraparaumu, *B. C. Aston, s.d.*, WELT 31076a. NELSON: West Whanganui Inlet, *W. R. B. Oliver*, Dec 1946, WELT 15589; Wharariki Beach, Cape Farewell, *A. P. Druce*, Nov 1971, CHR 245164; North-West Nelson, Sandhills Creek, *A. P. Druce*, Nov 1975, CHR 285780. WESTLAND: Kokatahi, *J. L. Barton*, Dec 1957, AK 213215; West Coast, Arnold River, *W. McKay*, Oct 1929, CHR 112423. OTAGO: Akatore River, *J. Clarke*, Nov 1966, CHR 174945; Wangaloa, *D. Petrie*, Sep 1890, WELT 31128. SOUTHLAND: Gore, *D. L. Poppelwell, s.d.*, WELT 31127a; Invercargill, *T. Kirk*, Jan 1885, WELT 31073; Bluff Hill, *B. C. Aston*, Dec 1895, WELT 31132. STEWART ISLAND: Mason Plain, *D. Leask*, Nov 1959, WELT 67717. CHATHAM ISLANDS: Chatham Islands, *W. R. B. Oliver*, Dec 1909, WELT 15591; Chatham Islands, *L. Cockayne*, AK 103870.

NOTES: *Libertia peregrinans* shows some minor intraspecific variation. Plants from the west coast of the North Island generally have longer (300–630 mm) and thinner (4–9 mm) leaves than more southerly plants (130–550 mm × 3–7 mm). Accessions from Southland and the Chatham Islands have longer, curled pedicels, and bigger inflorescences. Plants from North-West Nelson lack coloured midveins and are discussed under *L. ixioides* × *L. peregrinans* (q.v.).

*Libertia peregrinans* differs from *L. grandiflora*, *L. ixioides*, *L. mooreae*, and *L. micrantha* by its possession of elongate rhizomes ("stolons"). It also differs from *L. grandiflora* and *L. mooreae* by its short inflorescences, oblong petals, large sepals, and indehiscent capsules. It differs from *L. ixioides* by its smaller, indehiscent capsules and red or orange raised leaf veins (Fig. 7E,F), and from *L. micrantha* by its size, leaf anatomy, and flower form. *Libertia edgariae* and *L. cranwelliae* also have elongate rhizomes, but *L. edgariae* has longer inflorescences, orbicular petals, small sepals, and green or yellow leaf veins, while *L. cranwelliae* has large capsules which turn orange on ripening, leaves that are

straight and turn yellow in summer, and is dodecaploid (Table 1).

Plants of *L. peregrinans* were previously included within *L. ixioides*, but several authors, including Poppelwell (1919) and Hooker (1864), noted the form of *L. ixioides* with long stolons as being different, with Poppelwell suggesting it deserved specific rank, and Hooker calling it *L. ixioides* var.  $\beta$ . Moore (1967) noted comments by W. Colenso and B. C. Aston agreeing with this. Cockayne & Allan (1926) described this taxon as a new species, *L. peregrinans*, from plants collected in sand hollows near Foxton. Unfortunately no Cockayne or Allan specimen suitable for use as a Type specimen could be found, but there is no confusion over the name or the description. Several B. C. Aston or L. Cockayne specimens held within L. Cockayne's herbarium were examined for selection of a neotype, and one from Paraparaumu Beach (WELT 31076) is designated here in preference to those from the Chatham Islands (e.g., AK 103870) or Levin Beach (WELT 48437). Three other specimens with the same accession number (WELT 31076a,b,c) are isoneotypes. There is no collector listed on the label of the neotype, but the handwriting matches that on the three isoneotypes which have B. C. Aston listed as collector.

DISTRIBUTION AND HABITAT: Restricted to the west coast of the North Island between Kawhia and Wellington (with one old collection from Piha, Auckland, AK 103868). Found in the South Island, in coastal north Westland, Nelson, and Marlborough, and coastal sites in Southland and Otago. Also found on Stewart Island, and it is the only species of *Libertia* present on the Chatham Islands. Inland collections from North-West Nelson are hybrids with *L. ixioides* (*L. ixioides* × *L. peregrinans* q.v.). Other inland collections from Lake Te Anau, Taranaki, and near Mt Ruapehu have some *L. ixioides* characters, and may also belong to this hybrid. *L. peregrinans* sens. str. is restricted to sandy or peaty soils in coastal sites such as beaches, dune systems, river mouths, estuaries, and coastal scrub. It is often associated with *Apodasmia similis*, *Festuca arundinacea*, *Gleichenia dicarpa*, *Isolepis nodosa*, and *Poa tussocks*, and on the Chatham Islands with *Sporadanthus traversii*.

#### *L. ixioides* × *L. peregrinans*

Fig. 12

DESCRIPTION: Plants consisting of leafy fans crowded or emerging at intervals from far-spreading horizontal stolons; stolons c. 3 mm diam., pale yellow in colour. Leaves 120–350 mm × 3–8 mm,

the two surfaces similar; usually dark green; nerves many, the median ones crowded and uncoloured, or sometimes pale yellow; margins not usually scabrid, may be scabrid at tip; leaf in transverse section convex lens-shaped, two rows of vascular bundles present centrally, marginal vascular bundles present, sclerenchyma present on inside of leaf sheath. Inflorescences short, not usually carrying flowers over leaves, peduncles also short; panicle narrow, much but usually closely branched, lower bracts long, lanceolate, green-brown, upper bracts shorter and brown, occurring singly, 2–5 flowers (often 2) per branch. Pedicels stout, glabrous, c. 14–20 mm long. In flower bud, perianth often yellowish externally, similar in size or slightly larger than the ovary. Flowers 20–28 mm diam.; tepals all white internally, widely patent; outer usually  $> \frac{1}{2}$  the length of the inner, narrower, blunt-elliptical, flattened, without an apiculus; inner oval-elliptical, shortly unguiculate, usually leaving most of outer tepals visible, cleft present at tip. Staminal filaments very shortly connate; anthers c. 3 mm long, dark yellow, pollen sacs broad, connective also broad; pollen ellipsoidal, monosulcate,  $30.4\text{--}38.0 \times 26.6\text{--}34.3 \mu\text{m}$ . Ovary barrel-shaped, green; style branches very slightly winged, pointing upwards. Capsule usually  $< 10$  mm long, ovoid-barrel shaped, ripening from green to yellow then black on maturity, often indehiscent for more than a year after ripening. Seeds c. 1.5 mm diam., subglobose, surface texture reticulate-foveolate, orange or orange-brown. Chromosome number:  $2n = 9x = c. 171$  (Blanchon et al. 2000a). FL Oct–Dec; FR Jan–Dec.

REPRESENTATIVE SPECIMENS: SOUTH ISLAND: NELSON: Balloon Hut Track, Cobb Valley, D. Blanchon, Nov 1995, AK 240221; Upper Elford Creek, S. McLennan, Jan 1985, CHR 419246; Mt Arthur, J. Adams, 1886, AK 14642.

NOTES: *L. ixioides*  $\times$  *L. peregrinans* closely resembles *L. peregrinans*, distinguished mainly by its uncoloured leaf veins and  $9x$  ploidy level. Morphological (q.v.) and cytological (Blanchon et al. 2000a) data indicate *L. peregrinans* and *L. ixioides* to be the parents of this hybrid. Both 5S rDNA and trnL cpDNA spacer sequences were the same as in *L. ixioides*, suggesting that this species is the female parent (Blanchon 1999).

DISTRIBUTION AND HABITAT: North-West Nelson, possibly also Lake Te Anau (CHR 259600), Taranaki (CHR 245713), and Mt Ruapehu (AK 103869), in moist upland stream valley sites in open beech forest (*Nothofagus menziesii*, *N. fusca*), also associated with *Blechnum fluviatile*, *Carpodetus*

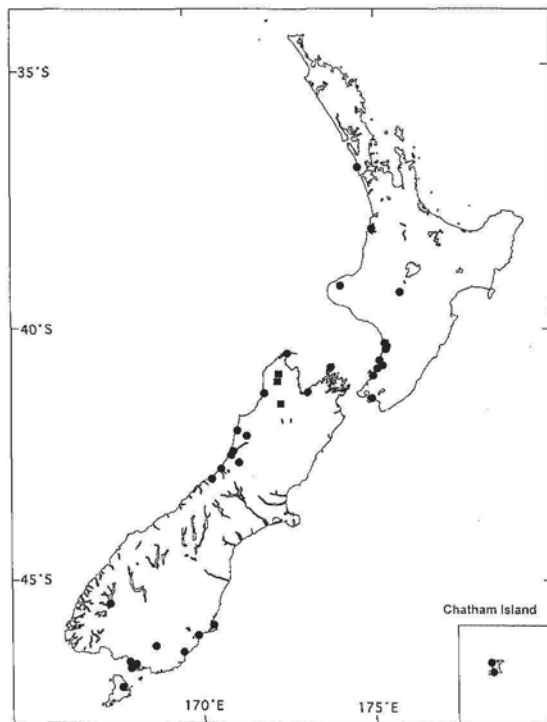


Fig. 12 Distribution of *Libertia peregrinans* (circles) and hybrid (squares).

*serratus*, *Coprosma propinqua*, *Griselinia* spp., *Hypolepis millefolium*, *Microlaena* spp., *Polystichum vestitum*, *Rubus*, *Uncinia*, and *Viola* spp.

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