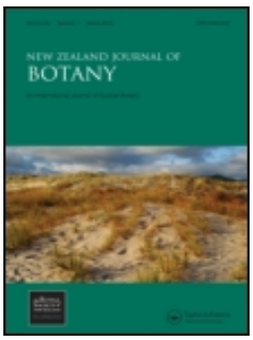

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Iti lacustris (Brassicaceae), a new genus and species from southern New Zealand

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Abstract *Iti lacustris*, a small annual herb from Fiordland, south-west New Zealand, is described and illustrated. It belongs in tribe Sisymbrieae, but its adaptations to an unusual habitat and its unspecialised reproductive morphology obscure its affinities.

Iti lacustris is a minor component of lake-edge turf on cobble beaches at Lakes Manapouri and Te Anau. Although *I. lacustris* is rare and possibly endangered, its distribution within Fiordland National Park, and the legal confinement of the levels of Lakes Manapouri and Te Anau, provide considerable protection of its habitat.

Keywords *Iti lacustris;* Brassicaceae; Sisymbrieae; New Zealand flora; taxonomy; new genus; new species

INTRODUCTION

In 1971, one of us (PNJ) first collected a small plant belonging to the Brassicaceae (=Cruciferae) from the shore of Lake Te Anau in Fiordland National Park (Johnson 1972, p. 130, 134) and the species has since been found at two further sites at Lake Te Anau and two at nearby Lake Manapouri. Detailed study of its vegetative and reproductive morphology, and seed and embryo structure has not resulted in the clear recognition of derived character states shared with other species which would enable us to place it in a known genus. Consequently we here name and describe this plant as a new monotypic genus endemic to New Zealand.

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DIAGNOSIS

Iti lacustris Garnock-Jones et P. Johnson, gen. et sp. nov.

A *Pachycladone* Hook.f. duratione ephemera vel annua, valvis siliquarum non carinatis, seminibus uniseriatis, radicula embryonis brevissima, cotyledonibus embryonis transverse plicatis differt.

Holotypus: New Zealand, Henry Creek, east side of Lake Te Anau, *P. N. Johnson*, 21.5.1971, CHR 286399.

GENUS AND SPECIES DESCRIPTIONS

Iti Garnock-Jones et P. Johnson

Herb. Roots fibrous. Hairs absent or simple. Stems absent, or prostrate, creeping and rooting at nodes. Leaves simple or pinnatifid. Flowers solitary in leaf axils or sometimes apparently 2–(3) together. Sepals erecto-patent, not saccate. Petals white, weakly clawed. Stamens 4, weakly didynamous, or rarely 6, weakly tetradynamous; filaments without appendages. Nectaries in a nearly continuous ring between the corolline and staminal whorls, best developed beside bases of lateral stamens but not surrounding them. Stigma capitate, sessile. Fruit a latiseptate silicle; beak absent; valves weakly convex, not veined or with 1 weak vein; septum intact, cells of septum parallel-sided. Seeds cylindric, lying horizontally in 1 row per cell; testa finely bireticulate; mucilage bodies present in epidermis, broad, weakly staining. Radicle incumbent, $^1/_3$ as long as the transversely folded cotyledons.

I. lacustris Garnock-Jones et P. Johnson
Fig. 1, 2, 4, 5

Minute ephemeral or annual rosette herb. Stems on young plants very short, on older plants lateral, ascending at first, later prostrate, geniculate, rooting

Fig. 1 *Iti lacustris*: young plant at top left, old plant at top centre and leaves at top right (all × 2). Flowers and fruits (all × 10) as follows: 1 flower bud, 2 opening flower, 3 mature flower partly dissected, 4 open flower from above, 5 flower after pollination, 6 developing fruit, 7 ripe fruit, 8 dehiscence, 9 the seeds displayed.

regularly, up to 5 cm long, reaching 0.8–2 mm diam., glabrous or sometimes with sparse, fine, slightly recurved hairs. Leaves glabrous, or with sparse simple hairs on petiole, slightly glossy, dull green or tinged purplish-grey, in rosettes and clustered on stems. Early rosette leaves entire, linear-spathulate; later rosette and cauline leaves pinnatifid, 20–30–(50) mm long; petiole 2–12 mm long, 0.5–1 mm wide; terminal lobe narrow-spathulate, 2–3–(5) mm broad; lateral lobes narrowly oblong-spathulate, 4–10 mm long, sometimes single or in uneven numbers, but usually in 1–2–(3) subopposite pairs. Peduncle glabrous, 1–2 mm long, reaching 2–5 mm long at fruiting. Sepals suberect, oblong, glabrous, green with narrow pale margins, 1.5–2 × 0.6–1 mm. Petals white, suberect, oblong- to obovate-spathulate, obtuse, 1.8–2.5 × 0.8–1.2 mm, weakly clawed; limb spreading. Stamens suberect; median stamens usually 2, rarely 4, 1.6–2 mm long; lateral stamens 1–1.5 mm long. Ovary ellipsoid, 1–1.6 mm long; stigma sessile, 0.4 mm diam.; locules each with (5)–7–8 ovules. Silicle elliptic to oblong, (1)–2–3–(3.5) × 1–1.7 mm; valves pale straw coloured, thin, convex, glabrous, not veined or with 1 weak vein. Seeds *c.* (5)–8 in one row in each locule, pale to reddish brown, oblong, *c.* 1 mm long. Chromosome number 2n = 48 (CHR 324822, E. J. Beuzenberg, pers. comm.).

Distribution: New Zealand, South Island: confined to Lakes Manapouri and Te Anau (Fig. 3). The plants grow on cobble beaches on lake shores, in silty sediments lodged between stones.

Specimens additional to the type: L. Manapouri, Circle Cove, *P. N. Johnson,* 27.2.1974, CHR 253287; L. Manapouri, just south of Supply Bay, *P. N. Johnson,* 1.3.1974, CHR 253288.

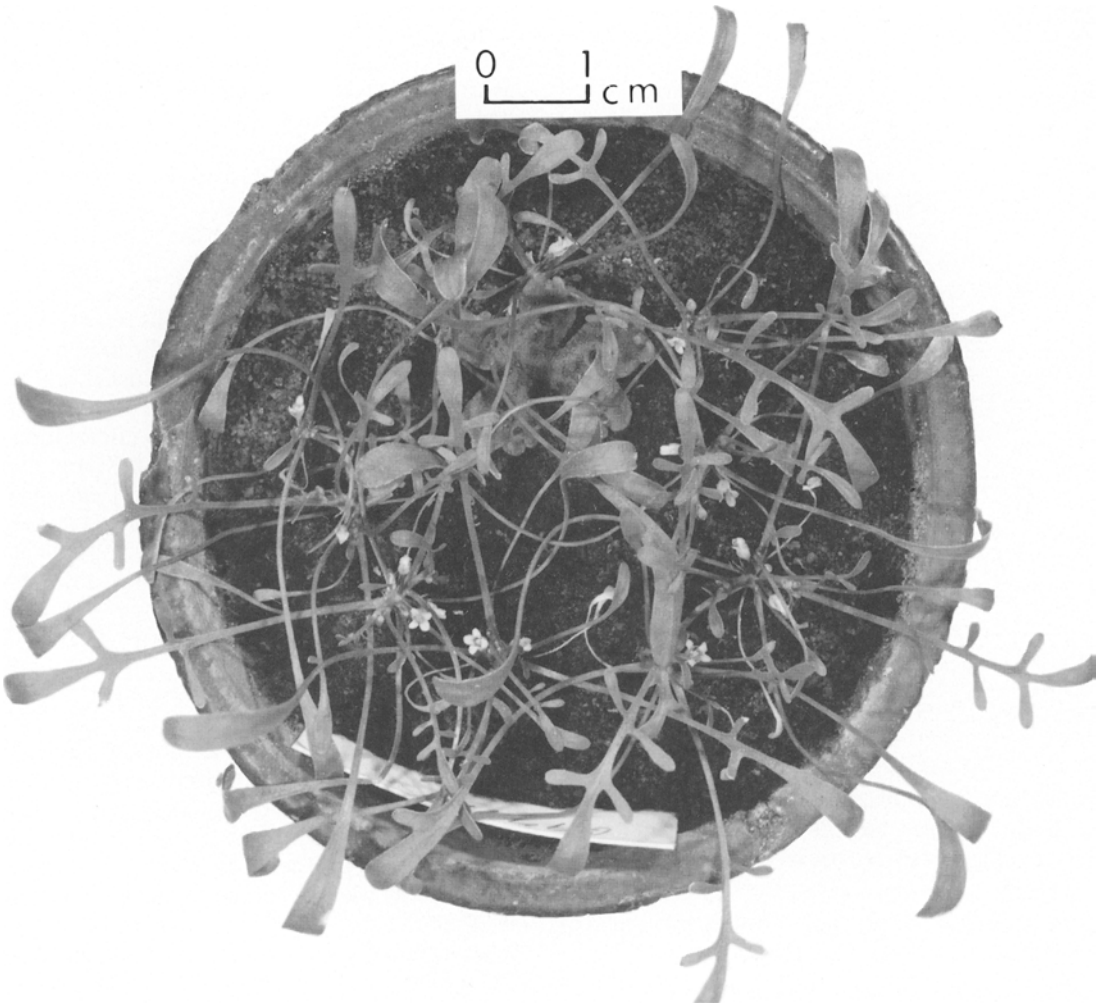

Fig. 2 *Iti lacustris:* flowering plants in cultivation. The habit in cultivated plants is more lax than in wild plants.

The generic name *Iti* is the Maori word for "diminutive or insignificant thing" (Williams 1957); the epithet *lacustris* refers to the lake shore habitat of this species. The letter i in Maori is pronounced as the english vowel sound -ee-. We assign the feminine gender to *Iti*.

OTHER PLANTS OF SIMILAR APPEARANCE

Another cress bearing a close resemblance to *Iti lacustris* is an undescribed *Cardamine*, probably related to *C. corymbosa*, known from moist margins of tarns, kettles, and streams in S.E. Nelson, inland Canterbury, and Otago. Plant size and leaf shape are very similar to *Iti lacustris* but the *Cardamine* differs most obviously in its long penduncles and a narrow, explosively dehiscent silique 10–15 times as long as its width. Further, *Cardamine*, in tribe Arabideae, has the radicle accumbent in the embryo.

Other herbs of Lakes Manapouri and Te Anau shores that resemble *Iti lacustris* in size, habit, and leaf features may be distinguished vegetatively as follows:

Limosella lineata (Scrophulariaceae): leaves linear or narrow-spathulate, stolons obvious, leaf base with membranous sheath.

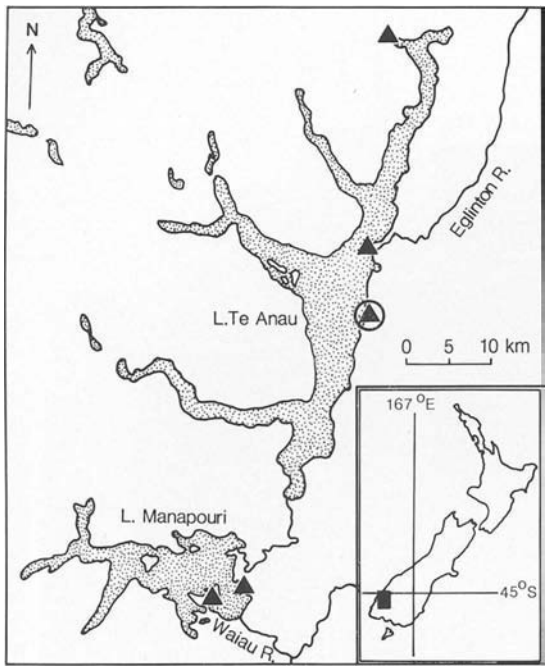

Fig. 3 *Iti lacustris:* distribution. The five sites, north to south, are Worsley delta, Eglinton R. mouth, Henry Creek (type locality, circled), Shallow Bay, and Circle Cove.

Ranunculus limosella (Ranunculaceae): leaves linear or spathulate, some leaves distant on far-creeping rhizomes, leaf base with membranous sheath.

Lilaeopsis novae-zelandiae (Apiaceae): leaves septate, bases with long sheath.

Neopaxia australasica (Portulacaceae): leaves linear or long-spathulate, papery sheath obvious.

Leptinella maniototo (Asteraceae): leaves linear or pinnate, pointed, usually hairy, on stout, creeping, branching rhizomes.

Brachycome linearis (Asteraceae): leaves linear, occasionally pinnate, tip pointed, dark midrib obvious.

Glossostigma spp. (Scrophulariaceae): leaves spathulate, opposite.

Plantago triandra (Plantaginaceae): leaves linear to pinnate, in compact flat rosettes.

Myosurus minimus subsp. *novae-zelandiae* (Ranunculaceae): leaves linear-spathulate, petiole furrowed, leaf tip dimpled.

Triglochin striatum (Juncaginaceae): leaves narrow-linear with ligulate sheath.

FLOWER

The very small flowers of *Iti lacustris* are borne among the leaves. Although the petals are weakly clawed, the claws are not strictly erect, and the sepals are suberect giving the flower an open, unspecialised structure. Usually only 4 stamens are present, 2 median and 2 lateral, and the stamen filaments are weakly curved at the base. The nectary forms a virtually continuous ring between stamens and petals with slightly enlarged lobes adjacent to the bases of the lateral stamens. This arrangement is common in tribes Sisymbrieae and Arabideae.

In cultivation, self-pollination is usual, and most flowers develop normal fruits bearing a full complement of seeds. We have no information on flower visitors, but nectar production seems slight.

The relatively simple flower of *Iti lacustris* is similar to flowers of other self-pollinated members of the family. However, this does not indicate a relationship between those and *Iti,* because of the strong likelihood of parallelism.

FRUIT AND SEED

The fruit of *Iti lacustris* is an oblong silicle. The valves are thin, and curl back from the top or bottom in dehiscence, often not being completely shed. The valves are not veined or occasionally a weak midvein is present. The seeds are tightly compressed in one row in each cell of the silicle, each seed held at 90° to the axis of the fruit. In pot-grown plants, seeds are not dispersed at all, remaining attached to the replum at the base of the parent plant and eventually falling and germinating there. In the wild, seeds are probably dispersed by water as the lake level fluctuates and beaches are eroded and reformed by wave action. Seeds in a beaker of water floated for ten days, and many germinated while afloat.

The seeds of *Iti lacustris* are red-brown and cylindric with a fine, regularly bireticulate surface (Fig. 4). Both epidermis and palisade layers are very narrow. The periclinal walls of the epidermis and the outer periclinal wall of the palisade are not thickened. The inner periclinal wall of the palisade is slightly thickened (Fig. 5). The anticlinal walls of both layers are slightly thickened especially at their bases. The cells of both outer layers collapse inwards in the dry seed and the more rigid anticlinal cell walls produce the bireticulate surface of the testa. The slime bodies in the epidermis cells are

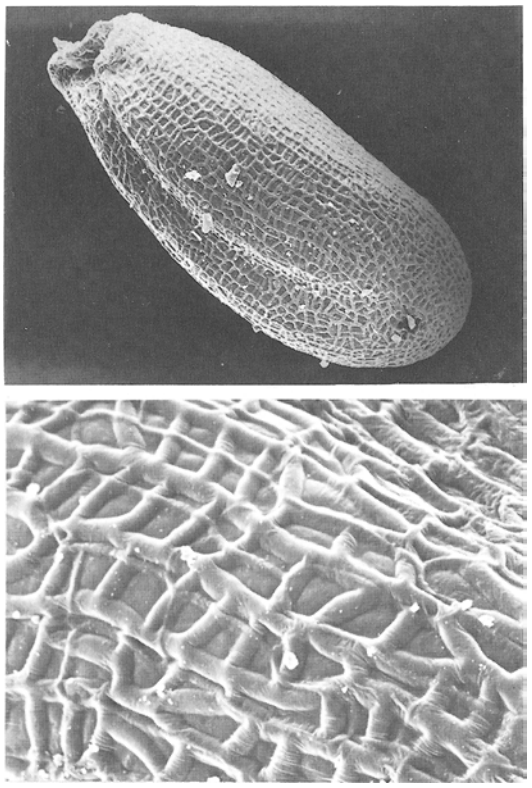

Fig. 4 *Iti lacustris:* scanning electron micrographs of seed (×75) and detail of testa surface (×375).

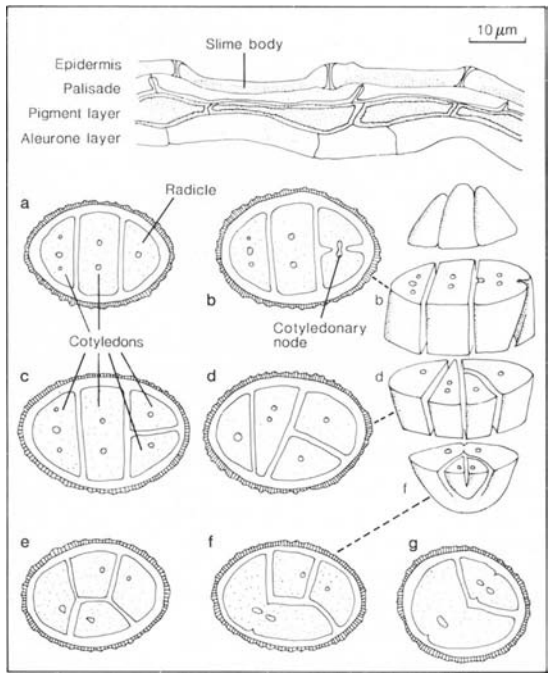

Fig. 5 *Iti lacustris:* anatomy of testa in transverse section (top); selected serial sections through seed (a–g) and diagrammatic representation of embryo configuration.

broad and weakly staining, and very low because of the flattened nature of the epidermis. Seeds tend to adhere to their neighbours in a silique, and to the septum, although the amount of mucilage produced is not sufficient to be visible.

The embryo (Fig. 5) is folded, as is typical of the family, but whereas most crucifers have the embryo folded at the cotyledonary node, *Iti lacustris* has the fold in the cotyledons. Thus the cotyledons are about 3 times as long as the radicle. The cotyledons are narrowly oblong, similar in shape to the true leaves. The radicle of the embryo is incumbent (i.e., it lies against the face of one cotyledon). In a minority of seeds, embryos with accumbent radicles occur (i.e., the radicle lies along the edges of both cotyledons).

AFFINITIES OF *ITI LACUSTRIS*

The subfamilial classification of the Brassicaceae is generally considered to be unsatisfactory (Hedge, *in* Vaughan et al. 1976). It seems that some tribes (e.g., Sisymbrieae) are defined by character states which are plesiomorphic (ancestral). Similarly, pairs of tribes (e.g., Sisymbrieae and Arabideae) are separated on characters, such as embryo configurations, whose states may have evolved independently many times. In spite of this, some tribes (e.g., Brassiceae, Heliophileae, and probably Lepidieae, at least in part) are based on synapomorphies (shared, uniquely-derived character states) and may thus be considered natural groups. A fully natural classification will not be attained until much more data (e.g., on seed anatomy and morphology, nectary configurations, chemistry of glucosinolates and other compounds, and cytology) have been gathered and critically assessed.

Following the classifications of Schulz (1936) and Janchen (1942), *Iti lacustris* should be placed in tribe Sisymbrieae because of its incumbent radicle and the oblong silicle which, although short, is best regarded as a reduced silique. The distinction between silicles and siliques in the Brassicaceae is convenient but largely artificial.

Beyond placing *Iti* in Sisymbrieae, further assessment of its affinities is difficult. Although *Iti*

is unusual in several respects, these are peculiar adaptions related to its habitat and life cycle, and therefore reveal nothing about its relationships. The small flowers, narrow, usually simple, leaves, sparse indumentum, and barely dehiscent fruits are probably all best regarded as despecialisations or as adaptions to the lake shore habitat. Character states which may have indicated relationships with other New Zealand Brassicaceae have perhaps been lost.

Among the native members of the Brassicaceae in New Zealand, *Iti* shares some features with *Pachycladon* which is also placed in Sisymbrieae (Schulz 1936, but note that Allan, 1961, placed *Pachycladon* in Lepidieae), but the phylogenetic significance of these characters is unclear. Both *Iti* and *Pachycladon* have few-flowered lateral inflorescences, but *Pachycladon* differs from *Iti* in its perennial habit, keeled silicle valves, seeds in 2 rows in each cell of the silicle, and embryo folded at the cotyledonary node.

When *Pachycladon novae-zelandiae* (ovule parent) and *Iti lacustris* (pollen parent) were experimentally crossed, six seeds (36%) resulted, but all were poorly formed. One of these seeds germinated but damped off before true leaves were formed. This result may suggest an affinity between the two species involved; the opportunity to repeat the cross has not arisen since.

Phytochemical research in the Brassicaceae has mostly concentrated on glucosinolates because of their importance as flavour precursors (Heywood, *in* Vaughan et al. 1976). Flavonoids have not been widely studied in the family (Harborne 1967). In a preliminary survey of flavonoids of New Zealand members of the family, *Iti lacustris* and *Pachycladon novae-zelandiae* were found to accumulate glycosides of isorhamnetin, an aglycone not found in *Ischnocarpus novae-zelandiae*, *Rorippa gigantea*, *Cheesemania fastigiata*, or *C. latisiliqua* (R. J. Grayer-Barkmeijer, pers. comm.). Del Pero de Martínez and Aguinagalde (1982) found no glycosides of isorhamnetin in four species of *Sisymbrium* from Argentina. However, isorhamnetin has been reported for tribes Brassiceae, Hesperideae, and Matthiolieae and is likely to be common in the family (Harborne 1967).

The chromosome number of 2n = 48 is a common one in the family. In New Zealand, several species of *Cardamine* (Pritchard 1957) and also *Rorippa gigantea* (CHR 313381, E. J. Beuzenberg pers. comm.) have 2n = 48. The chromosome numbers of *Pachycladon* and *Ischnocarpus* are not known.

The seed coat anatomy of *Iti lacustris* is very similar to *Pachycladon* and *Ischnocarpus* except that the cell layers are very thin, especially the epidermis and palisade layers. Features the three genera have in common include broad slime bodies virtually filling the epidermis cells, relatively thin anticlinal walls in palisade cells, and weakly thickened lower periclinal walls in palisade cells. This type of testa is quite common in the family, being known in species of *Goldbachia, Cheiranthus, Erysimum* (Hesperideae), *Cardamine, Arabis* (Arabideae), *Coronopus* (Lepidieae), and *Arabidopsis* (Sisymbrieae) (Vaughan & Whitehouse 1971). It therefore does not necessarily indicate any close relationship between *Ischnocarpus, Iti*, and *Pachycladon.*

ECOLOGY AND CONSERVATION

Iti lacustris grows on gently-sloping lake shores usually within a sparse turf of other plants where a thin cover of silt or fine sand is lodged among firm and stable cobbles or gravels. Such sites tend to be neither the most sheltered nor the most exposed available, but are subject to moderate wave action and the resultant periodic disturbance of sediments. Like *Limosella lineata*, *Iti* can behave as a pioneer on fresh surfaces. At both Lakes Manapouri and Te Anau, *Iti* is confined within the range of lake level fluctuation and, more specifically, has been recorded only at or below mean lake level at times when the lakes have been low. At Lake Manapouri (total fluctuation 4.57 m – Johnson 1972) it has been seen growing at mean level (177.77 m a.s.l.) and 0.6 m below this. At Lake Te Anau (total fluctuation 3.50 m), *Iti* was recorded at the Henry Creek and Worsley delta sites at a level 0.4 m below the mean (202.19 m a.s.l.).

Iti shares its habitat with up to 16 other turf species characteristic of frequently submerged sites, notably *Limosella lineata, Lilaeopsis novae-zelandiae, Myriophyllum propinquum, M. pedunculatum, Pratia perpusilla, Glossostigma elatinoides, Scirpus aucklandicus, Callitriche petriei* and *Isoetes kirkii* (an aquatic, here near the upper extent of its vertical range).

Seeds of *Iti lacustris* germinate readily, and by the age of 6 weeks plants can produce a crop of ripe seed. Although plants may often be short-lived in the wild, they are potentially capable of living for at least 9 months, continuing to flower and seed profusely. Persistence of *Iti* plants is demonstrated

by a neglected tray of cultivated plants left at the base of a hedge where, despite repeated drying out and waterlogging, and invasion by thallose liverworts, the *Iti* population remained for at least a year.

Annual or ephemeral herbs are rare in the indigenous New Zealand flora, although in other parts of the world they are commonly found in disturbed habitats such as lake-shores. *Iti* has been recorded from only five sites along the extensive shores of these two well-botanised lakes which may reflect low success of this species. Yet, among the large flora of lake-edge turf plants at these lakes are several other species behaving as ephemerals or local rarities. Thus, *Myosurus minimus* subsp. *novae-zelandiae* was collected from Lake Manapouri shores in 1945, but has not been seen there since. On one turfy beach at Lake Manapouri, *Parahebe canescens* and *Gratiola nana* appeared briefly at different times in the 1970s, but were not in evidence on later visits. None of these three species is known from other sites around either lake.

In addition to *Iti lacustris*, two other taxa are locally endemic to turfy lake shores in eastern Fiordland. These are *Brachycome linearis* (confined to Lakes Manapouri and Te Anau) and *Ranunculus recens* var. *lacustris* (Lakes Manapouri, Te Anau, and nearby Lakes Orbell and Te Au).

Considering the categories of threatened plants defined internationally by the IUCN (Given 1976), *Iti lacustris* must be considered at least as "rare", but could readily proceed to placement in the "vulnerable" or "endangered" categories. Casual searches by PNJ have failed to reveal populations of *Iti* near previous known localities since 1976, though high lake levels at the time of visits have reduced the likelihood of finding it. Much the greater part of both Lake Manapouri and Lake Te Anau shores lie within Fiordland National Park, a status which offers considerable legal habitat protection. Levels of both lakes are subject to control for hydro-electric power generation. Although raising the lake levels as originally proposed for the hydro-electric development would have inundated and obliterated the natural shores, the situation now resolved is that both lakes are operated according to a set of guidelines (confirmed by government legislation) which aim to maintain the natural lake fluctuation regimes (Mark & Johnson 1985). The guidelines govern periodicity of flooding and de-watering within the lakes' natural ranges as well as limiting draw-down rates in order to maintain stability of lake-shore sediments. Provided guideline values are not much exceeded, the requirements of *Iti lacustris* for a periodically disturbed and a repeatedly flooded habitat should continue to be satisfied.

Certain weed species of lake shore habitats (Johnson 1982) could threaten *Iti* and other rarities. Crack willow (*Salix fragilis*) has the potential to colonise most of the turf-upon-sediment shores, but such willow infestations as formerly existed have now been largely eradicated by Fiordland National Park staff. Herbaceous naturalised plants such as *Juncus articulatus, Prunella vulgaris, Sagina procumbens*, and *Poa annua*, already present around the lakes, tend not to cover much ground to the exclusion of native plants; they would threaten *Iti* habitat only if encouraged by nutrient enrichment or by the lakes being held at low levels for unnaturally long periods.

The future of *Iti lacustris* would be more secure if it were further cultivated. Seed is available from the authors.

ACKNOWLEDGMENTS

The Fiordland National Park Board gave permission for collection of *Iti*; Elizabeth Edgar helped with the Latin diagnosis and discussed nomenclatural matters. Ernst Beuzenberg prepared seed sections and counted chromosomes; Renée Grayer-Barkmeijer examined flavonoids of *Iti* and other New Zealand genera of Brassicaceae; Osvaldo Boelcke, Margaret Bulfin, Helen Hewson, Bengt Jonsell and Reed Rollins examined material of *Iti lacustris* and discussed its affinities; Elizabeth Edgar, Helen Hewson, Trevor Partridge, and Colin Webb criticised the manuscript; Murray Dawson and Mary-Ann Bloomfield prepared Fig. 4. To all these people we express our thanks.

REFERENCES

Allan, H. H. 1961: Flora of New Zealand, Vol. I. Wellington, Government Printer.

Del Pero de Martínez, M. A.; Aguinagalde, I. 1982: Contribucion al estudio de los flavonoides en el genero *Sisymbrium*. *Parodiana 1:* 287–299.

Given, D. R. 1976: A register of rare and endangered indigenous plants in New Zealand. *New Zealand journal of botany 14:* 135–149.

Harborne, J. B. 1967: Comparative Biochemistry of the Flavonoids. London, Academic Press.

Janchen, E. 1942: Das System der Cruciferen. *Ostereiches botanische Zeitschrift 91:* 1–28.

Johnson, P. N. 1972: Applied ecological studies of shoreline vegetation at Lakes Manapouri and Te Anau, Fiordland. 2. The lake edge flora – habitats

and relation to lake levels. *Proceedings of the New Zealand Ecological Society 19:* 120–142.

———1982: Naturalised plants in south-west South Island, New Zealand. *New Zealand journal of botany 20:* 131–142.

Mark, A. F.; Johnson, P. N. 1985: Ecologically derived guidelines for managing two New Zealand lakes. *Environmental management 9:* 355–363.

Pritchard, G. G. 1957: Experimental taxonomic studies on species of *Cardamine* Linn. in New Zealand. *Transactions of the Royal Society of New Zealand 85:* 75–89.

Schulz, O. E. 1936: Cruciferae. *In:* Engler, A.; Prantl, K., Die naturlichen Pflanzenfamilien, 17b, pp 227–658.

Vaughan, J. G.; MacLeod, A. J.; Jones, B. M. G. *ed.* 1976: The Biology and Chemistry of the Cruciferae. London, Academic Press.

Vaughan, J. G.; Whitehouse, J. M. 1971: Seed structure and the taxonomy of the Cruciferae. *Botanical journal of the Linnean Society 64:* 383–409.

Williams, H. W. 1957: A dictionary of the Maori language. Wellington, Government Printer.