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Lepidium naufragorum (Brassicaceae), a new species from Westland, and notes on other New Zealand coastal species of *Lepidium*

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Abstract A new species, *Lepidium naufragorum* Garn.-Jones et D.A.Norton, is described. It is compared with *L. flexicaule*, with which it had previously been included. *L. naufragorum* is endemic to Westland, and known from only six sites. It is assigned the IUCN threat status of "Rare", reflecting its restricted distribution and potential for decline. *L. flexicaule* is apparently extinct in the North Island, but occurs sparingly between Cape Farewell and Punakaiki in the South Island, where its distribution overlaps with that of *L. naufragorum*. Taxonomic status and variation of *L. banksii*, *L. obtusatum*, and *L. oleraceum* are discussed, and a key to indigenous coastal species of *Lepidium* is provided.

Keywords *Lepidium naufragorum*; *L. flexicaule*; Brassicaceae; New Zealand flora; new species; taxonomy; coastal habitats; conservation; key

INTRODUCTION

Coastal species of *Lepidium* were among the first New Zealand plants to attract the attention of Europeans. Captain Cook used *L. oleraceum* and other

coastal herbs to ward off scurvy among his crew (Beaglehole 1962, 1968) as early as 1769.

Banks and Solander, naturalists on Cook's first voyage, named two coastal species, *L. frondosum* and *L. incisum*, but both names were illegitimate because they were not effectively published. *L. incisum* was effectively published when taken up by Hooker (1853), by which time it was illegitimate as a later homonym of *L. incisum* Roth. Kirk (1882) provided a name for *L. incisum* Hook.f. when he described *L. flexicaule* from Auckland, later (1899) including Coromandel in the distribution by citing Banks and Solander's material from Mercury Bay. Cheeseman (1906, 1925) added a Townson collection from near Westport. Allan (1961) gave the South Island range as "coastal rocks on western coast to lat. 42° 30'". Garnock-Jones (in Webb et al. 1988) included South Westland populations under *L. flexicaule*, pointing out differences of indumentum and habit for South Westland plants.

Since 1988 the South Westland entity has been studied in detail, its distribution extended northwards to near Punakaiki, and consistent morphological differences from *L. flexicaule* noted. The distribution of this Westland entity and that of *L. flexicaule* overlap near Punakaiki, but they have not been found growing together. In this paper we describe these glabrous Westland forms previously treated under *L. flexicaule* as a new species, *L. naufragorum*, compare it with *L. flexicaule*, and discuss their distribution, habitat, and conservation status. We also provide notes on the status of other coastal *Lepidium* species (*L. banksii*, *L. obtusatum*, and *L. oleraceum*).

TAXONOMY

Lepidium naufragorum Garn.-Jones et
D.A.Norton, sp. nov.

Fig. 1A, C

A *Lepid. oleraceo* foliis pinnatifidis, siliquis emarginatis; a *L. flexicauli* caulibus glabris, ascendentibus vel suberectis, dentibus foliorum acutis, margine laminae glabro, petalis unguiculatis, limbo petali patenti, emarginato, staminibus quattuor differt.

Perennial herb. Stems ascending to erect, 15–30

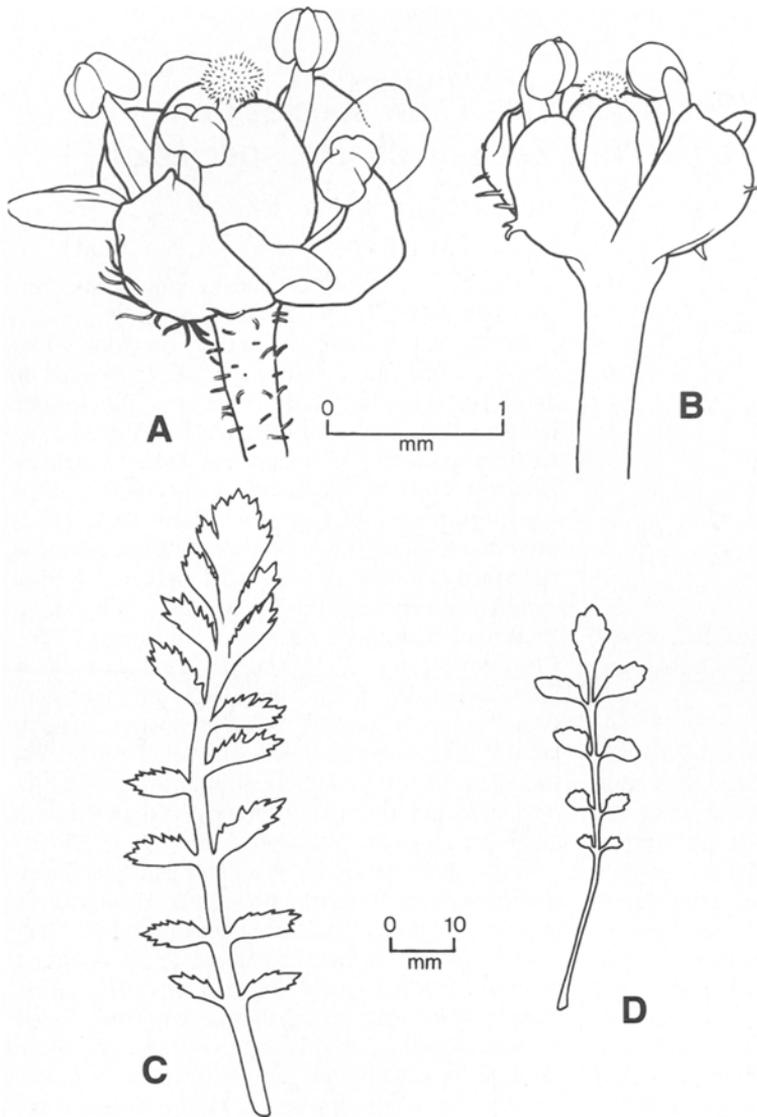


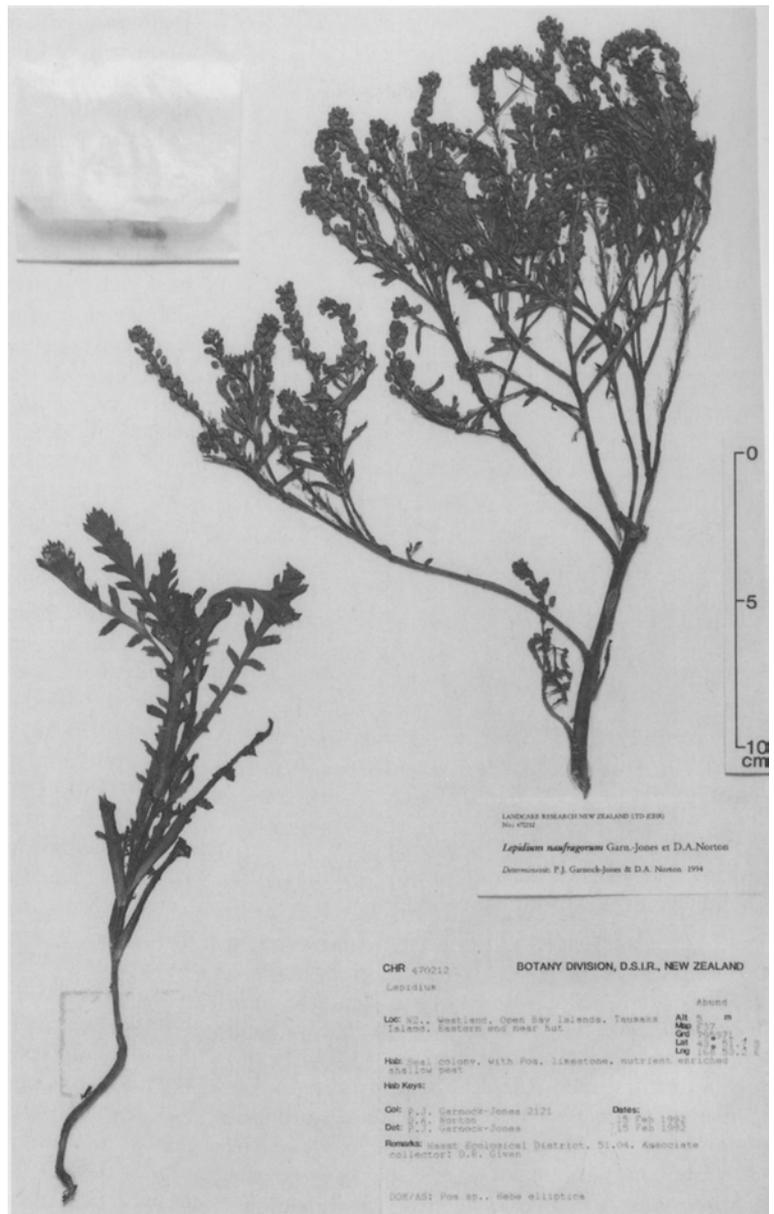
Fig. 1 Flowers and rosette leaves of *Lepidium naufragorum* (A, C) and *L. flexicaule* (B, D).

(–45) cm long, glabrous. Leaves glabrous, fleshy, bright grass-green. Basal and lower stem leaves withering at fruiting, pinnatifid, narrow-oblong to narrow-oblongate, 6–12 × 1.5–2.5 cm; pinnae in 3–7 pairs, sharply toothed at apex and distal margins. Middle stem leaves similar, or becoming shallowly pinnatifid, sharply serrate. Upper stem leaves narrow-obovate to linear-oblongate, pinnatifid to simple, sharply toothed at apex and at apex of pinnae if present, cuneate at base, 10–30(–50) × 2–6(–10) mm. Racemes 30–70(–100) mm long, terminal and axillary; rachis glabrous or sparsely hairy; pedicels sparsely hairy, erecto-patent, 3–5 mm long at

fruiting. Flowers c. 3 mm diameter. Sepals glabrous or sparsely hairy, often some glabrous and some hairy within one flower, green with scarious margins, c. 1 × 1 mm. Petals white, slightly longer than sepals, spreading, clawed; limb obovate, emarginate. Stamens 4, equal. Nectaries 4, subulate, c. 0.25 mm long; nectar copious. Siliques* broadly elliptic, 2.8–4.0 × 2.3–3.2 mm; style 0.1–0.2 mm long, free from the narrow wing, equal or exceeding the shallow

*We use the term *siliqua* in preference to *silicle* since the distinction between the two terms is artificial.

Fig. 2 *Lepidium naufragorum*: holotype.



notch; stigma 0.4 mm diam.; valves glabrous. Seed obovoid, orange-brown, not winged, 1.7–2 mm long, mucilaginous when wet. FL Oct–Mar, FR Nov–Apr. HOLOTYPE: New Zealand; Westland; Open Bay Islands, Taumaka Island, eastern end, 5 m a.s.l.; seal colony, with *Poa*, limestone, nutrient enriched shallow peat; *P.J. Garnock-Jones 2121*, *D.A. Norton*, & *D.R. Given*, 15 Feb 1992; CHR 470212 (Fig. 2).

DISTRIBUTION* (Fig. 3): New Zealand: South Island, Westland, known from six sites: Taumaka

*Note added in proof: A new population at Motukiekie, 25 km south of Perpendicular Point, was recently discovered comprising several juvenile and adult plants associated with fairy prion burrows (Motukiekie, 25 km south of Perpendicular Point, on a rock stack, *G. Loh*, Jan. 1995, CANU 37018).

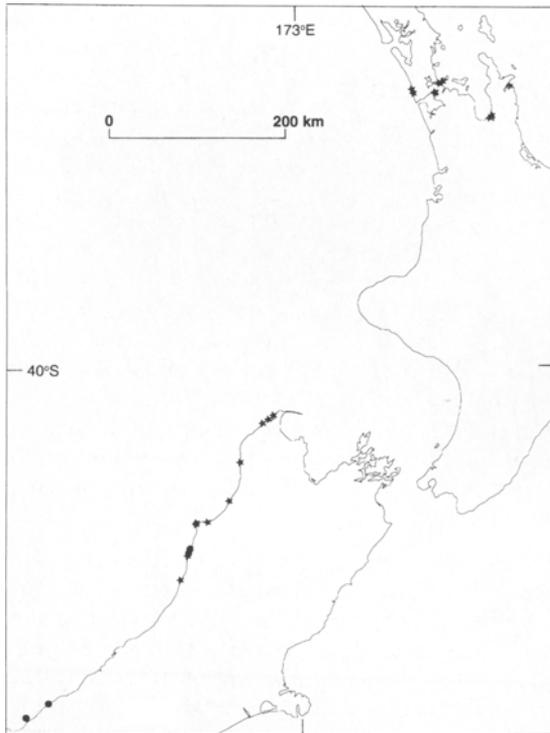


Fig. 3 Distribution of *Lepidium naufragorum* (•) and *Lepidium flexicaule* (★).

and Popotai (Open Bay Islands), Arnott Point, Knights Point, Perpendicular Point, Seal Island.

HABITAT: *Lepidium naufragorum* grows mainly in open sites, either in rock crevices or on organic or mineral soils (often with *Crassula moschata* and *Hebe elliptica*) in the zone between coastal shrubland and high tide mark. On Taumaka (Open Bay Islands) it also occurs with *Carex comans* and *Rumex neglectus* in sites experiencing regular disturbance by seals. Substrate fertility and the presence of indigenous animals are strongly associated with the distribution of *L. naufragorum*. All known sites are on base-rich substrates (limestone, calcareous muddy sandstone, olivine basalt flows), and this species is absent from nutrient-poor substrates, even at localities which experience nutrient enrichment from animals (e.g., on granite at the Cape Foulwind seal colony). The *L. naufragorum* sites are also associated with indigenous animal breeding or resting areas (New Zealand fur seals, *Arctocephalus forsteri*; blue shags, *Stictocarbo punctatus steadi*; Fiordland crested penguins, *Eudyptes pachyrhynchus*). These animals maintain habitat suitable

for *Lepidium naufragorum* by regular disturbance (reducing competition with other plants) and nutrient enrichment. They may also be dispersal agents (e.g., shags use the species, which has mucilaginous seeds, as nesting material).

L. naufragorum is one of only a few plant species presently known to be endemic to Westland, although further searching may extend its range into Fiordland where the combination of rocky coasts, base-rich substrates, and seal colonies also occurs. The absence of endemism in the Westland flora is commonly attributed to the effects of glaciation (e.g., Wardle 1963; Burrows 1965). The localised distribution of *L. naufragorum* is typical of several other species of *Lepidium* (D. R. Given, P. J. de Lange, & D. A. Norton unpubl. data), and its presence in Westland may be a result of local speciation and survival through glacial periods in milder coastal sites.

CONSERVATION: Although common on both Open Bay Islands, Popotai (F. Overmars pers. comm.) and Taumaka, *Lepidium naufragorum* is very uncommon at the other known sites, while at its northern limit on Seal Island only two plants are known. *L. naufragorum* may have been more widespread in the past, particularly if fur seals, which have declined since c. 1800, are important in maintaining suitable habitats. However, it probably always occurred in disjunct local populations, although, as seen on Taumaka and Popotai, such populations can be large. Current threats include insect herbivory (especially from caterpillars of cabbage white butterfly, *Pieris rapae*, and diamond-backed moth, *Plutella maculipennis*), infection with the fungus *Albugo candida* (e.g., CHR 470203), and over-collecting. Although this species has a very limited distribution, there is no evidence of current decline, and the Open Bay Islands plants in particular appear relatively secure. It is therefore appropriate to assign this species the IUCN threat status of "Rare", reflecting its potential for decline (Cameron et al. 1995).

REPRESENTATIVE SPECIMENS SEEN: Seal Island, Punakaiki Ecological District, crack in rock above seal pullout, D. A. Norton, 29 Dec 1991, CANU 36438; Westland, Perpendicular Point, ledges on calcareous sandstone cliffs, shag colony, soil enriched with guano, P. J. Garnock-Jones 2112 & D. A. Norton, 13 Feb 1992, CHR 470203; Knight's Point, Paringa Ecological District, rocks above seal colony, D. A. Norton & J. M. Lord, 1 Jan 1990, CANU 35508; Open Bay Island, W. Coast, S. Island, B. C. Aston, Jan 1909, WELT 30114; Westland,

Open Bay Islands, Taumaka Island, western end, north side, rocks of seal colony, limestone, nutrient enriched, *P. J. Garnock-Jones 2118*, *D. A. Norton*, & *D. R. Given*, 15 Feb 1992, CHR 470209.

ETYMOLOGY: The epithet *naufragorum* is the genitive plural form of *naufragus*, a castaway (Lewis & Short 1922) or ship-wrecked person, and commemorates a sealing gang set down on the Open Bay Islands in 1810. Their vessel, the brig *Active*, set sail for Sydney and was never heard from again. Led by David Loweriston, the 10 men survived nearly 4 years of hardship and misfortune until they were rescued (Begg & Begg 1979). Their diet was fern root and often putrid seal flesh; *Lepidium naufragorum*, which is abundant on the shores of the islands today, could have contributed to their survival.

SIMILARITIES: *Lepidium naufragorum* is most similar to *L. flexicaule*. Both have similar general appearance and habit, pinnatifid basal leaves which wither at fruiting, and small white flowers. *L. naufragorum* differs from *L. flexicaule* in having ascending to erect stems, branching above, bright green leaves with sharply serrate pinnae, longer racemes which are not so clearly leaf-opposed, larger flowers with clawed emarginate petals longer than sepals, 4 stamens, larger nectaries producing copious nectar, and slightly larger siliques.

VARIATION: The populations at Seal Island and Perpendicular Point have leaves more deeply pinnatifid than those at Knights Point and Open Bay Islands.

***Lepidium flexicaule* Kirk, Trans. N.Z. Inst. 14: 380 (1882)** (Fig. 1B, D)

LECTOTYPE (here designated): Onehunga, *T. Kirk 341*, WELT 30080 (Fig. 4)! Kirk cited two collections and hinted at the existence of others: "North Island, rocky places near the sea, Waitemata, Manukau, etc." Hewson (1981, 1982) did not select a lectotype. There are two eligible collections in Kirk's herbarium at WELT: North Head, Waitemata, *T. Kirk 342*, WELT 30081; Onehunga, *T. Kirk 341*, WELT 30080 (WELT 30089, 27620, OTA 15636, and CHR 329219, 329221 are probably duplicates of the latter). Both match the protologue, although neither shows radical leaves, but Kirk has labelled the Waitemata specimen "var. *petiolata*" suggesting that at some stage he regarded it as not typical.

= *L. incisum* Banks et Sol. ex Hook.f., *Flora Novae-Zelandiae* 1, 15 (1853), *nom. illeg.*, non Roth, *Neue Beytr. Bot. 1*: 224 (1802), nec Edgew., *Trans. Linn.*

Soc. 20: 33 (1851). LECTOTYPE (here designated): Opuraga, on the beach, rare, *Banks and Solander*, BM. Isolectotypes: AK 100095!, WELT 63696a,b! Hooker's protologue cited three collections: "Opuraga, on the beach, rare, *Banks and Solander*; Port Nicholson, on rocks near the sea, *Colenso*; limestone rocks in the subalpine region of Waimakariri [sic], alt. 2000 ft., *Haast*". Hooker clearly stated that his description was drawn from Banks and Solander's specimen and drawing, "Mr Haast's being very young and apparently dwarfed". Haast's Waimakariri material is *L. sisymbrioides* (Kirk 1882). Banks and Solander's material is clearly most appropriate to select as the lectotype. ≡ *Nasturtium neozelandicum* Kuntze, *Rev. Gen. Pl.* 2: 937 (1891). This was clearly proposed as a replacement name for the illegitimate *L. incisum* Hook.f.

Perennial herb. Stems prostrate to decumbent, 10–25(–40) cm long, finely puberulent with short papillate or tapered hairs. Leaves fleshy, dull green. Basal and lower cauline leaves withering at fruiting, glabrous above, with papillae or denticles along midrib beneath and margins, pinnatifid, obovate to oblanceolate, 5–7 × 1.5–2.5 cm; pinnae in 1–3 pairs, bluntly toothed or crenate at apex and distal margins. Cauline leaves obovate, oblanceolate, or spatulate, bluntly toothed to crenate distally, cuneate at base, 10–25(–30) × 5–10 mm, with triangular denticles dense on margins and sparse to dense beneath, glabrous above. Racemes 15–40(–50) mm long, terminal and leaf-opposed; rachis and pedicels puberulent with short tapering hairs, or glabrous; pedicels erecto-patent, 3–4 mm long at fruiting. Flowers c. 2 mm diameter. Sepals glabrous or sparsely hairy, green with scarious margins, c. 1 × 1 mm. Petals white, about equalling sepals, erect, not clawed, narrow-obovate to narrow-oblong, entire and rounded at apex. Stamens 2. Nectaries 4, very small; nectar slight. Siliques broadly elliptic to broadly ovate, (3.2–)3.5–3.8 × 2.2–2.5(–2.8) mm; style 0.1–0.2 mm long, free from the narrow rounded wing, shorter than the notch; stigma 0.3 mm diam.; valves glabrous. Seed broadly obovoid, brown, not winged, 1.6–2 mm, mucilaginous when wet. FL Oct–Jan, FR Dec–Apr.

DISTRIBUTION (Fig. 3): New Zealand: North Island, Auckland, Coromandel; South Island, Buller, Westland; Australia: Tasmania. Coastal rocks and herbfields, boulder beaches. A Colenso record from Port Nicholson referred to *Lepidium incisum* by Hooker (1864) has not been seen by us, but suitable

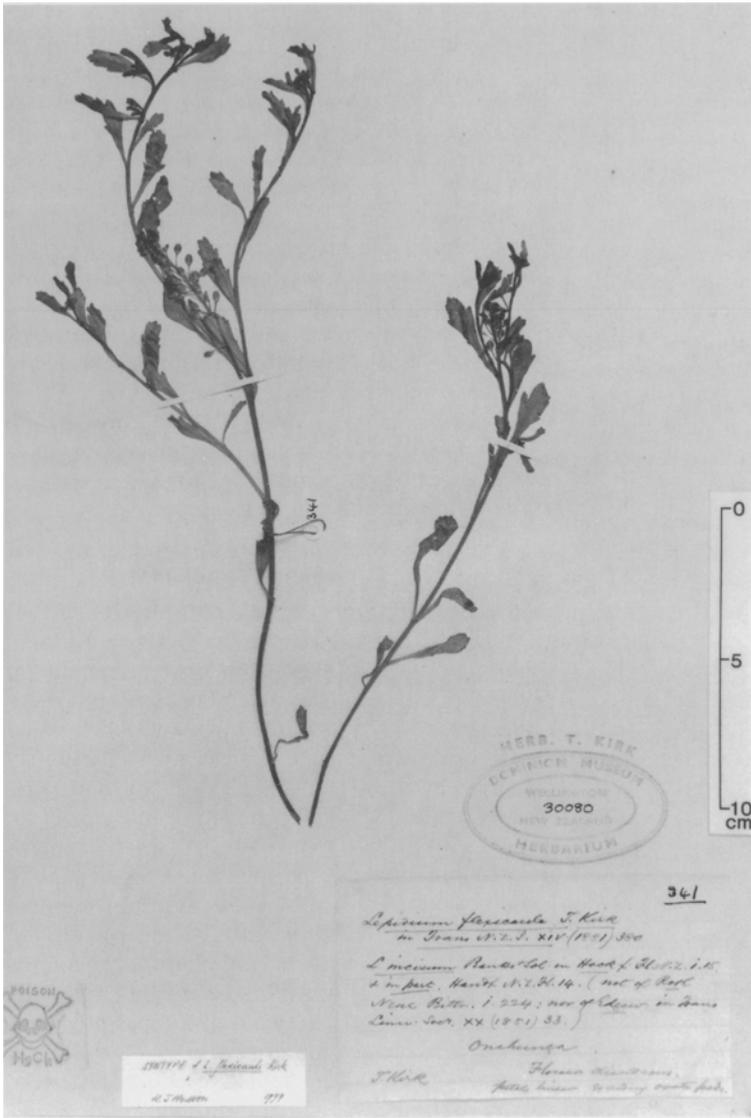


Fig. 4 *Lepidium flexicaule*: lectotype.

habitats for *L. flexicaule* are present near Wellington (P. J. de Lange pers. comm.).

HABITAT: *Lepidium flexicaule* has been recorded in recent times from a range of sites including turf communities, tracksides, rock crevices, and the strand-line on bouldery beaches. Herbarium records suggest that strand-line sites may be the most common habitat for this species, both in New Zealand and Tasmania. Such sites typically comprise rocks and boulders of various sizes, with plants growing in fines between boulders or in crevices in rocks at

the strand-line. Plants are usually within the high tide spray zone. These sites have few other plants present, are fertile (owing to sea spray, decomposition of stranded material, and presence of coastal birds), and experience regular disturbance. Common associated species include *Apium prostratum*, *Lobelia anceps*, *Hebe elliptica* (especially on rock stacks), and *Isolepis cernua*. Most populations consist of only a small number of plants. At one site *L. flexicaule* occurs in a turf community with *Isolepis cernua*, *Lachnagrostis filiformis* var. *littoralis*, and *Apium prostratum*, while at another we have observed it

growing on a rock stack among shag nests. The shags were using *L. flexicaule* as nest material, and they may disperse seeds in this way.

CONSERVATION: Cheeseman (1925) noted that *Lepidium flexicaule* is “an exceedingly local plant, and is fast becoming extinct in the few habitats at present known”. There are no recent records from the North Island (the most recent being 1934), despite considerable searching, and it is now probably locally extinct there (P. J. de Lange pers. comm.). Although still present at several sites along the Heaphy coastline, at Cape Foulwind, and Dolomite Point, it has not been seen recently at other South Island sites with earlier records (e.g., Point Elizabeth, Orowaiti Lagoon) (Fig. 3) and has recently declined at the largest known Heaphy site. Our current knowledge of the plant’s past and present distribution suggests that *L. flexicaule* is an uncommon and declining species, and extant populations are generally small. *L. flexicaule* also appears to have a limited distribution in Tasmania, but herbarium label annotations suggest that it may be locally common.

The current major threats to *Lepidium flexicaule* are natural disturbances such as severe storms inducing coastal erosion (although such events are important in creating fresh habitat), over-collecting, infestation with *Albugo candida* (e.g., CHR 277841), and insect herbivory. Because of the prostrate habit of this species, and its presence in the strand-line, browsing by stock or feral mammalian herbivores does not appear to be a major threat. Coastal development has been a major cause of decline in *L. flexicaule* (e.g., around Auckland), but we know of no current developments which threaten extant populations. Cameron et al. (1995) assign this species the IUCN threat status of “Endangered”. This is appropriate given the substantial evidence for recent decline and the absence of any known large extant populations. We believe that the long-term security of *L. flexicaule* is not assured in New Zealand.

REPRESENTATIVE SPECIMENS SEEN: Waitakere, West Auckland, *Ball*, May 1885, AKU 002995; Bethells, West Coast, near Auckland, *L. B. Moore* & *L. M. Cranwell*, 7 Jan 1934, AK 100102, CHR 21727; Rangitoto Island, *T. F. C[heeseman]*, Dec 1882, AK 4481; North Head, Waitemata, *T. Kirk*, WELT 30081; Mangare Point, Manukau Harbour, *T. F. C[heeseman]*, AK 4480; Piako, Thames, *J. Adams*, AK 14865, 14866, 4479; Paturau, N.W. Nelson, coastal, *L. B. Moore*, Jan 1947, CHR 51620; NE of Shark’s Head, NW Nelson, coastal herbfield, amongst limestone rocks, *A. P. Druce*, Nov 1974,

CHR 278093; West Coast, Heaphy Ecological District, S. of Swanburn, just above high tide mark among boulders, *P. J. de Lange 1444* & *D. A. Norton*, 13 Aug 1992, CHR 478524; Scotts Beach, Karamea, NW Nelson, trackside gravel and rocks, close to beach, *D. A. Norton* & *F. B. Overmars*, 5 Jan 1991, CANU 35268; southern shore of Orowaiti Estuary, near Westport, *R. Mason* & *N. T. Moar 2163*, 31 Jan 1953, CHR 81618; Cape Foulwind, near Westport, *W. Townson*, AK 4478, 206057, WELT 30085; Westland, Dolomite Point, near walkway, coastal turf on ledges on steep rocky slope, calcareous sandstone, *P. J. Garnock-Jones 2110* & *D. A. Norton*, 13 Feb 1992, CHR 470201; Point Elizabeth, near Greymouth, *H. H. Allan*, 16 Mar 1941, CHR 65325.

ETYMOLOGY: *flexicaule*, with flexuous stems.

SIMILARITIES: *Lepidium flexicaule* is compared with *L. naufragorum* above. The terminal inflorescence is very soon overtopped by lateral shoots, to give a leaf-opposed seemingly lateral inflorescence. The first inflorescence is produced on a short erect stem arising in the centre of the rosette. Termination of this axis leads to the early development of lateral axes which are decumbent to procumbent.

VARIATION: Specimens from the Auckland region are generally larger and more lax in habit than South Island collections. Kirk (1882) mentioned a solitary flower below the raceme; this is not apparent on South Island material.

OTHER NEW ZEALAND COASTAL SPECIES

L. banksii Kirk and *L. obtusatum* Kirk

Lepidium banksii and *L. obtusatum* are both very locally distributed. *L. banksii* is known from the Marlborough Sounds and Tasman Bay, but only three small populations are extant. A specimen (CHR 446772) collected in 1985 from north of Scotts Beach near Karamea has not been supported by more recent searches for further material; only *L. flexicaule* has been found. *L. obtusatum* was originally collected at Seatoun (Kirk 1892); a collection from Manukau was later (Kirk 1899) identified as *L. obtusatum*. The species is considered extinct at both sites.

Lepidium banksii and *L. obtusatum* are thought likely to be related because they share one apparently apomorphic character state, large winged siliques.

Together with *L. oleraceum* they share also simple basal leaves, but that character state occurs in other species which may be related (e.g., *L. nesophilum*) and some which are not related (e.g., *L. africanum*). *L. banksii* differs from *L. obtusatum* by one autapomorphy, its clavate hairs on the pedicels. The type population of *L. obtusatum* also has one autapomorphy, blunt leaf teeth; however, the teeth in the Manukau specimens are sharp. The slight differences between *L. banksii* and *L. obtusatum* suggest that their status should be re-examined along with closer comparison with other New Zealand, Australian, and South Pacific species.

L. oleraceum Sparrm.

Lepidium oleraceum is the most widespread coastal species of *Lepidium* in New Zealand, having been recorded from the Kermadec Islands (subtropical) to the Auckland Islands (subantarctic), and east to the Chatham Islands. It still persists on some mainland sites, especially in Cook Strait and Otago, but is commonest on offshore islands. Lord Howe Island material, previously referred to *L. oleraceum*, has recently been placed in a new species, *L. nesophilum* Hewson, endemic to Lord Howe Island (Green 1990). *L. oleraceum* has never been recorded from the West Coast of the South Island. This species

appears to have experienced a considerable decline in abundance (Wilson & Given 1989), which is still continuing.

Allan (1961) listed three named varieties of *Lepidium oleraceum* (var. *frondosum* Kirk, var. *acutidentatum* Kirk, and var. *serrulatum* Thell.) and commented that this species needs much further study. We have seen only one specimen that matches var. *serrulatum*, the type (held at Paris). Recently it has been suggested that an undescribed species is present on the Chatham Islands (A. P. Druce unpubl. species list, Sep 1992). This material differs from mainland and other Chatham Islands forms of *L. oleraceum* in its procumbent to weakly ascending habit, very fleshy leaves, which are entire except for usually three teeth near the apex, and smaller, sometimes absent petals (P. J. de Lange pers. comm.). Analysis of variation within *L. oleraceum* is not easy, as plants show considerable morphological variation with development, which can mask infraspecific differences. While forms matching named varieties can be recognised, there is considerable variation (possibly clinal) present within *L. oleraceum*. A critical investigation of the whole complex, based on genetic as well as morphological analyses, is required before any taxonomic changes within this species are formalised.

KEY TO THE INDIGENOUS COASTAL SPECIES OF *LEPIDIUM*

1. All leaves simple, margins toothed or crenate at least at apex 2
Basal and lower stem leaves pinnate to pinnatifid, lobes toothed or crenate 4
2. Siliques acute at apex, not winged, not notched, 3–4(–5)
× 2.5–3.5(–5) mm *L. oleraceum*
Siliques obtuse at apex, winged and notched, 4.5–5.5 × 4–5 mm 3
3. Siliques truncate to cordate at base; leaves sharply toothed; pedicels with
sparse pale or golden clavate hairs *L. banksii*
Siliques cuneate to abruptly cuneate at base; leaves toothed to crenate;
pedicels glabrous *L. obtusatum*
4. Inflorescences terminal and leaf-opposed by overtopping lateral
racemes; stamens 2; leaf margins bluntly toothed or crenate *L. flexicaule*
Inflorescences terminal and axillary; stamens 4; leaf margins acutely serrate 5
5. Stems prostrate; petals shorter than sepals; siliques suborbicular,
1.5–2 × 1.5–1.8 mm *L. tenuicaule*
Stems suberect to erect; petals slightly longer than sepals; siliques
broadly elliptic, 2.8–4 × 2.3–3.2 mm *L. naufragorum*

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