Protection and recovery of the pygmy button daisy

2001–2011

THREATENED SPECIES RECOVERY PLAN 34

Department of Conservation
Te Papa Atawhai

Recovery plans

This is one of a series of recovery plans published by the Department of Conservation. Recovery plans are statements of the Department's intentions for the conservation of particular species of plant and animal. Recovery plans focus on the goals and objectives of species management, guide the Department in its allocation of resources and are used to raise public awareness of the species recovery process.

A recovery group that consists of people with knowledge of the ecology and management needs of *Leptinella nana* (pygmy button daisy) has been established. The recovery group prepared this plan in conjunction with people interested in, or with expert knowledge of, the species. Relevant Conservation Boards and people interested in conservation management of the pygmy button daisy were consulted and the plan was amended as a result.

The recovery group will review progress in implementation of this plan and will recommend to the Department changes that may be required in management. Comments and suggestions regarding conservation of the pygmy button daisy are welcome and should be directed to the recovery group via any office of the Department or to the Biodiversity Recovery Unit.

The species recovery planning process provides opportunities for consultation between the Department and tangata whenua and others. Those interested in being more involved in species management or in receiving information should also contact the recovery group.

The Central Regional Manager of the Department of Conservation formally approved this plan in April 2001. A review of the plan is due after ten years (2011), or sooner if new information leads to proposals for a significant change in management direction. It will remain operative until a reviewed plan has been prepared and implemented.

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Cover photo: *Leptinella nana*, Whitireia Park, Titahi Bay.
Photo by Jeremy Rolfe.

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Abstract

Leptinella nana (pygmy button daisy) is a very small, perennial herb which forms very low open mats. It is one of New Zealand's most threatened species. It has a disjunct distribution and is known from only three sites: Titahi Bay coast (Wellington), Rai Valley (Marlborough), and Port Hills (Canterbury). Populations at Titahi Bay and the Port Hills comprise only a few plants and extend over extremely small areas, whereas at the Rai Valley the species is scattered along 15 km of river margin.

The habitat of *L. nana* varies from forest to cliff-top grassland, but common features are the need for disturbance patches, shelter, and supply of moisture. The species appears to have adopted a strategy of constant colonisation of small patches of bare ground and so occupies a highly dynamic and changing micro-habitat.

The Titahi Bay and Port Hills populations occur in reserves managed by the Department of Conservation. The Rai Valley population occurs in a fenced area of riverbank forest owned by Marlborough District Council. The continued survival of *L. nana* is threatened by several factors that include trampling by people and stock, competition from adventive and native plants, and long periods of drought. The size of each population makes the species vulnerable to stochastic effects such as flooding and land slips.

The objectives for recovery of *L. nana* are to ensure that the plant continues to exist in the wild in New Zealand, and that the three extant populations become or remain self-sustaining. To achieve these ends the actions required are: to secure long-term management agreements; to institute regular monitoring; to propagate and maintain *ex-situ* stocks for research, advocacy, and insurance purposes; to increase population sizes by interventionist management; and to assess disturbance effects caused by walkways.

1. Introduction

Leptinella nana (D.G. Lloyd) D.G. Lloyd et C.J. Webb (pygmy button daisy) is one of New Zealand's most critically endangered species. The main purpose of this plan is to describe the key actions that will be necessary to ensure continued survival of the species in the wild. This plan has also been prepared to provide information about the distribution, ecology and habitat requirements of *L. nana*.

1.1 NOMENCLATURE

Species

Leptinella nana (D.G. Lloyd) D.G. Lloyd et C.J. Webb, *New Zealand Journal of Botany* 25:103, 1987. *Cotula nana* D.G. Lloyd, *New Zealand Journal of Botany* 10:340, 1972.

Family

Asteraceae, tribe Anthemideae

Common name

Pygmy button daisy

1.2 DESCRIPTION

Leptinella nana (Figure 1) was first collected in 1907 from Titahi Bay but was not formally described until 65 years later. It is a distinctive but very localised and rare species (Box 1), closest in affinity to *Leptinella minor* (endemic to Banks Peninsula, Canterbury), and *L. filiformis* (eastern South Island). These are prostrate lowland-montane species belonging to series Radiata of Lloyd 1972.

Figure 1: *Leptinella nana*, Whitireia Park, Titahi Bay. Photo: Jeremy Rolfe.

BOX 1: DETAILED DESCRIPTION OF *LEPTINELLA NANA*

Very small, frequently branching, perennial herb which forms small, very low mats (Fig. 1). Rhizomes slender, green, soft and sparsely hairy. Branches common, at the frequent flower nodes and sometimes also at 1–3 nodes immediately behind; short shoots variable, often converted into rhizomes. Leaves one to several at the apex of branches but mostly distant, 5–10 mm apart, 1-pinnatifid, 4–20 × 2–4 mm, obovate or narrow-obovate, thin, green (can be brown when in full sun), hairless or sparsely hairy. Pinnae 6–8 pairs, distal ones close-set or overlapping and cut about $^2/_3$ way to midrib, proximal ones more deeply cut, teeth 0–3 on distal margins of proximal pinnae, narrow and acute. Proximal part of leaves can be brown. Flower stems on rhizomes, usually shorter than leaves, 3–10 mm long, hairy, becoming erect, sometimes later bending to 180° at fruiting. Flowers yellow tubular florets forming minute heads (capitula) up to 2 mm wide, pistillate florets 20–40 and staminate florets 5–7 in each capitulum. Fruit an achene up to 1 × 0.5 mm, lacking bristles (pappus). 2n = 26.

The type locality and specimen is cited as '…wet depression, base of cliffs, Mt Pleasant, Port Hills, Christchurch, 13 February 1965, D.G. Lloyd 65216 (CANU 17221)…' The type description provides a distribution map and illustration.

1.3 CONSERVATION STATUS

Leptinella nana is one of New Zealand's most critically endangered plant species and is one of the Department of Conservation's highest priorities for conservation management (Table 1). It was described by Lloyd (1972) as '…one of the rarest Angiosperms in New Zealand, having been collected from only three localities…'

TABLE 1: THREATENED STATUS AND PRIORITY RANK OF *LEPTINELLA NANA*

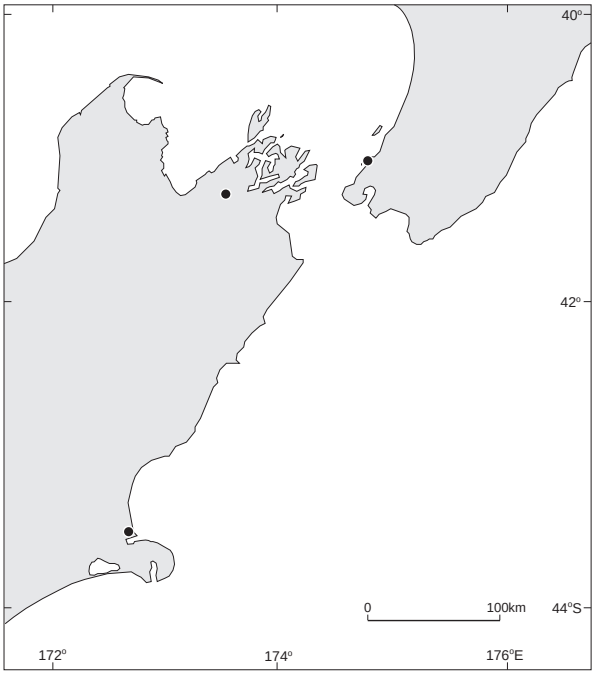
IUCN Category (from de Lange *et al*. 1999)	Critically Endangered
Species Priority Rank of the Department of Conservation (from Molloy & Davis 1994)	Category A

2. Distribution and cause of decline

2.1 DISTRIBUTION

Leptinella nana is endemic to New Zealand and has been known from only three localities: near Titahi Bay (Wellington) on the southwest coast of the North Island; Rai Valley (Marlborough), South Island; and Mount Pleasant (Port Hills), Canterbury, South Island (Figure 2). The plant is still known from only those three localities and no further sites have been discovered since the species was described in 1972.

Figure 2: Distribution of *Leptinella nana*



The Titahi Bay locality is the site of the earliest known collections by B.C. Aston in 1907, and *L. nana* was rediscovered there by T. C. Moss in January 1977. The plant occurs at two sites mingled with both indigenous and introduced pasture plants.

The Rai Valley site was discovered by Thomas Kirk (date of collection not known) and rediscovered by D.G. Lloyd in 1967. This site is the most anomalous of the three, given that it is significantly inland, in a higher rainfall region, and associated with open forest. More recently, small pockets of the plant were discovered during field surveys undertaken by the Department of Conservation downstream of the main site and along 15 kilometres of river margins.

At Mount Pleasant, *L. nana* was discovered by A. Wall in February 1918.

2.2 POPULATION SIZE AND STRUCTURE

The three populations of *Leptinella nana* are all of very limited extent and this, in itself, is a reason for its vulnerability. Estimates of population size at the three sites are shown in Table 2. Only area of occupancy is shown but that is only one measure of population size. The abundance of the plant within that area, and therefore population density, can vary markedly over time.

2.3 POPULATION TRENDS AND CAUSES OF DECLINE AND THREATS

Leptinella nana is a species which is so rare and inconspicuous, and for which so little past collecting data exists, that it is not possible to be certain of any trends in the changing size of populations. Detecting change in the number of plants in a population is hard because it is difficult to determine what constitutes an individual plant. Study of the Mount Pleasant and Titahi Bay sites (e.g., Moss 1985) indicated

TABLE 2: ESTIMATES OF POPULATION SIZES

LOCALITY	AREA OF OCCUPANCY[1]	DATE
Titahi Bay (Wellington)	40 x 6 m	June 1999
Rai Valley (Marlborough)	2080 m^2	March 2001
Mt Pleasant (Port Hills, Canterbury)[2]	200 x 4 m	June 2000

[1] *This is the total area which was seen to have plants of this species at the time of survey; within this area, distribution can be highly discontinuous.*

[2] *At this site,* Leptinella nana *is found in two locations, both along a walkway. The first location is c. 20 x 4 m, the 4 m being the track width of which* L. nana *is confined to a very narrow strip on the track edges. The second location is also of similar dimensions and is found c. 200 m from the first site (N. Head, pers. comm.).*

that the species undergoes frequent seasonal fluctuations in abundance and that makes long-term estimation of population changes difficult. The regular fluctuation in population size also makes it difficult to interpret the significance of those changes. Six years of study at the Mount Pleasant site indicated no significant change in overall abundance, although the precise distribution of patches of the species can change markedly (Given, Baird and Head, unpublished data).

There are several vulnerable points in the biology and ecological requirements of *L. nana*:

(a) the requirement for small bare sites for colonisation is quite critical. Sites are dynamic and require a disturbance regime and constant creation of these habitat openings. It is apparent at Mount Pleasant that a small to moderate amount of disturbance by the passage of people is beneficial in maintaining and creating bare sites, but that too much foot traffic will also destroy plants by compaction, crushing and smothering;
(b) the species seems to have a narrow range of soil moisture tolerance. It does not tolerate drying out for long periods in summer, but with too much moisture sites are pre-empted by other small herbs, grasses and bryophytes;
(c) mats are small and quite loose so that they can be readily colonised by other, taller-growing plants.

The peculiar and distinctive distribution pattern, with three widely separated sites, suggests that it may have been formerly more widespread but overlooked. Likely factors in any local extirpation of *L. nana* include loss of temporary open sites for colonisation, increased competition from other plants, opening up of protective vegetation allowing sites to dry out or become weedy, increased erosion or deposition of debris, excessive trampling by people and animals, loss of seed dispersal vectors like terrestrial birds and other animals, seed loss to unsuitable habitat, and indiscriminate herbicide use. Slugs are a threat to cultivated *L. nana.*

3. Species ecology and biology

Leptinella nana is a plant of bare sites, usually prone to some disturbance, and with some loess, clay, or sand fraction in the soil (Box 2). It is characteristically found at sites which under the normal course of events would be succeeded by grassland, herbfield (or these mixed with shrubs)—but which are maintained in a successional state by local circumstances.

Each of the three known sites is, superficially at least, very different from the others (Box 2). Appendix 2 provides more information about the ecology and biology of *L. nana.*

BOX 2: SITE DESCRIPTIONS

TITAHI BAY

Top of exposed cliff overlooking sea; on bank with slopes of (10)–30–(80)° in shade or full sun; in crumbly and sometimes well-consolidated but well-drained clay-loam; microsite of more or less bare patches up to 30 × 20 cm; vegetation of pasture and native short grasses with some grazing, and some scattered tussocks of *Poa cita*, small number of interstitial herbs present and some cryptogams but not generally closely associated with *Leptinella*; general vegetation is coastal grassland with scattered tussocks.

RAI VALLEY

Riparian, between 0.2 and 1.5 m above normal river level but often flooded; on terrace at slope of c.5°; in dappled shade and sheltered, either on riverside or under totara (*Podocarpous totara*) and silver beech (*Nothofagus menziesii*) forest with small-leaved understorey; in sandy, well-drained loam with some clay; microsite site either almost bare or covered in mat-forming mosses. Found in association with *Hydrocotyle elongata* and other ground-creeping herbs; general vegetation open, somewhat degraded forest and river bank.

MOUNT PLEASANT

Foot of cliff on small terracelets; slopes from <5–45°; in dappled to moderately-deep shade and well sheltered by shrubs and small trees; in compacted but well-drained clay loam; microsite of more or less bare patches up to 1 m across, sometimes along loose stones; generally associated with few other creeping herbs but sometimes with sparse and low grasses or sedges; general vegetation partly bare grassland/herbfield shrubbery.

4. Past conservation effort

4.1 SITE PROTECTION

At Titahi Bay, *Leptinella nana* occurs at Whitireia Park—a recreation reserve administered by the Whitireia Park Board. The Department of Conservation undertakes day to day management of the site. A public walkway passes within a few metres of the plants.

The *L. nana* population on the banks of the Rai River (Nelson/Marlborough Conservancy) is situated on road reserve owned by Marlborough District Council and on private property. The species is regarded as unprotected at these sites.

L. nana is legally protected at Mount Pleasant where it occurs within the Lyttelton Scenic Reserve (part of the Port Hills Reserves complex) which is managed by the Department of Conservation. Public use of the site provides a difficult management problem. The species occurs at the base of cliffs that have become popular for rock climbing in recent years (see Main 1998).

4.2 SURVEY

Surveys for *L. nana* have been carried out 1 km upstream and downstream of the originally-known site on the true left of the Rai River (Marlborough) from 1999 to 2001. These have resulted in the discovery of new populations in the vicinity of the main Rai Valley site. The Titahi Peninsula has also been extensively surveyed but no further discoveries of *L. nana* have been made. Botanists have carried out *ad hoc* surveys in the Port Hills (Canterbury) and along parts of the Wellington Coast.

4.3 MONITORING

The spatial distribution of populations of *L. nana* at Titahi Bay has been mapped as part of a monitoring programme to detect change in the distribution and amount of the plant. That population is visited more than twice per year during which time weeds are removed. More detailed mapping of the populations along two fixed transects is undertaken less regularly.

The Rai Valley site is inspected three times per year to monitor changes in the density of plants and the area of occupancy of the species for seven fixed quadrats (600mm x 6000mm). Fixed point photography of part of each quadrat has also proved to be useful.

Part of the Mount Pleasant population has been regularly monitored since September 1990 by estimating the density of plants in 500mm × 500mm quadrats every metre along a series of five permanent transects. Transects range in length from 7 to 14 m. This site is visited twice each year during which time a brief of survey is undertaken in and around the existing population.

4.4 RESEARCH

Table 2 lists some of the research that has been undertaken on *Leptinella nana*. The species as a whole received preliminary study by Lloyd (1972) in the course of his taxonomic revision. Moss (1985) summarised almost a decade's observations of the species and the results of informal management at Titahi Bay. Part of the Mount Pleasant population has been monitored since 1989. Observations on the population dynamics of the species at Mount Pleasant have been summarised by members of the species recovery group but not yet published. No published research has been conducted on the Rai Valley population.

TABLE 3: RESEARCH UNDERTAKEN ON *LEPTINELLA NANA*

Baird, A. 1990: Assessment of *Leptinella nana*, Lyttelton Scenic Reserve. Unpublished Report to Department of Conservation, Conservancy Office, Christchurch, October 1990.
Carson, J. A.; Leung, D. W. M. 1994: In vitro flowering and propagation of *Leptinella nana* L., an endangered plant. *New Zealand Journal of Botany* 32:79–83.
Lloyd, D. G. 1972: A revision of the New Zealand, Subantarctic and South American species of *Cotula*, section *Leptinella*. *New Zealand Journal of Botany* 10:277–372.
Lloyd, D. G.; Webb, C. J. 1987: The reinstatement of *Leptinella* at generic rank, and the status of the 'Cotuleae' (Asteraceae, Anthemideae). *New Zealand Journal of Botany* 25:99–105.
Moss, T. C. 1985. Observations on *Cotula nana* Lloyd. *Wellington Botanical Society Bulletin* 42:64–67. Government Printer, Wellington.

4.5 OTHER MANAGEMENT (E.G., FENCING AND PEST PLANT CONTROL)

At Titahi Bay regular weeding of encroaching vegetation is undertaken. A small fence has also been constructed to direct walkers away from one of the two sub-populations.

In the Rai Valley, the area of forest where *Leptinella nana* occurs has been fenced to exclude cattle. Regular weeding is carried out to remove exotic plants such as vines and ground cover weeds that compete with *L. nana* for habitat. Some planting of native species has been undertaken to control the spread of weeds and provide more suitable habitat for *L. nana*. Transplanting trials have also been carried out to increase the spatial extent of the species. Liaison with adjoining landowners has also been undertaken with regard to site management.

At the Mount Pleasant site, part of the area is traversed by a public walkway. That has meant the excavation of steps, shifting of boulders and increased foot traffic in the area where monitoring lines have been established. A warning sign has been installed nearby to warn public of the presence of rare plants and to recommend that people do not disturb the area. Meetings have been held with recreational users of the site. Some planting trials have also been undertaken in the Port Hills.

4.6 EX-SITU

The species is held in cultivation in New Zealand at several of locations (Table 4). Cultivated material of known provenance is sourced from either the Titahi Bay or Mount Pleasant populations. No *ex-situ* material is held from the Rai Valley population. In addition to those ex-situ holdings, plants of *Leptinella nana* (sourced from Banks peninsula) have been gifted to people living on the Coromandel Peninsula (Tom Moss pers. comm.). Plants sourced from Titahi Bay have also been introduced to a site at Pencarrow Head, near Wellington (Paul Hughes pers. comm.).

TABLE 4: LOCATION OF CULTIVATED *LEPTINALLA NANA* OF KNOWN PROVENANCE

LOCATION	PROVENANCE
Otari Native Botanic Garden, Wellington	Titahi Bay, Wellington Coast
Percy Scenic Reserve, Petone	Titahi Bay, Wellington Coast
Private gardens in Wellington City	Titahi Bay, Wellington Coast
Landcare Research, Lincoln, Canterbury	Titahi Bay, Wellington Coast
Mana Island	Titahi Bay, Wellington Coast
UCol (Levin Campus)	Titahi Bay, Wellington Coast
Motukarara Nursery garden, Canterbury	Mount Pleasant, Christchurch
Landcare Research, Lincoln, Canterbury	Mount Pleasant, Christchurch
Christchurch Botanic Gardens, Christchurch	Mount Pleasant, Christchurch

4.7 ADVOCACY

Information about *Leptinella nana* is included in various publications such as "The Conservation Requirements of New Zealand's Nationally Threatened Vascular Plants" by Dopson *et al.* (1999), "Rare and Endangered Plants of New Zealand" by Given (1981) and "Threatened Plants of New Zealand" by Wilson and Given (1989). *L. nana* is included in "The Red Data Book of New Zealand" published by the Nature Conservation Council in 1981.

Information about *L. nana* is also included in a guide to threatened plants of Wellington Conservancy published by the Department of Conservation (Sawyer *et al.* 1998).

The Department of Conservation has prepared unpublished field guide fact sheets about each wild population to raise awareness of the plant amongst staff. The species is also referred to in a climbing guide to the Port Hills (Main 1998).

5. Options for recovery

With site management and the maintenance of *ex-situ* collections, there are good prospects for the continued existence of *Leptinella nana*. All three sites are relatively secure in terms of land tenure, which simplifies the implementation of conservation management and increases options for recovery work.

However, the guaranteed survival of *L. nana* in the wild is still dependent on management of the three extant populations. Management options to secure the species' survival in the wild include population management, *ex-situ* cultivation, advocacy, research, monitoring, and propagation for introduction to new sites and for enhancement of existing sites.

6. Recovery mechanisms

LONG-TERM GOAL

The long-term goal for *Leptinella nana* is to ensure the species becomes, and continues to remain, self-sustaining in the wild (with no need for management).

PERFORMANCE MEASURE

Implementation of population management plans to achieve the long-term goal will result in the IUCN rank for *Leptinella nana* (see de Lange *et al.* 1999) shifting from Critically Endangered to Endangered (or lower). The Department of Conservation's priority species rank for *L. nana* is also expected to change from Category A to Category B (or lower). That shift will be recorded during the period 2001–2011 and will be one method for determining the plan's effectiveness at achieving the long-term goal.

OBJECTIVES AND MANAGEMENT ACTIONS

The following are six objectives for the recovery of *Leptinella nana*. for each objective, management actions are described and an explanation is provided. Department of Conservation responsibilities for carrying out that work are identified. In most cases, responsibilities are assigned to the relevant Area office of the Department in which the population occurs or in which work will be undertaken. In some cases the Conservancy office is identified as responsible for arranging the work. Other agencies or parties interested in achieving the goal of this plan may work alongside the Department to implement some aspects of the work plans, but this will be co-ordinated by the Department. Priorities for each action are shown in Table 5.

Recovery of *L. nana* will require integration of *in-situ* and *ex-situ* strategies. Population management plans have been prepared as a supplement to this species recovery plan and are published separately (Sawyer, Head and Courtney 2001). Those plans include maps of the exact location and spatial extent of each population and details of the management required at each site to ensure survival.

1. Protect existing populations of *Leptinella nana* by active management to control key threats to their survival

Performance measure

No population is lost by 2010 and the spatial extent and abundance of the plant has not declined.

Actions

a. Negotiate legal protection of the Rai Valley population (Sounds Area).

b. Ensure that the legal classification of protected sites is appropriate for protection and conservation management of *L. nana* and its associated plant and animal community (Kapiti and North Canterbury Areas).

c. Secure and implement management agreements at all three sites between the Department of Conservation and other site management agencies.
An agreement over site management is required at Titahi Bay between the Department of Conservation, the lessee, and the Whitireia Park Board (Kapiti Area).
An agreement is also required at Rai Valley between the Department of Conservation, Marlborough District Council and the adjacent landowner (Sounds Area).
The Lyttelton Reserve population is managed entirely by the Department of Conservation. However, the management roles of the Department and Christchurch City Council at that site must be clarified to ensure that council staff do not assume that the reserve is part of the other Council Port Hill reserves when undertaking maintenance work (North Canterbury Area and Canterbury Conservancy office).

d. Develop and implement weed control and surveillance plans.
Pest plants have been identified as a threat to the survival of *L. nana*. Weed control plans will be developed and implemented for each site where *L. nana* grows, including regular inspection as part of a weed surveillance programme (Sounds, Kapiti and North Canterbury Areas). Several visits to each site will be undertaken each year for weed control. Control plans will include weed control objectives for each pest species, control methods, a timeframe for carrying out work, and details of monitoring to determine the effectiveness of weed control.

e. Maintain fences at existing sites where appropriate.
Fences at Titahi Bay and at the Rai Valley sites will be inspected regularly and maintained to exclude domestic stock (Sounds and Kapiti Areas).

f. Undertake regular inspections of all populations using a standard procedure, and report on results.
Monitoring of *L. nana* is required to detect changes in the spatial extent of species populations and number of plants. Monitoring is also required to

determine the effectiveness of management, to ensure continuation of the appropriate frequency, magnitude and type of habitat disturbance. The monitoring regime adopted will probably differ at each site. A basic standard procedure is described in Appendix 3.

The Department of Conservation already inspects all three populations of *L. nana* site as part of a long-term monitoring programme (see section 4.3). That monitoring will continue and results will be made available through the publication of an annual report on the status of *L. nana.* (see Appendix 3) (Sounds, Kapiti and North Canterbury Areas). That report will include details of the distribution and abundance of the species and of the management carried out and the results of those actions for each population.

g. Consult with iwi.
Where possible the Department of Conservation will ensure site management is in accordance with iwi policies for management of taonga species. For example, Ngai Tahu has a special relationship with a number of endemic and threatened species, many of which are taonga.

f. Increase population size through a replanting programme.
To ensure survival of *Leptinella nana*, it is essential that the population size is greatly increased at Titahi Bay and to a lesser extent at Mount Pleasant (Kapiti and North Canterbury Areas).

The small size of *L. nana* populations and their dependence on natural and/or human-induced disturbance makes them vulnerable to extirpation should disturbance processes change. The small populations are also vulnerable to stochastic events. A single landslip, rockfall or high flood could quickly destroy a site.

A replanting programme will use vegetatively propagated material, planted from 50 mm tubes. In addition, a limited quantity of seed will be harvested and planted into the wild using re-locatable frames to allow assessment of survival and growth. A propagation and replanting programme will be used to greatly strengthen population sizes. The aim at Titahi Bay will be an annual increase of 100 percent over five years (2001–2006).

2. Raise public and iwi awareness of *Leptinella nana* conservation

Performance measure

Key and interested stakeholders are aware of the species and understand and have regard for its conservation requirements

Actions

a. Identify further stakeholders in *L. nana* conservation (e.g., see Appendix 1).

b. The Department of Conservation will consult with iwi to determine their relationship with the species.

c. Establish and/or maintain appropriate signs at all wild sites to explain the significance of the species and the site and to identify a point of contact for more information (Sounds, Kapiti and North Canterbury Areas).

d. Make information about the species and the sites where it occurs available to individuals and groups with interest and/or expertise in management of the populations as appropriate for achieving the objectives of this plan (Sounds, Kapiti and North Canterbury Areas).

e. Carry out discussions with rock climbers at Mount Pleasant, especially schools, in order to lessen site impacts (North Canterbury Area).

f. People preparing local authority plans, local brochures and guides will be provided information about *L. nana* and the sites where it occurs (Canterbury, Nelson/Marlborough and Wellington Conservancies).

g. Agencies or individuals involved in land management at or near the three populations will be informed of the species recovery work to be carried out and who has responsibility for that work (Sounds, Kapiti and North Canterbury Areas).

h. Promote local nurseries as sources of local provenance material (e.g., Motukarara Nursery for Banks Peninsula provenance).

3. To undertake and promote research relevant to recovery of *Leptinella nana*

Performance measure

Achieve 60 percent of research projects identified below by 2010.

Actions

a. Information will be provided each year about the research needs of *L. nana* to tertiary institutions (Wellington, Canterbury and Nelson/Marlborough Conservancies).

b. The above research topics will be put forward by the Department of Conservation whenever opportunities arise for funding of biological research (Conservancy Advisory Scientists at Wellington, Nelson/Marlborough and Canterbury Conservancies).

Research needs

Management of *L. nana* is likely to identify further research needs and different priorities. However, the following are initial research needs for *L. nana*:

a. Determine long-term patterns of persistence and recolonisation of *L. nana.*

b. Determine the responses to combinations of competition and soil characteristics, including fertility and moisture.

c. Evaluate the utility of *L. nana* in managed turf amenities (e.g., bowling greens).

d. Determine the dispersal vectors of *L. nana*.

e. Investigate the use of herbicides to control pest plants without threatening *L. nana*.

f. Determine the effect of predation on wild populations of *L. nana*.

g. Determine the genetic diversity amongst populations and gene flow within populations;

h. Determine the minimum amount of disturbance to maintain suitable habitat for *L. nana* (e.g., amount, frequency, duration and seasonality).

i. Develop a method for successful translocation of *L. nana* or for introduction of propagules of the species to enhance existing populations.

j. Assess the effect of walkways and recreation use at Mount Pleasant on *L. nana*. (North Canterbury Area).

4. Survey to locate new populations and to identify potential sites for translocation

Performance measure

Survey work will be completed at all potentially suitable coastal localities by 2005.

Explanation

Searches should be undertaken during winter and spring, and concentrated on sites with open short tussock, some signs of erosion, and soils with a high clay or loess content.

Actions

a. Searching all coastal localities where suitable patches of habitat may occur in the northeast of South Island and along parts of the Wellington coastline, specifically:
   - along the coast between White Bluffs and Ure River in Marlborough (South Marlborough Area);
   - flood plain of the Pelorus River (Sounds Area);
   - North Canterbury, seaward of Parnassus and Cheviot (North Canterbury Area);
   - coastal cliffs to the north and south of Titahi Bay (Kapiti Area).

b. Identify sites to which plants can and should be introduced to establish wild populations at new locations. Potential sites include Mana Island, Matiu/Somes Island, other sites at Whitireia (Titahi Bay), Port Hills, and other reserves on Banks Peninsula (Wellington, Canterbury and Nelson/Marlborough Conservancies).

5. To maintain representative *ex-situ* collections for each population of the species at separate locations

Performance measure

By 2004 each wild population will be represented by at least two secure *ex-situ* collections in New Zealand.

Explanation

The cultivation of *Leptinella nana* at separate and secure locations sourced from each of the three populations is a key objective of this plan. *Ex-situ* stocks are essential for implementation of a programme to replant the species at wild sites (see below) and can be valuable for advocacy and research purposes. Plant material held in cultivation is also an insurance against loss of *L. nana* from any of the wild sites and the possibility of species extinction. No agency will be permitted to hold plants of *L. nana* from more than one population in close proximity to each other.

Actions

a. Propagate plant material for replanting into the wild and for maintenance as *ex-situ* collections for each population of the taxon at separate locations (see Section 4.6 for current *ex-situ* holdings) (Wellington, Canterbury and Nelson/Marlborough Conservancies).

b. Maintain a register of the location, provenance and current status of *ex-situ* material of *L. nana*. The register will be held by the Recovery Group Leader and updated annually upon receipt of the regional monitoring reports from the three conservancies (see Appendix 3) (Wellington, Canterbury and Nelson/Marlborough Conservancies).

c. Establish and maintain at least two *ex-situ* populations at secure locations that are representative of each wild population (with accompanying documentation of provenance) (Sounds, Kapiti and North Canterbury Areas).

d. Investigate whether *L. nana* seed should be placed in a long-term seed storage facility (Species Recovery Group).

6. To establish at least one population at a new site in each conservancy (following standard operating procedures for translocations when available)

Performance measure

Establish at least one new self-sustaining population in each conservancy within (or adjacent to) current known areas of occurrence by 2011.

Explanation

New populations of *Leptinella nana* will be established in suitable habitats to increase the likelihood of survival, and to lessen the impacts of stochastic events on the wild population as a whole (Wellington, Canterbury and Nelson/Marlborough Conservancies).

Actions

a. Establish new populations of the Canterbury population in appropriate existing habitat in other Port Hills reserves not adversely impacted by recreational use (North Canterbury Area).

b. Establish new populations of the Titahi Bay provenance in appropriate existing habitat in reserves near Titahi Bay (e.g., Mana Island) (Kapiti Area).

c. Establish new populations of the Rai Valley provenance in appropriate existing habitat in other nearby reserves (Sounds Area).

d. Evaluate whether introduction of *L. nana* is appropriate at sites (within the species' range) at which ecological restoration is being undertaken by the Department of Conservation or other agencies (Wellington, Canterbury and Nelson/Marlborough Conservancies).

TABLE 5: PRIORITIES FOR ACTIONS

OBJECTIVE	ACTION	PRIORITY			
		Essential	High	Medium	Low
Protect existing populations of *Leptinella nana* by active management to control key threats to their survival	Negotiate legal protection of the Rai Valley population.		Sounds Area		
	Ensure that legal classification of protected sites is appropriate for protection and conservation management of *L. nana.*				Kapiti and North Canterbury Areas
	Secure and implement management agreements at all three sites between the Department of Conservation and other site management agencies.		Sounds, Kapiti and North Canterbury Areas		
	Develop and implement weed control and surveillance plans.	Sounds, Kapiti and North Canterbury Areas			
	Maintain fences at existing sites where appropriate.			Sounds and Kapiti Areas	
	Undertake regular inspections of all populations using a standard procedure, and report on results.	Sounds, Kapiti and North Canterbury Areas			
	Consult with iwi.	Sounds, Kapiti and North Canterbury Areas			

TABLE 5 cont.: PRIORITIES FOR ACTIONS

OBJECTIVE	ACTION	PRIORITY			
		Essential	High	Medium	Low
	Increase population sizes at Titahi Bay and, to a lesser extent, at Mount Pleasant through a replanting programme.		Kapiti Area		North Canterbury Area
Raise public and iwi awareness of *Leptinella nana* conservation	Identify further stakeholders in *L. nana* conservation.		Sounds, Kapiti and North Canterbury Areas		
	Consult with iwi to determine their relationship with the species.	Sounds, Kapiti and North Canterbury Areas			
	Establish and/or maintain appropriate signs at all wild sites to explain importance of species and site and to provide a point of contact for more information.		Sounds, Kapiti and North Canterbury Areas		
	Make information about the species and the sites where it occurs available to people with interest in management of *L. nana*.			Sounds, Kapiti and North Canterbury Areas	
	Carry out discussions with rock climbers at Mount Pleasant, especially schools, in order to lessen site impacts.	North Canterbury Area			
	Provide people preparing local authority plans, local brochures and guides with information about *L. nana*.				Canterbury, Nelson/Marlborough and Wellington Conservancies

TABLE 5 cont.: PRIORITIES FOR ACTIONS

OBJECTIVE	ACTION	PRIORITY			
		Essential	High	Medium	Low
	Others involved in land management at or near *L. nana* will be informed of species recovery work to be carried out and who has responsibility for that work.		Sounds, Kapiti and North Canterbury Areas		
	Promote local nurseries as sources of local provenance material (e.g., Motukarara Nursery for Banks Peninsula provenance).		Sounds, Kapiti and North Canterbury Areas		
To undertake and promote research relevant to recovery of *Leptinella nana*	Information will be provided each year to tertiary institutions about the research needs of *L. nana*.		Wellington, Canterbury and Nelson/Marlborough Conservancies		
	Research topics will be put forward by the Department of Conservation whenever opportunities arise for funding		Conservancy Advisory Scientists at Wellington, Nelson/Marlborough and Canterbury Conservancies		
	Determine long-term patterns of persistence and recolonisation of *L. nana*.				Canterbury, Nelson/Marlborough and Wellington Conservancies
	Determine the responses to combinations of competition and soil characteristics, including fertility and moisture.		Canterbury, Nelson/Marlborough and Wellington Conservancies		

TABLE 5 cont.: PRIORITIES FOR ACTIONS

OBJECTIVE	ACTION	PRIORITY			
		Essential	High	Medium	Low
	Evaluate the utility of *L. nana* in managed turf amenities.				Canterbury, Nelson/Marlborough and Wellington Conservancies
	Determine the dispersal vectors of *L. nana*.			Canterbury, Nelson/Marlborough and Wellington Conservancies	
	Investigate the use of herbicides to control pest plants without threatening *L. nana*.		Canterbury, Nelson/Marlborough and Wellington Conservancies		
	Determine the effect of grazing on *L. nana*.				Canterbury, Nelson/Marlborough and Wellington Conservancies
	Determine the genetic diversity amongst populations and gene flow within populations.		Canterbury, Nelson/Marlborough and Wellington Conservancies		
	Determine the minimum amount of disturbance to maintain suitable habitat for *L. nana*.	Canterbury, Nelson/Marlborough and Wellington Conservancies			

TABLE 5 cont.: PRIORITIES FOR ACTIONS

OBJECTIVE	ACTION	PRIORITY			
		Essential	High	Medium	Low
	Develop a method for successful translocation of *L. nana* or for introduction of propagules of the species to enhance existing populations.				Canterbury, Nelson/Marlborough and Wellington Conservancies
	Assess the effect on *L. nana* of walkways and recreation use at Mount Pleasant.		North Canterbury Area		
Survey to locate new populations and to identify potential sites for translocation	Searching along the coast between White Bluffs and Ure River in Marlborough.		South Marlborough Area		
	Search along the flood plain of the Pelorus River.		Sounds Area		
	Search North Canterbury, seaward of Parnassus and Cheviot.		North Canterbury Area		
	Coastal cliffs to the north and south of Titahi Bay.		Kapiti Area		
	Identify sites to which plants can and should be introduced to establish wild populations at new locations.			Canterbury, Nelson/Marlborough and Wellington Conservancies	

TABLE 5 cont.: PRIORITIES FOR ACTIONS

OBJECTIVE	ACTION	PRIORITY			
		Essential	High	Medium	Low
Maintain representative *ex-situ* collections for each population of the species at separate locations	Propagate plant material for replanting into the wild and for maintenance as *ex-situ* collections.			Canterbury, Nelson/Marlborough and Wellington Conservancies	
	Maintain a register of the location, provenance and current status of *ex-situ* material of *L. nana*.		Canterbury, Nelson/Marlborough and Wellington Conservancies		
	Establish and maintain at least two *ex-situ* populations at secure locations, representative of each wild population.	Sounds, Kapiti and North Canterbury Areas			
	Investigate whether *L. nana* seed should be placed in a long-term seed storage facility.				Recovery Group
To establish at least one population at a new site	Establish new populations of the Canterbury population in appropriate existing habitat in other Port Hills reserves.			North Canterbury Area	
	Establish new populations of the Titahi Bay provenance in appropriate existing habitat in reserves near Titahi Bay.	Kapiti Area			
	Establish new populations of the Rai Valley provenance in appropriate existing habitat in other nearby reserves.			Sounds Area	

TABLE 5 cont.: PRIORITIES FOR ACTIONS

OBJECTIVE	ACTION	PRIORITY			
		Essential	High	Medium	Low
	Evaluate whether introduction of *L. nana* is appropriate at sites at which ecological restoration is being undertaken.			Wellington, Canterbury and Nelson/Marlborough Conservancies	

7. Acknowledgements

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Appendix 1

RECOVERY GROUP MEMBERS AND KEY CONTACTS FOR CONSULTATION AND ADVOCACY

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Iwi

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Appendix 2

LEPTINELLA NANA ECOLOGY AND BIOLOGY

The following information about the ecology and biology of *Leptinella nana* is intended to supplement the text included in the recovery plan. The subject areas covered include: seral requirements; biology and reproduction; characterisation of typical habitat; moisture regime; and associated species.

SERAL REQUIREMENTS

Disturbance is a common factor (flooding at Rai Valley, sheep and human impacts at the other two sites, surface water movement (run-off) from the cliff above at Mount Pleasant, and ground baring by wind-blown tussock at Titahi Bay). Disturbance requirements appears to have led to a strategy in which there is constantly dying out and re-establishment of plants, reflecting a changing mosaic of available habitat.

Moss (1985) noted that where plants of *L. nana* do persist, they maintain a slightly greater dampness than on surrounding bare soil, and over several years they can build up small domes of soil trapped between the interlacing stems. The retention of moisture has been noted at both Titahi Bay and Mount Pleasant throughout the summer, and build up of soil to a depth of 1–2 mm has been observed following rain. However, *L. nana* only appears to be able to cope with very small increments of soil; greater rates and it becomes buried.

At Titahi Bay, Moss (1985) noted that there are "many local variations of habitat and not all the plants are doing the same thing at any given time". Recent and ongoing study of the Mount Pleasant population by David Given and Amanda Baird suggests that this is probably a reflection of a constant pattern of recolonisation and extirpation within the site.

Under cultivation it can grow vigorously and form a dense mat, but in a relatively short period will often die out in the centre of the original patch, and reroot around the edges to form new patches. In this way it is simulating behaviour in the wild which seems adapted to short term colonisation of available habitat.

BIOLOGY AND REPRODUCTION

At Titahi Bay, Moss (1985) identified a series of stages in the annual growth cycle:

- *end October*: shortage of soil moisture, growth and, therefore, flowering ceases.
- *summer-early autumn*: becomes brown and aestivates. A series of changes: leaves become dull and flaccid, leaf lamina sometimes becomes fleshy and new leaves are smaller. Leaves become yellow, then brown, and finally blacken and die.
- *early autumn*: remarkable recovery if temperatures remain mild. Recommence flowering.

- *winter*: flowering and growth ceases.
- *early spring*: recommencement of flowering and vegetative growth; germination of seeds to produce small mats.

The species is capable of profuse flowering which occurs under a good combination of soil and moisture conditions when it is grown in cultivation. Being monoecious, with small, inconspicuous capitula, the species is capable of self-pollination. Pollination vectors are not known but are likely to be generalist insects including thrips, ants, collembola, syrphids, and weevils. These have been observed crawling over the plants.

At both Titahi Bay and Mount Pleasant, numerous small seeds are produced. These are capable of being dispersed over one metre, and possibly much greater distances, especially by water and on footwear, as originally suggested by Moss (1985). Observations at both these sites show that there is a steady production of new plants from seed. The distribution patterns of both larger and smaller plants and timing of appearance of new plants confirms that this occurs. There are no special adaptations for dispersal and yet the species is widely distributed. Dispersal agents in the past might have been terrestrial and sea birds, wind and rain, and reptiles. The species may also have been dispersed by Maori.

Moss (1985) suggested that only a very small percentage of seed germinates, but he did not offer definitive data. At the other major study site, flowering has been sporadic at best during the study period. The bending of peduncles following anthesis is frequent and may be a strategy to ensure that at least some seeds are deposited among the leaves and stems of the parent plant.

No particular seasonal pattern of germination and seedling production appears to exist; the species is probably an opportunist that takes advantage of any period of prolonged dampness for establishment of new individuals. Flower production has even been observed in mid-winter during spells of mild weather. However, maximum flower production appears to be during both autumn and spring (April/May) and (August–October), with ripe achenes observed in May/June and September–November.

Moss (1985) noted that under particularly adverse conditions, this species can act as an annual, although this has not been observed at Mount Pleasant, possibly because for the period of study and preceding it conditions have been unusually moist and cool.

CHARACTERISATION OF TYPICAL HABITAT

The variability of habitat at the three sites might be expected to pose problems for formulation of an overall recovery plan. The Rai Valley site, in particular, does not conform to many of the generalities that are used to describe the other two sites. However, there are some similarities. Each site consists of a mosaic of bare areas that are maintained short term (3–5 years) but are not necessarily constant in the long term. The bare areas are often in the order of 100–300 mm across. All three sites are sheltered: at Titahi Bay tussock grasses provide shelter, at Rai Valley it is totara, beech and willow, and at Mount Pleasant shelter is given by shrubs and a cliff. The population on Mount Pleasant is south and southeast-facing so the habitat is shaded for most of the year. Soils are young, silty and sandy riparian deposits at

Rai Valley, and have a moderately high clay or loess content at the other sites. All sites are relatively fertile.

The three known habitats of *L. nana* differ perhaps as a result of human influences. The following are some suggested typical habitats for *L. nana* that it may have occupied in times past:

- a relatively ephemeral species along with other diffuse, mat-forming species of *Crassula, Hydrocotyle,* cryptogams, etc.
- a plant of taller vegetation than often supposed which is now in suboptimal, relatively open habitats. For example, the Rai Valley site under forest and in the shelter of shrubs at Mount Pleasant.
- Sites kept open by a combination of seabirds and storms or floods (hinted at by Moss 1985).

MOISTURE REGIME

Sites have appreciable soil moisture until early summer at least, but are not wet and are moderately well drained. Moss (1985) noted that even sudden growth of bryophytes or *Nostoc* can exclude air from the soil, and increase water content to the extent that the *Leptinella* can no longer survive. Mid-winter observations of all three sites indicated that they are rarely if ever saturated. Only a few days after extensive floods at the Rai Valley site the plant habitat was found to be only slightly moist. However, plants in small depressions on the lower terrace can survive inundation for several days until the water table lowers.

Moss (1985) also noted that *L. nana* at Titahi Bay grows in much drier conditions than would be anticipated from observations on the habitats of the two South Island colonies. Observations made in mid-winter show that the species occupies sites that have at least some moisture at this time of the year, but never seem to be saturated. Moss described the habitat as:

"…along cliff-tops where cliff plants such as *Poa leavis* [*P. cita*] and *Cassinia leptophylla* [*Ozothamnus leptophyllus*] mingle with farm pasture plants. Patches of *Cotula* [*Leptinella*] *nana*—some diffuse, some quite dense—occur on bare soil where other plants have been eliminated by the effects of sun and winds, steepness of habitat, lack of sufficient water and shading by shrubs…"

ASSOCIATED SPECIES

Sagina procumbens appears to be an indicator species for *Leptinella nana*, having been found in association at about 80 percent of sites in the Rai Valley. It is also recorded at Mount Pleasant with *L. nana*. Few other species seem to be directly associated with *L. nana*. Indeed, the species is markedly adverse to competition, and does not seem to be able to compete with other mat plants, grasses and sedges. This is confirmed by observations on the species under cultivation. For the Titahi Bay site, Moss (1985) suggested that the species cannot grow quickly upwards to avoid being shaded out by its competitors, and it will not tolerate increased soil moisture as a result of shading. However, at the Rai Valley site *L. nana* is strongly associated with mosses and other ground cover plants.

Appendix 3

MONITORING *LEPTINELLA NANA*

Inspections of all populations of *Leptinella nana* will be undertaken as part of a national programme to regularly assess the condition of the species in the wild. Those inspections will be undertaken to detect change in the species' condition over time that might result from environmental changes such as climate change, weed encroachment, or catastrophic disturbance. Inspections will also be carried out to determine the effectiveness of management undertaken at each population.

The following is the basic standard procedure that will be followed. Additional monitoring to achieve other research objectives may be undertaken as and when required.

Population attributes

The four population attributes that will be monitored are:

1. Total area of occupancy of all sub-populations at each site.
2. Exact area of land covered.
3. Numbers, extent and abundance of associates (including adventives) at wild sites.
4. Location, condition and provenance of all *ex-situ* collections.

Methods

The methods described in the plan (see Section 4.3) will continue to be used to monitor the populations.

Frequency

Inspections will be made at least twice each year at each population.

Timing

The inspections will be undertaken on or as near as possible to 1 October and 1 April.

Analysis of data

Conservancy offices of the Department of Conservation where *L. nana* is found will hold data from this monitoring. The data will also be copied to the Species Recovery Group leader who will collate and analyse the information and investigate any changes nationally in the condition of the species in the wild and *ex-situ*.

Compilation and dissemination of results

The species recovery group leader will compile results of monitoring into an annual report that will be published by the Department of Conservation. Copies will be sent to all individuals and agencies identified in Appendix 1. Further copies of those reports may be obtained upon request from the Department of Conservation.

Published recovery plans

NUMBER	SPECIES	YEAR APPROVED
33	*Hebe cupressoides*	2000
32	Inland *Lepidium*	2000
31	*Muehlenbeckia astonii*	2000
30	North Island kokako	1999
29	Weka	1999
28	*Pittosporum patulum*	1999
27	*Cyclodina* skinks	1999
26	Coastal cresses	1999
25	Threatened weta	1998
24	Striped skink	1998
23	Fairy tern	1997
22	Blue duck	1997
21	Kakapo	1996
20	Stitchbird	1996
19	Brown teal	1996
18	Native frogs	1996
17	New Zealand (Hooker's) Sea Lion	1995
16	*Dactylanthus taylorii*	1995
15	Bat (peka peka)	1995
14	Otago and grand skinks	1995
13	Giant land snail	1995
12	Takahe	1994
11	South Island saddleback	1994
10	New Zealand Dotterel	1993
9	Tuatara	1993
8	Kowhai ngutukaka	1993
7	Subantarctic teal	1993
6	Mohua (yellowhead)	1993
5	Chevron skink	1993
4	Black stilt	1993
3	Whitaker's and robust skinks	1992
2	Kiwi	1991
1	North Island kokako	1991
–	Yellow-eyed penguin*	1991

Available from DOC Science Publications, Science & Research Unit, P.O. Box 10-420, Wellington.
* Available from Otago Conservancy, Department of Conservation, P.O. Box 5244, Dunedin.