

# *Dactylanthus taylorii* recovery plan review: 1995-2000

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S. Holzapfel

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# *Dactylanthus taylorii* recovery plan review: 1995-2000

S. Holzapfel

Conservancy Advisory Scientist, Waikato Conservancy, Private Bag 3072, Hamilton, New Zealand

## ABSTRACT

This review summarises the achievements of the recovery programme for *Dactylanthus taylorii* between 1995 and 2000, its specified life span. It also includes some associated findings before and after these dates. For each of the seven objectives stated in the 1995-2000 plan, recommendations are made for future recovery planning under the same or changed objectives. Four objectives have been achieved to a large degree. Two objectives have been fulfilled as far as the work plan was followed, but the outcomes sought from these objectives were either not achieved or the objective and the outcome were too ambiguous to assess success. One objective was not achieved, mainly due to a shift by the *Dactylanthus* Recovery Group in its approach to cultivation. Overall, recovery planning for the species has been very successful, and has allowed the species to set fruit in a large number of populations, presumably for the first time in decades. Advocacy has established a stronger awareness of the public of the conservation issues associated with *D. taylorii*, and protection of the species on private land has been exceptionally successful in places. The review has confirmed the status of *D. taylorii* as a threatened plant. It recommends future recovery planning is designed around its findings and continues to be coordinated nationally through a Recovery Group.

Keywords: *Dactylanthus taylorii*, wood rose, objectives, parasitic plants, recovery plan, review, New Zealand

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# 1. Introduction

## 1.1 BACKGROUND

*Dactylanthus taylorii* Hook f. is the only fully parasitic flowering plant endemic to New Zealand. A member of the predominantly tropical Balanophoraceae family, it lives mainly underground attached to the roots of a number of native tree and shrub species, where it forms a characteristic distortion on the host root in the area of attachment (the 'wood rose'). In autumn, each plant produces inflorescences filled with nectar which grow just above the forest floor. *Dactylanthus* is dioecious, usually producing male and female inflorescences on different individuals. The endemic short-tailed bat (*Mystacina tuberculata*) is the only confirmed native pollinator. Mice (*Mus musculus*) and introduced ship rats and Norwegian rats (*Rattus rattus* and *R. norvegicus*) have been shown to be introduced pollinators, though rats often destroy flowers rather than pollinating them.

Because of an observed failure to reproduce caused by browsing of the inflorescence by introduced animals (possums and all species of rats, including kiore, *R. exulans*), an apparent decline in distribution over the last 50 years, and ongoing destruction of specimens by wood rose collectors, the Department of Conservation (DOC) formed a Recovery Group for *Dactylanthus taylorii* (Molloy 1993). A recovery plan was published in 1995 (Ecroyd 1995b), with a term of 5 years. In accordance with the Standard Operating Procedure for Species Recovery (Brown & Molloy 1999) a decision was made by the Recovery Group to review the achievements before recommending further planning requirements (Anon.1999). The present publication constitutes this review.

Every effort has been made by the author to provide and review the available information on an objective basis at the time of writing (2001). However, this review should not be viewed as a robust audit, but rather as a summary of achievements as seen by the Recovery Group itself.

## 1.2 TERMS OF REFERENCE

- To assess the achievement of the management goal and each of the objectives listed in the Recovery Plan (Ecroyd 1995b) over the term of the plan (1995–2000).
- To assess future recovery planning requirements, in particular whether the goal and objectives of the current plan are still valid, need modification, or can be deleted.

## 1.3 METHODS

Information of the progress of the 1995–2000 recovery programme was gathered by:

- Reviewing documents and reports, in particular the annual Recovery Group minutes with their appended conservancy reports.
- Analysis of monitoring data collected by all member conservancies since 1995 to assess flowering, seed set, protection measures and associated information. This data was transferred from individual conservancy spreadsheets into a standardised spreadsheet and collated by the author during the 1999/2000 financial year. (An example of the standardised spreadsheet is attached as Appendix 1.)
- Sending a questionnaire to all member conservancies in the 1999/2000 financial year to ascertain survey and advocacy actions undertaken and their results. (An example of the questionnaire form is attached as Appendix 2.)
- Dedicating two sessions, one each during the 1999 and 2000 annual Recovery Group meetings (a total of 6 h), to discuss the achievement of the objectives in the recovery plan (Anon. 1999; Holzapfel 2000).
- Reviewing available departmental information (in particular files held at Waikato Conservancy and those collated by successive Recovery Group leaders).
- Reviewing published literature.

This review is presented in a standard format. The original wording of each objective, as given in section 10 (Recovery strategy: work plan) of the 1995–2000 Recovery Plan (Ecroyd 1995b), including its explanation, plan, outcome sought and key personnel, is shown first. This is followed by the findings gathered for the review (Results), and a discussion of the achievement of the objective. Conclusions and Recommendations arising from these data are finally presented. Some findings are summarised in tables and figures.

### 1.3.1 Terminology

Because it is usually not possible to identify individual plants of *D. taylorii* among a single tuber-growth, findings in this report sometimes refer to ‘clumps’, which may mean one or several plants growing closely together so as to resemble a single plant.

Throughout this report *Dactylanthus* is used informally to denote *D. taylorii*, except in direct quotes from material which used the full binomial.

The abbreviations for conservancies used in the text are: Northland (NOR), Auckland (AUCK), Waikato (WAIK), Bay of Plenty (BOP), Tongariro / Taupo (T/T), East Coast / Hawkes Bay (EC/HB), Wanganui (WANG), Wellington (WELL) and Nelson / Marlborough (NELS/MARL).

On 10 Jan 2005 the Research, Development and Improvement Division (RD&I) of DOC came into being, following a reorganisation of Science Technology and Information Services (STIS). Under this new structure, various units were renamed / replaced. As this review deals primarily with events before the reorganisation, the old Division / Section titles are retained when reproducing extracts from the 1995–2000 Recovery Plan, or when discussing roles up till 2005; but, where recommendations for future action are made, the new titles have been used, as appropriate.

## 2. Findings

### 2.1 OBJECTIVE 1

**Objective 1:** As a minimum, to protect representative plants from possums, rats and other recognised threats at all known sites on land administered by DOC.

#### *Explanation*

*Dactylanthus* populations are generally declining and a strategy for holding their numbers is necessary until there is an improved knowledge of the species to enable careful selection of populations. Plants need to be protected from possum and rat browsing, wood rose collectors, cattle trampling and pig rooting.

#### *Plan*

*Dactylanthus* plants should be protected using exclosures or effective possum control, whichever is practical. Exclosures can be camouflaged if necessary. On Hauturu / Little Barrier Island where kiore are browsing the flowers, the plants should be protected with rat-proof exclosures. The flowers may need to be hand-pollinated if an exclosure constructed of fine mesh is used.

#### *Outcome*

This protection should ensure survival of the species at a number of sites until research results enable sites to be more carefully selected. Protecting the plants on Hauturu / Little Barrier Island will help ensure their survival until the kiore are eradicated.

#### *Key personnel*

Protection, Pest Control, Scientific and Field Staff in Auckland, Waikato, Bay of Plenty, East Coast / Hawkes Bay, Tongariro / Taupo and Wanganui Conservancies.

#### 2.1.1 Results

##### *Review of Objective 1*

This objective was reviewed twice during the duration of the Recovery Plan.

In 1999, the objective was refined to 'a minimum of 20–40 clumps per population' to be protected, with emphasis on sufficient female plants to produce seeds.

In 2000, emphasis was further moved from protection of plants to protection for allowing fruiting success and preventing mortality (Holzapfel 2000).



### Protection

In 2001, plants were protected at 66 populations (83% of the currently known populations) over the entire distribution range of *Dactylanthus* and in all member conservancies (Figs 1-3). Individual conservancies had protected between 40% and 100% of their known populations (Fig. 3). The actual number of clumps (see section 1.3 for definition) protected in each population is difficult to assess due to the cryptic nature of the species, in particular where protection is carried out using toxins (see Table 1). At these sites conservative estimates (based on known plants only) show a total of more than 1200 clumps under protection, with an average of 80-100 clumps protected per population, ranging from 8 to 192 clumps. The true mean is likely to be higher.

Figure 1. *Dactylanthus taylorii* populations in New Zealand (as at 2002).

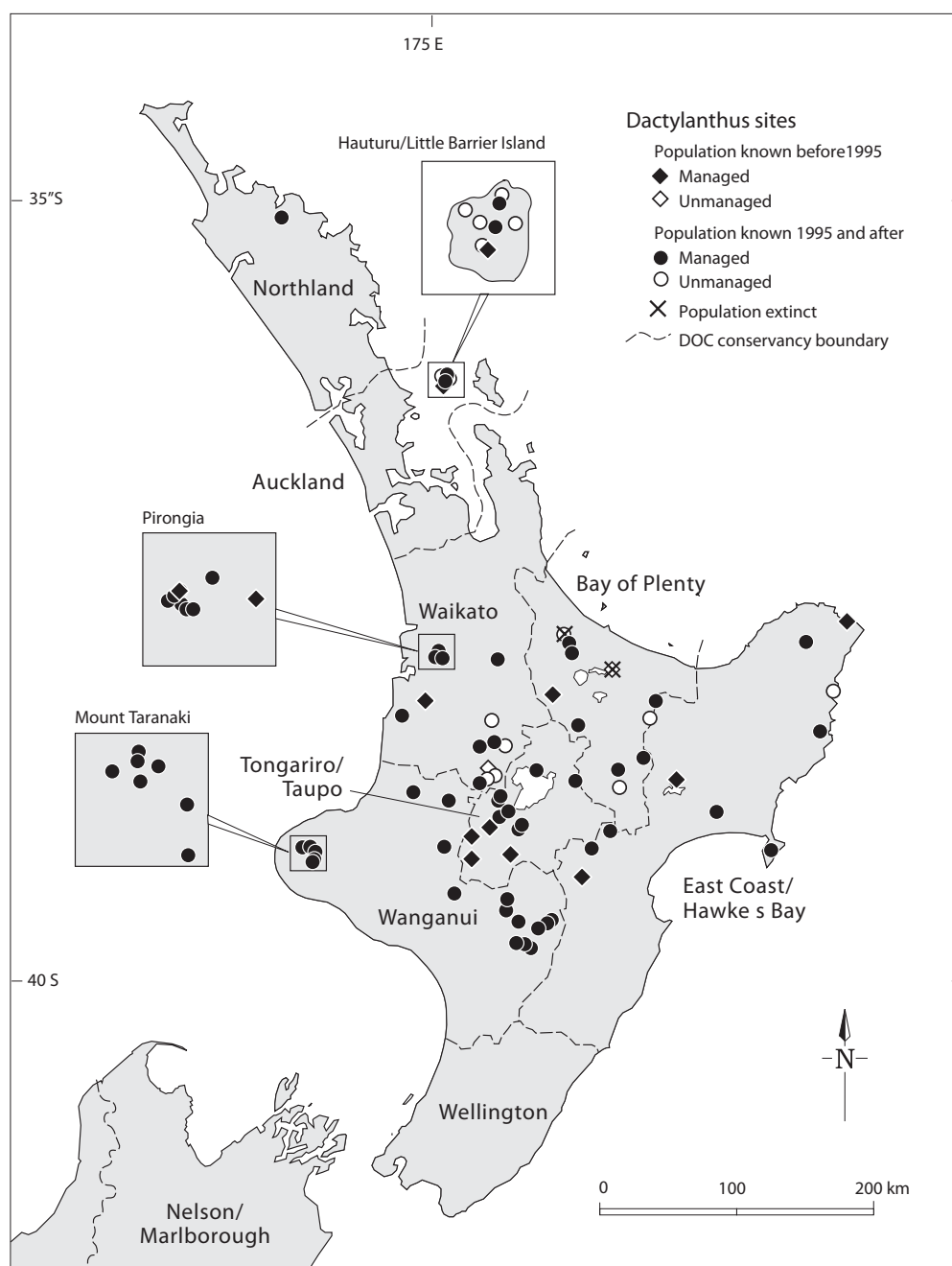


Figure 2. Number (cumulative) of known and protected populations of *Dactylanthus taylorii* in New Zealand 1994–2001.

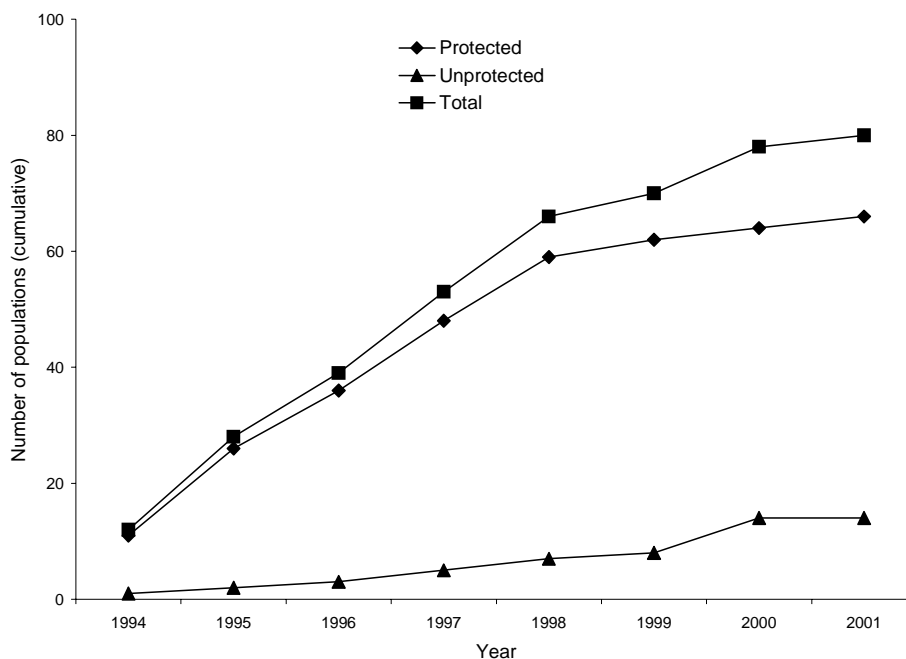


TABLE 1. METHODS OF PROTECTION FOR *Dactylanthus taylorii* USED IN EACH CONSERVANCY BETWEEN 1995 AND 2001.

METHOD	CONSERVANCIES*							TOTAL†
	NOR	AUCK	WAIK	BOP	EC/HB	T/T	WANG	
Caging (all mesh sizes) (individual clumps)	●	●	●	●	●	●	●	48
Toxic possum control			●	●	●	●	●	20
Rat control (toxins and snap traps)			●		●			2
Aluminium exclosures (for kiore)		●						1‡
Possum exclosure (many clumps)				●	●			2
Deer exclosure					●			1
Board walk			●					1
Animal repellent				●	●			2§
Pig control					●			1

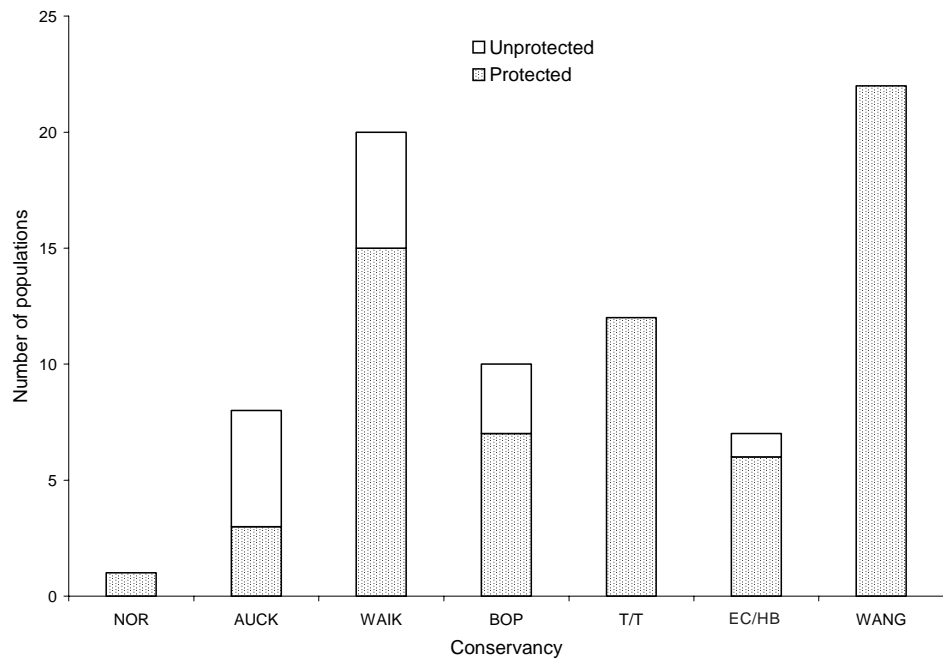
\* Abbreviations for conservancies: Northland (NOR), Auckland (AUCK), Waikato (WAIK), Bay of Plenty (BOP), Tongariro / Taupo (T/T), East Coast / Hawkes Bay (EC/HB), Wanganui (WANG).

† Total number of populations where these methods have been employed at any one time.

‡ Discontinued in 1997.

§ On trial basis in 1999/2000.

Figure 3. Number of known and protected populations of *Dactylanthus taylorii* in each conservancy in 2001.



The total number of clumps protected through caging in 2001 was 1525 (Fig. 4). On average, 22 clumps were caged per population, ranging from 1 clump (6 populations) to 192 clumps. Four populations contained more than 100 clumps. There was a wide range among conservancies in the number of clumps caged (Fig. 5), reflecting either the small number of known and / or caged populations (NOR and AUCK), or a higher number of large caged populations (BOP).

Figure 4. Number (cumulative) of caged clumps of *Dactylanthus taylorii* in New Zealand 1994-2001.

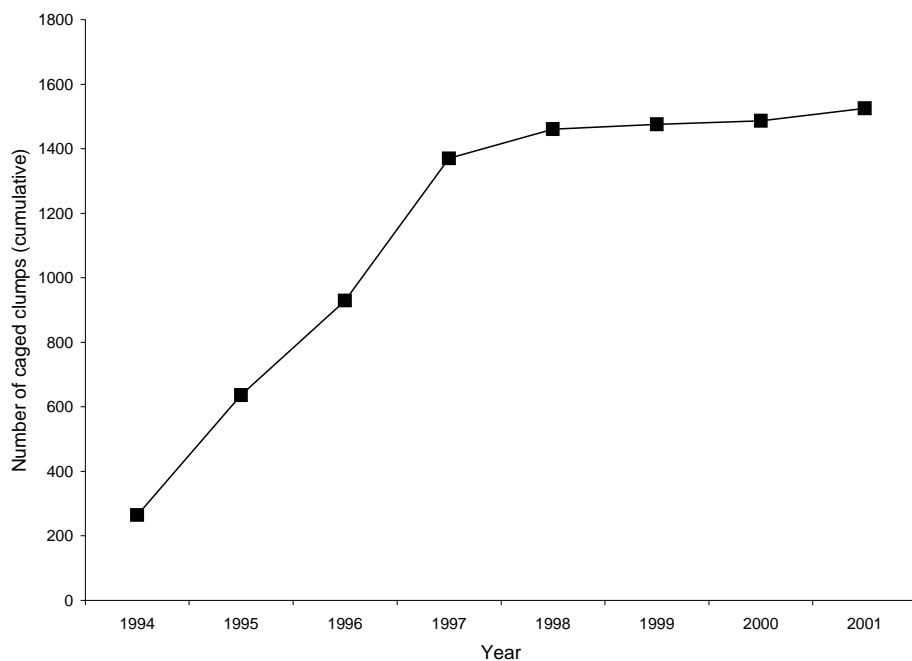
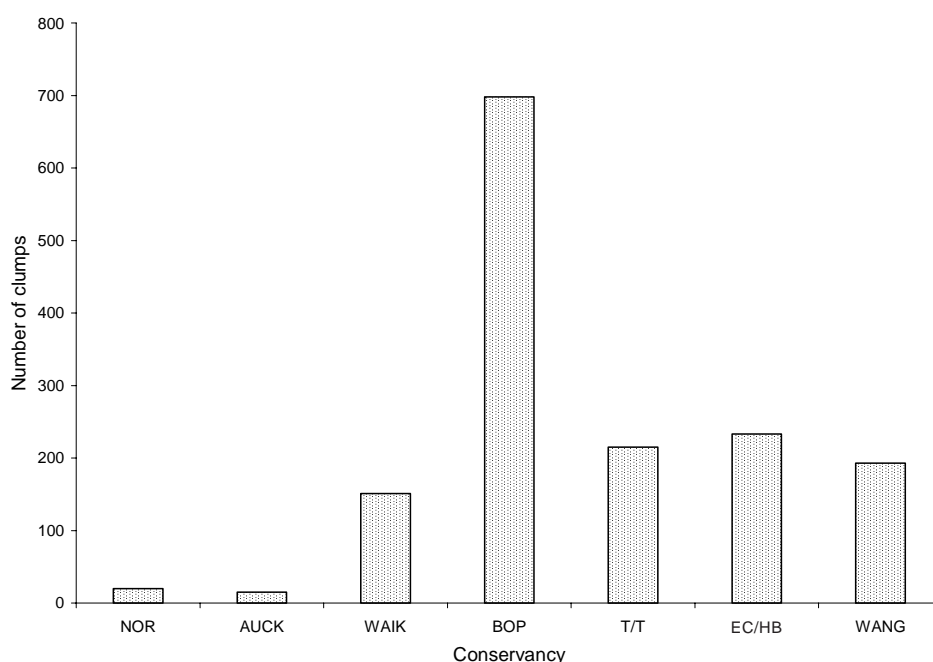


Figure 5. Number of caged clumps of *Dactyloctenium aegyptium* in each conservancy in 2001.



### **Methods of protection since 1995**

A range of methods have been employed to protect *Dactyloctenium aegyptium*, including:

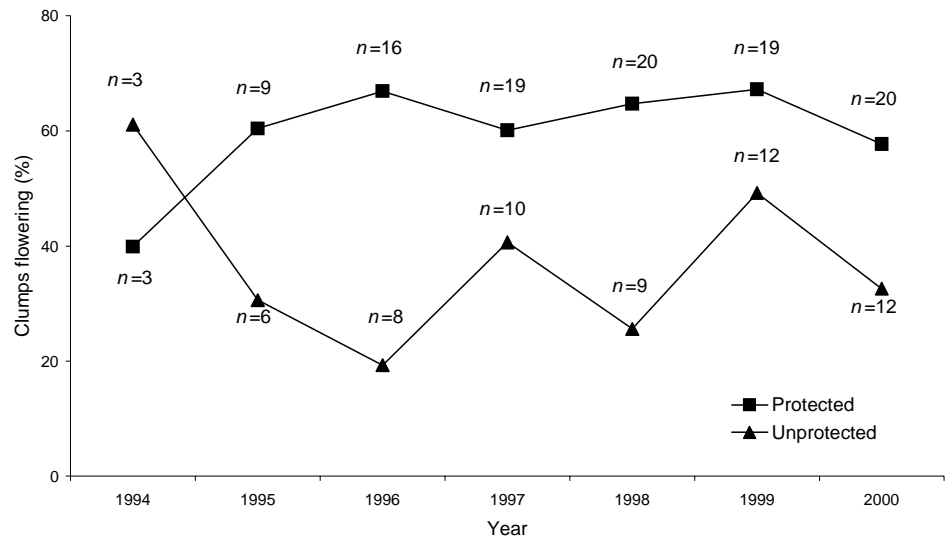
- Possum-proof caging (50-mm mesh size) of individual clumps (as per Recovery Plan standard design or modified)
- Possum- and rat-proof caging (25- or 15-mm mesh size) of individual clumps
- Possum control through toxins (1080 aerial, 1080 in bait stations, cyanide or brodifacoum in bait stations)
- Possum-proof, roofed, walk-in enclosures covering many plants over a large area (e.g. 20 × 20 m [EC/HB] and 25 × 25 m [BOP])
- Rat control using toxins (bait stations with pindone pellets, brodifacoum or 1080) or snap traps
- Kiore-proof aluminium enclosures ('chimneys') around individual *Dactyloctenium aegyptium* clumps (Hauturu / Little Barrier Island only)
- Deer-proof enclosure to prevent destabilisation of scree slope and trampling of clumps (EC/HB only)
- Boardwalk replacing a section of tramping track through fragile *Dactyloctenium aegyptium* habitat to prevent trampling by trampers (WAIK only)
- Animal repellents
- Pig control

Table 1 lists the various methods used for protection in each conservancy and the total number of populations where these were employed.

### **Achievement of protection**

Figures 6 and 7 show the level of flowering and fruiting of unprotected and protected (individual or site protection) clumps since 1994.

Figure 6. Flowering success of protected and unprotected clumps of *Dactylanthus taylorii* 1994–2000. Percentage of clumps producing at least one inflorescence in each population (averaged for all populations (*n*) monitored each year).

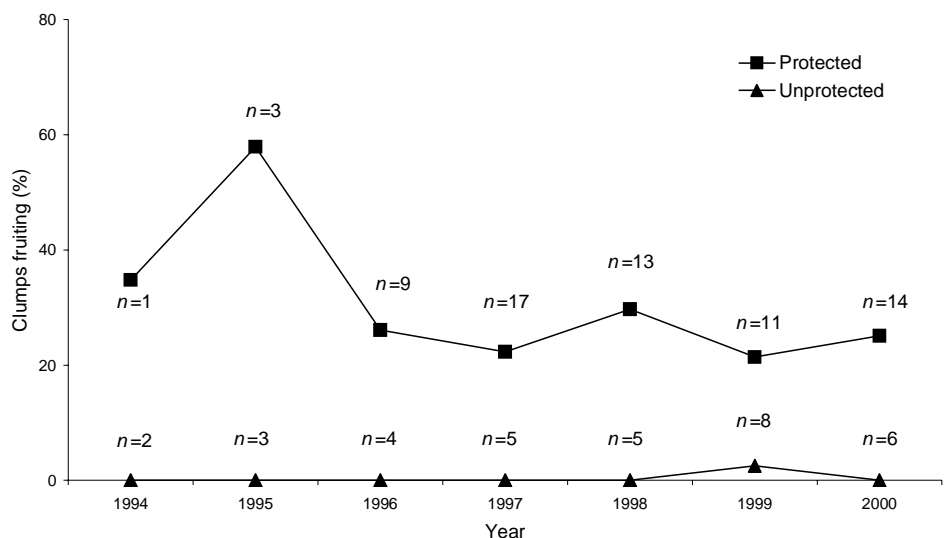


Flowering success of protected clumps has been consistently higher from 1995 to 2000, with 1.4–3.5 times as many protected clumps flowering on average over all monitored populations (Fig. 6). In 1994, the higher average flowering of unprotected clumps was due to the small sample size and thus a strong sensitivity to individual population results. In this case, a single uncaged clump was monitored in one of the three populations and successfully flowered. This result of 100% flowering pushed the average to 61% for all three populations. If this single clump is excluded, the average is 27.8%.

Note that even without protection, populations appeared to be able to achieve a flowering success between 20% and 50% in all years (see below).

Fruiting, in contrast to flowering, success was only achieved by protected populations between 1994 and 2000 (Fig. 7). Between 2000 and 1996 fruiting success in protected populations was consistently between 20% and 30%. The higher averages in 1994 and 1995 are less reliable because of small sample sizes (as discussed above). Fruiting success was monitored for all protected clumps, regardless of whether they had produced female inflorescences that year. The

Figure 7. Fruiting success of protected and unprotected clumps of *Dactylanthus taylorii* 1994–2000. Percentage of clumps producing at least one infructescence in each population (averaged for all populations (*n*) monitored each year).



number of clumps that produce male inflorescences in most populations greatly exceeded (by up to 6 times) that of clumps producing female inflorescences (Ecroyd 1996). The percentage of successfully fruiting of clumps reported here is, therefore, likely to be a gross underestimate of the true success of these populations.

A comparison between the results for flower and fruit monitoring indicates that inflorescences that have survived on unprotected clumps to the time of monitoring have not been able to produce seed. It can be assumed that the reason for this is browsing after monitoring rather than lack of pollination, as in most populations protected clumps growing in the same population have set seed successfully.

Site protection (through poisoning operations) has allowed flowering and fruiting of otherwise unprotected clumps when possum numbers have been sufficiently reduced. The possum density (as indicated by RTC) that allows flowering of *Dactylanthus* is different for individual sites. While an extremely low RTC of 1%-2% was required for flowering at Pureora, Mount Pirongia (both WAIK) and Pukerimu (BOP), plants at Te Araroa (EC/HB) were sufficiently protected by a RTC of 4%. One hypothesis to account for this difference is that the greater abundance of *Dactylanthus* at the latter site may have provided a sufficient spread of damage by resident possums over many plants.

However, the data collected are not suitable for formally comparing various levels of RTC with flowering success. In particular, flower monitoring data at higher RTC values (> 5%) are too few.

Possum-proof cages still allow access by rats and thus do not prevent rat browse. The generally lower level of browsing by rodents compared to possums and the assumed benefit of occasional pollination by rats appear to confirm the standard design of cages (50-mm mesh size) as appropriate for most situations. Cage mesh size for the Hauturu / Little Barrier Island populations had to be reduced to exclude kiore. Because this also excludes the short-tailed bat as the native pollinator, hand pollination is necessary at this site.

Aluminium exclosures (Hauturu / Little Barrier Island) were found to be unsuccessful. A change of micro-climate inside the exclosures was suspected of contributing to a high mortality of plants protected in this manner; kiore were still able to enter the exclosures and bats were not entering the exclosures (possibly because the complete reflection of echolocation calls by the solid aluminium made the clumps 'invisible' to bats)

Large possum exclosures (BOP and EC/HB) were successful in preventing access by possums and allowing flowering and fruiting. However, clumps at both enclosed sites appear to be less productive (at least in regards to fruiting) than at neighbouring sites with a different protection regime. The reasons for this are not fully understood and may be related to intrinsic factors (possibly old age) of both populations (Holzapfel 2000).

Animal repellents have been able to reduce browsing (in particular by rats) at some sites. The level of reduction compared to untreated plants and the small sample size makes an assessment of the success of this method impossible at this stage.

### 2.1.2 Conclusions

In general, Objective 1 has been achieved to a large degree. Populations are protected over the entire range of distribution. The number of populations protected is sufficiently large ( $n = 66$ , or 83% of all known populations) as to be satisfactory, with a conservative total of more than 2700 *Dactylanthus* clumps under protection through cages or pest control. Those parts of the objective that have not been achieved are:

#### ***Protection***

Populations are not protected at **all** sites on land administered by DOC. Reasons for populations remaining unprotected include the fear of destruction of plants by collectors alerted to cages (e.g. WANG), and the large number of populations in some conservancies (e.g. T/T).

Non-achievement of complete protection at all sites is a function of the increased number of populations found since 1995 (see Objective 4), at a scale that was not foreseen. The larger number of populations made protecting all populations with given resourcing unachievable. At the same time, nearly all (26 out of 28) populations known in 1995 are protected today. The two exceptions are populations both known from a single clump only and located near larger, protected populations at Pureora Forest Park (WAIK). In this regard, the objective has been fulfilled in its 1995 context.

#### ***Representativeness***

There is no clear measure of whether those plants that are protected are representative of the site in the case of large populations. Small populations are generally fully protected rather than by a representative sample.

Non-achievement in regards to representativeness relates to the lack of a clear measurement for 'representativeness' within single populations. No effort has gone into selection of clumps in terms of representativeness within a single population, apart from an increased emphasis over the last years for the protection of female clumps. Furthermore, genetic work (Holzapfel et al. 2002) has highlighted that, as with between-population variation, physical closeness of clumps within one population does not necessarily equate to closer genetic similarity. This means that there is no certainty that where only a selection of clumps has been protected, this selection is representative of the population.

#### ***Other***

One aspect of protection which was not explicit in the 1995–2000 Recovery Plan was the protection of host species. *Dactylanthus* completely depends on the presence of hosts, and it appears that in any one site only a portion of available species are infected. Therefore, protection of the habitat that includes those species is important to allow survival of existing plants as well as to maintain recruitment through infection of new host plants.

Another anomaly of the Objective 1 is the fact that its focus is on populations on land administered by DOC. A considerable number of populations known and managed are on land not administered by the Department. This includes the site of the most intensive *Dactylanthus* protection, at Te Araroa, EC/HB (see details

under Objective 2). Because the number of clumps at this site is large, the success of the project has a considerable bearing on the overall achievement of protection and recovery of the species. It should, therefore, be included, along with other sites on land not administered by DOC, under the same objective as sites administered by the Department. Objective 2, which currently covers populations on land not administered by DOC, has a focus on encouraging protection at these sites rather than protection itself (see section 2.2).

### 2.1.3 Recommendations

1. That the objective is retained for further recovery planning in a refined form.
2. That the objective is refined to take into account the increased number of populations known today.
3. That the objective is refined to take into account the knowledge gained from inner-and intra-population genetic variation research.
4. That the objective is refined to take into account threats that have emerged or been recognised since 1995 (e.g. pigs, rats, lack of pollination, see Objective 5).
5. That the objective includes protection of host species as well as *Dactylanthus*.
6. That the objective takes into account the importance of protection of populations on land not administered by DOC either by including these sites under the same objective, or strengthening the original Objective 2 to support opportunities to undertake effective protection on non-conservation land.

## 2.2 OBJECTIVE 2

**Objective 2:** Promote public interest and involvement in the recovery of *Dactylanthus taylorii*, encourage its protection on private land.

### *Explanation*

The assistance of the general public is essential if we are to prevent widespread loss of plants to wood rose collectors. There are land owners interested in protecting plants on their property and many members of the public are willing and enthusiastic about assisting with this work. Under the Conservation Act, Reserves Act, and National Parks Act it is an offence to take a plant from land administered by DOC.

### *Plan*

To form a network of people, preferably a self-motivated 'Friends' group, willing to assist with locating and protecting plants and to use publicity in the form of talks, displays, media releases, a poster, brochures or other handouts to inform the general public of the importance of conserving *Dactylanthus*, to seek their assistance with its protection from possums and collectors and to gain sponsorship for this work. The *Dactylanthus*-short-tailed bat relationship and the exploitation of *Dactylanthus* for wood roses provide focus points for



publicity. The integration of publicity on *Dactylanthus* with other conservation-related activities will be encouraged; for example *Dactylanthus* is an excellent example of a plant at risk due to possum browsing. Publicity should be targeted at landowners with *Dactylanthus* on their property, wood rose collectors, hunters, possum trappers and others most likely to find *Dactylanthus* plants, conservationists and rural communities in *Dactylanthus* areas. Visits by DOC staff should be made to all retail outlets which sell, or have been known to sell, wood roses to discourage retailers from accepting wood roses for sale.

### ***Outcome***

Public awareness and support for the recovery goal, as well as a wider appreciation of conservation issues. Reduced collection of wood roses and protection of plants on some private land.

### ***Key personnel***

Advocacy personnel in Northland, Auckland, Waikato, Bay of Plenty, East Coast / Hawkes Bay, Tongariro / Taupo, Wanganui, Wellington and Nelson conservancies, Public Awareness Unit staff, Queen Elizabeth II National Trust, and non-governmental organisations such as the Royal Forest & Bird Protection Society, Maruia Society, and various Botanical Societies.

## **2.2.1 Results**

### ***Network***

A network of interested members of the public ('Friends of *D. taylorii*') was initiated in 1996 and officially launched in 1997 with 23 members. Co-ordination of this network was carried out by the Auckland Conservancy<sup>1</sup>. At the time of writing the network had 31 members.

Members of the network were suggested by each member conservancy and initially contacted for their agreement to be included. Members include volunteers, former *Dactylanthus* collectors, land owners with populations of *Dactylanthus*, and the generally interested public. A newsletter has been sent out by the co-ordinator at least once a year (except 1998), following the annual meeting of the Recovery Group. The newsletter contains items of general interest from the meeting minutes. Other items of interest are sent out at an ad hoc basis. Communication is largely one-way (from the co-ordinator to the network members).

Feedback from Recovery Group members indicates that the network has succeeded in informing network members and in some cases has facilitated a change in attitude towards conservation of *Dactylanthus*.

### ***Publicity***

At least 31 articles have been published about *Dactylanthus taylorii* in national and regional newspapers and magazines. All articles emphasise the conservation message for *Dactylanthus*.

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<sup>1</sup> Rebecca Stanley acts as co-ordinator (as of 2005).

Seven scientific publications dealing exclusively or mainly with *Dactylanthus* have been published since 1995 (Ecroyd 1995a, b; Ecroyd et al. 1995; Jones 1995; Holzapfel 2001b; Holzapfel et al. 2002; Holzapfel & Dodgson 2004). In addition, presentations (mainly oral) have been given at scientific national conferences: New Zealand Ecological Society, Plant Physiology Society, Microscopy Society, and Insular Biota conference; and at international conferences: Nature Conservation 4: The role of networks (Australia), Southern Connection (Chile), and Phytochemistry (England).

### ***Advocacy and education***

Two regular newsletters—‘Friends of *D. taylorii*’ (see above) and ‘Te Araroa *D. taylorii*’—and miscellaneous articles in DOC internal newsletters (*Rare bits*, *Associates Newsletter*) have been published. Annual reports of the Te Araroa *D. taylorii* restoration project (e.g. Atkins 2000) and the national recovery programme (e.g. Holzapfel 2001a) are produced.

An identification sheet, now in its second edition (Barkla & Holzapfel 1997), DOC threatened plant fact sheets (AUCK and WAIK), a DOC fact sheet sponsored by the Naturally Native plant nursery, and a possum gut survey fact sheet for *Dactylanthus* (Atkins & King 1999) have been produced.

A number of public talks on *Dactylanthus* have been given to Botanical Societies, Forest & Bird Groups, Junior Naturalists and iwi. Presentations have also been made at a possum technology transfer workshop (in Hamilton in 1999) and a bat workshop (in Wellington 1995).

General advocacy and education has included signage erected at several populations (WAIK), field visits with Conservation Boards, Forest & Bird and botanical groups to populations and DOC internal training sessions for Field staff, hunters and threatened plant staff. Regional and District councils (Auckland, Wanganui) have been involved in survey and trained through fact sheets and direct discussions. Iwi have participated at the 1998 and 2000 annual Recovery Group meetings (Te Araroa and Hauturu / Little Barrier Island), and have facilitated a two-day korero on *Dactylanthus* at Manu Ariki Marae, Taumarunui.

Selected populations are used as advocacy tools for visiting public and school groups, and co-ordinated volunteer working parties have carried out surveys and management of populations in several conservancies, adding to many person-months of work. Conservancies have reported that involvement with *Dactylanthus* has created a high level of enthusiasm in volunteers (see also specific comments on Te Araroa and Oropi below).

### ***Visits to shops/outlets selling or displaying wood rose***

Based on information available for this review, 12 premises (private and commercial) were reported to have wood roses for sale or on display between 1995 and 2000. Eight of these have been visited or contacted (AUCK: 1, BOP: 5, WAIK: 2, T/T: 1). Sale of wood roses was confirmed at one shop. Of those premises not visited, three were reported to have large quantities (several dozens) of wood roses for sale. Two of these referred to an open air market in Christchurch, with plants allegedly collected around the central plateau (T/T).

## **Other**

Parts of this objective not progressed or completed despite recommendations from the Recovery Group included:

- A communication plan for *Dactylanthus taylorii*. A draft plan was prepared in 1994 but not finalised after two successive departures in 1995 of Public Awareness Unit staff who had taken the responsibility to progress the plan. There is little subsequent reference to the plan in recovery planning minutes or reports.
- Recommendations in 1995 and 1996 to bid for funding to the Public Awareness Unit for an education kit on *Dactylanthus* were not followed up.
- A poster was to be developed by the Recovery Group. This has not been progressed beyond an initial costing.

### **2.2.2 Conclusions**

Objective 2 has been largely achieved.

The profile of *Dactylanthus* has been raised considerably, both in the general public's eye and within DOC. This is mainly due to the effort by individual staff in each conservancy to foster the education and advocacy role surrounding conservation of the species and to fairly regular newspaper items and presentations at scientific and general meetings. In this regard, the success was not based so much on a co-ordinated approach, but on individual enthusiasm and good working relationships of group members.

Specific appeals made by conservancies for information from the public usually resulted in several to many leads from members of the public, some of which resulted in the location of previously unknown populations (see Objective 4).

*Dactylanthus* is now regarded as an important species in Resource Management Act matters and has been considered in granting consents for felling of pine trees where the species is present on understorey hosts (Holzapfel 2000). Carter Holt Harvey has become actively involved in protection by setting aside land with *Dactylanthus* populations (Holzapfel 2000).

Nine protected / managed sites are on land not managed by the Department (Oropi, Te Araroa (Kakanui), Tolaga Bay, Tawhiti, Frasertown, Robbie Ganges, Mokai station, Ngaurukehu and the original Taylor population). Two examples highlight the successful outcome:

**Te Araroa (EC/HB) *D. taylorii* project**—This project is carried out, with DOC funding, entirely on private (iwi) land. It ensures protection of one of the largest known populations of *Dactylanthus*. Because of its long-term focus it has gradually received increased support in the local community to the stage that the population is now regarded as a local taonga. This is in large part due to the active project management by the EC/HB conservancy staff and a full-time project manager at Te Araroa. Local and conservancy staff have involved the community from the initial stages of the project through discussions, hui and newsletters.

**Oropi (BOP) *D. taylorii* project**—This project protects an extensive population on District Council land in a water catchment. It is almost entirely run by volunteers, with DOC Tauranga Area staff providing the material, acting

as project supervisors and carrying out the monitoring of flower and fruit set. The level of protection achieved is of highest standard, which has been possible because of a well-developed network of volunteers at Tauranga Area office and a high level of enthusiasm generated around the conservation of *Dactylanthus*.

On the other hand, wood roses are still found for sale in a number of shops.

Despite the raised conservation profile of *Dactylanthus*, plants are still being dug up by collectors, with 30 clumps lost at one site (Pureora) alone over the last 5 years (see section 2.3.1). In some cases, the increased information about *Dactylanthus* appears to have led collectors to a specific site.

### 2.2.3 Recommendations

1. That this objective is carried over for future recovery planning.
2. That the current level of advocacy, information sharing (including press releases) and involvement of the public is maintained.
3. That support for the protection of populations on private or council land is continued, at least at the same level as currently operates (see also section 2.1.3, Recommendation 6)
4. That increased effort is put into the 'Friends of *D. taylorii*' network so it becomes a stronger group supporting the conservation of the species

## 2.3 OBJECTIVE 3

**Objective 3:** Advocate for the listing of *Dactylanthus* in CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) to prohibit the export of wood roses.

### *Explanation*

Collectors dig up *Dactylanthus* plants for interest and ornament, supplying wood roses for tourist and local markets. Listing under appendix I of CITES would help curtail the export of wood roses by tourists.

### *Plan*

At future CITES meetings, work towards inclusion of *Dactylanthus* in appendix I of CITES.

### *Outcome*

No export of *Dactylanthus* plants from New Zealand.

### *Key personnel*

Protected Species Policy Division.

### 2.3.1 Results

#### *CITES*

A proposal to include *Dactylanthus* in appendix I or II of CITES to ensure that international trade in the species does not threaten its survival was prepared by

Rod Hay on behalf of the New Zealand Government in 1994, with input from the Recovery Group.

Later that year the CITES Plant committee, and CITES delegates from Australia and certain European countries, favoured withdrawing the proposal for a range of reasons which included a perceived lack of: adequate legislation to protect *Dactylanthus* in New Zealand; trade in the actual plant (as only the host root is traded, while *Dactylanthus* has been destroyed and removed); and clear evidence of actual international trade. The Recovery Group leader was asked for information on international trade in the species, and the Recovery Group put in some effort to collate evidence.

The proposal was formally rejected on 18 November 1994. While the threat status was accepted by the reviewers, rejection was mainly on the grounds that no current legislation existed to prevent trade within New Zealand, and because of a lack of documentation of export figures.

### ***Other legislation***

Following the rejection of the CITES listing proposal, other forms of legal protection were investigated by the Recovery Group:

- The Native Plant Protection Act (1934) provides some power to disallow collection from land not administered by DOC without the owner's consent, provided that the species is not depleted in any one habitat. Fines of \$10 and \$20 were not seen by the Recovery Group as adequate to deter collection.
- The Forest Amendment Act (1993). The suitability of this act was investigated with the Ministry of Forestry in 1995. The Act was found to be unsuitable, as wood roses fall outside the definition of 'timber' in the Act, and because the Act does not cover the report of personal effects.

Because of the lack of current adequate legislation to protect *Dactylanthus*, and threatened plants in general, a number of recommendations have been made by the Recovery Group since 1995 advocating for new legislation. Recommendations included liaison with Protected Species Policy Division<sup>2</sup>, other Threatened Plant Recovery Groups and Biodiversity Recovery Unit (BRU).

Apart from initial discussions within the Department, these recommendations were not followed up by the Recovery Group. For example, a suggestion in 1997 by BRU that the Recovery Group take the issue of legal protection to the Central Policy Division for sounding out the Minister of Conservation was not followed up.

### ***Other***

Evidence was gathered from 1995 of sale and / or collection of wood roses to support any further attempts at legislative protection. Sale of wood roses has been reported on six occasions, involving seven different outlets and vendors,

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<sup>2</sup> On 10 January 2005 the Research, Development & Improvement Division (RD&I) of DOC came into being, following the reorganisation of STIS. Under this new structure, the Threatened Species Section and Threatened Species Science section largely replaced BRU. As this review deals mainly with events before the reorganisation, old Division / Section titles are retained when discussing their roles up until 2005.

mainly in the North Island, but including a large volume (30–40 wood roses) at a Christchurch market on two occasions.

Anecdotal evidence or reports from the public of large-scale collection of *Dactylanthus* for wood roses has come from several sources, including the East Coast, Pureora and Turangi, and as recently as 1999.

Confirmed evidence of wood rose collection has been found at five sites, including more than 30 plants from Pureora between 1996 and 1998. This information has been sent to Richard Hutchinson, CITES officer in DOC, in 1998 to support further any future CLE approach.

In 1998 a person was convicted of taking *Dactylanthus* from land administered by DOC at Pureora and fined \$2000. This was also the first prosecution for the theft of any threatened plant from land administered by DOC.

### 2.3.2 Conclusions

This objective has been fulfilled only so far as its work plan, but not in terms of the outcome sought. The formal CITES listing proposal was rejected. No adequate legislation is in place to protect *Dactylanthus* or any other threatened plant on land not administered by DOC.

### 2.3.3 Recommendations

1. That the objective is not maintained for further recovery planning.
2. That the Recovery Group explores a suitable objective to advance the development of adequate protection of threatened plants on all land.

## 2.4 OBJECTIVE 4

**Objective 4:** To obtain better information on the distribution, condition and trends of *Dactylanthus taylorii*.

### **Explanation**

*Dactylanthus* has been recorded in the past from many sites where it may still be present. Priority should be given to relocating old sites in Ecological Districts where it is currently not known to occur and to sites near or beyond the present limits of distribution such as Northland, East Cape, Hawkes Bay, Wellington and northwest Nelson. Given its apparent poor seed dispersal and the long isolation of widely separated sites, these areas are likely to have genetically different populations. Monitoring is essential for understanding the population trends and rates of change.

### **Plan**

Prepare a report for publication in the Ecological Management bulletin on survey methodology, collection of data at *Dactylanthus* sites and design of cages. For each location where *Dactylanthus* is found a rare plant survey form should be completed and sufficient details recorded to ensure the site can be relocated. Historic data will be distributed to relevant conservancies to follow

up but enquires should also be made to people likely to be familiar with *Dactylanthus* sites. The condition and trends of all protected populations should be monitored. The following areas which are listed by conservancy, are considered potential sites which could be worth surveying for *Dactylanthus*.

Northland Conservancy: Survey Omahuta Kauri Sanctuary and Waipoua Forest.

Auckland Conservancy: Survey sites near Mt Hobson (Great Barrier Island), at Warkworth and near the Huia Dam (Waitakeres).

Waikato Conservancy: Survey old sites on the Coromandel Peninsula between Port Charles and Cape Colville, near Crosby's Track (Kauaeranga Valley), Tawerau Forest, Headwaters of the Marokopa River and Hauhungaroa Range.

Bay of Plenty Conservancy: Survey possible sites in the Waiotahi Valley, near Lake Rotoiti, Maungawhakamana, Mt Edgecumbe, Mamaku Plateau, Te Kopia Scenic Reserve and near Pohokura (near Napier-Taupo Highway).

East Coast / Hawkes Bay Conservancy: Survey sites in the Waikura Valley, near Te Araroa at East Cape, Willow Flat (Mohaka) and sites near Waikaremoana. Survey sites near Puketitiri, above the Ngaruroro River near the Napier-Taihape Road and in the Ahimanawa Range near Tarawera.

Tongariro / Taupo Conservancy: Survey sites near Opopo Scenic Reserve and Kaimanawas (Access 10).

Wanganui Conservancy: Survey sites on the Pouakai Range and other areas of Egmont National Park, Mangamahu (Whangaehu Valley), Hihitahi Forest Sanctuary, Waitaanga Conservation Area and Ngaurukehu Scientific Reserve.

Wellington Conservancy: Survey sites near Kaitoke, and Karapoti Road in the Akatarawa Valley.

Nelson Conservancy: Survey potential sites between the Patarau and Anatori Rivers, and near the Anatoki Forks Hut, Anatoki Valley.

### ***Outcome***

This information will help fill the gaps in our knowledge of *Dactylanthus* distribution. Any sites found will be important for the genetic diversity research and potential sites for long-term protection. Monitoring will indicate trends and provide data showing whether further action is necessary for the population to survive.

### ***Key personnel***

All conservancies listed above, non-government organisations such as Botanical Societies, Maruia Society, Royal Forest & Bird Protection Society, and other members of the public.

## **2.4.1 Results**

### ***Distribution***

Considerable effort has gone into surveys for *Dactylanthus*. Appendix 3 gives a full list of surveys conducted between 1993 and 2001.

Between 1995 and 2001, information is on file for 97 surveys, of which at least 70 were successful. Twenty-nine of the successful surveys were extensions of

known populations, while 30 found populations at new sites. The remaining (21 populations) had no information available in this regard.

Between 1995 and 2001, 30 surveys (29 successful) were conducted based on known populations at or near the site, 10 on historic records (3 successful), 15 on leads from the public (8 successful), 3 on other leads such as suitable habitat type (2 successful) and 12 surveys (10 successful) were fortuitous searches carried out during other work.

In addition, 26 surveys (13 of which were successful in locating new plants) were conducted in 1993 and 1994, before the 1995–2000 Recovery Plan was formally produced. Most of these surveys were based on the increased level of co-ordination and communication among members of the Recovery Group in these first years before the plan was formally adopted. They are, therefore, listed here as well. The total number of surveys 1993–2001 is thus 123, of which 83 were successful (Fig. 8).

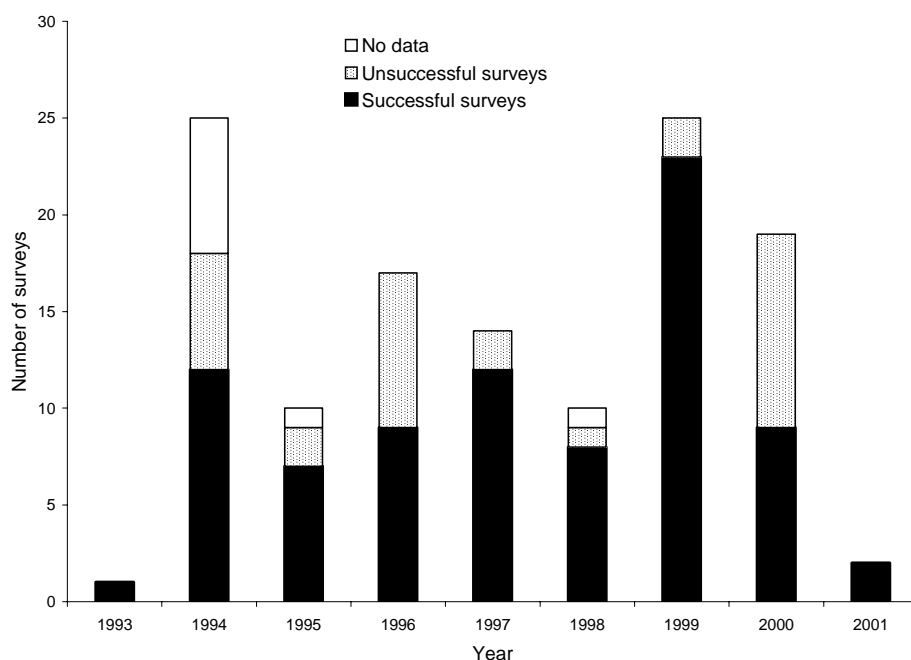
Ten of the 30 sites (33 %) listed as priority sites in the 1995–2000 Recovery Plan (Ecroyd 1995b) were surveyed (Anon. 2000).

It is evident from the extensive correspondence on file that historic records, and leads from public (often after a news item) have been distributed among conservancies. Most of the more recent leads have been followed up, however, some leads are still awaiting follow-up despite pointing to areas recognised as high priority for survey in the Recovery Plan.

As a consequence of the survey effort, the number of populations known today has increased from 12 in 1994, to 80 in 2001—a 6.7-fold increase (see Fig. 2).

Threatened Plant site record forms have been filled out for the majority of populations and are kept on file in the relevant conservancies, area offices and field centres. Where a new finding was an extension of an existing population, rather than an entirely new site, new site record forms may not always be completed.

Figure 8. Number of surveys conducted for *Dactylanthus taylorii* 1993–2001. Successful surveys are those where the species was found during the survey. Note: The data for 2001 only includes surveys up to July 2001.





Three articles on survey methodology have been published (Jones 1995; Holzapfel & Dodgson 2004; King & Atkins 2001). Jones (1995) also covered monitoring methods and cage design.

A novel gut sample survey technique using possums (King & Atkins 2001) was developed at Te Araroa and successfully used in several conservancies.

### ***Monitoring for condition and trend***

Monitoring has in most cases been conducted according to a standard monitoring form developed for the Recovery Group in 1994.

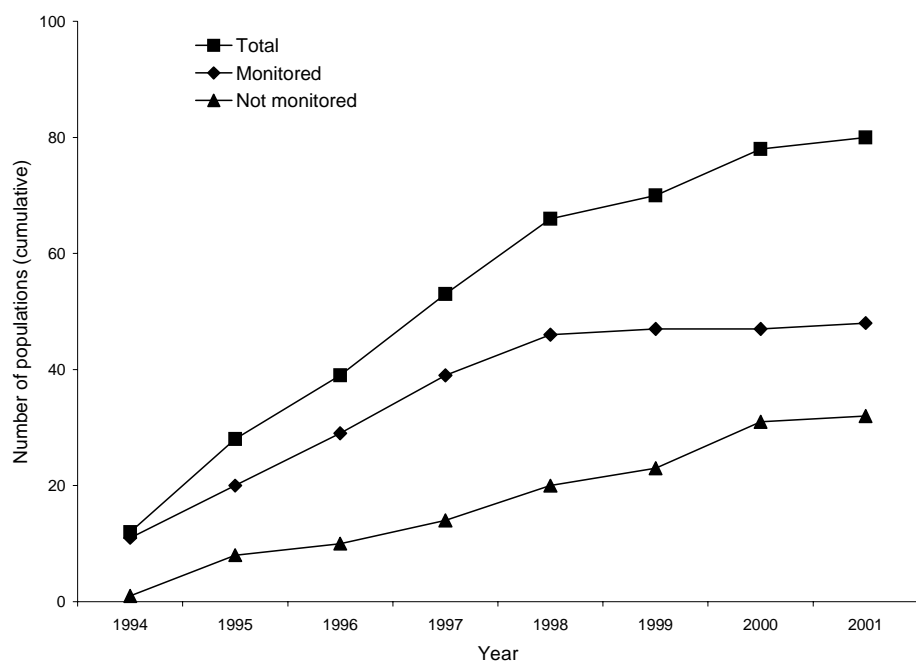
Forty-eight of the 80 known populations in 2001 (60%) were monitored regularly (Fig. 9). Monitoring was carried out for flower success (42 populations), fruiting success (43 populations), mortality (21 populations), or a combination of two or all three aspects in some populations. In 2000, a total of 1062 clumps (920 caged and 142 uncaged) were monitored.

The rationale for monitoring, and what minimum data should be collected, has been debated at nearly every Recovery Group meeting, reflecting the large effort that goes into monitoring by each conservancy and thus the desire to avoid unnecessary data collection.

Data was collected and analysed by each conservancy separately until 2000, using various approaches. In 1998, a standardised analysis was discussed for the first time. In 1999 a recommendation was passed to collate all monitoring data in one central place and analyse the entire set. A preliminary analysis was presented in 2000 and completed in 2001. Results will be presented in a scientific publication and have been summarised in this report under the review of Objective 1 (section 2.1.1).

Emphasis was shifted in 2000 from monitoring for flowering to fruit set, a consequence of a similar shift in emphasis of protection (see section 2.1.1

Figure 9. Number (cumulative) of monitored and unmonitored populations of *Dactylanthus taylorii* in New Zealand 1994-2001.



Results for Objective 1). At the same time, minimum standards for monitoring were recommended (Holzapfel 2000).

Monitoring for mortality has occurred in some conservancies only, and no monitoring for recruitment has occurred in any conservancy because of a lack of an established monitoring technique.

#### 2.4.2 Conclusions

This objective has been fulfilled to a large degree. Our knowledge of the current distribution has greatly increased due to a large survey effort, aided by novel, standardised techniques and leads from the public following news items. The most recent find of the first confirmed population in Northland since the early twentieth century serves as a good illustration of this point. Monitoring has not been undertaken at **all** populations, as stated in the objective, but at a sufficiently large number of populations, spread over all member conservancies, to allow an assessment of the condition and trends of populations. While this assessment is sufficient to demonstrate annual fluctuations in flowering and fruiting success, and differences between populations, it does not allow for assessment of mortality and recruitment in populations.

#### 2.4.3 Recommendations

1. That the objective shall be retained in a refined version to reflect the progress made since 1995.
2. That emphasis regarding the distribution of *Dactylanthus* shall be put into surveys of high-priority sites (Northland, mainland Auckland, Great Barrier Island, Coromandel, Wellington, Nelson, South Island West Coast) with no, or only very few, currently known populations despite historic records.
3. That a clear objective for continued monitoring shall be discussed in light of the analysis of data collected since 1995 and recommendations be made for a shift in monitoring, such as towards mortality and recruitment, the continuation of the existing minimum monitoring regime, or the cessation of monitoring at some or all sites.

### 2.5 OBJECTIVE 5

**Objective 5:** To carry out or promote research on the propagation, genetics, ecology and protection of *Dactylanthus taylorii*.

#### *Explanation*

Although seedlings of *Dactylanthus* have been established in cultivation, their growth rate has been very slow and only a very small percentage of the seed sown has germinated and established.

Currently, intensive long-term management of all *Dactylanthus* sites is impractical due to the number of sites. Information on the genetic diversity of the species could allow insight into patterns of gene flow and contribute to a

selection of sites to be managed so that a representative portion of the species diversity is protected.

There is a need for new methods to protect plants from possums because wood rose collectors have found plants protected with exclosures, and methods such as trapping, using cyanide or aerial application of 1080 poison have serious disadvantages in many situations. Research is required to determine the effects of different densities of possums on flowering and seeding. The effects of other introduced animals such as rats, deer and goats also needs further research. The effectiveness of animals other than short-tailed bats as pollinators needs to be studied.

### ***Plan***

To fund / support research on:

- The propagation and genetic diversity of *Dactylanthus*
- *Dactylanthus* ecology
- Repellents, and various methods of reducing possum numbers using the presence of seed on *Dactylanthus* plants as an indicator of success. Accurate details need to be kept of any possum control operation in a *Dactylanthus* area and notes kept on the quantity of *Dactylanthus* seed produced.

### ***Outcome***

Improved cultivation techniques, faster seedling growth rates and better methods for controlling possums which could have benefits for a wide range of plants and animals. Increased understanding of the genetic diversity of *Dactylanthus* and information to assist the careful selection of sites to be managed over the long term, in order to maintain the genetic diversity and thereby the resilience of the population.

### ***Key personnel***

Science & Research Division, Estate Protection Policy Division, North Island Conservancies, John Barkla (co-ordination of monitoring on possum control operations), Chris Ecroyd, universities, nurserymen.

## **2.5.1 Results**

Fifteen research projects, of various sizes, were undertaken and published on a range of topics (Appendix 4). At least two planned research projects did not eventuate. Oral presentations or posters presented at scientific conferences are listed under Results (section 2.2.1) for Objective 2.

## **2.5.2 Conclusion**

This objective has been fulfilled to a large degree.

There has been a significant realisation of research on *Dactylanthus*. Funding sources, both from within DOC and from external sources, have been utilised to achieve this outcome. Research uptake has been good, facilitated mainly through close contact of the Recovery Group with researchers.

Research on the link between possum densities and success of *Dactylanthus* flowering and seeding (as listed under this objective in the 1995–2000 Recovery Plan) has not been formally undertaken (see Objective 1).

A number of new research questions have been generated within the last few years, some based on results of research undertaken. In particular, questions of seed distribution, the role of introduced and native fauna species as pollinators, recruitment and mortality of *Dactylanthus* and impact of pigs warrants closer investigation in light of the results of genetic diversity of *Dactylanthus*.

### 2.5.3 Recommendations

1. That a bibliography of papers on *Dactylanthus* and topics related to its management is compiled and published. A possible venue for publication could be the intranet or DOC internet web pages on threatened plants, and the BioWeb threatened plants database.
2. That results from research carried out so far on *Dactylanthus* be considered in all aspects of conservation management of the species, including advocacy and information transfer within DOC.
3. That results from the above research be considered for future recovery planning for *Dactylanthus*.
4. That an objective 'to carry out or promote research on *Dactylanthus*' be maintained in any new Recovery Plan for the species, and that this objective lists those questions that have not, or not adequately, been answered by previous research (see suggestions in Anon. 1999; Holzapfel 2000).

## 2.6 OBJECTIVE 6

**Objective 6:** Establish *Dactylanthus taylorii* on at least one island free of kiore and possums.

### *Explanation*

It may be difficult to ensure long-term survival of *Dactylanthus* on the mainland, even with possum control, and establishing the species on islands could be an effective means for conserving the species. However, pollinators such as the short-tailed bat should be present, otherwise hand pollination may need to be carried out. Transferring *Dactylanthus* to such sites, and subsequent monitoring, would be of interest to members of the public and their involvement should be encouraged.

### *Plan*

To eradicate kiore from Hauturu / Little Barrier Island and to select other islands free of possums and kiore but with suitable habitat for *Dactylanthus*, and to sow seed close to potential host roots or transfer infected host plants. Suggested islands include: Taranga (Hen), Lady Alice, and Whatupuke (Northland Conservancy), Fanal and Tiritiri (Auckland Conservancy), Cuvier, Red Mercury and Stanley (Waikato Conservancy), Mokoia and Mayor (Bay of Plenty Conservancy), Kapiti (Wellington Conservancy), Chetwodes (Nelson

Conservancy). Islands must have an abundance of suitable host species, habitat which does not suffer severe drought, suitable pollinators present and no possums or kiore. The tangata whenua should be consulted before any transfers are undertaken and the nearest seed source should be used. A trial introduction of *Dactylanthus* should be attempted on at least one of these islands during the term of this plan.

### **Outcome**

*Dactylanthus* will be secure from browsing damage at one or more sites.

### **Key personnel**

Northland, Auckland, Waikato, Bay of Plenty, Wellington and Nelson conservancies, tangata whenua, non-government organisations, and other members of the public.

## **2.6.1 Results**

*Dactylanthus* seeds have been transferred to three islands which are free of possums and rats (all species): to Tiritiri Matangi, Auckland Conservancy (in 1998); to Whanga o Keno (East Island), East Coast / Hawkes Bay Conservancy (in 1999); and to Mokoia Island, Bay of Plenty Conservancy (in 2000).

At the time of writing (2001), no establishment of *Dactylanthus* on any of the three sites had been confirmed. Given the long time expected between sowing and flowering (8 years in the only successful previous trial, see Anon. 1998) any confirmation is not expected before 2006, or even later.

Removal of kiore from Hauturu / Little Barrier Island has been planned for several years by Auckland Conservancy. If undertaken successfully, this would fulfil the objective, given that *Dactylanthus* is present in considerable numbers on the island. While, strictly speaking, no population of *Dactylanthus* would have been established on the island following the removal of kiore, the outcome would be identical to that stated under this objective.

No clear time frame is given for removal of kiore from Hauturu / Little Barrier Island. Auckland Conservancy requested a statement of support for the removal from the *Dactylanthus* Recovery Group and this was submitted in December 1998.

## **2.6.2 Conclusions**

The objective, work plan and outcome are ambiguous. The stated objective is to 'establish *D. taylorii* on at least one island ...', while the work plan refers to sowing seeds [on suitable islands] only, and specifies that 'a trial introduction ... should be attempted on at least one of these islands during the term of this plan'. The stated outcome, in turn, refers clearly to a secure (and, therefore, successfully established) population.

The work plan has been achieved in terms of trial introductions, through the sowing of seeds. However, the objective itself, and the desired outcome, has not been achieved. This will only be the case if the establishment of both male

and female plants and subsequent successful pollination, seed set and recruitment is confirmed on at least one island free of possums and kiore.

The second part of the work plan, referring to the removal of kiore from Hauturu / Little Barrier Island, has not been achieved. As this issue is not under the mandate of the Recovery Group it should not have been included in the work plan and only a reference to this project should have been made.

### 2.6.3 Recommendations

1. That the objective is maintained for future recovery planning.
2. That the work plan is changed to reflect the shift from trial introductions to monitoring of establishment, seed set and recruitment.
3. That further introductions are encouraged to other suitable islands, given the long time expected between sowing and flowering. The risk of wasted effort in the case of unsuccessful sowings is seen as smaller than the risk of nine years (or longer) lapsing before further introductions are made.
4. That reference is made to the use of the Translocation SOP (QD no. NH 1042, DME: WGNRO-13668)<sup>3</sup> for any movement of seeds.
5. That in a new work plan reference is made to findings of the genetics research (Holzapfel et al. 2002) and its implications on the issue of eco-sourcing of *D. taylorii* seeds.
6. That reference is made to the planned kiore removal on Hauturu / Little Barrier Island, and support is stated for such an undertaking. Emphasis in discussions regarding management of kiore should be on overall ecosystem benefits.
7. That introductions to possum- and rat-free environments (islands) are extended to sites where these species are controlled to levels adequate for *Dactylanthus* flowering on a long-term basis ( e.g. Karori mainland island and other mainland island sites).

## 2.7 OBJECTIVE 7

**Objective 7:** Establish *Dactylanthus taylorii* plants in cultivation for transfer purposes, research and public education, and establish a seed bank.

### *Explanation*

Plants should be grown in cultivation and a seed bank established to support conservation of the species diversity, supply plants for establishment on islands, and provide material for scientific study and for advocacy purposes.

### *Plan*

To establish a seed bank and cultivate plants in appropriate plant collections, but not to start a commercial trade in this species. Before a seed bank can be established research is needed to devise suitable germination tests and to find the best ways to store the seed.

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<sup>3</sup> Documents available to DOC staff on the Department's internal website.

### ***Outcome***

Plants established in cultivation would be used for transfers to islands, research, display, and together with the seed bank, help ensure that some of the genetic diversity of the species survives.

### ***Key personnel***

Chris Ecroyd (FRI, Rotorua), New Zealand Botanic Garden Network (Mike Oates).

## **2.7.1 Results**

### ***Cultivation***

Plants have been established in cultivation by Chris Ecroyd (FRI, Rotorua). The scale of establishment is very small (4–6 plants), and is more a demonstration of the possibility of cultivation rather than cultivation on a scale sufficient to achieve the objective. Given the long time that can be expected between sowing and establishment (see section 2.6.1), the Recovery Group has decided that any transfer of plants would be carried out using seeds rather than established plants (Anon. 1999).

Cultivation for advocacy purposes or as ex-situ populations of Botanic Gardens has not been undertaken or promoted. The Recovery Group has discussed this issue on several occasions (Anon. 1999; Holzapfel 2000) and has made a conscious decision not to progress these aspects of the objective further. The reasons for this decision included the perceived risks of creating a demand for *Dactylanthus* and, in turn, wood roses that might increase collecting pressure on wild populations; and that interest and support for the conservation of the species in the wild would decrease if plants were also in cultivation

### ***Seed bank***

No seed bank at a central locality has been established for *Dactylanthus*. Storage of seed has been discussed (Anon. 1995), and recommendations passed by the Recovery Group that each year seeds from 3–5 inflorescences per population should be collected and stored for one year, as a supply for transfer / restoration purposes.

While some seed is in storage at various locations (Holzapfel 2001a), collection of seeds has not been undertaken in a co-ordinated manner, and little documentation exists regarding the various holdings. A confounding issue has been the lack of a national seed bank scheme for plants in general, since discontinuation of the DSIR scheme in 1994.

The Recovery Group has reviewed this part of the objective and has recommended that no formal seed bank is to be established for *Dactylanthus*, as seed is readily available in the field from managed populations and its supply is not seen as at risk as long as management of populations continues (Anon. 1999; Holzapfel 2000).

## **2.7.2 Conclusions**

This objective has not been fulfilled. The reasons for this include:

- A change, by the Recovery Group from transfer of entire plants to seed transfer as the preferred method for restoration / translocation
- A conscious decision not to encourage cultivation
- No effort being made to establish a seed bank, as seed appeared to be readily available in the field

### 2.7.3 Recommendations

1. That cultivation in Botanical Gardens for advocacy and research purposes is discussed as a possible objective for future recovery planning, in consultation with all stakeholders (including iwi) and under consideration of practical, scientific and spiritual aspects.
2. That the establishment of a seed bank for *Dactylanthus* is discussed fully for future recovery planning, including a risk analysis of relying on seed production in the wild.
3. That cultivation of plants for establishment of populations (e.g. on islands) is not included as an objective for future recovery planning.

## 2.8 GENERAL FINDINGS

A number of general findings, unrelated to specific objectives in the 1995–2000 Recovery Plan, are briefly discussed below.

The Recovery Group members have worked well together as a team and within their individual conservancies. Tasks and action points allocated during Recovery Group meetings were usually followed up within the following year. Formal minute keeping, and a review of progress of action points and matters and decisions made at the next meeting have assisted monitoring the outcome of decisions.

Minutes of Recovery Group meetings were most useful when distributed shortly after the meeting. Failure to do so for the 1998 minutes resulted in incomplete documentation of the 1997/98 conservancy reports for all members and some confusion over assigned tasks. However, a strong awareness and history of recovery planning for *Dactylanthus* within each conservancy meant that work was continued in a co-ordinated way.

The development of the Standard Operating procedure for Recovery Planning (Brown & Molloy 1999) assisted with structuring the meetings, reporting, identification of responsibilities for members / leader / lead conservancy / lead region, and in undertaking the present review.

Formal distribution and response to recommendations through the Annual Conservation Directions for 2000/2001 has worked well to ensure the national approach of recovery planning is supported on all levels.

The involvement of key field staff and specialists in all phases of the recovery planning for *Dactylanthus* is seen as a real strength and reason for a cohesive, realistic and successful management, including key findings such as the novel possum gut survey technique (see section 2.4.1). Structuring Recovery Group meetings to include a training session for field staff, and holding the annual meeting in a different member conservancy each year has resulted in a strong



awareness of the species throughout all member conservancies, and a high expertise of field staff not directly involved in the formal recovery work. By 2001, all member conservancies had hosted at least one annual meeting, and an estimated 100 field staff had participated in field training sessions.

The threat status of *Dactylanthus* was changed twice during the course of the 1995–2000 Recovery Plan, from ‘Vulnerable’ to ‘Endangered’ in 1995 (Cameron et al. 1995) and from ‘Endangered’ to ‘Recovering (Conservation Dependant)’ in 1999 (de Lange et al. 1999). The latter change did not involve input from the Recovery Group, who were not aware that a change in status was being considered by the authors. In at least one conservancy (Wanganui) a consequence of the status change was that work on *Dactylanthus* was immediately reduced, despite the qualifier ‘Conservation Dependant’ attached to the new status.

In 1999 the Recovery Group undertook a trial of the new threat classification developed by BRU<sup>4</sup> with *Dactylanthus* as a test case, confirming its status as critically endangered (3 criteria) or outside the threatened category (2 criteria). Findings were communicated to BRU in 1999 (Anon. 1999). The new threat status provisionally allocated at the time of writing (November 2001) is ‘Threatened—Gradual Decline’, with attached qualifiers ‘Conservation Dependant’ and ‘Recruitment Failure’.

### 2.8.1 Recommendations

1. That recovery planning for *Dactylanthus* continues to follow the formal structure developed over 1999/2000 and which is also laid out in the Standard Operating Procedure for species recovery (Brown & Molloy 1999) regarding aspects of meeting / reporting / reviewing requirements and responsibilities.
2. That in addition to one full Recovery Group member for each member conservancy key field staff and specialists continue to be involved in recovery planning for *Dactylanthus* on all levels, including their presence at Recovery Group meetings. The latter is to be decided on a needs basis for each meeting and in consultation with individual staff managers.
3. That meeting frequency and venue be discussed for future recovery planning.
4. That the Recovery Group will prepare a submission for future revisions of the threatened and uncommon plant lists.
5. That the threat status for *Dactylanthus* as identified in the new DOC threat classification (Hitchmough 2002) will be taken into account for future recovery planning.

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<sup>4</sup> See footnote 2 and section 1.3.1 for reorganisation of BRU, post 10 January 2005.

### 3. Discussion

The recovery programme for *Dactylanthus* has been very successful overall. The number of populations and plants protected today is several times larger than before planning began. Information gathered on the ecology of the species and results from standardised monitoring have improved assessment of the status of the species and the impact of recovery work plans. Advocacy and community-run projects are an integral part of all conservancies involved, and have brought the species and its situation into the consciousness of the public. Future recovery planning will build on these achievements.

Surveys have succeeded in locating a considerable number of populations where protection can be undertaken and has demonstrated that, without protection, the chances for any plant to set fruit are close to zero. Ongoing recovery planning, with a particular emphasis on recruitment, will be vital to ensure the survival of the species. The new threat classification system has recognised recruitment failure as one chief cause for the ongoing decline of the species and the dependency on sustained conservation efforts to maintain or improve the current threat status. This review has confirmed the status of *Dactylanthus* as threatened, and has been able, through synthesis of the available information, to refine existing objectives or create new ones for future recovery planning. A national approach to the recovery of *Dactylanthus*, as exercised by the Recovery Group, is the best way to co-ordinate and communicate approaches in all participating conservancies.

### 4. Overall recommendations

Five overall recommendations can be made, on the basis of the current review:

1. That a new recovery plan should be prepared for *Dactylanthus*, taking into account findings and recommendations of this review.
2. That a new recovery plan should list an overall vision, goals and objectives for the recovery of the species, with clearly defined targets under each objective to allow assessment of whether, and when, a goal has been reached.
3. That the main part of any new recovery plan should consist of the planned work programme for the next 5 years in each member conservancy.
4. That these work plans are presented to the *Dactylanthus* Recovery Group and agreed to in regard to priority sites and actions as recommended in this review.
5. That iwi, through the Kaupapa Atawhai manager network, be invited to comment on planned work and to submit further suggestions for work to be undertaken

## 5. Acknowledgements

This review would not have been possible without the constant assistance and enthusiasm of all members past and present of the *Dactylanthus* Recovery Group, including observers and specialist advisors. Dave Hunt made valuable comments on the finer points of recovery planning and review writing in general, and Elaine Court diligently typed the hand-written notes into legible text. All Recovery Group members and observers and Des Williams reviewed earlier drafts and made valuable suggestions for its improvement. And finally, my managers and ‘the line’ supported me in working on the recovery of *Dactylanthus*, and proceeding with this review.

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# Appendix 1

## STANDARDISED SPREADSHEETS HEADINGS FOR CONSERVANCY MONITORING DATA

### Spreadsheet 1—General site information

Name of Conservancy:	
Population (name):	
Location (name):	
Area Office (name):	
Grid reference (7 digits)	Easting: Northing:
Elevation range (m):	
Population known since (year):	
Live clumps known in 2000 (number):	
Dead clumps known in 2000 (number):	
Method of protection:	
Caged clumps in 2000 (number):	
Monitored for (tick)	Flowering: Fruiting: Mortality:
Short tailed bats present (yes/no):	
Other notes:	

## Spreadsheet 2—Monitoring information

(for monitored populations only)

Name of Conservancy:	
Population name:	
Grid reference (7 digits)	Easting: Northing:
Year of assessment:	
Monitored clumps (number)	Caged: Uncaged:
Monitored clumps flowering (number)	Caged: Uncaged:
Number of intact flowering inflorescences/buds:	
Caged:	♂ m: ♀ f: unknown/buds:
Uncaged:	♂ m: ♀ f: unknown/buds:
Date of flowering assessment:	
Monitored clumps with browse (number)	
	Caged: Uncaged:
Monitored clumps with fruit (number)	
	Caged: Uncaged:
Number of seedheads and quality of their seedset	
Caged:	light: medium: heavy: unknown:
Uncaged:	light: medium: heavy: unknown:
Date of seed set assessment:	
Hand pollination carried out? (yes / no / some):	
Mortality of monitored clumps (number)	
	Caged: Uncaged:
Disappearance (and cause) of clumps (number)	
Collection:	Caged Uncaged:
Pigs:	Caged: Uncaged:
Unknown / other causes:	Caged: Uncaged:
Wild animal control prior to flowering season (type of control / none):	
Residual trap catch rate (possums/100 TN):	
Rat tracking index (% tracking):	
Other notes:	

# Appendix 2

## QUESTIONNAIRE FOR DATA ON SURVEYS, PUBLICITY, AND EVIDENCE OF WOOD ROSE SALES

### Conservancy sites surveyed

CONSERVANCY NAME:						
YEAR OF SURVEY	SITE NAME	LOCALITY (7 digits)*		REASON <sup>†</sup> FOR CHOICE OF SITE	<i>Dactylanthus</i> LOCATED (yes / no)	OTHER NOTES
		EASTING	NORTHING			

\* Grid references should be in 7-digits, i.e. include base digits (found at lower left hand corner of maps) and with two zeros added after grid reference (for 10 and 1 meter scale, which we do not cover). For example, a 'normal' Grid reference (Easting) would have been '937'. However, '26' is added in front (from base reference found in corner of the map sheet), and '00' is added at the back (for all references).

† Examples of reasons: Historic site, new information (e.g. from public), extension of known population.

### Publicity, advocacy, and CITES information

CONSERVANCY:				
NUMBER OF NEWSPAPER ARTICLES, etc. ON <i>Dactylanthus</i> SOLICITED FROM CONSERVANCY	NUMBER OF SHOPS / OUTLETS/ PRIVATE INDIVIDUALS BROUGHT TO ATTENTION FOR SELLING <i>Dactylanthus</i> WITHIN THE CONSERVANCY	NUMBER OF THESE SITES CONTACTED/ VISITED	OUTCOMES (e.g. NUMBER OF OUTLETS WHICH HAVE CEASED SALE OF <i>Dactylanthus</i> )	OTHER NOTES

# Appendix 3

## SURVEYS FOR *Dactylanthus taylorii* CONDUCTED 1993–2001

LOCATION SURVEYED	CONSERVANCY <sup>1</sup>	YEAR	MONTH <sup>2</sup>	EFFORT	PLANTS FOUND (yes/no)	LEAD <sup>3</sup>					REFERENCE <sup>4</sup>	LISTED <sup>5</sup> (yes/no)
						k	h	p	o	f		
Puketi	NOR	2001	3		yes					x		no
Puketi	NOR	2001	3		yes	x						no
Hunua Ranges	AUCK	2000			no			x			2000 RG minutes	no
Little Barrier Island	AUCK	2000	4	4 staff, 13 days	yes	x					2000 RG minutes	no
Waitakere Ranges (ARC)	AUCK	2000		1 staff, 3 days	no			x			2000 RG minutes	yes
Belk Road	BOP	2000	7		no			x			2000 RG minutes	no
Otanewainuku Forest	BOP	2000			no						2000 RG minutes	no
Te Kopia (Paeroa Range)	BOP	2000	2		yes	x					2000 RG minutes	yes
Whirinaki (Pukeroa Rd)	BOP	2000	3		yes	x			x		2000 RG minutes	no
Oropi	BOP	2000	2		yes	x					2000 RG minutes	no
Te Araroa	ECHB	2000		lineal km surveyed extended to >100 km	yes	x					2000 RG minutes	yes
Tokomaru Bay	ECHB	2000			yes						2000 RG minutes	no
Wairoa	ECHB	2000			yes						2000 RG minutes	no
Raetea Forest (Omahuta?)	NOR	2000	3 & 4	1200 trap nights	no			x			2000 RG minutes, also conservancy review table WAICO-12906	yes
Hakarimata Range	WAIK	2000			no						2000 RG minutes	no
Maungakawa SR	WAIK	2000			no						2000 RG minutes	no
Mt Pirongia	WAIK	2000	2	2 staff, 4 volunteers, 5 days	yes	x					Waikato CO file FLO 009-3-48	no
Te Kauri Park	WAIK	2000			no			x			2000 RG minutes	no
Mt Egmont	WANG	2000			no						2000 RG minutes	yes



LOCATION SURVEYED	CONSERVANCY <sup>1</sup>	YEAR	MONTH <sup>2</sup>	EFFORT	PLANTS FOUND (yes/no)	LEAD <sup>3</sup>					REFERENCE <sup>4</sup>	LISTED <sup>5</sup> (yes/no)
						k	h	p	o	f		
Taylor's population, site 1	WANG	2000	5		yes		x	x			2000 RG minutes	
Taylor's population, site 2	WANG	2000	5	6 staff, 4 hours (c.)	no		x				2000 RG minutes	
Waitaanga pines	WANG	2000			yes	x					2000 RG minutes	yes
Waitakere Ranges (ARC)	AUCK	1999			no		x				1999 RG minutes	yes
Oropi	BOP	1999	2	40 volunteers and staff	yes	x					1999 RG minutes	no
Te Kopia (Paeroa Range)	BOP	1999			yes	x					1999 RG minutes	yes
Te Whaiti Maori land	BOP	1999	8		yes			x			WAICO-12951 conservancy review table	no
Waione Frost Flats, Minginui	BOP	1999	8		yes	x					1999 RG minutes	no
Waione Frost Flats, Minginui	BOP	1999		1 volunteer, several days	yes				x		1999 RG minutes, also WAICO-12951 conservancy review table	no
Ahipura	EC/HB	1999			yes	x					1999 RG minutes	no
Frasertown (Wairoa)	EC/HB	1999			yes						1999 RG minutes	no
Makino (Kaweka)	EC/HB	1999			yes						1999 RG minutes	no
Paoreone	EC/HB	1999			yes						1999 RG minutes	no
Stoney Creek (Tarawera)	EC/HB	1999			yes	x					1999 RG minutes	yes
Tawhiti	EC/HB	1999			yes						1999 RG minutes	
Te Araroa	EC/HB	1999		20% increase in surveyed area	yes						1999 RG minutes	yes
Tolaga Bay	EC/HB	1999			yes	x					1999 RG minutes	no
Kakaramea	T/T	1999			yes			x			Waikato CO file Waikato CO file FLO 009-3-17	no

<sup>1</sup> Abbreviations used for conservancies are as follows: Northland (NOR), Auckland (AUCK), Waikato (WAIK), Bay of Plenty (BOP), Tongariro/Taupo (T/T), East Coast/Hawkes Bay (EC/HB), Wanganui (WANG), Wellington (WELL), Nelson/Marlborough (NELS/MARL).

<sup>2</sup> Months: 1 = January, 2 = February, etc.

<sup>3</sup> Lead: k = known plants in vicinity, h = historic record, p = information from the public, o = other leads, f = fortuitous survey, no entry = no data available.

<sup>4</sup> As Recovery Group minutes are mostly unpublished and anonymous, these are not listed as formal references here, but can be obtained by contacting the *Dactylanthus* Recovery Group. Addresses for DME documents are given, where relevant.

<sup>5</sup> 'Listed' means listed in *Dactylanthus* Recovery Plan, Objective 4 (Ecroyd 1995b).

LOCATION SURVEYED	CONSERVANCY <sup>1</sup>	YEAR	MONTH <sup>2</sup>	EFFORT	PLANTS FOUND (yes/no)	LEAD <sup>3</sup>					REFERENCE <sup>4</sup>	LISTED <sup>5</sup> (yes/no)
						k	h	p	o	f		
Mt Pirongia	WAIK	1999	1	2 staff, 1 volunteer, monitoring team, (6 days)	yes	x					Waikato CO file FLO 009-3-43	no
Te Kauri Park	WAIK	1999	2	4 staff	no		x				Waikato CO file FLO 009-3-31	
Whareorino	WAIK	1999			yes					x	Waikato CO file FLO 009-3-19	no
Hihitahi	WANG	1999			yes	x					1999 RG minutes	yes
Mokai Station	WANG	1999			yes						1999 RG minutes	
Mt Egmont	WANG	1999			yes					x	1999 RG minutes	yes
Mt Egmont (2 sites)	WANG	1999			yes						1999 RG minutes	yes
Ruahine FP	WANG	1999			yes	x					1999 RG minutes	
Taihape SR	WANG	1999			yes						1999 RG minutes	
Titirangi SR	WANG	1999			yes						1999 RG minutes	
Little Barrier Island	AUCK	1998	4	4 staff, 5 days	no data		x				Waikato CO file FLO 009-2-56	no
Little Barrier Island	AUCK	1998	5		yes					x	Waikato CO file FLO 009-2-73	no
Pukerimu EA (across stream)	BOP	1998			no	x				x	WAICO-12951 conservancy review table	no
Oropi	BOP	1998	11		yes			x				no
Te Kopia (Paeroa Range)	BOP	1998			yes	x					WAICO-12951 conservancy review table	yes
Stoney Creek (Tarawera)	EC/HB	1998			yes					x		yes
Mt Pirongia	WAIK	1998	2	2 staff, 4 volunteers	yes	x					Waikato CO file FLO 009-2-57	no
Waihaha/Nuffield track	WAIK	1998	2		yes					x	Waikato CO file FLO 009-2-74	no
Whareorino	WAIK	1998			yes	x					Waikato CO file FLO 009-3-13	no
Dress Circle Reserve	WANG	1998	6		yes						Waikato CO file FLO 009-2-77	
Little Barrier Island	AUCK	1997	5		yes	x						no
Taumata SR	BOP	1997	7		yes			x			Waikato CO file FLO 009-2, 1997 CO report	no
Te Kopia (Paeroa Range)	BOP	1997	4		yes	x					WAICO-12951 conservancy review table	yes
Whirinaki F.P. (near Minginui)	BOP	1997	5		yes		x				Waikato CO file FLO 009-2, 1997 CO report	no

LOCATION SURVEYED	CONSERVANCY <sup>1</sup>	YEAR	MONTH <sup>2</sup>	EFFORT	PLANTS FOUND (yes/no)	LEAD <sup>3</sup>					REFERENCE <sup>4</sup>	LISTED <sup>5</sup> (yes/no)
						k	h	p	o	f		
Whirinaki F.P.												
(Totara Salvage Rd)	BOP	1997	6		no		x				Waikato CO file FLO 009-2, 1997 CO report	no
Makino River	ECHB	1997			yes			x			Waikato CO file FLO 009-2, 1997 CO report	no
Te Araroa	ECHB	1997		20 lineal km	yes	x						yes
Kotukunui	WAIK	1997			yes					x	Waikato CO file FLO 009-2-23	no
Mt Pirongia	WAIK	1997	1	2 staff, 4 volunteers, 6 days	yes	x					Waikato CO file FLO 009-2-12, also 1997 RG minutes	no
Whareorino	WAIK	1997			yes					x	1997 RG minutes	no
Mangaweka (5 sites)	WANG	1997			no					x	1997 RG minutes	
Motutara	WANG	1997			yes	x					1997 RG minutes	
Mt Egmont (5 sites)	WANG	1997			yes						1997 RG minutes	yes
Waitaanga	WANG	1997		brief survey	yes	x					1997 RG minutes	yes
Te Kopia (Paeroa Range)	BOP	1996			yes			x			Waikato CO file FLO 009-2, 1996 CO report	yes
Te Araroa	ECHB	1996		25-30 lineal km	yes	x					Waikato CO file FLO 009-2-24	yes
Anatori River coast	NELS/MARL	1996			no						WAICO-12963 Conservancy review table	
Sandhills Creek	NELS/MARL	1996	8	9.5 person days, staff	no			x			1996 RG minutes	
Berghan Point (Mangonui)	NOR	1996			no						1996 RG minutes	
Omahuta	NOR	1996		4 person days	no			x			1996 RG minutes	yes
Paranui	NOR	1996			no						1996 RG minutes	
Mt Tohua	WAIK	1996	3	2 staff, 1 day	yes	x					Waikato CO file FLO 009-2-14	no

<sup>1</sup> Abbreviations used for conservancies are as follows: Northland (NOR), Auckland (AUCK), Waikato (WAIK), Bay of Plenty (BOP), Tongariro/Taupo (T/T), East Coast/Hawkes Bay (EC/HB), Wanganui (WANG), Wellington (WELL), Nelson/Marlborough (NELS/MARL).

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LOCATION SURVEYED	CONSERVANCY <sup>1</sup>	YEAR	MONTH <sup>2</sup>	EFFORT	PLANTS FOUND (yes/no)	LEAD <sup>3</sup>					REFERENCE <sup>4</sup>	LISTED <sup>5</sup> (yes/no)
						k	h	p	o	f		
Pukeokuhu	WAIK	1996	3		yes						Waikato CO file FLO 009-2-11	no
Pureora	WAIK	1996			yes						1996 RG minutes	no
East Egmont	WANG	1996			no							yes
Mangonui	WANG	1996			yes	x						
Maude Track	WANG	1996			yes							yes
Motutara	WANG	1996		2 students, 7 days	yes							
Paengaroa SR	WANG	1996			no					x		
Pouakai	WANG	1996			yes					x		yes
Akatarawas	WELL	1996			no						1996 RG minutes	
Hongis Track	BOP	1995			yes		x				WAICO-12951 conservancy review table	yes
Tutukau Maori Block	T/T	1995			yes		x				Waikato CO file FLO 009-2 , 1995 CO report	no
Omahuta	NOR	1995			no		x				Waikato CO file FLO 009 -1	yes
Victoria Valley	NOR	1995			no		x				1995 RG minutes, also Waikato CO file FLO 009-1-34	no
Ohakune	T/T	1995			yes							no
Opoto SR	T/T	1995			yes							no
Pihanga (Southern slopes)	T/T	1995			yes							no
Mt. Pirongia	WAIK	1995	3		yes	x						no
Mangamahu	WANG	1995			no data							yes
Rangitiki	WANG	1995			yes					x		
Kaweka FP	EC/HB	1994			yes	x						no
Te Araroa	EC/HB	1994	9		no data			x			1994 RG minutes	yes
100 Acre Bush	T/T	1994			yes	x					1994 RG minutes	no
Erua Forest (Middle Road)	T/T	1994			no						1994 RG minutes	no
Erua Road	T/T	1994			no data						1994 RG minutes	no
Fisher's Road	T/T	1994			no data						1994 RG minutes	no
Hinemaiaia	T/T	1994			yes	x					1994 RG minutes	no

LOCATION SURVEYED	CONSERVANCY <sup>1</sup>	YEAR	MONTH <sup>2</sup>	EFFORT	PLANTS FOUND (yes/no)	LEAD <sup>3</sup>					REFERENCE <sup>4</sup>	LISTED <sup>5</sup> (yes/no)
						k	h	p	o	f		
Last Spike (SH4)	T/T	1994			no						1994 RG minutes	no
National Park Substation	T/T	1994			no data						1994 RG minutes	no
Opepe	T/T	1994			yes						1994 RG minutes	no
Opepe	T/T	1994			yes	x					1994 RG minutes	no
Pakuri SR	T/T	1994			no						1994 RG minutes	no
Pihanga	T/T	1994			yes	x					1994 RG minutes	no
Raurimu	T/T	1994			no data						1994 RG minutes	no
Tihia (Maungakotote SR)	T/T	1994			no						1994 RG minutes	no
Tirohanga	T/T	1994			no						1994 RG minutes	no
Waituhi-Kuratau	T/T	1994			yes	x					1994 RG minutes	no
Whakaipo	T/T	1994			yes						1994 RG minutes	no
Maralopa	WAIK	1994			no data						1994 RG minutes	no
Mt Pirongia	WAIK	1994			yes	x					1994 RG minutes	no
Pureora	WAIK	1994			yes						1994 RG minutes	no
Waipapa	WAIK	1994			no						1994 RG minutes	no
Waitomo	WAIK	1994			no data						1994 RG minutes	no
Egmont National Park (several locations)	WANG	1994			yes							yes
Waitaanga	WANG	1994			yes	x						yes
King Country (23 sites)	WAIK	1993			yes						Waikato CO file FLO-009-2-38	no

<sup>1</sup> Abbreviations used for conservancies are as follows: Northland (NOR), Auckland (AUCK), Waikato (WAIK), Bay of Plenty (BOP), Tongariro/Taupo (T/T), East Coast/Hawkes Bay (EC/HB), Wanganui (WANG), Wellington (WELL), Nelson/Marlborough (NELS/MARL).

<sup>2</sup> Months: 1 = January, 2 = February, etc.

<sup>3</sup> Lead: k = known plants in vicinity, h = historic record, p = information from the public, o = other leads, f = fortuitous survey, no entry = no data available.

<sup>4</sup> As Recovery Group minutes are mostly unpublished and anonymous, these are not listed as formal references here, but can be obtained by contacting the *Dactylanthus* Recovery Group. Addresses for DME documents are given, where relevant.

<sup>5</sup> 'Listed' means listed in *Dactylanthus* Recovery Plan, Objective 4 (Ecroyd 1995b).

# Appendix 4

## RESEARCH ON *Dactylanthus taylorii*

### Research carried out on *Dactylanthus taylorii* 1995–2001

TOPIC / TITLE	KEYWORDS	RESEARCHER <sup>1</sup>	FUNDING	COMPLETED (as of 2005)	REPORT / REFERENCE
Ecology / threat of <i>D. taylorii</i>	Distribution, protection, pollination, germination, repellents, nectar composition, synthetic nectar	Chris Ecroyd (FRI Rotorua)	DOC (S&R Inv. no. 595), others	1995	Ecroyd 1995a, 1996; Ecroyd et al. 1995
Survey technique for <i>D. taylorii</i>	Walk-through survey, protection	Cathy Jones (DOC T/T)	DOC (internal)	1995	Jones 1995
Gut survey technique for <i>D. taylorii</i>	Possum gut / rat gut staining, survey tool	Graeme Atkins, Dave King (DOC EC/HB)	DOC (internal)	1997	Atkins & King 1999; King & Atkins 2001
Seeding trial (Waipapa)	Seed transfer, habitat range, host range	John Dodgson (DOC WAIK)	DOC (internal)	Ongoing (1997–)	Dodgson 1997
Seeding trial (Tiritiri Matangi Island)	Seed transfer replication	Bec Stanley (DOC AUCK)	DOC (internal)	Ongoing (1998–)	Anon. 1999
Seeding trial (Waipapa)	Sowing density, replication, host range, habitat range	Avi Holzapfel, John Dodgson (DOC WAIK)	DOC (internal)	Ongoing (1999–)	Anon. 1999; Holzapfel 2000; Holzapfel & Dodgson 2004
Seeding trial (Tongariro / Taupo)	Sowing density, replication, host range,	Nick Singers (DOC T/T)	DOC (internal)	Ongoing (1999–)	Anon. 1999
Seeding trial (Mokoia Island)	Sowing density, replication, host range, habitat range	Paul Cashmore (DOC BOP)	DOC (internal)	Ongoing (2000–)	Holzapfel 2000
Pollinator study (Oropi)	Pollination, cage exclusion, cage mesh size, mice, rats	John Heaphy (DOC BOP)	DOC (internal)	Ongoing (1998–)	Anon. 1999; Holzapfel 2000

TOPIC / TITLE	KEYWORDS	RESEARCHER <sup>1</sup>	FUNDING	COMPLETED (as of 2005)	REPORT / REFERENCE
Pollinator study (Te Araroa)	Pollination, rodent control, cage exclusion, cage mesh size, mice, rats	Graeme Atkins, Dave King (DOC EC/HB)	DOC (internal)	Ongoing (1999-)	Anon. 1999
Autecology of <i>D. taylorii</i> on Little Barrier Island	Kiore gut survey, seed bank, pollination, cage exclusion	Sam Ferreira, Bec Stanley, Irene Petrove (and others)	DOC (SIN 3206)	2004	Holzapfel 2000 Ferreira et al. 2001 Ferreira 2005
Ecology / morphology / genetics of <i>D. taylorii</i>	Flower morphology, germination, genetic variation, vegetative reproduction	Avi Holzapfel Free Univ. Berlin/ Univ. of Waikato (DOC WAIK)	DOC (SIN 2054), others	1999	Holzapfel 1999; Holzapfel 2001b
Vocalisation of short-tailed bats when feeding on <i>D. taylorii</i> nectar	Short-tailed bats, pollination, feeding	Jonathan Millar (Univ. of Waikato)	University of Waikato (special topic)	1999	Millar 1999
Genetics of <i>D. taylorii</i>	Genetic variation (nationwide), RAPDs	Marty Faville, Chrissen Gemmill (Univ. of Waikato), Avi Holzapfel (DOC)	DOC (SIN 2469)	2000	Faville et al. 2000; Holzapfel et al. 2002
Host specificity and spatial distribution of hosts of <i>D. taylorii</i>	Host distribution, micro-site characteristics, micro-distribution of <i>D. taylorii</i>	Megan Kupko (SIT, <sup>2</sup> Hamilton)	SIT <sup>2</sup>	2001	Kupko 2001

### Research planned, but not conducted, between 1995 and 2000

TOPIC/TITLE	KEYWORDS	RESEARCHER	FUNDING	REASON NOT COMPLETED
Genetic variation and seed dispersal	Feeding trials, genetic variation	Janet Oddy (University of Waikato)	DOC (SIN 2469)	Student changed academic Department. Genetic component subsequently carried out by Faville et al. (2000)
Pig impacts on <i>D. taylorii</i>	Habitat disturbance, tuber destruction, browsing, feral pigs	-	Proposed incorporation into pig research by Clare Veltman (RD& I)	Not incorporated

<sup>1</sup> The abbreviations used for conservancy names are: Northland (NOR), Auckland (AUCK), Waikato (WAIK), Bay of Plenty (BOP), Tongariro / Taupo (T/T), East Coast / Hawkes Bay (EC/HB), Wanganui (WANG). FRI = Forest Research Institute, Rotorua.

<sup>2</sup> School for International Training, Hamilton, New Zealand.