DUNE RESTORATION TRUST OF NEW ZEALAND

Technical Article No. 8.5

Restoration of Sand Daphne (*Pimelea villosa*) on Coastal Dunes

- a plant in decline

INTRODUCTION

Sand daphne (*Pimelea villosa*) is a low growing shrub that inhabits the transition zone between spinifex (*Spinifex sericeus*)-dominant foredunes and backdunes. It is one of a small suite of backdune native species that occurs on unconsolidated sand dunes and in dune hollows of the North Island and Chatham Islands of New Zealand (Merrett 2007).

The species is listed as in 'decline' (NZ Plant Conservation Network www.nzpcn.net.nz). This decline has been linked to a range of factors from issues with the reproductive biology of the species to various environmental and site factors caused by human-induced changes in the coastal zone (Forester and Townsend 2004).

Populations of sand daphne on some sites have such high levels of mortality that the species has become locally extinct in some regions. A number of councils, the Department of Conservation and Coast Care groups have been planting and managing sand daphne in coastal dunes in several regions for some years with varying degrees of success. This article collates background information on the status and restoration options of sand daphne.

Plant characteristics

Sand daphne (also known as autetaranga or toroheke) is a sprawling woody low-growing plant radiating out from the centre with many layering branches. When well-established they can form a large often circular plant over a metre in diameter. Branches are often buried in sand and can develop adventitious roots with plants forming a low mound. The branches are densely covered in small medium-green leaves.

Sand daphne inhabit both open and densely vegetated dunes. This plant, on a lightly vegetated dune immediately landward of the spinifex zone on a Northland beach, contrasts with sand daphne found amongst dense marram grass on the Wairarapa coast (inset).

Flowering and fruiting

Sand daphne flowers usually from September to March and are white or sometimes cream coloured. The species has separate male and female plants although some plants are hermaphrodites (have both male and female flowers). The flowers are highly scented. Pollination may be by small flying insects, possibly butterflies, moths and lizards.

Fleshy round, dark purple fruits are found from October to April (Burrows 2009). Lizards like the fruit and probably distribute it, or if not present, the seed falls off and has been seen to roll down dune slopes. Newly germinated seedlings have been found amongst unthrifty mature plants.

HABITAT

Sand daphne is often found growing on the landward side of foredunes usually associated with swales and flats of semi-stabilised backdunes (NZ Plant Conservation Network). It is found in free-draining sites but sometimes bordering streams in places prone to sudden flooding. It can also be found in the vicinity of blowouts.

Sand daphne can occur in the same mid-dune zone as sand coprosma (*Coprosma acerosa*), which is also a woody ground cover with a similar low-growing habitat. This zone is often an open sandy habitat especially where it has not become dominated by exotic weeds. Like sand coprosma, sand daphne has the ability to trap some windblown sand but it cannot cope with excessive sand movement such as the sand binders pingao (*Ficinia spiralis*) and spinifex (*Spinifex sericeus*) that inhabit the more exposed and mobile seaward dunes.

Depending on the region, other associated native species found within the open sandy mid-dune sites with sand daphne include knobby club rush (*Ficinia nodosa*), sand wind grass *(Lachnagrostis billardierei* subsp. *billardierei)*, speckled sedge *(Carex testacea)* and pohuehue (*Muehlenbeckia complexa*), and sometimes scattered small tauhinu (*Ozothamnus leptophylla*).

Marram grass and other exotic species can vigorously compete with sand daphne within the mid-dune zone

Sand daphne can be found growing with other woody ground cover natives such as sand coprosma.

THREATS

Site factors

Sand daphne is threatened by competition from a range of factors most of which are human induced. These include invasion of exotic weeds, trampling by cattle, sheep and horses; browsing of seedlings by rabbits and possums; seed destruction by rodents; damage by beach users including both pedestrian and vehicles; and fire. Major threats continue to be lack of recruitment, habitat loss from development for housing, invasion of exotic plants including marram grass (*Ammophila arenaria*) planted historically to stabilise moving sand, and disturbance from vehicles on beaches (Forester and Townsend 2004).

Major invasive exotic plant species in the mid-dune zone that competes with sand daphne include marram grass, the exotic South African ice plant (*Carpobrotus edulis*), buffalo grass (*Stenotaphrum secundatum*), kikuyu grass (*Pennisetum clandestinum*) and a range of other exotic pasture grasses as well as garden escapes. Natural threats to vulnerable natural populations of sand daphne include erosion of dunes by high seas from storms and landward migration of dunes both of which are likely to increase on some sites with expected impacts of climate change.

CAUSE OF DECLINE NOT CLEAR

The decline of natural populations of sand daphne in many regions is often uncertain. On some sites, natural populations of sand daphne on semi-stabilised dunes can comprise plants at various stages of plant size and vigour including remnants of dead of dying plants. Often there is no apparent correlation between differences in site characteristics such as dense weed-infested sites compared to open sandy sites, dune morphology and proximity to the sea. Mature healthy plants can occur adjacent to dead or dying individuals with no apparent causes of plant decline and mortality.

Similarly, reasons for the relatively poor performance of sand daphne planted on a range of what is considered to be appropriate semi-stable dunes sites are also not clear. For instance, while threats have included browsing by rabbits, evidence of browsing is not necessarily obvious.

The causes of differences in plant vigour are not always clear. Sand daphne plants on semi-stable dunes at Pataua North, east of Whangarei, Northland, range from vigorous (1) to unthrifty plants (2) to dead (3) on the same semi-stable frontal dune amongst a light cover of invading buffalo grass. But an apparent healthy plant (4) appears to be thriving in the lee of a wilding pine and amongst 30 cm high buffalo grass and pohuehue.

(1)

(2)

(3)

(4)

Flowers of sand daphne (Pimelea villosa)

Reproductive biology factors

Published literature indicates that reproductive biology may not be the limiting factor with sand daphne. In a study of the recruitment failure of sand daphne of several populations from the lower North Island Dawson et al. (2005) examined recruitment patterns, flowering, pollination, and seed germination limits on regeneration. Surveys indicated that natural populations of sand daphne were dominated by medium-sized and a few large individual plants suggesting recruitment failure at all sites. They found plenty of flowering with insects appearing to be the main pollen vectors, and successfully germinated some seed from both female and hermaphrodite flowers. They concluded that recruitment failure probably occurs during the seedling establishment phases, due to environmental pressures and/or predation.

Similarly, in an investigation of 18 populations of sand daphne from throughout the North Island of reproductive biology and population size-class structures, Merrett (2007) found no evidence that sex ratios or fruit set were contributing factors to recruitment failure.

Recruitment of sand daphne is often poor. The fate of these young regenerating seedlings requires further investigation.

Newly germinated seedling of sand daphne within the branches of a dead or dying mature plant.

OPTIONS FOR RESTORATION

Seed collection and propagation

Ripe seed of sand daphne can be hand-picked from the plants just before it is about to fall. Alternatively, fallen seed can be collected from beneath plants on dunes by scooping up the duff with seed and then sowing it.

Sand daphne can be grown from seed but there has been variable reports on success of germination. One source indicates it may take several years to germinate (New Zealand Plant Conservation Network – www.nzpcn.org.nz). Robyn Smith (Greater Wellington Regional Council, pers. comm.) reports very high germination rate from freshly collected seed when the seed is broadcast sown in seed-raising potting mix with a light cover of mix over the seed. Slugs and snails however do need to be controlled.

Sand daphne is also easily grown from semi-hardwood cuttings using standard propagation methods.

Planting

Success of planted sand daphne varies between sites and different Coast Care groups. Several plantings involving small numbers of plants along the Kapiti Coast, Wellington, have had some success with preferred sites on backslopes of the frontal dune. Large nursery raised plants (e.g. PB3 planter bags) may be more successful when planted on dunes than smaller plants (Robyn Smith, pers comm.). Sand daphne planted on the lee of a frontal dune where plants naturally occur did not survive possibly because the plants were small.

In contrast, most sand daphne planted on bare sandy inland backdunes at Riversdale Beach, Wairarapa, died during the summer months following planting with 10% survival after 2 years, and only 40% survival on a mid-dune site after one year. Failure has been attributed possibly to extended droughts (Robyn Smith, pers. comm.). Mortality was also high in swales where sand daphne may find it too wet. Similarly, several hundred sand daphne planted as part of major restoration programmes on east coast Coromandel beaches over many years have resulted in loss of most seedlings within two years of planting (Jim Dahm, coastal scientist, Coromandel). These were planted as PB2 or PB3 stock mostly in the open zone between spinifex-dominated foredunes and the mid-dune zone were other coastal natives such as pohuehue and knobby club rush had been planted.

Sand daphne growing on the semi-stable mid-dune zone showing signs of dieback, reasons for which are not known.

Sand daphne growing vigorously within the spinifex-dominated foredune zone, Ocean Beach, Northland.

RESEARCH

There are clearly substantial issues with both the decline of natural populations of sand daphne on the mainland of New Zealand and performance of restoration plantings of the same species on a range of sites. Research is required aimed at reversing the decline of plants within remaining natural populations with a likely focus on investigating a range of environmental and site factors. In addition, planting trials are required to improve the propagation and planting of nursery-raised plants as part of restoration programmes. Research options include:

Existing plant populations – focus on range of size classes including newly regenerating seedlings:

- Surveying existing plants on regional and national scales;
- Determining any correlations between plant performance and site factors (e.g. location on dune, moist depressions vs exposed sites);
- Determining any correlations between plant performance and association with other plant species both exotic and native;
- Excluding browsing animals (e.g. rabbits, hedgehogs, snails); and
- Testing effect of various treatments to boost growth (e.g. light applications of sand, fertiliser, weed control).

Planting – a range of site and environmental factors that could be evaluated:

- Propagation options (e.g. seedlings vs cuttings, container and plant size, direct seeding);
- Site preferences (e.g. proximity to sea, degree of sand movement, location on dune).
- Shelter and plant competition (e.g. exposed open site vs dense vegetation cover);
- Application of fertiliser at planting –with and without slow release fertiliser.
- Exclusion and control of browsing animmals (e.g. rabbits, snail bait);
- Planting a range of associated native species within habitat.

Ongoing evaluation of natural plant populations and planting trials are planned on at least one Northland site where sand daphne is declining. This will complement ongoing monitoring of a number of Coast Care plantings underway in several regions.

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"To see the majority of New Zealand dunes restored and sustainably managed using indigenous species by 2050".